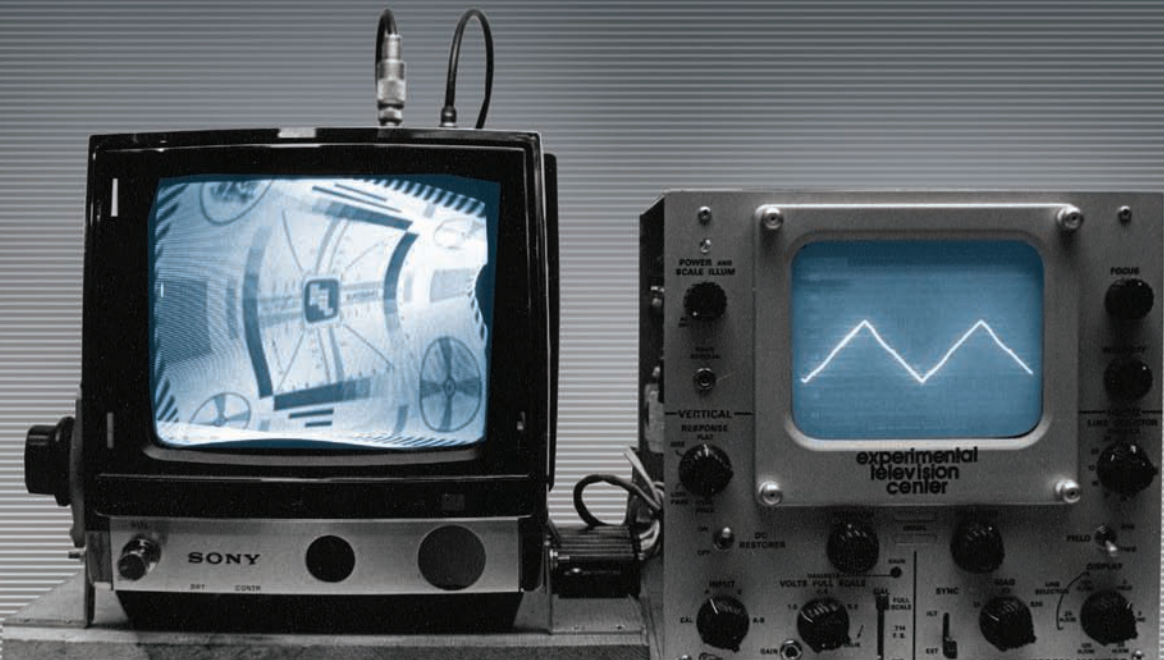
THE EMERGENCE OF VIDEO PROCESSING TOOLS volume 2



TELEVISION BECOMING UNGLUED

Edited by KATHY HIGH, SHERRY MILLER HOCKING and MONA JIMENEZ

The Emergence of Video Processing Tools

Television Becoming Unglued

Volume 1

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Dedication

For those who have passed on – Barb Abramo, Connie Coleman, Evangelos Dousmanis, Dara Greenwald, Bill Hearn, David Loxton, Don McArthur, Phil Morton, Nam June Paik, Mary Ross, Steve Rutt, George Stoney and Jud Yalkut. Your work helped shape this project and still inspires.

And for the artists and technologists who have contributed to the creation of instruments and those who continue to do so

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And finally, we three old video dames hope that this book and the works included will inspire the next generation – especially young women – to become imaginative and creative artists embracing technology with confidence and precision.

With apologies, we regret any errors; they are our own.

– Kathy High, Sherry Miller Hocking and Mona Jimenez

PREFACE

Kathy High, Sherry Miller Hocking and Mona Jimenez

> Senses and the physical world have always been my main directors. The theoretical has not been of much interest to me.
>
> – Ralph Hocking

> The Experimental Television Center [ETC] was created by an artist for other artists, and is guided by that spirit. If the artwork is experimental, the process, the discourse and the practice should also be experimental. While many early organizations operated as collectives in order to produce collaboratively and share the cost and use of then-expensive tools, the Center was organized as an egalitarian assembly of individuals – artists, educators and technologists – working together to help define electronic media art and the programs which sustain it.
>
> – Sherry Miller Hocking

Making marks is an impulse as old as humankind. Throughout history, tools for art making have constantly evolved to reflect technological change. *The Emergence of Video Processing Tools: Television Becoming Unglued* explores the development of early video instruments and systems designed and built by artists and technologists during the late 1960s and '70s. It is a story of art and science, collaborations among inventors, designers and artists resulting in video tools that had not existed before, in order to create images that had never been seen. It examines the role of the political and social milieu of the '60s and '70s as a necessary agent for the explorations in art and technology which occurred. It is told by those 'video pioneers' active at the time, as well as young contemporary artists and technologists who continue to design, build and hack media tools. It explores the impulses underlying tool creation, and the systems which help collaborations in art and science flourish. It looks at the social and economic matrices of support for designing tools, as well as the organizational principles which encourage artists to use them. It explores the language artists used to describe the works they created with these tools – variously and misleadingly called electronic image processing, video synthesis, video art. It portrays an intensive study of the language of the video image by artists using these initial personal media-making tools. It presents models for understanding the tools and systems and how they were used, and explores the possibilities of preserving them.

The Emergence of Video Processing Tools presents affectionate case studies of a number of organizations which were concerned with processing tools, from independent media arts centers like ETC and Media Study/Buffalo, to laboratories based at the Public

Broadcasting Service (PBS) stations around the US, to university-based programs like that at Circle Campus in Chicago. It is intended as a core sample rather than a comprehensive historical survey of the field of electronic image making, with an emphasis on the work done in the Northeast US and especially New York State.

The book's voice is an eclectic collage of the individual voices of the artists themselves. It is told by many individuals, all of whom believe passionately in creating and studying imaging devices. Media artworks are tied inextricably to a complex cultural context that this book strives to elaborate. What aspects of a historical moment encourage inventiveness of this kind? What drives artists to create custom technological instruments? How are they then used? What were the particular sociopolitical and technical environments and cultural policies which foster collaborations in the arts and sciences? Can it be replicated or was it an accident of particulars – time, technology and personalities?

In the early 1970s, artists were moving outside existing organizational structures in attempts to create more utopian systems, in critique of television and even the art world and the economic engines they serviced. Artists struggled to access the new media tools of production, as well as the system of distribution. As personal video tools were introduced, independent video was seen by some as an alternative to the one-way production and delivery system of broadcast television. Video art evolved alongside the centralized one-way communications system of TV, then the dominant entertainment and information system. The instruments of TV were redefined from an institution of social and economic control into a system for creative activity, and a means of self-determination within a two-way interactive communications system. Video was introduced within the countercultural milieu of the 1960s – a political and social climate marked by concerns for democratic process, a critique of the capitalist economic system, radical questioning of existing power structures, and collective or collaborative organizing principles.

> To some extent, early video manifested a dualist position – critiquing existing political, communications and arts cultures, while seeking to play an active role in those very institutions. But we all, in our own ways, wanted to talk back to the TV and to the interests which controlled it. (Hocking 2005a: 3)

Within this matrix, a group of artists and technologists immediately saw both the possibilities of the new medium and its limitations. The few consumer video tools available were modeled after broadcast equipment and based on corporate economic interests. They were engineered in specific ways to eliminate serendipity, accident, distortion, random behaviors – exactly those qualities many artists sought.

While television had been in existence for more than fifty years and had become a global system of communication, the creation and use of new or customized video tools – synthesizers, colorizers, keyers, capture devices, etc. – encouraged the growth of a new art practice, bringing together the intersection of performance, electronics and abstraction through the video signal – a medium that was not photography, not film, not radio and not television.

> Functions as defined by commercial toolmakers were rejected in a subversive and radical act. By creating their own tools, artists could determine the nature of their own marks and mix their own colors, could parse the language of the electronic image, and indeed define it. (Hocking 2005b)

Artists wanted to expand the image-making capacity of existing tools and also to create tools which didn't exist, to do things which had not yet been imagined. In collaboration with designers, technicians and software developers, new tools came into being.

One such story is that of ETC. In the early 1970s, the Experimental Television Center (ETC) became a center for video engineering and artistic activity, first in Binghamton, and relocating to Owego, New York, in 1980. In this small, quiet, upstate town, a vital center of activity was established that would significantly affect video art history in New York State and beyond.

Ralph Hocking and the artists at ETC created machines and tools to manipulate sound and image. These experiments were often pursued with little formal training and an amateur's attitude towards invention. What might now be called a 'hacker' model of reworking video and video systems, in the early 1970s emerged from an interest in exploring uses of the tools of television to create a new genre of visual arts and performance – an art created in dialogue with the machine. While ETC shared much with others active in the initial explorations of independent media in the late 1960s and early 1970s, instrument building, the design and creation of unique image-processing tools and systems, coupled with a conviction towards experimentation in electronic moving-image and sound and performance media art, have been constant goals of ETC.

Ralph Hocking is the Founder and Director of ETC. Together with Assistant Director Sherry Miller Hocking, ETC has provided various services to the media arts community for over 40 years including: an artists' residency program; a sponsorship program for artists' projects; a range of grants; a vital online video history database (collecting ongoing contributions); and a variety of workshops. In Ralph's words, he created the Center as 'a learning place and not a production house.' It was not a place where engineers provided technical services to artists (as seen in broadcast television studios), but rather a place where artists and technicians worked in tandem. Ralph built the Center as a model, encouraging artists to emulate it for themselves: 'As we developed machines, mostly through David [Jones]'s efforts, for the express purpose of trying to make visual art, I tried to encourage individuals to set up their own studios.' In ways that statement was prophetic: Ralph and Sherry anticipated a future where artists might own their own portable video gear and could build their own studios, systems and processing tools – until it became more and more common. ETC's history is one that predicted our own present. And this model of tinkering, experimenting and building is one that is worth examining and encouraging.

In the late 1960s Ralph Hocking began working with television. At the time he was teaching at Binghamton University, a part of the State University system. Ralph taught the only photography class on the university campus, and at this early stage was not associated with any particular department. (Hocking later became a faculty member and Chair of the Cinema Department, where he taught video.) He was committed to developing new models for teaching technology and the arts.

> My charge was to make something happen that related to visual understanding and education. I remembered several experiences with 'Educational Television' in the early 1960s. One was to observe a group of college students in [Pennsylvania] as they viewed several monitors in a classroom that had no proctor. They reacted in the most amazing ways to the information being given to them. Much of the reaction was childish but some seemed to come from the frustration of not being able to believe what they were watching and certainly they had no control over their situation. I guess in some ways that incident and just generally thinking about technology and education was how I became interested in working with Video. It seemed to me that there must be better ways to use television as a tool for expression but I really didn't have any answers as to what those ways might be. I knew then and know now that technology is not going to go away and that unless there is some way to temper technology with human sensibilities, technology will not serve the culture in general, just those who are in control of it […]. In 1969 I was able to convince the administration at Binghamton University to purchase several portable television systems. With some difficulty we then convinced the administration in Albany that it was ok to buy these things even if they were made in Japan. I was told that this was the first purchase of anything other than American made television equipment by the SUNY [State University of New York] system.
>
> In 1969, my first approach to video was to lend the portapaks to the students and faculty to see what they would do. The only stipulation was that they would have to give the equipment back to me. A year later I proposed to do the same thing in the community and received support from NYSCA [New York State Council on the Arts] to begin ETC. We continued to lend portapaks and at the same time began to develop the tools necessary for the artistic exploration of electronic imaging. This led to an artist in residence program that eventually became our primary involvement with video. (Hocking 1983)

Getting video tools into the hands of users was an initial goal of many videomakers and nonprofit video groups at this time. ETC and others were interested in creating a new paradigm, an 'anti-TV paradigm of "producer."' Especially in New York State, where there was a burst of video collectives, artist-run organizations and art production were evolving.[1] This was in large part thanks to the development of the funding structures that supported this growth. In 1961, the New York State Legislature created NYSCA, which received initial funding of $450,000. In 1965, Rockefeller Foundation began to fund artists for experimentation with video, and helped establish artists' laboratories at PBS studios such as WGBH, KQED and WNET. In 1969, NYSCA"s Film and Television Program began accepting applications for electronic media projects.

Ralph Hocking began the Student Experiments in Television (SET) project on the campus of Binghamton University in 1968–69. Along with students, community members were introduced to portable video production tools and techniques. In 1969, Angel Nunez taped *Bedford Stuyvesant Kids*, a street tape which documented neighborhood kids arrested by police after stealing from a factory. This tape was shown widely throughout the state and proved instrumental in obtaining funding for a number of drug-related and inner-city improvement projects. Parts of the tape were eventually broadcast by WNET-TV. Equipment was used by many community-based organizations.

The Experimental Television Center began as an outgrowth of SET. Ralph recounts the origins of the program at ETC:

> Nam June [Paik] told me to talk to Russ Conner, who was the person in charge of NYSCA's new video attempt. I was encouraged to apply for a grant. My premise was more of the same: give people machines and see what happens. Arts, education, and other interested people were the definition. It translates to everyone. (High, Hocking and Hocking 2005: 77)

Ralph Hocking wanted to set up a program to invite artists into a studio to create work. He also wanted to encourage not just artists – but all parties – to participate. He was setting up a studio to support non-exclusive, non-hierarchical practices. Using collectivist principles of resource sharing, ETC instituted programs providing tools for artistic production, sharing the studio and video instruments with the media arts community, along with educational programs for those unaware of the possibilities of the new technology – thus providing free access for all.

With support from the New York State Council on the Arts, Hocking incorporated in 1970–71 as the Community Center for TV Production (later the Experimental Television Center), a nonprofit media center, in order to facilitate the uses of the new technology by three major constituencies: artists, community organizations, and interested citizens. The primary programs were designed to help artists explore this new art form; ETC offered a residency program for artists, sponsorship to various foundations in support of artists' projects, and the design of media arts tools.

An excerpt from Ralph Hocking in an interview with Kathy High:

> [With the first grant money] I opened a studio above a drugstore in Binghamton, bought some equipment, hired three people. I had no problem finding people who were interested on many levels. This was all about using the machines, experimentation, and unquestioned trust, but not about collectivizing, directed outcomes, or other business, educational, or tribal goals. My approach was passionate but not judgmental. My history as a student in our educational schemes is one of miserable failure. I didn't want the traditional approach to dominate my efforts. It didn't and doesn't. As an educational experiment the Experimental Television Center was and is a resounding success. It is ignored by traditional academia.

> While we were handing out portapaks we were also supporting Nam June's efforts to build video synthesizers. (High, Hocking and Hocking 2005: 77)[2]

In the US, video was introduced within the countercultural milieu of the 1960s – a political and social climate marked by a critique of the capitalist economic system, and radical questioning of existing power structures. According to Hocking, 'In the '60s and '70s, collaboration flourished in music and performative arts, and was adopted by media artists in the late 1960s and early '70s as they struggled to create new working models for the then-new medium of video' (Hocking 2005c: 6). Collaboration was partly an economic strategy: some video instruments were beyond the reach of individual ownership. In 1969, a video recording system that recorded monophonic sound with black-and-white images, yet lacked the ability to play back the tape, would cost the equivalent of $6,000 today. Group ownership was also a way to address the rapid advances in technology. 'Production units' – co-ops, collectives, and media arts groups – also reflected the social and political zeitgeist of the times. ETC initially loaned equipment to 'democratize' the tools of the medium. But another focus of the Center was the development of tools. ETC was and is a unique program because of an emphasis on developing 'thinking systems' – artist-designed instruments.

Ralph Hocking again:

> My intention was to support as much unconventional machinery as possible while urging the usage of whatever we had for the development of video art. Joan Jonas drove from NYC in a snowstorm to borrow a video projector. Bill T. Jones and Arnie Zane performed a time-delay dance. Woody and Steina [Vasulka] broadcast within the space. Nam June watched student videotapes and told them not to worry because he could see them while he was asleep [Nam June Paik had a propensity to sleep through many meetings]. The first Gay Video Festival ever. (See Color Plate 19.) And on and on. Bob Diamond was the first fix-it guy I hired, and David Jones was the second (and last). Both of them wanted to invent and were bored with the day-to-day upkeep of machines. They were influenced by Nam June and Shuya Abe during the time of synthesizer development and they both went on to develop their own machines. We were in constant revision with existing equipment, trying to make them do things they were not supposed to do. This was the interesting part of the studio structure that eventually won out over the lending to the community and having a space to show and tell [The community-lending program was dropped in 1979, and the exhibition programming a few years later.][3] This was a deliberate push by me since it was obvious that we could not do all for everyone. It also became a situation where other organizations purchased available portable stuff and didn't need to borrow from us. Invention ruled and the artist-in-residence program was defined. (High, Hocking and Hocking 2005: 78)

Supporting artists interested in investigating video as a contemporary art-making medium has always been the most important aspect of the Center's activities, reflecting Hocking's own background in the visual arts and his commitment to the individual artist. Initiated to provide a more flexible set of imaging tools to artists, the Research Program facilitated the design and construction of new video tools.

> As we developed, mostly through David [Jones]'s efforts, machines for the express purpose of trying to make visual art, I tried to encourage individuals to set up their own studio. The norms had been and for the most part still are for artists to book time at studios that satisfy their current needs. My interest was for people to wake up in the morning and practice their art making as painters, sculptors, others in the visual arts, musicians, dancers and others in performing arts also do. It seemed not enough to occasionally visit the stuff of the art making. It would be like a painter having access to paint a few times a year... I feel the basis for my approach is the history of visual art and not theater that seems to dominate in the arts and television in general. (High, Hocking and Hocking 2005: 78)

Designing the tools

> The instruments and systems at ETC share certain traits. They are flexible and open-ended; they support a branching architecture, and allow artists to create unique combinations of image and sound; they are immediately responsive, and usable by amateurs without a specialized knowledge base; they help expand the vision and function of television tools; they require thought and engagement, and challenge presumptions; they are performative and generative; they encourage individual ownership. (Hocking 2000)

The collaboration between artist and technologist had precedents and origins in the art of the early twentieth century. Those working in the area of 'experimental' video, 'image processing' or 'video art' in the 1960s and 1970s engaged in tool design because the commercially available tools were limited. Rejecting the restrictive definitions of what was 'permissible' with image and sound, ETC began making tools to discover what might be possible.

In the early 1970s, the existing commercially available video tools for individual use were on the one hand astounding in their power and immediacy, but were modeled after broadcast capabilities and designed to meet specific television and educational requirements. In the hands of artists, these tools soon seemed unimaginative, expensive and restrictive. In rejecting the definition of function as determined by commercial toolmakers, ETC engaged in a subversive and radical act. By creating tools, artists could make their own marks and mix their own colors, could parse the language of the electronic image, and indeed define it.

Some of the first tools ETC put into the hands of artists were deconstructed and repurposed, or altered from their original design. ETC technicians began with modifications to existing tools – bringing out the controls on a portable camera to let artists manipulate gain and pedestal, reverse the field vertically or horizontally, or allow constant vertical or horizontal drift by altering the sync. In 1971, funding was received from the New York State Council on the Arts for construction of the Paik/Abe Video Synthesizer. One system was designed and built in 1972 at the Center by Shuya Abe and Nam June Paik, for eventual placement at the TV Lab at WNET-TV. This system was used while still at the Center by the WNET TV Lab to produce a portion of Paik's *The Selling of New York*. A second Paik/Abe was completed for use in the Artist-in-Residence program at the Center.

During the decade of the 1970s, ETC supported additional refinements of the Paik/Abe Video Synthesizer, as well as a host of other devices by artists and designers. David Jones designed colorizers, keyers, sequencers and interface and control systems for use in the studio. In the mid-1970s, recognizing the importance of digital technologies, the Center began to research the interface of an LSI-11 computer with a video-processing system, a collaborative project with the Vasulkas and supported by the NEA. Ultimately, two different approaches emerged because the systems were to be used in very different environments. While the Vasulka system was designed as a personal instrument, ETC's goal was to permit artists without extensive experience to use the digital imaging system in what at the time was extremely complex software programming; to achieve this ETC developed familiar interfaces such as keyboards, joysticks and knobs.

ETC approached electronic technology as a medium of art making and looked to the inherent properties of the medium: color, light, sound, motion. 'Image processing' became the name of the 'genre', and the techniques were also applied in various works. ETC shared a dedication to these systems with individual artists like the Vasulkas, Gary Hill and Dan Sandin; designers and technologists like Bill Etra, Steve Rutt, Bill Hearn, and David Jones; PBS efforts including the National Center for Experiments in Television at KQED and the Artists Television Lab at WNET.

Fulfilling the mandate of sharing resources, making video tools and systems accessible to all, ETC viewed their research as open-source. They shared information – from the operators' manuals, to texts they wrote about the concepts of image processing, to information about how to construct processing devices. Sherry Miller Hocking states that:

> [W]e were committed to disseminating the tools – to help put them in the hands of individual artists; essentially we were trying to put ourselves out of business. Once all artists could have in their individual studios these creative tools, there would be no more need for 'media centers' like ETC, and the art form would flourish. We envisioned desktop video synthesizers which artists could assemble themselves. (Hocking 2005b: 6)

ETC was designed to put itself out of business when all artists had equal and reasonable access to the tools of electronic cinema production, exhibition and distribution.

To achieve this goal, ETC hosted informal groups of artists interested in building their own systems. ETC also authored equipment manuals which were widely disseminated to Media Study/Buffalo and other university-based and independent media groups. Many of these how-to and operator's guides are now posted on the Center's Video History Project website.[4]

In the 1980s, as costs fell and capabilities increased dramatically, and as more community groups acquired their own video systems, access programs became unnecessary or shifted focus to other emerging, expensive tools such as computers. As a result of these technological changes, by the late 1970s and early 1980s the Center chose to refine its focus on artists' video, maintaining the residency and sponsorship programs, offering a grants program for artists and arts organizations in the state, and encouraging the exhibition of works. The research program began to shift from the building of hardware to the development of software, the repurposing of commercial systems to make them more artist friendly, and the integration of old and new tools and systems. One software initiative provided control over image elements in still images of video that could then be printed. A natural extension of moving-image processing, this became an electronic darkroom for artists, and a conceptual ancestor to Photoshop and other graphics programs. The Center continued to refine the relationship between artist and computer. The General Purpose Interface Board brought together analog imaging equipment with an 8-bit computer, allowing manual knob settings to be 'remembered' and repeated digitally. ETC employed existing digital systems from the CAT Buffer to the Amiga computer, which offered a glimpse into the future of digital moving-image works.

The Center is well known for its Artist in Residence program, providing artists with a unique tool set and an open-ended environment for exploration and creative growth. (See Color Plate 3.) The image-processing system was a hybrid tool set, permitting the artist to create interactive relationships between older, historically analog instruments and new, digital technologies. The tools are integrated into an evolving system developed over the years that speaks to the very philosophy of ETC. The emphasis is on interrelationships and not discrete components. Each visiting artist 'built' his or her own unique system by patching component devices together. Artists went there to experiment and learn the systems, to work in dialogue with the machine.

As a social space, a working space, ETC was unique in its emphasis on experimentation and process. As a laboratory, ETC is being emulated in universities and in artist studios across the country. In this day of corporate monopoly and institutionalization, ETC has remained singularly independent, with a keen interest in amateur invention. ETC's adaptive strategies, forward thinking and dissemination of a unique tool set has allowed artists to develop their work, create a new vocabulary and build the field of media arts. ETC has been a key organization in the history of new media and in the history of media arts in New York State and the country.

> Artists are risk-takers. They envision what hasn't been. In this process, they may 'misuse' or 'misapply' the instruments – whether aesthetic tools or organizations – deploying them in ways unforeseen and unpredictable. As an organization, ETC incorporates this thinking and provides programs and resources to support, encourage and celebrate artists and their honesty and courage in the creative processes. (High, Hocking and Hocking, 2005: 81)

While the history of ETC has its own unique narrative, there are shared motifs among the other individuals and organizations that played important roles in the development of video processing tools. We all faced similar needs, asked similar questions and solved similar puzzles. The solutions were unique while having many attributes in common.

Throughout the years, many of us engaged in dialogues about systems, new technology, software development and access. For example, the Hockings' relationship with the Vasulkas began as early as 1971, with an exhibition of their work at the Experimental Television Center. The Hockings and Vasulkas remained friends and colleagues, while Ralph, Woody and Steina had teaching positions at Binghamton University and University of Buffalo respectively. In fact, editor Kathy High was a graduate student studying with Steina. ETC and the Vasulkas engaged in other exhibitions and conferences together, and worked on a parallel project during the mid to late 1970s, interfacing an early computer with video processing tools. Today they are sharing ideas concerning preservation strategies for ETC's unique archives.

As Woody Vasulka remarked when contacting Ralph Hocking at ETC about the organization of 'Eigenwelt der Apparatewelt: Pioneers of Electronic Art', a large exhibition of processing tools and works at 'Ars Electronica' in 1992:

> Ralph Hocking, founder of the Experimental Television Center […] is now by default the only large-scale producer and facilitator of personalized, custom-built video instruments. By even greater default, Ralph and Sherry Miller Hocking are the only collectors and archivists of many of these instruments. Ralph picked up the phone as if we were having an uninterrupted conversation over the years. (Dunn 1992: 11)

The Emergence of Video Processing Tools seeks to disconnect media instruments and their makers from old categories and definitions, to build awareness of the wealth of historical information about the early media instruments, and to encourage a dialogue about the relationships between 'old' and 'new' media artists and art practice. Along with ETC's DVD sets *ETC: Experimental Television Center 1969–2009* (a set of five DVDs containing up to 70 artist video works, with a 132-page catalog) and *Early Media Instruments* (a set of 8 DVDs with a 'how-to' review of the machines/tools at ETC),[5] significant new resources have been created for educators, students, researchers and curators.

The editors of this unconventional anthology share a long history together and with the other authors in the collection. We participate in a community of artists, thinkers, scholars, tinkerers. We have worked together at times and have shared resources. Mona Jimenez has been actively involved in media preservation since the mid-1980s. She and Sherry Miller Hocking have collaborated on many projects, such as the Regional Cataloging Initiative and the National Moving Image Database project of the American Film Institute and the forerunner of the Independent Media Arts Preservation (IMAP) organization. Hocking and Jimenez collaborated on several conferences. 'Video History: Making Connections' (1998) brought together over 250 pioneering practitioners and contemporary artists working in new media and interactive technologies. In June 2002, conference organizers invited over sixty media arts professionals, conservators, technical experts and artists to gather at the historic firehouse home of Downtown Community TV Center in New York for 'Looking Back/Looking Forward', a two-day working symposium on moving-image preservation. The symposium was organized in association with IMAP and Bay Area Video Coalition. Focused on the physical preservation of independent electronic media works and related issues concerning tools and ephemera, 'Looking Back/Looking Forward' facilitated an honest and sometimes disturbing evaluation of our progress as a field. The edited proceedings and reports are posted on the Experimental Television Center's Video History Project website. Jimenez and Hocking also partnered on the original design of the Video History Project website, begun in 1994, to make resources available and foster dialogue about the origins of media art. High has been a contributing member of the media arts community in New York State since the 1970s, and believes passionately in supporting and participating in the development of this field. As the editor of the community-based book series *FELIX: The Journal of Art and Communication*, in 2000, when we began this project, High envisioned video tool development could be a theme for a new publication in the spirit of *FELIX* – but this book evolved instead.

The editors and authors are members of a close and dedicated community committed to telling the stories of early video tool development. We look at ourselves as artists and sometime archivists who assume personal and institutional responsibility for preserving and providing access to 'records of enduring value […] and protect the materials' authenticity and context.'[6]

The authors and editors want to foreground original texts and other ephemera as important storytelling devices. We drew extensively upon the archival and object collections of the Experimental Television Center (ETC), the Daniel Langlois Foundation for Art, Science and Technology (now at the Cinémathèque québécoise), and personal collections of Ralph Hocking and Sherry Miller Hocking and Steina Vasulka and Woody Vasulka, which include machines, technical documents, photos, correspondence, event publicity, audio/video interviews and artworks from the 1960s and 1970s, and more. In addition, numerous contemporary interviews with tool designers, builders and users were conducted, providing additional documents, photographs, schematics and proposals.

Finally, a note on words and inconsistent spelling throughout the book. The lexicon of video is peculiar and rather insular, of concern to a small group of scholars, historians and makers. A small genre of the larger video and new media fields, image processing's vocabulary is even more arcane. The vocabulary of tools and processes evolved alongside the development of the instruments and the art form. You will find this reflected throughout the book. We left the historic articles that we are reprinting intentionally unedited to retain their 'period authenticity'. In part this diversity evidences individual variants by the writers, as well as a disagreement among many authors in the field. Most of these words aren't in any dictionary. There is a very small body of literature concerning this topic of video tool development to draw upon. We have tried to respect the author's voice, while acknowledging the reader's need for clarity.

The editors hope that the book will stimulate the writing of histories of electronic tools, and will encourage additional research on the past and present ways that electronic tools are conceived, produced and used by artists. The book seeks to create a rich discussion of systems of practice, rather than be limited solely to specific tools. We see the tools in a larger context of systems – much like the living systems of biology – and would like these tool sets and interdisciplinary practices to live on. In addition, the editors hope to see more work on issues of historiography with these tools, and the need for the conservation of the tools and related archival material.

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Notes

1. In the media universe of the late 1960s and early 1970s, collaborations and other forms of working relationships were initiated by artists, and artists with technologists, across many arts disciplines. Artists created collaborative working relationships to achieve projects that pushed the boundaries of conceptual and activist artworks, including collectives such as Ant Farm, TVTV, Raindance, the Videofreex and Lanesville TV. Alternate media centers were also being created throughout the US to provide a means of production, supported by a gift economy with public and private funding.

2. The Paik/Abe Video Synthesizer (PAVS) was developed in several places, including in collaboration with students at Cal Arts and for the New Television Workshop at WGBH-TV in Boston. The first PAVS, built at ETC in 1970–71, was placed at the TV Lab at WNET in New York. The second system built at ETC was then placed in the ETC studio and made available through the Residency program. This allowed artists and others an opportunity to explore PAVS's imaging possibilities, thus opening up the use of this instrument more broadly.

   While artist-in-resident at WGBH, the necessity of such a device became acutely clear to Paik, who was frustrated by the production means of the large television studio: 'Big TV studio always scares me. Many layers of "Machine Time" parallely running, engulfs my identity. It always brings me the anxiety of Norbert Wiener, seeing the delicate yet formidable dichotomy of Human Time and Machine Time. [...] In the heated atmosphere of TV control room, I yearn for the solitude of a Franz Schubert, humming a new song in the unheated attics in Vienna [...].'
3. ETC had a regular exhibition series every spring for many years, the first video screening series in the Southern Tier, and brought many artists to Binghamton to show work and meet audiences. ETC saw the exhibition of work as integral to the making process. They offered regular exhibition series, which were formalized in 1976 as 'Video by Videomakers', and as well hosted many traveling series such as the 'Ithaca Video Project Festival' and the Creative Artists Public Service Program Fellows for the regional community. The annual exhibition series brought to the Southern Tier video artists such as Beryl Korot, Woody and Steina Vasulka, Harald Bode, Ernest Gusella, Gary Hill, Shigeko Kubota and Dickie Landry.
4. Begun in 1994, ETC's Video History Project is a research initiative that reflects the complex evolution of the media arts field and its many stories, and encourages a collective voice in the crafting of our histories. The Video History Project utilizes the implementation of collaborative strategies for the advancement of electronic moving-image preservation resources and tools. See http://www.experimentaltvcenter.org/history/index.html.
5. See http://www.eai.org/title.htm?id=14719. Accessed August 2, 2012.
6. See http://www.festivalofthearchives.com/. Accessed October 22, 2012

SECTION 1

HISTORIES

Introduction

Kathy High

This first section of *The Emergence of Video Processing Tools: Television Becoming Unglued* offers a context for the historical moment when the building of custom tools began, and looks at concepts that were critical in the formative years of video art and remain resonant in twenty-first-century digital culture. The writings trace the social impacts, funding changes, and art-historical influences that contributed to the evolution of tool making, and the art produced by these machines. The section documents the history of a set of electronic art-making tools developed in the United States from the 1960s through the mid 1980s and looks at their effect on contemporary new media artists who today make machines and systems a crucial part of their art process – from analog-to-digital to signal-to-code. What aspects of a historical moment encourage this kind of inventiveness? What drives artists to seek custom-built instruments, and how are they used? What are the influences of cultural policy, technological innovation, and the sociopolitical environment on tool development and use?

The section opens with 'Beginnings (With Artist Manifestos)', an essay by Kathy High that looks at the lineage of radical concepts linking early twentieth-century art movements and those of the 1960s and 1970s: 'From what disciplines or movements did the artists come to this form of practice in the first few decades of video and tool development? How did the discourse develop about the aesthetic and conceptual qualities of artist works using electronic tools, in particular the association of custom tools to image processing?' Her essay is accompanied by a selection of artist manifestos describing working methods and an enthusiasm for the medium of video.

Jeremy Culler's essay, 'Mapping Video Art as Category, or an Archaeology of the Conceptualizations of Video', examines four areas of activity that characterized the context within which tool development occurred: alternative media centers and video collectives, galleries and museums, the published record, and academic institutions and conferences. How do early electronic tools or 'instruments' fit into the changing discourse about video art during its first few decades, as technology-dependent artists' works became part of institutional and gallery and museum systems?

In their essay, 'Impulses – Tools', curator Christiane Paul and artist/critic Jack Toolin place 1970s tool development in a broad continuum of impulses present within contemporary art practices. This essay offers comparisons of conceptual and structural frameworks within art from the 1970s to the current period, considering shifts in technology and other media processes: i.e., how artists use systems in addition to single tools, as instruments; develop custom interfaces and forms of interactivity; use real-time media performance to process image/sound; trigger moving images and effects through external devices or signals; interrupt signal transmission and networks; and reverse engineer or 'hack'.

Tom Sherman's original text 'The Art-Style Computer-Processing System, 1974' lays out a clever conceptual and art-historical approach to tool use, equating synthesizer effects to various painterly art styles, such as Abstract Expressionism, Cubism, Impressionism, Photorealism, Action Painting and more. Following this is another article, 'Machine Aesthetics Are Always Modern', where Sherman offers comparisons of conceptual and structural artistic frameworks and philosophies, from early modernism to the current period, considering shifts in technology and other art and media processes as to how machines 'assist in codetermining and implementing aesthetic choices'. Looking at the different machine functions (and video functions), Sherman parses the ways the usage of machines affects aesthetic outcomes, building a vocabulary of aesthetic choices based on amplitude, parallelism, random elements, juxtaposition, distortion and more.

In her essay, 'Electronic Video Instruments and Public Sector Funding', Mona Jimenez finds that despite the antiestablishment and anti-television impulses of many tool designers and users, they relied heavily upon resources made possible by educational and public television. This essay reveals the institutional and funding structures that supported custom tool development and artist access to electronic tools in the 1970s and 1980s: arts organizations, public television labs, universities, arts councils and foundations. In addition, the chapter explores the relationship between tool development and the ideals prevalent in the first decades of media arts, such as the decentralization and 'democratization' of access, production and distribution, and the oppositional stance of many video experimenters to telecommunications and broadcast television.

The focus is on organizations in the northeastern United States, but the essay also includes activities occurring in the Midwest and the San Francisco Bay Area. Early groups include public television TV Labs, the University of Chicago – Circle Campus and the Art Institute of Chicago; the Electron Movers in Rhode Island; and in New York State, the Center for Media Study/Buffalo and the Experimental Television Center (ETC). The role of the Rockefeller Foundation is discussed, as well as the emergence and impact of public arts funding, specifically the role of the New York State Council on the Arts.

Articles by Howard Weinberg ('TV Lab: Image-making Tools') and John Minkowsky ('The New Television Workshop at WGBH, Boston' and 'The National Center of Experiments in Television at KQED-TV, San Francisco') focus specifically on the phenomenon of artist laboratories within public television stations that were sites for the development of machines such as the Direct Video Synthesizer, the Templeton Mixer, Don Hallock's Videola, the Paik/Abe Video Synthesizer and the Rutt/Etra Video Synthesizer, and places where ideas about art and technology circulated.

And finally, Jeremy Culler discusses the Experimental Television Center's history of technological development in his essay 'The Experimental Television Center: Advancing Alternative Production Resources, Artist Collectives and Electronic Video-Imaging

Systems'. Culler traces ETC's funding history, teaching record, and establishment as a laboratory for tool creation, building versions of the Paik/Abe Synthesizer. Culler also describes the 'Tele-Techno Conference' in its various iterations as an upstate New York telephone conference where not-for-profit groups compared notes on machine maintenance issues and more.

Beginnings (With Artist Manifestos)

Kathy High

> Formal transgressions are based on literary and plastic innovations which perpetuate the illusion of historical change; historical transgressions are essentially structural disruptions subverting the temporal myth of art; that is, they destroy the illusion that art progresses from one stage to the next through time. Historical transgressions, to use Marcel Duchamp's term, 'short-circuit' the evolution of formal transgression. (Burnham 1973: 46–47)

In his book *The Structure of Art*, Jack Burnham aptly points out the differences of what he calls 'formal' and 'historical' transgressions, and how these transgessions are dynamic ways that art can and does shift our focus. The rifts that these transgressions create is an opening for further understanding of art and culture – perhaps even leaps in consciousness. I would like to look at just such a transgressive moment in this text and to consider Burnham's statement here. I am particularly focusing on the moments leading up to early 'video art' in the 1970s and 80s. This was the 'image processing' video moment – if we can call it that – coupled with the creation of video processing machines, which lead to just such a 'short circuit' as a 'historical transgression'.

This opening chapter poses several questions: From what art disciplines or movements did the artists of the first few decades of video and tool development come to form this practice? How did the discourse develop about the aesthetic and conceptual qualities of artist works using electronic tools, in particular the association of custom tools to image processing? And in their own words, why do artists engage with, adapt and invent machines and other electronic tools? (See the artist manifestos at the end of this article.) Much has been written about the histories of video art and its inception. This chapter looks primarily at the history of video toolmakers, custom-built tools and systems, and the video that was produced with tools of the early period, from late 1960s to the 1980s.

At this time there were debates around image-processing video work, suggesting it perpetuated modernist concerns with its formalist approach. Jon Burris spoke of this formalist concern in his article 'Did the Portapak Cause Video Art? Notes on the Formation of a New Medium': 'These videomakers, like many artists of the period, were caught in what might be characterized as the dilemma of decadent modernism' (Burris 1996: 11). While the tenets of modernism can be found in some early video art, it also could be argued that the act and process of tool making was itself a fundamental means of understanding the medium and exploring its unique qualities of electronic signal and flow which led to future technology and art production – thus breaking this practice away from the avant-garde and placing it squarely in a do-it-yourself culture. As well, tool adaptation allowed certain machines to be more accessible to amateurs, empowering them with a unique means of communication. This breakdown of video's essence and investigation into video signal and systems permitted an intense liberation from traditional picture making, establishing a differentiation from traditional television and mass media. This moment, while sometimes seemingly a formal transgression, offered enough of an insight into an entire system of art and media production that it should be considered more likely a historical one, developing new ways of understanding art production through tool production. Or, as Jack Burnham also wrote: '[The] cultural obsession with the art object is slowly disappearing and being replaced by what might be called 'systems consciousness.' Actually, this shifts from the direct shaping of matter to a concern for organizing quantities of energy and information' (Burnham 1968: 369).

Historical background

Historically, highly developed cultures embraced art and technology with equal respect, and with a reverence for both the sciences and the arts. Rather than creating disciplinary divisions and specialty areas of knowledge, cultures that expressed an interest in furthering a broad notion of 'knowledge' encouraged knowledge producers to embrace multiple areas of study at once. An example of early-thirteenth-century Islamic societies is cited in Gunalan Nadarajan's article 'Islamic Automation: A Reading of al-Jazari's *The Book of Knowledge of Ingenious Mechanical Devices* (1206)':

> The word, '*ilm* that is most commonly used to denote 'knowledge' in Arabic, Hill reminds us, included a wide range of fields as astronomy, mechanics, theology, philosophy, logic and metaphysics. This practice of not differentiating between seemingly separate fields is best understood in the context of the Islamic view of the interconnectedness of all things that exist and wherein the quest for knowledge is a contemplation on and discovery of this essential unity of things. (Nadarajan 2007: 165)

Amidst descriptions of the elaborately designed automaton machines of this period, Nadarajan also refers to this quest for knowledge as 'a passionate quest to discover these signs and thus arrive at a better understanding and appreciation of God's magnificence' (Nadarajan 2007: 165). In contrast to this moment of early Islamic societies' sophisticated consideration of the interconnectedness of all learning and disciplines, we find in contemporary Western culture a separation of the disciplinary studies of the sciences, philosophy, engineering and art which potentially limits understanding of the world and natural phenomena. This divisiveness sets up segmented and compartmentalized areas of study where the 'essential unity of things' gets overlooked, and in some instances, where shunning scientific and artistic endeavors make them seem very distant to one another.

I would argue that this split into 'knowledge camps' within Western culture has created an elitist hierarchy of professionals who uphold strict boundaries between distinct disciplinary areas, with 'experts' overseeing knowledge production. This professional rigor, building fields of experts, also goes hand in hand with the goals of capitalism. The need to defy these boundaries and capitalist tendencies has been an underlying theme of many contemporary art movements in the twentieth century. These art movements are the 'historical transgressions' that Burnham speaks of, as they open up knowledge sources to more (common) people, empowering them and making them more self-aware and critical of their society. The Dadaists after World War I, in a reaction against the war, created art situations that broke societal taboos and the institutionalization of distinct disciplines. The Surrealists also were a cultural production movement, working with the irrational and intuitive to create a more thoughtful, political and inventive society. Martha Rosler writes: 'The aim of dada and surrealism was to destroy art as an institution by merging it with everyday life, transforming it and rupturing the now well-established technological rationalism of mass society' (Rosler 1990: 38–39). 'Technological rationalism' had brought a narrow focus that these movements worked to broaden. Experiments with photomontage and experimental photo and film techniques were part of the new expressions by these groups. For example, Dadaist and Surrealist visual artist Man Ray, who bought his first camera in 1915, experimented with various photographic chemical and lighting techniques such as rayograms, double exposure, solarization, and development methods using effects that broke from tradition and expanded photographic arts into new directions.

This revolutionary work of breaking down boundaries and societal norms through art actions was also practiced by other contemporary art groups such as the Situationists International of the 1950s and 1960s, who had 'the wish to "multiply poetic subjects and objects" and "to organize games of these poetic objects among these poetic subjects' (Guy Debord, *Rapport sur la construction des situations*, May 1957). It is the project of revisioning the world according to its smallest, most prosaic, everyday details and artifacts, then remaking the world on those same terms [...]' (Marcus 1989: 126). These anti-bourgeois, anti-capitalist, even anti-art actions led artists to explore ideas that de-structured society with a critical eye towards 'professionalism' and redefined ways to think creatively about technology and culture. They embraced filmmaking, psychogeography and *détournement* to express their ideas and expansive cultural critique.

Later, another group, Fluxus, an international community of musicians, artists, filmmakers and writers under the leadership of George Maciunas, including artists Nam June Paik, Wolf Vostell, Yoko Ono and Joseph Beuys, among others, grew out of the sentiments and actions taken by the Situationists, Dadaists and Surrealists: 'Fluxus was a typical avant-garde in its desire to deflate art institutions, its use of mixed media, urban detritus, and language; the pursuit of pretension-puncturing fun; its de-emphasis of authorship, preciousness, and domination' (Rosler 1990: 44). Honoring the artist Marcel Duchamp and musician/ composer John Cage, Fluxus work embraced 'chance' principles, playfulness and the unity of art and life, and focused on creativity and transformation. Their kind of culture jamming allowed for an experimental exploration of ideas, and it also brought new technological knowledge and new focus: 'The sciences of transdisciplinary complexity came into their own during the decades in which Fluxus emerged. Fluxus and intermedia were born just as technology shifted from electrical engineering to electronic engineering' (Friedman 1989). There was a paradigm shift in art practices that embraced interdisciplinary approaches, and fostered laboratories of new knowledge production. For example, Nam June Paik's *Utopian Laser Television* (1966) manifesto offered an idea of a future communication media with 'hundreds of television channels. Each channel would narrowcast its own program to an audience of those who wanted the program without regard to the size of the audience […] freeing us from the monopoly of a few commercial TV channels' (Friedman 1989). Paik here imagines a precursor for the Internet and its multichannel dissemination of information (Paik 1970: 14). Paik's progressive ideas were just the sort of 'historical transgressions' a la Burnham, freeing the medium of video from the stranglehold of broadcast television's commercial structure.

In the United States, the 1960s and early 1970s were times of great social and political upheaval. In the midst of the Cold War with the Soviet Union, the United States space race developed new satellite technologies, and by 1969 put men on the moon (Apollo 11). The Civil Rights movement, as well as the Women's Liberation and Gay Liberation movements, brought attention to inequalities practiced within US society. The anti–Vietnam War demonstrators and protestors objected to US involvement in what was seen as an unnecessary and misguided war. The American society was changing, and many were drawn to different ways of living, and learning, practicing Transcendental Meditation, experimenting with drugs such as LSD and marijuana and, in the spirit of 'free love', residing in communes and shared housing.

Out of this period came many other experiments with art and technology around the country, including The Experiments in Art and Technology. EAT artists such as Merce Cunningham, John Cage, Robert Rauschenberg, Billy Klüver and Yvonne Rainer participated in an historic event called '9 Evenings: Theater and Engineering' held at the Armory in New York City in October 1966. Klüver had been working with Bell Labs, who had fostered many computer engineer–artist–musician collaborations. And while many of the performances didn't actually function well on the nights of their premiere, the '9 Evenings' did present a unique 'collaboration between artists and engineers and scientists'. Here is a description of some of EAT's art and tech experiments:

> Closed-circuit television and television projection was used on stage for the first time; a fiber-optics camera picked up objects in a performer's pocket; an infrared television camera captured action in total darkness; a Doppler sonar device translated movement into sound; and portable wireless FM transmitters and amplifiers transmitted speech and body sounds to Armory loudspeakers. (EAT 2012)

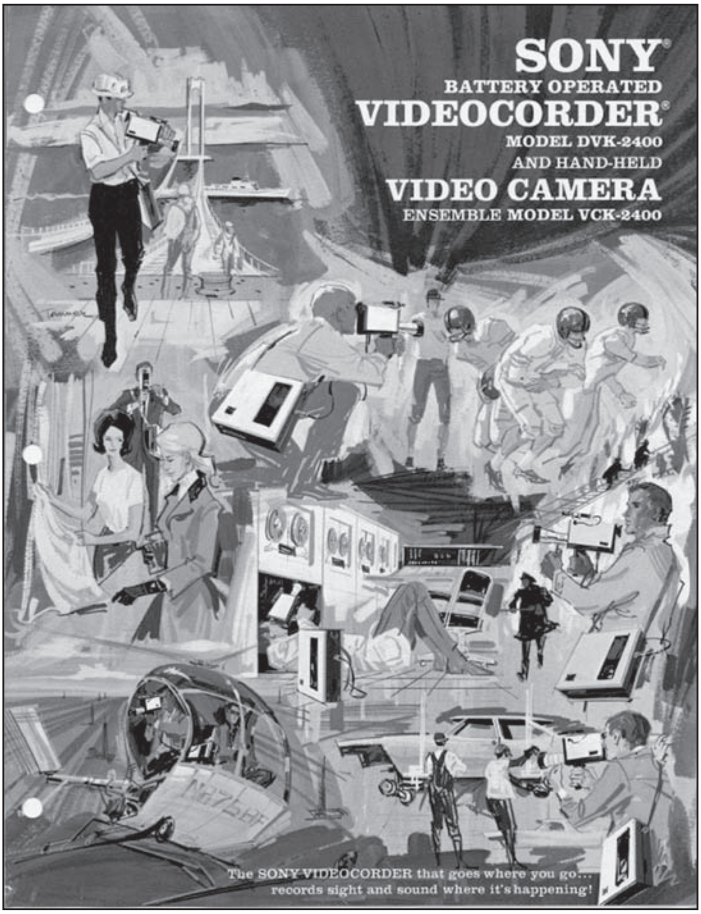


Figure 1. Sony Industry product literature for video portapak 2400 series (1967).

Synthesizer plus

'Linguistically art's effectiveness depends upon its surface "vagueness," which is not meant in the sense of a lack of focus, but rather in the artist's success in shifting our minds from an empirical level of comprehension to the mythic' (Burnham 1973: 13). Here Jack Burnham is referring to Lévi-Strauss's interest in the 'mythic' as a means to take everyday life to another level of significance. Events like '9 Evenings' created an interest in the use of technology, and begged the question: Can this art and engineering engagement create a possible 'mythic' situation? How does this art activity change from mere invention to one that triggers a kind of holistic imaginary? How did analog electronic performance devices affect visual art and transform our understanding of our artistic capacities?

The emergence of audio and visual electronic synthesizing devices began to radically reinvent ways to work with sound and image. As early as 1938, synthesizers were being invented: for example, the construction of the Russian ANS audiovisual synthesizer began in the late 1930s, designed by Evgeny Murzin. Murzin was part of the Russian avant-garde group the Futurists, who were very influenced by dynamism, modern machines, but also by political theory, particularly Marxism. The ANS was among the first electronic synthesizer designed to be a populist machine. The elegance of the ANS was that it was a literal drawing machine that produced live tones. The interface used the drawings as scores:

> [Y]ou etch images onto glass sheets covered in black putty and feed them into a machine that shines light through the etchings, triggering a wide range of tones. Etchings made low on the sheets make low tones. High etchings make high tones. The sound is generated in real-time and the tempo depends on how fast you insert the sheets. (Finley 2012)

Drawing from synesthetic ideas of audio and visual interplay, the ANS was named after and dedicated to the Russian experimental composer and occultist Alexander Nikolayevich Scriabin (1872–1915) (Finley 2012). The ANS designer, Murzin attempted to attain an idealized way of producing tones from a truly visual language: Sadly, '[t]he political tides turned against the Russian avant-garde by the time Murzin began working on the ANS in 1938 […] as most early sound art projects were destroyed' by government persecution (Finley 2012). As a result, Murzin did not complete the ANS until 1958.

The 1950s and 1960s began to witness a very specific shift in the US cultural use of electronic tools with regard to making art. Audio synthesizers created in the United States and Japan allowed for the manipulation and redesign of many different kinds of sound sources. These new instruments began to evolve the thinking concerning using various sound sources to create experimental music. In 1960, the German-born inventor and musician Harald Bode (Bode Electronics Company) was among the first in the United States to develop a synthesizer, called the Audio System Synthesizer. For Bode, it was a means of using modular thinking to develop systematic ways of working with the electronic signal to affect input and output sounds, as well to begin a conversation about the physics of sound and electronics. In a convention talk at the Audio Engineering Society, Bode presented the paper 'A New Tool for the Exploration of Unknown Electronic Music Instrument Performances', describing the exciting potential for this versatile synthesizing device:

> The System included a conventional tape deck, tape loop reverberation and plug-in modules. Harald had built the first patchable modular system with control voltage capability, and was aware of the instrument's significance, declaring 'we can visualize that the device may become an indispensable piece of equipment for modern production studios that involve sound'. The young Bob Moog took Harald's concept to heart and from it designed his own renowned Moog Synthesizers. (Palov 2011)

At the same time audio synthesizers were changing sound and music production, a Fluxus artist, Nam June Paik, originally from Korea, started creating artworks using audio, and video signals to disrupt typical ways of considering the media of television.

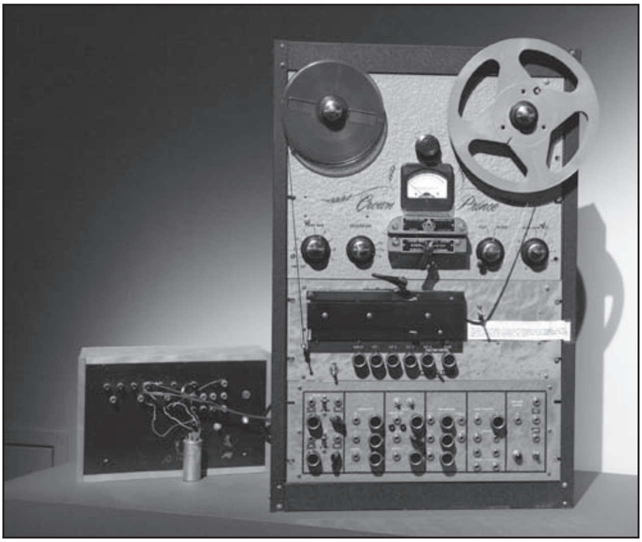


Figure 2. Harald Bode's Audio System Synthesizer (1960) on display as part of the exhibition 'Harald Bode. Tone Color - Known and Unknown Sounds' at the Burchfield Penney Art Center, Buffalo State College, Buffalo, New York, 2011–12. (photo & courtesy. Peer Bode)

Paik – who felt that 'the cathode ray tube will replace the canvas' (Simmons 1978: 9) – not only was experimenting with ways to manipulate sound/image; he also produced video to break video away from television as a corporate-controlled communication media – or as Martha Rosler said, Paik was 'freeing *video*' [italics original]:

> A number [of artists] (Paik among them) have referred to the use of video as being against television. It was a counterpractice, making gestures and inroads against Big Brother. They decried the idea of making art – Douglas Davis called *video art* 'that loathsome term.' The scientistic modernist term experimentation was to be understood in the context of the 1960s as an angry and political response. For others, the currency of theories of information in the art world and in cultural criticism made the rethinking of the video apparatus as a means for the multiple transmission of useful, socially empowering information rather than the individualized reception of disempowering ideology or sub-ideology a vital necessity. (Rosler 1990: 47)

Nam June Paik, among others, wanted to demonstrate that everyday people could make video. In the later 1960s, video devices were becoming more portable with the advent of the portapak, a precursor to today's camcorder, digital SLR cameras or cell phones with video recording capabilities. So video recording and playback machines were becoming accessible to a wide audience. At the same time, audio synthesizers introducing audio effects and filtering were more prevalent and in mass distribution. Nam June also wanted to bring custom-made video tools to the masses, such as his Paik/Abe Synthesizer – the first version built by Nam June and engineer Shuya Abe in 1970:

> Let us look back to the mid 19th century […] most people were deprived of the way for self-expression in the visual art. Only the selected few had access to tools, such as oil paints or canvas and know-how. But the invention of the camera changed the scene and made everyone into an active visual artist. The size of the camera industry and art business illustrates the massive desire to create an artwork, instead of watching a masterpiece on the wall. Will this process repeat itself in the TV world? Will the network program become a wall painting in the museum and we active video creators and creating machine, such as video-synthesizer etc., become as big as Kodak, Nikon, Zeiss Ikon combined? [sic] If yes, we will be able to subsidize the ailing NBC or CBS from our tax-deductable portion of income […]. Dear Phyllis: don't smoke cigarette, and live longer to see our D-Day. (Paik 2011: 12)

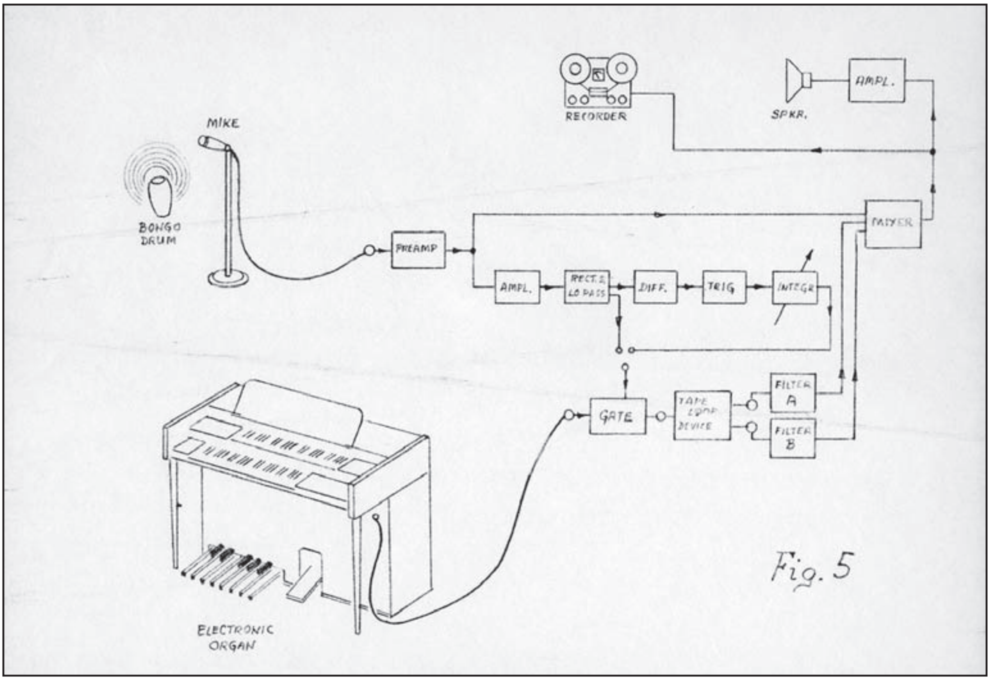


Figure 3. Harald Bode's drawing of Audio System Synthesizer (1961).

In upstate New York, north of New York City, Ralph Hocking, director and founder of the Experimental Television Center, was influenced by Paik's line of thinking:

> The notion of television being by people other than 'professionals' was my next interest. I had met Nam June Paik in the recent past and he was a curiosity in my mind. We corresponded and when I decided to set up a situation on the campus regarding the individual production of television he visited to help with administrative persuasion […]. My premise was to see what would happen when students, faculty and townspeople were able to borrow portable TV machines and use them for their own purposes. (Hocking 2006)

Hocking was interested in this medium as a new uncharted territory with 'no precedent, no body of history' (Hocking 2006). Hocking created the Experimental Television Center as a laboratory 'to support as much unconventional machinery as possible while urging the usage of whatever we had for the development of video art' (Hocking 2006). ETC, among other spaces, became important for custom tool design and the development of new machines. All of this took place where 'invention ruled, under the leadership of Ralph Hocking and later joined by Sherry Miller Hocking' (Hocking 2006).

Another artist group working with 'unconventional machinery' in proximity to ETC in upstate New York was the Videofreex, who built and broadcast with their own pirate television station. The Videofreex were a group who moved from New York City to Lanesville to live and work communally. They were committed to reaching out to local audiences to broadcast to their own local community, and to develop their concept of a community TV station. Once broadcasting, they 'urged people to call us and describe the quality of their reception; and a surprising number of people did' (Teasdale 1999: 76–77). The do-it-yourself aesthetic of custom-built tools was very much the spirit of the creation of the Videofreex TV transmitter:

> Chuck had completed the amplifier, but he had no way to test it on the bench. His second-hand oscilloscope from Canal Street did not have the sensitivity to measure the frequencies that would indicate whether the circuits he'd built would work. We'd have to run an experiment in the real world to determine what, if anything, it could do. The heart of the amplifier, the $50 transistor, a flat disk about the size of a quarter, was mounted with its companion circuitry in a small aluminum box. To run it required another little box, a power supply, which Chuck purchased from an electronics supply store in Kingston. I had always envisioned a transmitter as a kind of Dr. Frankenstein device, a Van de Graaff generator with bolts of static electricity sliding up and down gleaming posts. Ours looked a lot like a box of Animal Crackers. (Teasdale 1999: 75–76)

TELEVISION EXPERIMENTAL
TELEVISION VIDEO
VIDEO ART
VIDEO SYNTHESIS VIDEO
PROCESSING IMAGE
PROCESSING ELECTRONIC IMAGE
PROCESSING VISUAL
SIGNAL STRUCTURING ELECTRONIC
VISUAL DESIGN
COMPUTER GRAPHICS COMPUTER
CONTROLLED IMAGE
PROCESSING COMPUTER GENERATED
IMAGERY
ANALOG/DIGITAL IMAGE GENERATION
I KNOW WHAT IT IS BUT I DON'T
KNOW WHAT TO
CALL IT. I'M TIRED OF SAYING "IT'S
LIKE USING
ELECTRONS TO PAINT WITH". TO HELL WITH
WHAT IT'S
LIKE.HOW DO I SAY WHAT IT IS?
CASTING CABLE/BROAD
NOT MY CONCERN
I DON'T CARE ABOUT SHOWING MY
WORK ON
CASTING.
MY WORK DOESN'T RELATE TO
THE SOCIAL
CONDITION.
IT RELATES TO VIDEO'S CONDITION.
WE NEED A VIDEO GAME WHERE
NOTHING GETS
SHOT,KILLED,OR EATEN.
VIDEO IS MADE FROM STUFF..LIKE
POTTERY.
THE STUFF IS JUST MORE DIFFICULT
TO FEEL.

WALK/RUN IS ABOUT GOING
BACK..ZEROING
POTS,SWITCHING TO OFF,USING ONE CAMERA
(now it's COLOR)
AND THINKING ABOUT TIME. SHERRY
AND I ARE A
CONSTANT.

Figure 4. Ralph Hocking's *Television Poem* (1980).

There was something very specific and unique about the properties of video that allowed for this kind of investigation by artists: building a transmitter and transmitting pirate TV. Other artists such as Gary Hill, Barbara Buckner, Woody and Steina Vasulka, and Tom DeWitt, among others, worked with video circuits and building machines to better understand the technology and the signal flow. They were interested in the electronic properties of video and not just picture making or an alternative way of producing film. In the 1970s, there was division between the experimental film and video communities, as videomakers were trying to establish video as a viable medium. Much like the art battles photography had with painting in the first years of its existence, video took a while to be recognized as a medium with unique properties. Video could be used to document life's events – much like film. But when it came to custom-made video tools, the video creations that came from these experimental machines were 'so electronic, so video – it is not film. It can't be film' (Hill 2012), but these creations were particular to the medium of video. The artists who worked with machines understood the processual nature of video and that the video signal was built on current and cycling energy.

Observing and collaborating with electronic signals and the machine, video artist Gary Hill found inspiration in what George Quasha and Charles Stein have pointed to in his work as the 'liminal'. Hill was drawn to the actual process of the video signal, and to the transitory moments in between, ripe with possibilities. Speaking of his 1979 video *Resolution*, Hill describes the work:

> The idea was to focus on the moment that the line passed through the horizontal position – coming to and going from, literally, a space between the lines. Given that the video signal consists of 525 lines per frame, the line (white on black) passes through a kind of liminal moment in which it is 'deciding' which line will be scanning it and thus ambivalently creates an intermittent line, a momentary unruly dotted line, as it passes through the horizontal position. This was telling me in some way that there was a kind of hidden space that might be *an ingress for language*. (Hill 2009: 75)

Finding ambiguity in the electronic pauses, and 'space between the lines' was rich for Hill, and other video artists of the 1970s and 1980s, reading the energetic stops and starts as something beyond the cultural critique of the prevalent television media. As the signal performs, and we pause and examine it, there is a space opened up for language, for the development of - what Hill calls - the 'electronic linguistics' of the medium of video. Producing cameraless images created by the machine, these artworks, sometimes cited as merely formalist examples of modernist art, were in fact most radical for the very ways the artist 'tweaked' the systems used to make the works. And rather than Paik's 'anti-machine' approach, Hill's works were conceptual and poetic readings *with* the technology of video as a basis of language and life itself. But without his investigation of technology and art described by Hill as a 'necessity to dialogue with the technology', there would have been little opportunity to explore the performative possibilities of this medium. 'Going to a root sense of his word *dialogue* as the "speaking between," we find the feedback/playback phenomenon giving rise to a sense of engagement of self and other, where the "other" may be a machine' (Quasha and Stein 2009: 68).

In her talk presented at the Collective for Living Cinema in February 1978, entitled 'Light and Darkness in the Electronic Landscape: Some Aspects of the Video Image', artist Barbara Buckner pursued this line of thinking, exploring video's electronic current and the signal flow:

> The chain of Light and Dark, that serpentine spiral of electron flow which travels the height and breadth of the Brain is the same current which flows at the heart of the Machine. Deep in the heart of the video medium is a pulse which is the life breath – though invisible – in which the video system runs. It is not the wound motor and spring of the film camera, which when released will die the mechanical death. It is not the hand and brush of the painter which must dip and dip again into colored oil for texture and hue. Its source is the white light flow of electrons ever present as the hot line birth frequency of 60 cycles from any wall, from the ecstatic generator. This is the ever present power of the snake of alternating current manifesting in the electronic landscape as negative and positive charges – opposing Loves attracting to themselves magnetic webs of living matter. [...] As I see it, video appears to be the first visual art and information producing tool that has a built-in cyclical nature. Just as the processing of information in the brain is accomplished by an electrical sweep of scansion (to and fro) through the cerebral cortex, generating electrical activity in the form of alpha, beta and theta waves by which we monitor all sensory and nervous connections, so the video camera and monitor operate on the same cyclic principle of scansion – where each frame of video is scanned 30 frames per second at normal speed [...]. (Buckner 1978)

Buckner's ecstatic expression here, likening video to life cycles, embraces the notion of the very medium of video as having a kind of alchemical energy in and of itself. This recalls the idea of Gary Hill's 'dialogue with technology' and Woody Vasulka's 'dialogue with the machine' – as the machine, with its machine-produced current, takes on its own entity, and becomes a true collaborator. There is also a real respect for the physics of the operation of video and considering the transformative qualities as well: 'Everything lives in this landscape by virtue of the current [...]. The physics of the video machine are quite literally in the mind of the beholder' (Buckner 1978).

In these initial years, there was a relationship developing between the video medium and the artist, in which artists appreciated the synthesizers and other crafted machines as instruments that needed to be studied to be able to be performed well. There was the lure of the analog tools' unruliness and unpredictability, posing a challenging collaboration with the machine that needed to be understood and learned. Stephen Beck, one of the first synthesizer designers, wrote in 'Video Synthesis' that he began to build his Number 0 Direct Video Synthesizer in 1968 (Beck 1978: 49). He described a performance with his synthesizer later

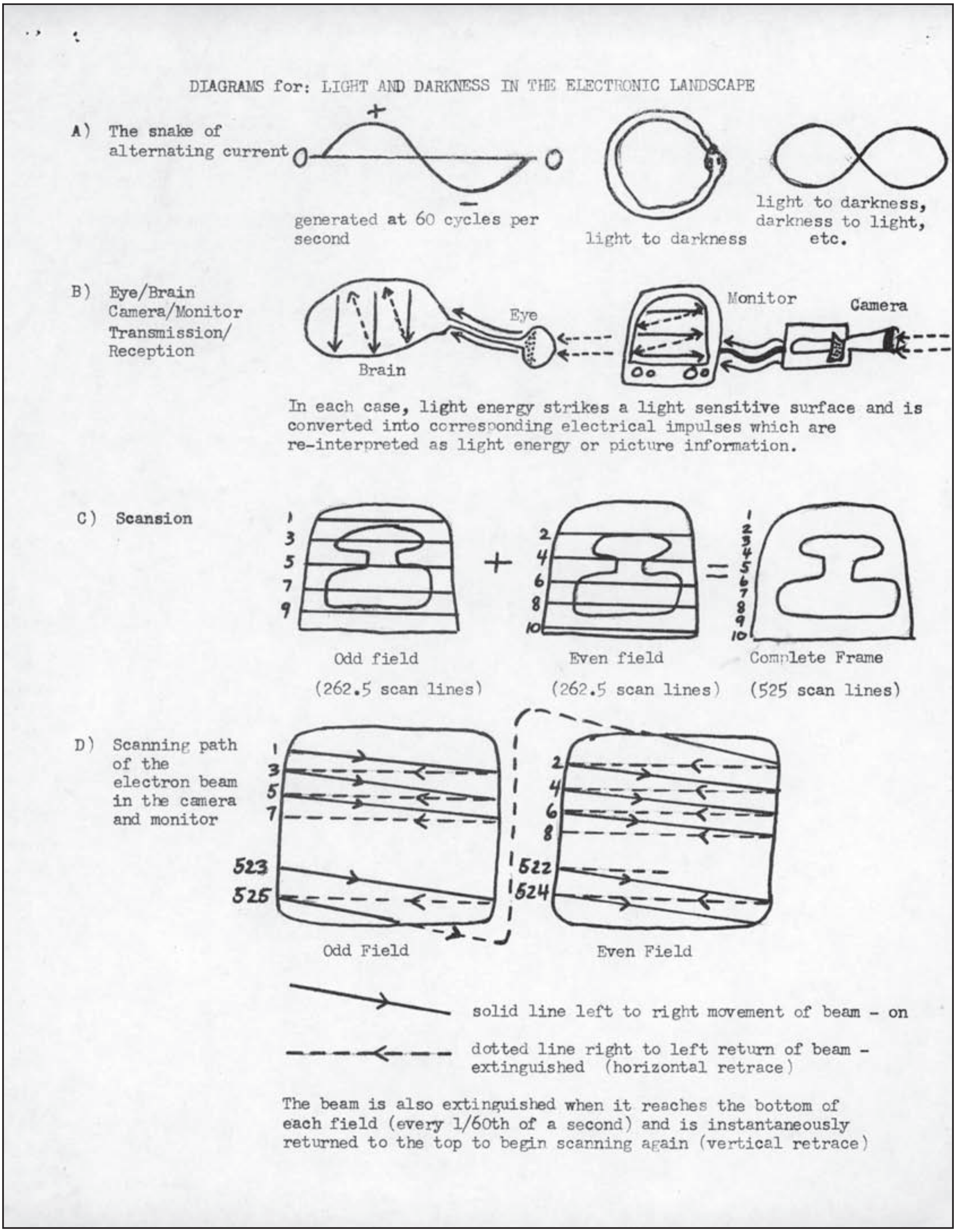


Figure 5. Barbara Buckner's drawings of video signals (1978).

in '72 on Channel 9 in San Francisco, 'which involved playing "live" imagery with recorded music':

> I could glance over and see my hands moving around, independent of anything that I was trying to make them do. At the same time, I had a great sensation of penetration or eruption of this imagery into me, through me, through the synthesizer onto the screen. (Beck 1978: 50)

Beck spoke of the synthesizer as playing an instrument using images. He went on to describe the synthesizer as 'an electronic sculpting device':

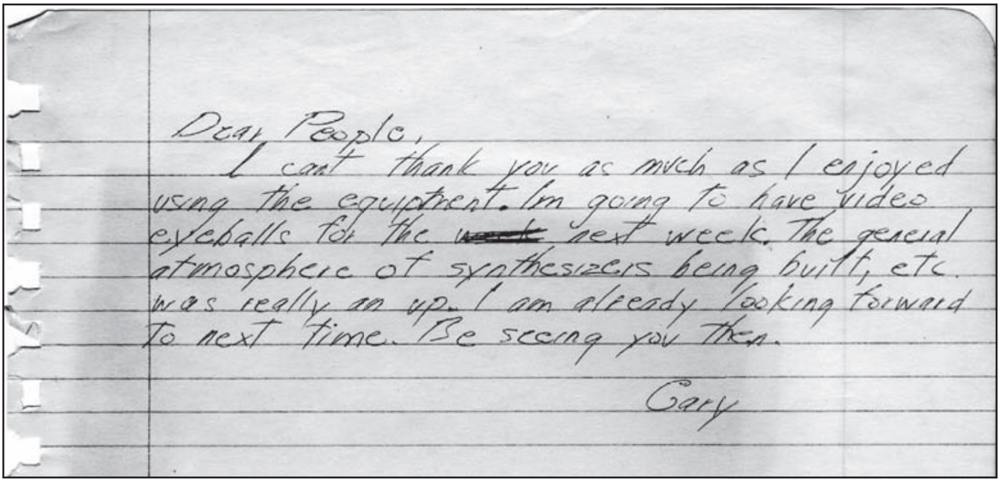
> The whole idea of the synthesizer as I conceive it is that of an electronic sculpting device. The circuit cards are the 'works,' the inside where it's all happening, hand-crafted. There are between thirty and forty soldered connections which are structured on these circuit cards. These don't make the image per se, but they give me a means of shaping and sculpting and forming the electronic current flow, which, when translated into the video picture, takes on quality and shape and texture and form, movement and color – the basic visual ingredients I work with. (Beck 1978: 50)

We can trace Hill, Buckner and Beck's interest in the development of the language and grammar of video art, mapping the relationship between aesthetics, physics and technology. While this practice of working with the signal quickly changed to what we know today as digital manipulation, its importance, and this early period, is often misunderstood and under-recognized. In fact, it was a moment of expansion, or as Gene Youngblood has said: 'When we say expanded cinema we actually mean expanded consciousness' (Youngblood 1970: 41).[1] In *Expanded* Cinema, Youngblood heralded the 'intermedia network of cinema and television […] that promised to expand man's communicative capacities beyond his most extravagant visions' (Youngblood 1970: 41). This historically transgressive moment of tool making created the consciousness to consider new integration of technologies into a post-industrial culture hungry for more open-ended systems of play and creative outlets, helping to build new networks, new exchanges and new visions for our future.

Artists' manifestos

Gary Hill

> My art has steadily moved from a perceptual priority of imaging toward a more conceptual method for developing idea constructs. Remaining throughout my work has been the necessity to dialogue with technology. The earlier image works, primarily concerned with color and image density, were engaged in the invention of new and



Dear People,
I can't thank you as much as I enjoyed
using the equiptment. I'm going to have video
eyeballs for the next week. The general
atmosphere of synthesizers being built, etc.
was really an up. I am already looking forward
to next time. Be seeing you then.
Gary

Figure 6. Thank-you note from Gary Hill after residency at ETC (1975).

more complex images within compositional and rhythmic structures. The current work involves image-text syntax, a kind of electronic linguistics, utilizing the dialogue to manipulate a conceptual space that locates mental points of intersection, where text forms and feeds-back into the imaging of those intersects. (Hill 2009: 73)

Shalom Gorewitz

One of the fleeting art-isms of the early 1980s, *energism*, was an apt description of art created using electronic and computer tools. […] My mantra during that time was *Salvation Through Chaos*. It seemed that the best results came from letting the machines do most of the work. My job was feeding moving images into as many channels as possible, patching voltage control frequency generators into the signal, and using potentiometers to subtly shift color, light, and shape. The machine would hint at new colors, ways of seeing, and new meanings. My job was finding the coincidence of the formal, machine combinated processing and the more physical, sensual, in this world human – seeing, hearing, touching, feeling, thinking.

Processing is always about transition; the hermetic retreat of ETC parallels practice of Zen retreats and other mindfulness paths, where observing, letting go and a non-judgmental attitude are trained. In a production oriented, materialistic society ETC is a sanctuary for reverie where it is possible to just play, while experimenting with new visual technologies. But just as the Bodhisattva stands up after meditation and goes back to the world and to live in it, the artist citizen leaves Owego to make sense of what's been recorded, and perhaps to make something that can be shared and appreciated in ways that connect the formal and expressive transformations inherent in the work. (Gorewitz 2007)

(See Color Plate 4.)

Peer Bode

I DO/NOT LIKE ART BECAUSE________________ it is not exact and overdetermined thereby leaving room to be speculative and provisional, room to construct, play and wonder.

I DO/NOT LIKE TECHNOLOGY ________________ it attempts at the absolute and exact and overdetermined. I have even discovered how to use it leaving room to be speculative and provisional, room to construct, play and wonder.

Electronic Imaging tools are perceptual and conceptual amplifiers.

If our habit of thought and social customs is linked to our religious, cultural, and linguistic backgrounds what happens when we enter into unknown languages such as Cybernetic, Digital, and Electronic (influenced) discourses?

New languages = change(s) in THOUGHT patterns […]. (Bode 1986: 16–17)

(See Color Plate 5.)

Alex Hahn

Dormant as magnetic information, converted into digital code, they come to life again in the computer. Seemingly processing screen images, on a machine level, I'm crunching numbers, as though looking for the solution of a mathematical equipment where it's only a matter of time until the calculator gets there. The question arises whether anything computer generated exists a priori, and the combined efforts of me and the machine will evenually take me there […]. (Hahn 1976–2006: 83–84)

[S]ometimes I fall asleep in the studio, while the machines continue to run. I press the buttons somnambulistically, and the next morning a result is there that I continue to work with. I proceed intuitively, like a detective who has initially stumbled across something that is still very vague. (Hahn 2007: 21)

Irit Batsry

'About the strange practice of living with the image'

breathing with the image
as if the sharing of oxygen can expand the hearts.

reading the traces, the scars the world has left inside the image.

freezing the image in a vain attempt
to make the constant flow of the world

stop

liberating the image from time.

letting the trembling of the image speak
so we can hear the echoes of our signs looking for a space in it.

letting a hand warm up the screen,
scratch a way out on the surface that separates the viewer from the image,

letting an eye show through the opacity of the screen,
looking back at the viewer,

letting the light blind the eye,
sending the viewers back into their eyes.

letting a question mark the limit
of understanding. (Batsry 1993: 8)

Ralph Hocking

I was trained in the making and study of pottery and sculpture. The Han Dynasty in China and The Medieval period of England produced what I wanted to do with pottery. Rodin did the same for sculpture. I turned to photography partly because of a lack of patience in the art-making process and partly because the art was stackable in a small amount of space. Video and computers were the logical next step because they are photography dealing with time and the processes are more immediate than film.

Video and computer tools can be used to generate and record images and sound. I welcome the limitations of these tools: a defined two-dimensional space governed by laws perpetuated by the profit motive. Much more understandable than the problems I have with charcoal and paper. Remote control, a concept dear to a child of the Thirties, knobs to twist, switches to flip, images being banged out by little hammers onto paper, and electrons spraying a magical pattern of light before my eyes. The stuff dreams are made of.

I live in my senses, especially the eyes, and then the ears and touch. Video gives me a connection between these parts and thinking. That's enough. I don't want to change society, protest current conditions, or make sense to others through my art. I do those things in other ways. My art is simply the result of my experience. The work has to do with naked women, sex, machines, and problems related to seeing.

My early work began with single camera images processed with a keyer and limited special effects generator. When I acquired a Paik/Abe synthesizer in 1972, I began exploring multiple camera images based on mixing, image reversal, horizontal and vertical rate switching and color. The next development was voltage control of the image processing. Most of this work was done in collaboration with Sherleen Miller. I would set up a situation and she would react to her image and I would keep changing the relationships she saw. The main body of the work was concerned with simultaneous views of Sherry in movement or in a single pose. Usually we would use between four and six cameras. Most often the cameras were black and white and the signals were processed through the synthesizer; I often used square waves to control the keyer's clip input allowing for offsetting of portions of the images. Most of the work during 1971 to 1978 was not edited. We would do several versions of the same setup, repeat ourselves, rather than try to edit on the decks available to us at that time. Time was not rearranged.

I am currently working with computer-processed frames of video. I have always had problems with the time aspects of video. I tend to see video as single frames strung in a continuum representing movement in time, which of course it is and should be. I have a tendency to look at the frames individually and become enamored with the structure of the individual frame, thus losing the sense of continuity needed to understand time. For now I have given in to the struggle and am concentrating first on the individual frame and secondly on exploring time using more than one frame within the design of a single space. I am still making tapes but they are all based on thinking about the resulting printouts from the computer.

In the process of this exploration, David Jones and I have developed a computer program that now encompasses 26 individual commands ranging from the input of images from tape, disk. or camera to outlines, keying, superimposition, and other traditionally analog video techniques. (See Figure 7.) All of these machine simulations are the result of software commands controlling locations of memory in a frame buffer and the main computer memory, thus making it possible to store two frames and have them interact with each other, store the result of the two, add another, and so on. The results are printed on a dot-matrix printer in 256 x 256 resolution. The printing is done with black on white. The shades of grey are dependent on multiple passes in an additive buildup of ink. While I am curious about using color printing I am also somewhat content with the strength of spatial and form definition in the black-and-white mode.

In addition to my personal art making I have been teaching video art making in the Cinema Department of The State University of New York at Binghamton, New York, for the past thirteen years. I am also the founder, president and director of the Experimental Television Center Ltd., located in Owego, New York. Both of these activities are directed toward the exploration and development of video as a visual art form. (Hocking 1986: 19–21)

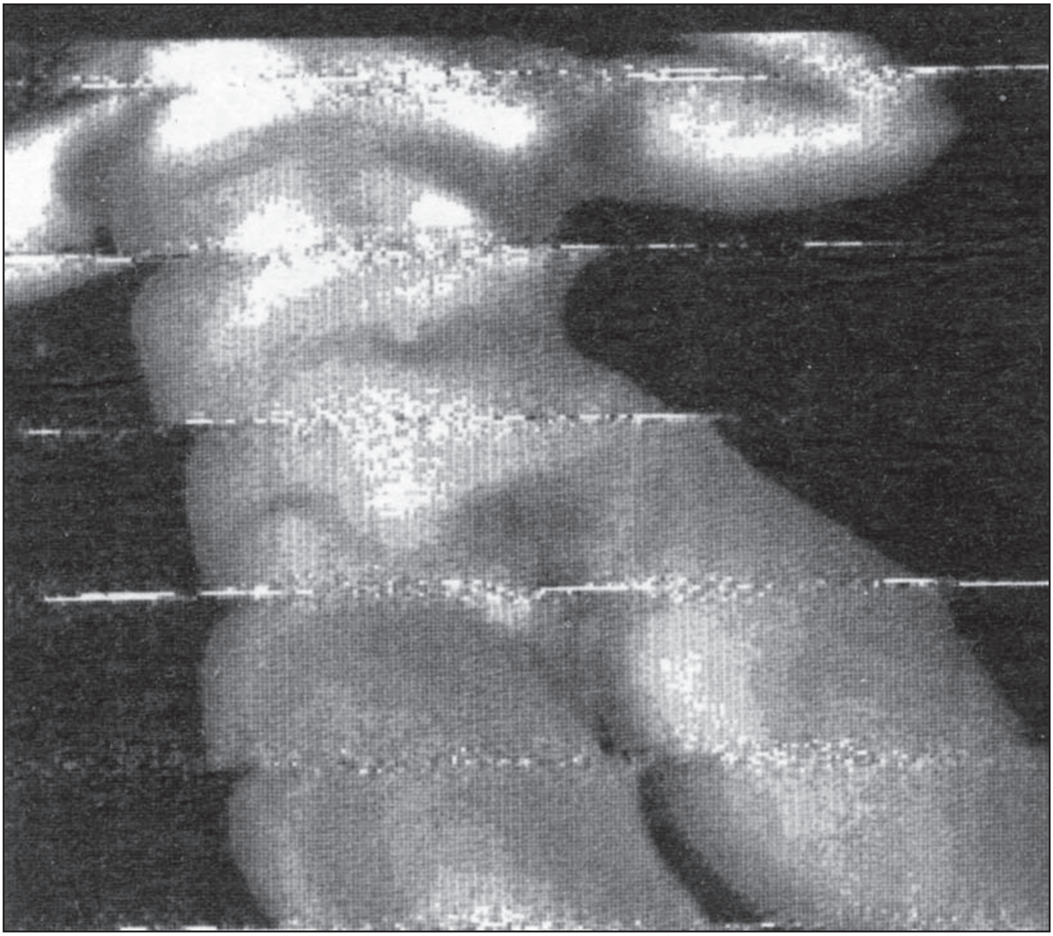


Figure 7. Dot-matrix print by Ralph Hocking using FinePrint program, *Torso Series* (1983).

Figure 8. Still from Ralph Hocking's computer animation *Running* (1994).

TV EXPERIMENTED

YouTube is interesting and informative
but browser glitches
are equally interesting and informative.
Enjoy both.
Jailbreak your phones, and enjoy both.
BBC incorporates, P(aik)BC samples, L(oVid)BC explodes.
Signals arise through decay;
corruption is the data.
Paik said 50 years ago
'Paper is dead'.
We say now
'TV is dead
except for experimental TV'.
The shift of main information storage
from physical to cloud (remote)
will bring another profound change
to our civilization.
The military developed the internet.
The next greatest cultural revolution is running in background.
The Facebook-boss said
'70% of money is made by selling
things to people
but in the future
so much more will be made by selling their thoughts'.

Our experiments contradict and contribute to this new stage
of information development.
For technical details
contact your wireless provider.
We are on an optical fiber for the time being.

LoVid
Owego, July 2011

Figure 9. *TV Experimented* by LoVid (2011). Note posted by final ETC artist residents.

TV EXPERIMENTS
by Nam June Paik

Radio Free Europe is interesting and informative
but the noise which jams this station
is equally interesting and informative.
Enjoy both.
Jam your TV sets, and enjoy both.
BBC widens, P(aik)BC deepens.
The sublime use of technique
is a technique which negates itself.
Nietzche said 100 years ago
'God is dead'.
I say now
'Paper is dead
except for toilet paper'.
The shift of main information storage
from paper to magnetism (cathode ray tube)
will bring a profound change
to our civilization.
The Chinese invented paper a thousand years ago.
The great great cultural revolution is happening here.
The Xerox-boss said
'70% of money is made in hardware
in the computer business
but in the future
so much more money will be made in software'.

My experiment contributes to this new stage
of computer development.
For technical details
ask your TV repair man.
I am on the other line for the moment.

Nam June Paik
London, July 1968

Figure 10. *TV Experiments* by Nam June Paik (1968). Sign hanging in ETC residency space since 1969.

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Notes

1. Gene Youngblood was one of the first authors to write about video image processing in his seminal book *Expanded Cinema* (1970) that discussed 'expanded' notions of film and video making.

Mapping Video Art as Category, or an Archaeology of the Conceptualizations of Video[1]

Jeremy Culler

During the 1960s and 1970s, a widespread expansion beyond the traditional parameters of art-object production, exhibition and viewer experience took place. While some artists continued to advance medium-specific programs, others, including a new generation of technically inclined artists, well versed in electronic countercultures, began to utilize broadcast television and video with the purpose of challenging and expanding the traditional boundaries of painting, sculpture, architecture and cinematic expression. In addition to expanding forms and incorporating cross-disciplinary approaches toward art making, they explored and challenged modes of artistic production that continued the modernist program of medium-specificity, which Clement Greenberg theorized as engaged in a type of self-contained, inward activity – an activity that not only finds purity within, but also seeks to reduce a specific medium to its essence (Greenberg 1965: 193–201). Under the conditions of reductivist modernism, the art object functions in the service of itself and, as a self-referential entity, its independence confirms its autonomy. In the late 1960s, however, experiential shifts in modes of artistic production and new forms of electronic reproduction began to problematize the conventional notion that artworks are authentic, autonomous objects hung on walls or placed on pedestals. The result brought forth new paradigmatic practices that cultivated an ever-increasing, expanded field of artistic production, expression and experience. In 'Sculpture in the Expanded Field', Rosalind Krauss characterized that a portion of this extended field provides for, on the one hand, 'an expanded but finite set of related positions for a given artist to occupy and explore', and, on the other, 'an organization of work that is not dictated by the conditions of a particular medium' (Krauss 1979: 42–43). Krauss's expanded field model is indeed useful for thinking about specific post-1960 artworks that extended the traditional definition of sculpture. However, one has to reconsider the scope of Krauss's model if other concurrent practices, such as those incorporating experimental television and video, are to be considered. And yet the following question arises if such a consideration is made: with the proliferation of emergent art forms and intermedia practices, could a fixed model or quantifiable framework ever suffice? Perhaps such a model would also be ultimately one of containment, one that does not lend itself well to the proliferation of the contemporary arts.

I would still like to consider in this text what it means to map 'video art' as a category and, after doing so, question whether such a conceptualization can ever be adequate. This is indeed a difficult task, which will lead me to propose an alternative mapping of the conceptualizations of 'video' as it emerged heterogeneously within distinct territories, institutions, and other spaces of practices – a mapping that does not seek to render the field within the confines of a neat model, but instead seeks to accept its untamable nature. I will do this by offering a different set of tools for thinking about the expanded field. I will then address five key institutions from which the concept of video art emerged, operated, and was constricted: public broadcast television, alternative media centers; galleries and museums, the published record and academic sites. In turn, I will argue that a totalizing concept or a linear history of video art could never address the discursive field of experimental television and video practices properly, especially since the field, which is institutionally dispersed and heterogeneous in character, cannot be elided by appeals to some common medium or monolithic category.

An archaeology of the conceptualizations of video

In his introduction to *The Archaeology of Knowledge*, Michel Foucault proposed a way in which to 'define a method of historical analysis freed from the anthropological theme' of linear successions (1972: 16).[2] In place of this method of historical analysis based on cultural totalities and linear chronologies, Foucault offered another type of historical project, one that specifically aims to reveal and 'distinguish various sedimentary strata' (1972: 3–4) like an archaeologist digging and sifting through layers of earth on a gridded site, seeking relative knowledge of a given culture or society. Unlike the traditional approach, this specialization of analysis turns away from notions of origin, derivation and development towards a new conception of the historian's task:

> The old questions of the traditional analysis (What link should be made between disparate events? How can casual succession be established between them? What continuity or overall significance do they possess? Is it possible to define a totality, or must one be content with reconstituting connections?) are now being replaced by questions of another type: Which strata should be isolated from others? What types of series should be established? What criteria of periodization should be adopted for each of them? What system of relations (hierarchy, dominance, stratification, univocal determination, circular causality) may be established between them? What series may be established? And in what large-scale chronological table may distinct series of events be determined? (Foucault 1972: 3–4)

These new questions signal a radically different historical perspective – one that no longer traces an evolving totality, but rather maps the emergence of practices and conceptual frameworks across a spatial terrain of sedimentary strata. In utilizing this methodology, emphasis shifts from a temporal, linear perspective to a spatial, stratified one, which now is concerned with the 'system of relations' between strata and the 'distinct series of events' defined within these relations (Foucault 1972: 3–4).

Indeed, using as a model Foucault's notion of an archaeology of knowledge would entail a spatialized conceptualization of the differential field of experimental television and video, and a mapping of the various sites of discourse, the 'system of relations' between them and the 'distinct series of events' elaborated within them. Such a project clearly differs from linear, chronological descriptions of the field of electronic, time-based media from which the category of video art stems. By contrast, a Foucaultean approach discloses a terrain of experimental television and video practices that is heterogeneous in character and institutionally dispersed. It is, to draw a parallel with John Tagg's theorization of the discursive field of photographic production, also a field of production:

> [D]emarcated and divided up in advance into specialized territories of practice and meaning which were congruent with one another only in their exercise of constraints on proliferation of […] discourses and in their articulation of a discontinuous field beyond which there was only a declared non-sense. (Tagg 1992: 112)[3]

Like the field of photographic production, the field of experimental television and video is decentered, discontinuous and differential. Unlike photography, however, experimental television and video involve durational forms based on intermedia practices and programs. Nevertheless, it is still a decentered, discontinuous field that I will attempt to define in this text and I will then trace across it key disputes from each of the institutional sites that I have mapped.[4] By this means, I will attempt to show that the ever-expanding, institutionally dispersed field of electronic, time-based media cannot be grasped in the terms offered by the linear narratives that have until now shaped what has been labeled as the history of video art. In citing key institutional sites that aided in this expansion, I will also show that the development of electronic, time-based media and the discourse invested in it was made possible by political, economic and technological factors, which led to the rise of distinct territories of practice and knowledge.

How then is an archaeology of experimental television and video knowledge to be constructed? My first strategy has been to select key, paradigm-shaping texts from an exhaustive chronological bibliography, which address the conception, development and defining characteristics of a body of work that has become known as 'video art'. What becomes evident, however, is that these texts, graphed on a diachronic axis, are not homogenous, but rather, across a synchronic plane, appear as institutionally dispersed.[5] This synchronic plane defines a series of sites of discourse that are constituted both as institutional spaces (of practice, production, and distribution or exhibition) and as the sites of distinct genres of discourse. The sites I have identified are public broadcast television studios, alternative media centers and video collectives, exhibition and curatorial spaces, the published record and academic institutions.

The five key institutional sites I have identified above are not, however, discrete or self-enclosed. Instead, the conceptual borders that distinguish these institutions as categories are fluid and, thus, interact with one another via their 'systems of relations', and 'distinct series of events' defined by these relations. Participants who navigate and traverse these sites not only share similar interests but also help institutions advance electronic, time-based media as viable art forms, even while these institutions cultivate distinct territories of practice and knowledge. What differentiates these sites are their distinct contributions and their means of transmission of production, discourse and knowledge. And while the conceptual borders are established in this study for the sake of historical specificity and conceptual clarity, the ultimate aim here is to gravitate away from notions of a unified video art toward a differential field of heterogeneous practices. The following institutions helped develop this differential field and contributed to making the tools of television and video accessible to artists, educators, activists and others.

1. Public broadcast television

I begin with public broadcast television for two reasons. First, this site helped to make the tools of television accessible to artists, educators and activists by offering workshops, economic resources and artist-in-residence programs. Second, public television studios, which devoted some resources to experimental programming, produced some of the first broadcasts presenting the idea of television as a viable art form.[6] Fred Barzyk's *Jazz Images* (1961), David Silver's *What's Happening Mr. Silver?* (1967–68) and *The Medium Is the Medium* (1969), Loren Sears and Robert Zagone's *Sorcery* (1968), and Ed Emshwiller's *Scape-mates* (1972) are some examples of the types of experimental programs made possible by educational, economic and technological resources at public television studios (Figure 1a; Color Plate 1).[7] The tools of television, however, were not always available to the public. Before the 1960s, the commercial broadcasting industry predominantly owned and controlled the technological resources and the telecommunications infrastructure needed for producing, editing and broadcasting television content. In addition to possessing economic capital, they also enjoyed a growing viewership that participated in one of the largest, most advanced socioglobal networks of information exchange – one that also benefited from the immediacy of television and its ability to relay information live.

The commercial broadcast industry was not the only institution involved in producing, disseminating or regulating television content. Indeed, the Public Broadcasting Corporation, community access television and governmental agencies, such as the Federal Communications Commission (FCC), also participated in regulating and shaping access to the industry. At the same time, each of these institutional sites played a distinctive role. For their part, commercial broadcasting companies such as CBS and ABC possessed economic resources to purchase, store and maintain costly and cumbersome equipment vital for the creation and distribution of broadcast television programming. Governmental agencies such as the FCC, on the other hand, had the authority to regulate interstate and international communications over radio, television, cable and satellite. So they too had a role to play if independent productions were to develop.

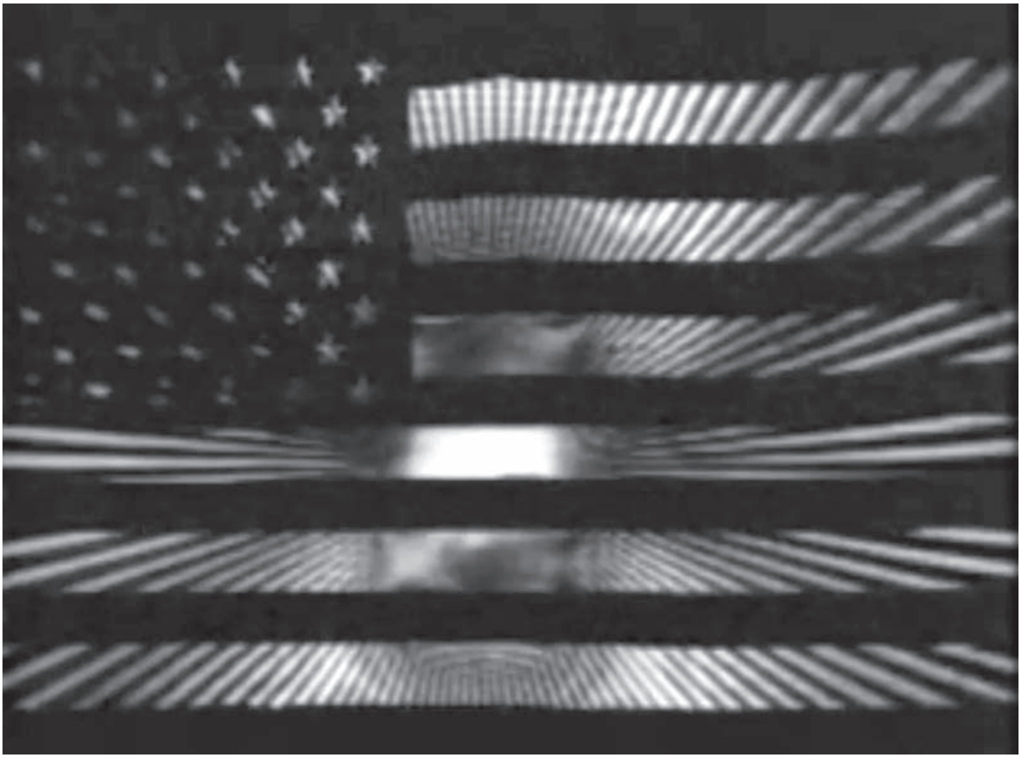


Figure 1. Video still from the television program *The Medium is the Medium* (produced and directed by Fred Barzyk, 1969). Opening sequence Nam June Paik.
See also Color Plate 1 *Electronic Opera #1*. (courtesy Nam June Paik Studios).

During the 1960s, television producers and directors at several American public television stations helped to develop the idea of (broadcast) television as an art form and, in the 1970s, the concept of video art. However, before video art emerged as a concept in public television, the United States Congress and the Federal Communications Commission established regulations that made it possible for public television stations to endorse experimental television as part of their cultural programming.[8] The Communications Act of 1934 and its provisions, including the Public Broadcasting Act of 1967 and the FCC Report and Order of 1972, represent the principal legislation that established these regulations and helped shape services provided by public broadcast television and community access television.[9]

In 1934, broadcasting meant radio. With the development of commercial television in the late 1940s and 1950s, however, it became necessary to amend the initial Act, extending its provisions to the increasingly important television medium. It is at this point that policies crucial for the development of experimental, cultural and educational television programming were laid down. The Public Broadcasting Act of 1967, which extended the provisions of the 1934 Communications Act, for instance, contained a very significant 'declaration of policy' that asserts 'it is in the public interest to encourage the growth and development of public radio and television broadcasting, including the use of such media for instructional, educational, and cultural purposes' (Corporation for Public Broadcasting 1967).[10]

The 'declaration of policy' also enforces a number of conditions on public television stations. First, the policy encourages the development of public telecommunications services for those interested in experimenting with broadcast television equipment and videotape cameras. Second, it promotes instructional, educational and cultural programming, and encourages public broadcast television stations to take creative risks.[11] Third, it declares, 'it is in the public interest to encourage the growth and development of *non-broadcast* telecommunications technologies for the delivery of public telecommunications services' (Corporation for Public Broadcasting 1967).[12] Fourth, it calls for the local and national expansion and development of public telecommunications services, nurtured by diversity, freedom, imagination and initiative. Finally, the 'declaration of policy' in the Public Broadcasting Act of 1967 underscores the necessity for 'the Federal Government to complement, assist, and support a national policy that will most effectively make public telecommunications services available to all citizens of the United States' (Corporation for Public Broadcasting 1967). It stresses that such services are seen as valuable resources for local communities.

Community access to public television studios, though, proved not to be the first priority. The first emphasis for providing a source of alternative telecommunications services was on expanding cultural programming that took creative risks with the new medium. Management at some public television stations put pressure on producers to ensure the production of broadcastable material from in-house attempts to expand the boundaries of television. In the process, three prominent public television stations – WGBH in Boston, KQED in San Francisco, and WNET in New York City – started offering workshops to invited participants as early as 1967.[13] Where they looked for a model of creative risk-taking was to the world of experimental fine art, already institutionally framed as an index of American cultural vitality. This began in 1967, when WGBH inaugurated an artist-in-residence program with financial help from a Rockefeller Foundation grant.[14] That same year, KQED initiated their short-lived Experimental Television Workshop, which they renamed the National Center for Experiments in Television (NCET) in 1969.[15] In 1972, following WGBH's example, WNET Thirteen established a television workshop also for artists, and began publishing reports on experimental television and video practices.[16] While these programs started at different times, they had similar aims:

to make production and post-production equipment and facilities accessible specifically to artists, to help advance the expressive potential of experimental television and to write reports that support the value of cultural television programming.

The main forms of writing on the potentialities of the television medium within the broadcast industry are government reports, internal commercial and public television documents, trade/technical reports, and journal articles by television producers and participants. Many of these texts that concern access to broadcast television discuss consequences and outcomes of the FCC's involvement in standardizing and regulating the developing industry.[17] For instance, in 1972, the United States Congress passed an act of legislation (the FCC Report and Order of 1972) requiring all cable franchises to include at least one public access channel. Although public television stations and public access channels existed before 1972, there were only a few; the most notable public television stations in the United States were WBGH, WNET and KQED. The FCC's report and ruling had an impact on the emergence of new spaces of practice. It did not democratize television, but it did help to make accessible the tools of television for those interested in alternative programming. This in turn led to the production and dissemination of discourse, works of art, and programs across the fluid institutional boundaries that also saw an economically motivated migration of artists, engineers, technicians and scholars. Most often, those participating or contributing gravitated toward production and post-production centers, such as the Experimental Television Center in upstate New York, the Kitchen in New York City, and Video Free America in San Francisco, among others.

2. Alternative media centers and video collectives

The emergence of the alternative television movement and video collectives in the United States occurred across three distinct institutional sites: equipment centers, alternative media centers, and public access and television studios. In contrast to the commercial broadcasting industry, these three sites sought to open a space for alternative television production by and for local communities. Equipment that was once available only to a few technicians working in the industry was now available to the public, though access to certain equipment was still limited, even into the 1980s. Nevertheless, by the early 1970s, equipment resource centers – such as the New York Media Equipment Resource Center (MERC) and the New Orleans Video Access Center – began offering services to individuals and collectives interested in alternative television production.[18]

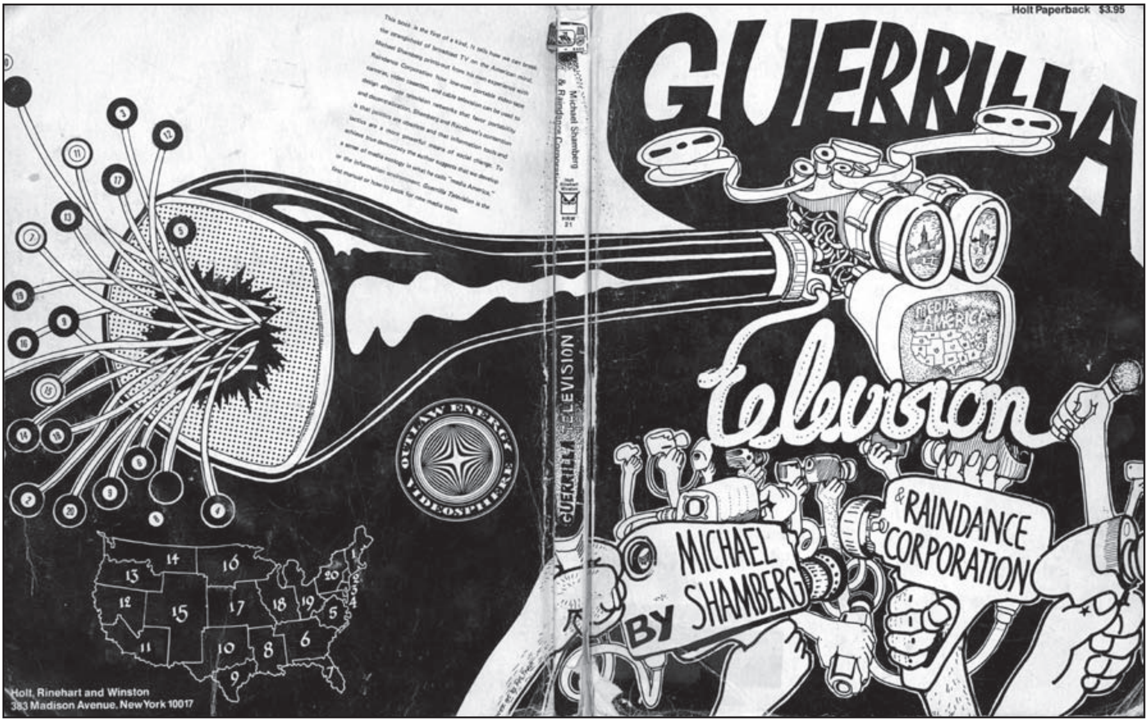
Alternative television centers, such as the Experimental Television Center, which Ralph Hocking incorporated in 1971, and the Kitchen, founded in 1971 by Woody and Steina Vasulka, also provided vital resources for those interested in experimenting and creating works of art using electronic projection devices, videotape cameras, and audio and video synthesizers.[19] These centers were established as production and post-production studios for artists and technicians who would not otherwise have access to costly equipment. In addition to providing access to production and post-production facilities, they also offered training, workshops and artist-in-residence programs. Such services and facilities were not, however, exclusive to alternative television and video centers. Indeed, a number of public television stations at this time also began workshop series and residence programs. In 1967, for instance, KQED initiated an experimental television workshop series in San Francisco and WGBH started an artist-in-residence program in Boston. Since work created at these stations rarely found its way into the commercial television market,[20] public television stations also served as a viable site of transmission (via broadcast), televising material produced at sponsored workshops and artist-in-residence programs.[21] Unlike alternative media centers, however, public broadcast television stations were shared sites with shared interests; experimental programming on the televisual arts was negotiated and mediated by public broadcast television producers and directors, who were required to work on other programs and projects with different interests.

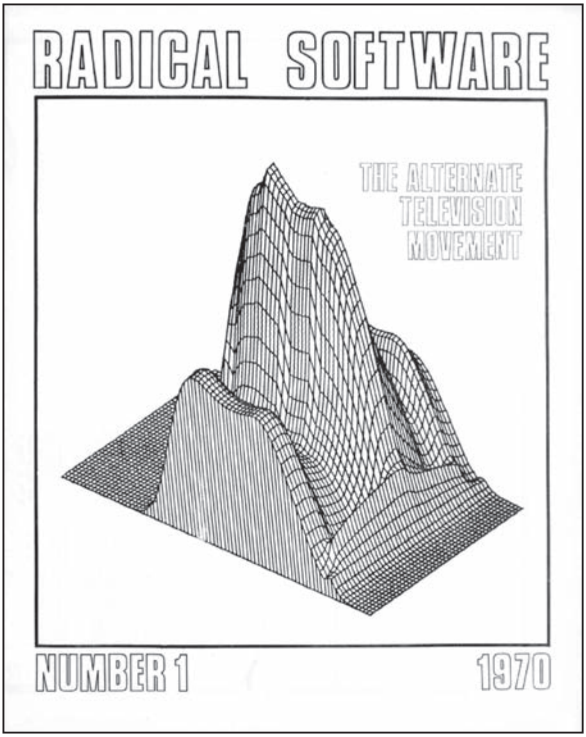
As is the case with public television, those participating in the alternative or experimental television movement also produced distinct genres of discourse. These include the following: ‘how-to’ trade manuals, such as Videofreex’s *The Spaghetti City Video Manual* (1973); counter-histories on alternative television practices, including *Guerrilla Television* by Michael Shamberg (1971); technical reports; and alternative, independent journals, such as *Radical Software* (1970–76) (Figures 2a-b; Color Plate 20). While these writings were institutionally motivated, it must be stressed that the conceptual borders between the sites specified in this text are not closed as their participants also migrated to where the opportunities were. These include galleries and museums, which, by the late 1960s and the early 1970s, started to establish exhibition values for framing and validating video art as a curatorial category.

3. Galleries and museums

Artists interested in alternative television also began to exhibit in galleries and museums. In 1973, for instance, the Whitney Museum showed Jaime Davidovich’s *Tape Project* during its Biennial exhibition.[22] Already by this time, though, a number of distinct institutional spaces that exhibited and screened works using television, video and videotape had emerged. These include three main domains: collecting and exhibiting institutions such as galleries, museums and databanks; festivals and performative sites; and neo-avant-garde spaces of practice.[23]

Although, as museum curators Chrissie Iles and Henriette Huldisch note, many moving-image works on television and videotape were not intended for ‘institutional display’ or ‘conventional collecting’ (2005: 65–66),[24] galleries started to embrace unconventional artworks that demonstrated television’s potential as a creative medium





Figures 2a-b. Front cover of *Guerrilla Television* (Shamberg and Raindance Foundation, 1971). Front cover of 'The Alternative Television Movement' issue of *Radical Software* (courtesy. Beryl Korot). See also Color Plate 20. *The Spaghetti City Video Manual* cover.

as early as 1963. Other moving-image works include film and video installations, which, during the 1960s, were also considered 'indifferent, or conceived in opposition, to the values of collectability, immutability, and objecthood' by museums (Iles and Huldisch 2005: 66; 82).[25] Before film and video installations appeared in museums, however, artists were demonstrating television's potential as a creative art form at nontraditional exhibition venues and traditional gallery spaces. In 1963, for example, Nam June Paik and Wolf Vostell participated in two events outside the traditional gallery system. These events, which demonstrated television's potential as a creative medium, included the 'Exposition of Music: Electronic Television' show (March 11 – 20, 1963) at Rolf Jährling's private residence in Wuppertal, West Germany, and Vostell's 'television dé-collage' happenings at George Segal's farm in New Jersey (Figure 3).[26] That same year, the Smolin Gallery in New York City, which was a more traditional exhibiting space, showed Vostell's modified television sets in 'Wolf Vostell & Television Dé-collage & Dé-collage Posters & Comestible Dé-collage' (Figure 4). Two years later, Paik had his first solo exhibition, 'Electronic Art', at the Galeria Bonino and, in 1967, the Howard Wise Gallery included Paik's *Electronic Blues* (1966) piece in 'Lights in Orbit' (February 4 – March 4, 1967). By 1969, however, exhibiting and collecting institutions began to shift their focus from demonstrating television's potential as a creative medium to advancing and validating 'television' and 'video' as legitimate art forms. The Howard Wise Gallery exhibition 'TV as a Creative Medium' (May 17 – June 14, 1969) is a case in point.[27]

'TV as a Creative Medium' was one of the first gallery exhibitions dedicated entirely to framing and validating television and video as expressive art forms in the United States.[28] The exhibition, according to gallery owner and director Howard Wise, legitimized television and video as expressive art forms at a time when a new generation of artists 'brought up on TV' began reading '"do it yourself" books on how to make radio and TVs' and 'repairing the neighbor's broken [television] sets' (Howard Wise Gallery 1969).[29] These artists, he wrote in the exhibition catalog, 'work[ed] with TV because they were fascinated with the results they were able to achieve, and because they sensed the *potential* of TV as the medium for their expression' (Howard Wise Gallery 1969; my emphasis).

While 'TV as a Creative Medium' gave the participating artists an opportunity to demonstrate the '*potential* of TV as the medium for their expression' (Howard Wise Gallery 1969),[30] it also enabled the artist to validate television and video as expressive art forms in a gallery context. Exhibition standards included exceeding the limits of commercial television programming and expanding the boundaries of television and video production. Participating artists expanded television and video in 'TV as a Creative Medium' by using custom-built image-processing devices, multiple monitor displays featuring live video camera feeds and closed-circuit time delays, and ½" videotape recording equipment.[31] By using expensive television and video equipment, the artists in the exhibition also placed new technical and economic demands on the Howard Wise Gallery. Wise's solution to meeting these demands was to close his gallery in 1970, and, in 1971, open Electronic Arts Intermix, a nonprofit center offering technical assistance and economic resources to artists interested in television and video as art forms.[32] Unlike the traditional gallery space, Wise believed that such a center would not limit artists from realizing the full potential of television, video and other electronic media.

As is the case with the other sites, those participating in institutions associated with exhibiting or screening also generated discourse on experimental television and practices using video and videotape. However, unlike the former sites, museums and galleries had a greater visibility. This was due to an influx of exhibitions (from the late 1960s onward) and their respective publications, which circulated across disciplines. As a privileged site, galleries and museums helped artists and collectives gain greater exposure. At the same time, artists, curators and scholars – especially those invested in emergent electronic art forms – began contributing to gallery and museum literature. These include curatorial historiographies and catalogs, advertising brochures, critical reviews, technical reports and neo-avant-garde statements. The first category of writing consists of opening statements and curatorial overviews of exhibited works. The second grouping comprises promotional items, which are not always informative, except in rare cases such as the 1964 brochure accompanying Nam June Paik's exhibition at the New School for Social Research. Primary documents, such as Paik's 1964 exhibition brochure or Howard Wise's promotional manifesto titled 'At the Leading Edge of Art' (1973), represent significant source material from a period when few informative writings existed on the subject.

Critical reviews and technical reports, on the other hand, cross all the domains delineated in this text. However, in contrast to exhibition reviews on the subject, technical reports were rarely circulated – published examples include the 1964 brochure accompanying Nam June Paik's exhibition at the New School for Social Research and Dan Graham's 'Two Consciousness Projection(s)'.[33] Critical exhibition reviews in major contemporary art journals – including *Afterimage*, *Artforum*, *ARTnews*, and numerous others – are more abundant and promote greater visibility for those in the field. Neo-avant-garde statements, such as Nam June Paik's 'afterlude to the EXPOSITION of EXPERIMENTAL TELEVISION' (Figure 5), however, were not circulated widely. Instead, they were included in limited publications, including the Fluxus journal, *Dé-collage: Bulletin aktueller Ideen*, and the newspaper, *fLuxus cc fiVe ThreE*.

4. The published record

The published record represents a kind of knowledge base from which a legitimizing critical language has invented frameworks for thinking about electronic art forms using television, video and videotape. While this knowledge base comprises material that is derived from a variety of institutions, a chronological study of the published record yields some surprising information concerning various areas of inquiry, changing roles of audiences and cultural institutions, and the impact of innovative technologies on cultural production and creative expression. My criteria for selecting material from this record has been to locate key, paradigm-shaping texts from an exhaustive chronological bibliography, which address the conception, development and defining characteristics of a body of work that has become known as video art. As for its impact on the proliferation of the electronic arts, these texts helped to invent a legitimizing critical language by covering the following topics: Fluxus and experimental television, experiments in public broadcast television and television as a creative medium, the alternative television movement and guerrilla television, the grammar of video and videotape, categories of video art, histories and genres of video art and video art theory. By examining the way

Figure 3. Wolf Vostell, 'Dé-collage performance happening at the "Yam Festival"', organized by the Smolin Gallery, New York at George Segal's Farm near South Brunswick, NJ, May 19, 1963. (photo. Peter Moore) © 2013 Estate of Wolf Vostell / Artists Rights Society, New York / VG Bild-Kunst, Bonn.

Figure 4. Wolf Vostell, installation view of 'Wolf Vostell & Television Dé-collage & Dé-collage Posters & Comestible Dé-collage', Smolin Gallery, New York, May 22, 1963. (photo. Peter Moore) © 2013 Estate of Wolf Vostell / Artists Rights Society, New York / VG Bild-Kunst, Bonn.

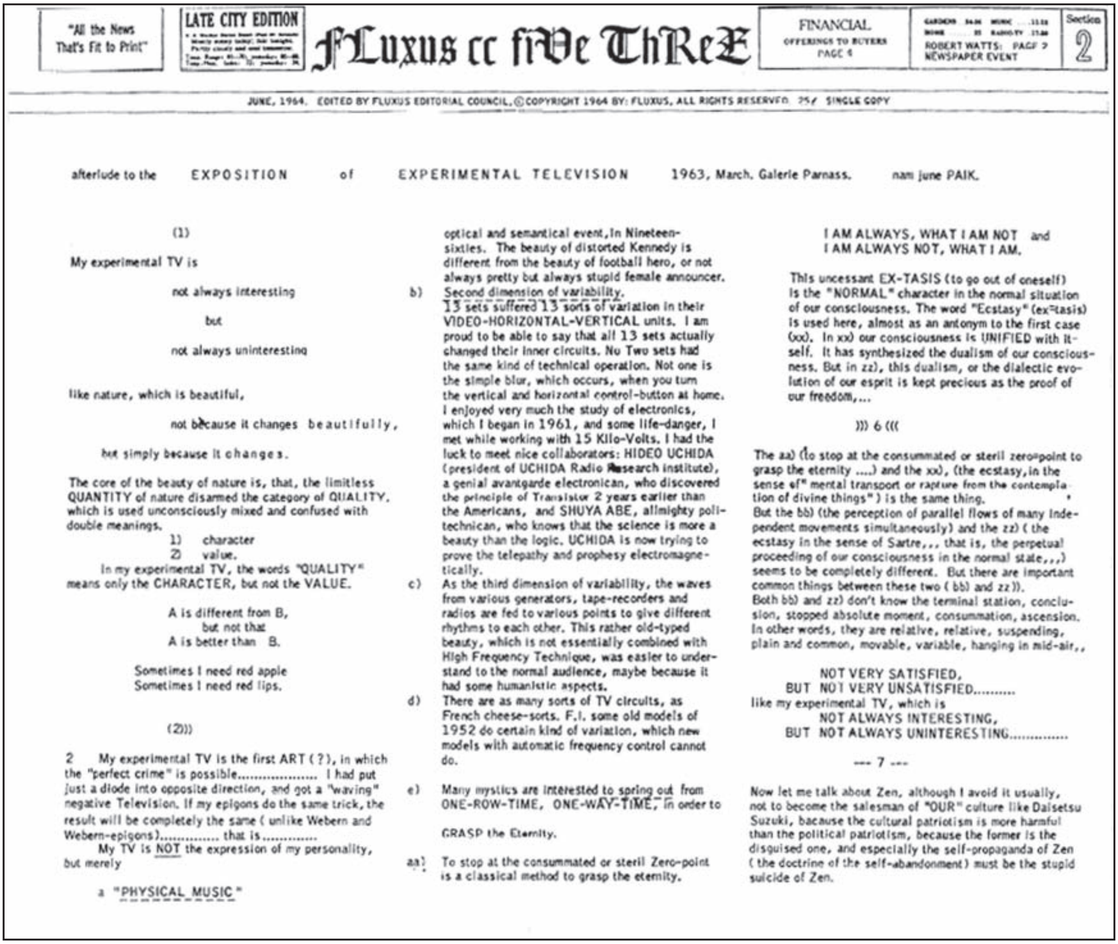
this literature addresses the emergence of a concept of 'video art', it also becomes evident that a totalizing and monolithic history of video art is problematic – especially since many discussions of the field are not specific to one medium, institution or discipline.

5. Academic institutions and conferences

If the aforementioned sites have defined the topography of the landscape across which video practice has emerged, then the reception of that practice has been powerfully shaped by discussions within the academic arena. Such discussions have crossed the disciplines of art history, film and visual studies, communication and media arts, and educational studios and workshops. What they have produced is a discourse drawing on the following methodologies: historiography, from art history; theory, from film and visual studies; sociology of media, from communication and media arts; and analyses of the technical aspects of video, from educational studios and workshops.

Like those working in public broadcast television, alternative media centers, and museums and galleries, academics began writing exhibition reviews and articles, participating in panel discussions and curating exhibitions. They also used their disciplinary frameworks for thinking about electronic art forms. The various frameworks adapted, however, were not always adequately suited for thinking through this emerging interdisciplinary work. As a result, materials informed by academic disciplines (for example, film, English and art history) were institutionally specific and therefore heterogeneous.[34] With the emergence of new theoretical perspectives in the 1970s and 1980s, though, newer interdisciplinary approaches were available, which in turn helped to shape a distinctive knowledge base – one that did not belong to a single academic discipline and, thus, moved freely across the conceptual borders in academia.

What is noticeable across all academic sites is a need for a reassessment of the state of the literature on the history of video art. This literature tends to treat this category as homogeneous. In addition to forming a monolithic conception of the field, some historical perspectives concentrate on offering a unified chronological history of video art. What many of these accounts fail to grasp is that the field is diverse and differential. By contrast, I propose to distinguish the sites and genres of writing on practices using television, video and videotape without assuming that they all refer to a common object of knowledge. These practices are indeed shown to be radically heterogeneous in ways that must be addressed and cannot be elided by appeals to some common medium. In avoiding such appeals in this text, I outline schematically an alternative way in which to think about the various threads of the expanded field of electronic, time-based media. I use as a basis Foucault's archaeology model, not in order to establish a fixed, all-inclusive category, but instead to establish some grounds for addressing electronic, time-based practices and artworks using television and video more adequately. In turning away from notions of origin, derivation and chronological development, I suggest an alternative method for addressing the many conceptualizations of video, as developed by institutions, their systems of relations, and the distinct series of events defined in these relations. Indeed, by using such a method, I do not attempt to offer a definitive history; actually, I only address a small portion to substantiate my method of address in this text. In place of a definitive history, I put forward an alternative mapping of the discursive field of experimental television and video practices, its institutions and their networks, with the aim of offering



"All the News That's Fit to Print"

LATE CITY EDITION

fLuxus cc fiVe ThReE

FINANCIAL
OFFERINGS TO BUYERS
PAGE 4

ROBERT WATTS: PAGE 2
NEWSPAPER EVENT

Section 2

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afterlude to the EXPOSITION of EXPERIMENTAL TELEVISION 1963, March. Galerie Parnass. nam june PAIK.

(1)

My experimental TV is

not always interesting

but

not always uninteresting

like nature, which is beautiful,

not because it changes beautifully,

but simply because it changes.

The core of the beauty of nature is, that, the limitless QUANTITY of nature disarmed the category of QUALITY, which is used unconsciously mixed and confused with double meanings.

1) character
2) value.

In my experimental TV, the words "QUALITY" means only the CHARACTER, but not the VALUE.

A is different from B,
but not that
A is better than B.

Sometimes I need red apple
Sometimes I need red lips.

(2))

2 My experimental TV is the first ART (?), in which the "perfect crime" is possible.................... I had put just a diode into opposite direction, and got a "waving" negative Television. If my epigons do the same trick, the result will be completely the same (unlike Webern and Webern-epigons).............. that is.............

My TV is NOT the expression of my personality, but merely

a "PHYSICAL MUSIC"

optical and semantical event, In Nineteen-sixties. The beauty of distorted Kennedy is different from the beauty of football hero, or not always pretty but always stupid female announcer.

b) Second dimension of variability.
13 sets suffered 13 sorts of variation in their VIDEO-HORIZONTAL-VERTICAL units. I am proud to be able to say that all 13 sets actually changed their inner circuits. No Two sets had the same kind of technical operation. Not one is the simple blur, which occurs, when you turn the vertical and horizontal control-button at home. I enjoyed very much the study of electronics, which I began in 1961, and some life-danger, I met while working with 15 Kilo-Volts. I had the luck to meet nice collaborators: HIDEO UCHIDA (president of UCHIDA Radio Research institute), a genial avantgarde electronican, who discovered the principle of Transistor 2 years earlier than the Americans, and SHUYA ABE, allmighty poli-technican, who knows that the science is more a beauty than the logic. UCHIDA is now trying to prove the telepathy and prophesy electromagnetically.

c) As the third dimension of variability, the waves from various generators, tape-recorders and radios are fed to various points to give different rhythms to each other. This rather old-typed beauty, which is not essentially combined with High Frequency Technique, was easier to understand to the normal audience, maybe because it had some humanistic aspects.

d) There are as many sorts of TV circuits, as French cheese-sorts. F.I. some old models of 1952 do certain kind of variation, which new models with automatic frequency control cannot do.

e) Many mystics are interested to spring out from ONE-ROW-TIME, ONE-WAY-TIME, in order to

GRASP the Eternity.

aa) To stop at the consummated or steril Zero-point is a classical method to grasp the eternity.

I AM ALWAYS, WHAT I AM NOT and
I AM ALWAYS NOT, WHAT I AM.

This uncessant EX-TASIS (to go out of oneself) is the "NORMAL" character in the normal situation of our consciousness. The word "Ecstasy" (ex=tasis) is used here, almost as an antonym to the first case (xx). In xx) our consciousness is UNIFIED with itself. It has synthesized the dualism of our consciousness. But in zz), this dualism, or the dialectic evolution of our esprit is kept precious as the proof of our freedom,...

))) 6 (((

The aa) (to stop at the consummated or steril zero=point to grasp the eternity ....) and the xx), (the ecstasy, in the sense of" mental transport or rapture from the contemplation of divine things") is the same thing.
But the bb) (the perception of parallel flows of many independent movements simultaneously) and the zz) (the ecstasy in the sense of Sartre,,, that is, the perpetual proceeding of our consciousness in the normal state,,,) seems to be completely different. But there are important common things between these two (bb) and zz)).
Both bb) and zz) don't know the terminal station, conclusion, stopped absolute moment, consummation, ascension. In other words, they are relative, relative, suspending, plain and common, movable, variable, hanging in mid-air,,

NOT VERY SATISFIED,
BUT NOT VERY UNSATISFIED..........
like my experimental TV, which is
NOT ALWAYS INTERESTING,
BUT NOT ALWAYS UNINTERESTING..............

--- 7 ---

Now let me talk about Zen, although I avoid it usually, not to become the salesman of "OUR" culture like Daisetsu Suzuki, bacause the cultural patriotism is more harmful than the political patriotism, because the former is the disguised one, and especially the self-propaganda of Zen (the doctrine of the self-abandonment) must be the stupid suicide of Zen.

Figure 5. Nam June Paik's 'afterlude to the EXPOSITION of EXPERIMENTAL TELEVISION' (1964). (courtesy. Nam June Paik Studios).

a starting point from which to address the proliferation of electronic, time-based arts with historical specificity and conceptual clarity. And I believe it is from this perspective that an archaeology of the conceptualizations of video can be pulled into sharp focus.

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Notes

1. This text is based on a larger project begun at Binghamton University, State University of New York. I would like to thank John Tagg for his insightful comments and professional criticisms made on an earlier draft.
2. Foucault noted that 'tools [inherited and of their own making] have enabled workers in the historical field to distinguish various sedimentary strata' and, as a result, 'linear successions, which for so long had been the object of research, have given way to discoveries in depth' (1972).
3. Tagg continues to note that 'across this field, the unity, integrity and continuity of photography was, from the beginning, only ever locally and discontinuously invoked' (1992).
4. I will not offer, however, a definitive or comprehensive mapping of the field, as such a project could never adequately cover the field in its entirety.
5. This is partly because much of this discourse derives from artists, scholars, activists, technicians and others working from distinct institutional vantage points.
6. Producers and participants working in (public) broadcast television also published some of the first texts on the subject. For some early examples, see the following: John Margolies (1969), 'TV – The Next Medium', *Art in America, 57*: 5 (September/October), pp. 48–55; George Stoney (1971–72), 'Mirror Machine', *Sight and Sound, 41*: 1 (Winter), pp. 9–11; and Robert de Havilland (ed.) (1972), 'Designing for TV', *Print*, 26: 1 (January/February).
7. *Jazz Images*, *What's Happening Mr. Silver?* and *The Medium Is the Medium* were produced at WGBH, Boston. Loren Sears and Robert Zagone created *Sorcery* at KQED, San Francisco. Ed Emshwiller created *Scape-mates* at the Television Laboratory at WNET/Thirteen.
8. The Communications Act has been updated to include amendments and provisions, such as the establishment, operation and funding of the Corporation for Public Broadcasting in 1967. See Corporation for Public Broadcasting (1967).
9. Public broadcast television and community access television are two different institutions. Unlike community access television, however, public broadcast television had a greater visibility. This is because, as early as 1967, public broadcast television studios began offering workshops and artist-in-residence programs

to invited artists. Other conditions include the following: (1) public television studios possessed economic capital for promoting experiments in television and telecommunications technologies (from governmental and privately funded grants); (2) they owned production and post-production facilities, which enabled their participants to record, edit and produce works in television; (3) they were backed by crucial governmental regulations and provisions promoting public telecommunications policies and services locally and nationally; and (4) they participated in debates in the literature, which concerned television's unrealized possibilities, the potentiality of television as a creative medium, and alternative methods and non-commercial modes of production. For some of these debates, see Margolies (1969: 48–55); Jonathan Price (1972), 'Video Pioneers: The Fascinating Future of TV as Visual Art', *Harper's Magazine*, 244: 1465 (June), pp. 87–92; Robert de Havilland (1972); and Fred Barzyk (1972: 20–29).

10. The declaration policy includes the following conditions: '(1) it is in the public interest to encourage the growth and development of public radio and television broadcasting, including the use of such media for instructional, educational, and cultural purposes; (2) it is in the public interest to encourage the growth and development of non-broadcast telecommunications technologies for the delivery of public telecommunications services; (3) expansion and development of public telecommunications and of diversity of its programming depend on freedom, imagination, and initiative on both local and national levels; (4) the encouragement and support of public telecommunications, while matters of importance for private and local development, are also of appropriate and important concern to the Federal Government; (5) it furthers the general welfare to encourage public telecommunications services which will be responsive to the interests of people both in particular localities and throughout the United States, which will constitute an expression of diversity and excellence, and which will constitute a source of alternative telecommunications services for all the citizens of the Nation; (6) it is in the public interest to encourage the development of programming that involves creative risks and that addresses the needs of unserved and underserved audiences, particularly children and minorities; (7) it is necessary and appropriate for the Federal Government to complement, assist, and support a national policy that will most effectively make public telecommunications services available to all citizens of the United States; (8) public television and radio stations and public telecommunications services constitute valuable local community resources for utilizing electronic media to address national concerns and solve local problems through community programs and outreach programs; (9) it is in the public interest for the Federal Government to ensure that all citizens of the United States have access to public telecommunications services through all appropriate available telecommunications distribution technologies; and (10) a private corporation should be created to facilitate the development of public telecommunications and to afford maximum protection from extraneous interference and control.'
11. Pioneering producers and directors interested in experimental programming at WGBH, WNET Thirteen and KQED supported such risks.
12. The Paik/Abe Video Synthesizer, which Nam June Paik and Shuya Abe first built with funds from WGBH, is an example of a non-broadcast technology.
13. In 1967, for example, WGBH director Fred Barzyk invited David Silver to develop *What's Happening Mr. Silver?* In 1969, WGBH invited six artists 'to find new ways of using television as an electronic art form' by collaborating with television engineers. See Ed Dowling (1969), *The Medium Is the Medium* [unpublished press release], March 11th, Boston, MA: WGBH Archives.
14. The media critic Marita Sturken noted, 'WGBH was actually the first of all three stations to support television and video experimentation, receiving funds from the Rockefeller Foundation in 1967 and, under the guidance of producer Fred Barzyk, producing several early experimental shows, including an innovative 1967 series, "What's Happening Mr. Silver?" and the seminal "The Medium Is the Medium" (1969)': Marita Sturken (1987), 'Private Money and Personal Influence', *Afterimage*, 14: 6, pp. 8–15.
15. Most of KQED's funding for the National Center for Experiments in Television came from the Corporation for Public Broadcasting and the National Endowment for the Arts.
16. The director of the National Center for Experimental Television (NCET), Paul Kaufman, and his participants published a series of reports. They include Stephen Beck, 'Video Feedback, Direct Video'; Paul Kaufman, 'Reflections on Values in Public Television'; Richard Moore, 'Communication, Organization and John Stuart Mill'; Brice Howard, 'About Television Reality and Performance'; Paul Kaufman, 'Television and Reality'; Marvin Duckler, 'Talking Faces, Eating Time and Electronic Catharsis'; Richard Stephens and Don Hallock, 'Suggestions Toward a Small Video Facility'; Bill Gwin, 'Reflections on Media'; and Brice Howard, 'An Ancient Gift'.

17. The Communications Act of 1934 and its provisions, including the Public Television Broadcasting Act of 1967, also regulate the industry.
18. The New York Media Equipment Resource Center (MERC) and the New Orleans Video Access Center were established in 1971.
19. Ralph Hocking incorporated the Experimental Television Center in 1971. It was the successor to Student Experiments in Television, established in 1968 at the State University of New York, Binghamton, and the Community Center for Television Production (CCTVP).
20. In 1969, the Videofreex and the producer Don West created *Subject to Change* for CBS; however, it was never televised.
21. One example is the television program *The Medium Is the Medium*, which WNET/Channel 13 aired at 8:00 p.m. on March 23rd, 1969. It features works produced at WGBH by Allan Kaprow, Nam June Paik, Otto Piene, James Seawright, Thomas Tadlock and Aldo Tambellini.
22. The eight works using video and videotape at the Biennial include the following: *Baldessari Sings Lewitt* by John Baldessari; *Kiva* by Peter Campus; *Tape Project* by Jaime Davidovich; *Sapphos* by Joan Jonas; *Sax* by Richard Landry; *Untitled* by Robert Morris; *Mat Key Radio Track* by Keith Sonnier; and *Selected Works* (1972) by William Wegman. By 1975, the Whitney Biennial had quadrupled the number of artworks that incorporated the video medium.
23. Examples of neo-avant-garde spaces include the 1963 Fluxus 'Exposition of Music: Electronic Television' in Wuppertal, West Germany, and the 'Annual New York Avant-Garde Festival' in New York City (1963–80). Other sites include private settings, such as artist studios and lofts.
24. Iles and Huldisch (2005) wrote: '[I]t was in the 1990s that private collectors and museums began collecting moving-image installations in earnest. In the flurry of selling and collecting that followed, an often contradictory array of arbitrary procedures emerged. Works were sold on VHS videotapes – sometimes signed by the artist – on specially edition laser discs and, later, on DVD […].' 'The long-term implications of what they had bought,' as Iles and Huldisch point out, was only thought about years later.
25. These moving-image works include 'sculptural media […] us[ing] film as one of many media with which to expand the parameters of sculpture and physical space', and artworks using video cameras and videotape equipment 'to record performative actions, sometimes in relation to live feedback.' Iles and Huldisch reference Robert Morris, Dan Graham, Richard Serra, Lawrence Weiner, Ana Mendieta, Dennis Oppenheim, Walter De Maria and David Lamelas as artists working with 'film as one of many media with which to expand the parameters of sculpture and physical space.' They reference Marina Abramović, Vito Acconci, Peter Campus, Joan Jonas, Bruce Nauman and Hannah Wilke as artists using video cameras and analog videotape equipment 'to record performative actions, sometimes in relation to live feedback.' Iles and Huldisch also added in an endnote that this body of work is 'largely distinct from what is most often termed avant-garde or experimental film, whose historical relationship with the museum has taken a very different course [...]' (Iles and Huldisch 2005: 66; 82).
26. Paik included his participation television experiments and prepared television sets in the 'Exposition of Music: Electronic Television'. Vostell's 'television dé-collage' happenings took place alongside his solo exhibition, 'Wolf Vostell & Television Dé-collage & Dé-collage Posters & Comestible Dé-collage' (May 22nd, 1963) at the Smolin Gallery in New York City. The Smolin Gallery sponsored two events: Vostell's gallery exhibition, which encouraged visitors to participate in do-it-yourself *dé-collage* performances; and the 'Yam Festival', which featured one of Vostell's 'television dé-collage' happenings.
27. The exhibition catalog to 'TV as a Creative Medium' also discusses the idea of 'video' as an expressive medium (Howard Wise Gallery 1999).
28. Three unpublished documents suggest that Wise was thinking about ways to frame and validate television and video art. They include the following documents: Howard Wise Gallery (1969); Howard Wise (1970), *To the friends of the gallery* (personal communication), December 16, 1970; and Howard Wise (1977), 'What is Video Art?', *Cablelibraries*, 5: 6.
29. In the introduction to the exhibition catalog, Wise wrote: 'Why has not art been affected by this pervading influence [of television]? Perhaps quite simply, because, up until now the time was not right. Perhaps it had to await the maturing of the generation who were in their sub-teens in the 1950's, those who were "brought up" on TV. They read "do it yourself" books on how to make radio and TVs. They earned pocket money repairing the neighbor's broken sets. Or they were trained in the technology while they were in the armed forces. As in every generation, some were artists. These have been at work for two, three, five and even more years, scrounging

around second hand shops for parts, working with TV because they were fascinated with the results they were able to achieve, and because they sensed the potential of TV as the medium for their expression' (Howard Wise Gallery 1969).

30. While the catalog to 'TV as a Creative Medium' frames the exhibition as artists using television as a creative medium, another document suggest that Wise saw the exhibition as an opportunity for artists to transcend the limits of commercial television programming by using television and video in new ways. Also see Howard Wise (1971), 'The Electronic Hokkadim' exhibition address, Corcoran Gallery of Art, Washington, DC, June 12, http://www.eai.org/kinetic/ch1/gallery/by_about_hw.html. Accessed July 11, 2010.
31. They were Serge Boutourline, Frank Gillette, Charlotte Moorman, Nam June Paik, Earl Reiback, Paul Ryan, John Seery, Ira Schneider, Thomas Tadlock, Aldo Tambellini and Joe Weintraub. The exhibition included Boutourline's *Telediscretion*, Gillette's and Schneider's *Wipe Cycle*, Paik's *Participation TV*, Paik and Moorman's *TV Bra for Living Sculpture*, Reiback's *Three Experiments Within the TV Tube*, Ryan's *Everyman's Moebius Strip*, Seery's *TV Time Capsule*, Siegel's *Psychedelevision in Color*, Tadlock's *The Archetron* and Tambellini's *Black Spiral*.
32. Wise incorporated Electronic Arts Intermix in 1972. As indicated in the Certificate of Incorporation, Wise's determination letter is dated January 20th, 1972. Electronic Arts Intermix, 'Certificate of Incorporation', http://www.eai.org/user_files/supporting_documents/incorporation.jpg. Accessed October 3rd, 2010.
33. Nam June Paik's technical notes are published in the exhibition catalog for 'Videa 'n' Videology: Nam June Paik, 1959–1973'. See Judson Rosebush (ed.) (1974), *Videa 'n' Videology: Nam June Paik, 1959–1973*, Syracuse, NY: Everson Museum of Art. Dan Graham's 'Two Consciousness Projection(s)' appeared in the December 1974 issue of *Arts Magazine*.
34. For example, Gene Youngblood, George Stoney and Robert Arn applied film theory, whereas Marshall McLuhan and Paul Ryan applied social media theory. Intervening discussions have most frequently stemmed from the theory and sociology of media. The earliest examples include Marshall McLuhan's *Understanding Media: The Extensions of Man* (1964) and *The Medium Is the Message* (1967), and Gene Youngblood's *Expanded Cinema* (1970). Examples that are more recent include Sean Cubitt's *Timeshift: On Video Culture* (1991) and *Videography: Video Media as Art and Culture* (1993). Technical reports from academic research facilities, workshops, and studios have also been a source of information on the state and potential of experimental television and video practice. Examples include Paul Ryan's 1968 essay on research conducted at Fordham University, titled 'Videotape – Thinking About a Medium', and Eric Cameron's 'The Grammar of the Video Image', which covers the structure of video-recording investigated at Nova Scotia College. These texts, however, remain only a fragment of a larger body of knowledge.

Impulses – Tools

Christiane Paul and Jack Toolin

This chapter will compare the impulses – or conceptual and technological goals – behind the development of tools for the creation of 'media art' in the 1960s and 1970s, and in contemporary 'new media art'. The notion of 'impulse' itself implies a change of momentum, be it of an object or an emotion, and suggests that it is difficult if not impossible to develop a systematic framework for the goals pursued in the creation of artistic tools. An exploration of this complex topic requires not only a careful framing of the issues involved, but also a definition of the terms media art, new media art and even tools.

In its standard usage, the term 'media' denotes communication, information or entertainment systems in their various forms and, until the later part of the twentieth century, was mostly associated with broadcast media – one-to-many distribution systems. Since the 1950s, the spectrum of 'older' media – most notably photography, radio, film and television – was broadened with the advent of technologies such as color television, news satellites, video recorders and tapes, videophones, cable television, and laser techniques, as well as computer and networking technologies. Throughout the past century, the term 'media art' has been used for art produced for and distributed by the above audio-visual mass media – photography, radio, television, film and video, as well as multimedia. Until the end of the twentieth century, the classifier 'new media,' which had coexisted with media art throughout the decades, described mostly film/video, as well as sound art and some hybrid forms. In the late 1990s and early twenty-first century, the expression 'new media' made a fluid transition from analog to digital and started to be applied to projects involving the digital technologies that became seemingly ubiquitous during the last decade of the twentieth century. The pervasive emergence of these technologies – and the devices and platforms they support, from personal computers, mobile phones and PDAs to the World Wide Web – in the 1990s makes it easy to forget that the foundations for many digital technologies were developed up to 60 years earlier. Artists used computers for the creation of their works throughout the 1960s, 1970s and 1980s (or even as early as the 1940s if one counts analog computing).

The label 'new media art', in the sense of digital art, mostly describes art that uses digital technologies as a medium – employing its process-based, potentially interactive and participatory, real-time, generative, modular and non-linear characteristics – rather than utilizing the technologies as a tool for the creation of a more traditional art object, such as a photograph, print or sculpture. Making use of the inherent features of its medium, new media art can take multiple forms, ranging from (networked) installation, cinematic works and immersive virtual reality projects, to net art, software art and locative media art.

In the context of media art, the notion of 'tools' equally seems to have changed throughout the decades. In the 1960s and 1970s, the term referred mostly to hardware and the apparatus, such as Sony portapaks and video synthesizers. Roughly since the 1980s, the word 'tool' increasingly began to be applied to software, too (although artists such as Ken Knowlton at Bell Labs had been developing software tools as early as the 1960s). A fairly recent phenomenon is the perception of tools themselves as 'art' rather than an apparatus or means for producing art. The 'tool as artwork' often provides a meta-commentary on a given function of a medium. Examples would be artist-created software tools, also known as 'artware', such as alternative Web browsers or search engines. The notion of the tool as art arguably was made possible by some of the theoretical frameworks proposed by conceptual art, among them the dematerialization of the art object, and the focus on idea and process. The rise of computerization and the importance of 'information' and cybernetic systems enabled the latter concepts to have more of an impact in the 1960s and 1970s, and one could argue that this in turn would not have been possible without the earlier process-oriented experiments of Dada and other art forms.

When it comes to tools for creating (new) media art, this essay will discuss artist-created tools that support new forms of creation, as well as artists' uses of industry-developed technologies for new forms of distribution. With regard to their distribution, artist-created tools can be distinguished according to different levels of accessibility: they can be proprietary and not accessible for public use, made available through licensing or open source.

Artist-created tools comprise a broad range of categories and it would be beyond the scope of this essay to cover all of them in depth. The following taxonomy was developed by classifying well-known and iconic media artworks from the past five decades according to the tools that were used in their creation. On a very general level, one can distinguish between five major groups of tools – categorized here according to their functionality – some of which have developed over decades:

1. Software and hardware tools for manipulating cinematic and videographic 'moving images'
2. Tools for the creation of drawings and for media production
3. Interfaces (from musical to display interfaces)
4. Software tools for reconfiguring Web platforms (browsers or search engines)
5. Hardware and software tools for activism.

The above groups cannot always be clearly delineated and occasionally overlap (for example, one could easily make the argument that a browser is a form of interface). Since the above classification is based on functionalities, the tools in the respective categories can take various forms, ranging from synthesizers and motion capture software, to reactive objects equipped with sensors and real-time data visualizations.

The first category – tools for manipulating images – has a close connection to video art, and has been a particularly broad area of artistic production. The tools discussed here will range from: Ken Knowlton's and Ron Baecker's softwares and programming languages for creating moving images and animations (1960s); interactive film and video as well as interactive video and sound systems (from 1970s onwards); contemporary VJing software; as well as experiments with video game systems and engines.

The comparison between the impulses behind the use and creation of tools for image-based (new) media art practice in the 1960s and 1970s and today will cover two main aspects: conceptual frameworks, referring to the cultural climate and dialog that the work finds itself in; and structural frameworks, meaning the technologies and tools used for production and distribution.

1. Conceptual frameworks

As is well known, the 1960s were a decade unlike any other, with a seemingly incongruous mix of conservatism lingering from the 1950s that clung to 'traditional values', and an ambitious utopianism that inspired cultural experimentation and exploration, testing the limits of 'civil tolerance'. We often resort to reductionism to file away complicated events, and taking a fresh look from a new perspective can reveal relationships that previously were thought to be unrelated, even contradictory. These relationships also existed in the 1960s, which saw the continued consolidation of corporate capitalism in the form of the media industry (in both the medium and the message), and the growth of countercultural, anti-materialist art movements that advocated, at least philosophically, for placing greater value on process than product and a more democratic exchange between artist and art institution.

To think of these two trends as diametrically opposed was common for artists, academics, cultural commentators and the public, but over the past two decades a more complex view of our relationships to media technology, the art object, the art market – indeed to mainstream culture – has evolved. This changing view can already be witnessed in, if not attributed to, developments within the art world such as the pop and postmodern movements. But the growing prevalence of the electronic media industry since television became *the* mass medium of the United States in the late 1950s and early 1960s can also be credited. The role of broadcast media and the visual language they utilize to captivate audiences was bound to migrate into the practice of artists working in the fine art world. After all, as theorists from Adorno (1973) to Stallabrass (2004) have commented, culture is saturated with the imagery propagated by these media, seemingly to the exclusion of all else. Contrary to neo-Marxist theory, media theorist James Carey (1992) and others have argued that the relationship between the mass media and the public is interactive, dynamic and cyclical (as opposed to top-down reinforcement), to the extent that determining a message's origin and its destination is problematic. This type of dynamic can also be traced in production values; for example, the sometimes challenging content and aesthetics of the independent movie maker can percolate into more marketable mainstream productions (for example, low-res image quality or shaky cam signifying first-person authenticity), while the production values of big budget films appear in independent productions as the technology becomes cheaper and more ubiquitous.[1]

The crossover between these deceptively disparate groups is not new, though it was less common in the past.[2] Some central themes of the conceptual art movements of the 1960s (the emphasis on process and collaboration, for instance), which have sustained and become prominent practices today, are akin to the ideas and methodologies that were being expressed in, of all places, the government defense sectors of the 1950s and 1960s. As authors such as Charlie Gere and Fred Turner have noted, the conceptual, collaborative, process-oriented spirit of art in the 1950s to early 1970s (such as the ephemeral work of John Cage, Ann Halprin, USCO, Fluxus and others; or the interactive work of Carolee Schneeman, Frank Gillette and Dan Graham) have shared sensibilities with developments taking place in areas like information theory, cybernetics, and networked communications. Computer engineers, mathematicians and information theorists, such as Vannevar Bush, J. C. R. Licklider and Ted Nelson, were contemplating information platforms at the dawn of the information age.[3] These proponents of information sharing perceived the value of nonhierarchical, interactive exchange made possible by information technologies, and their thinking was influential for many artists who applied it to non-technological interaction. While the parallels and cross-influences between these two worlds are often overlooked, the curatorial efforts and writings of Jack Burnham (1968a; 1968b; 1970),[4] the history of technological art laid out by Douglas Davis (1975) in the 1970s, as well as collaborations such as those between the artists and scientists of EAT (Experiments in Art and Technology), demonstrate that a significant trend was afoot. However, the increasing cross-fertilization between art and technology at the time did not necessarily translate into collaborations without tension.

Ken Knowlton, who collaborated with a sequence of five artists (Leon Harmon, Stan Vanderbeek, Lillian Schwartz, Laurie Spiegel and Emmanuel Ghent) at Bell Labs in the 1960s and 1970s, describes his experiences in the essay 'On the Frustrations of Collaborating with Artists' (2001). In each of these collaborations he saw himself as the 'engineer' of the pair, although the essay makes clear that the definition of roles was fluid.

In an e-mail exchange, Knowlton explains that he has little to say about his 'conceptual goals' at the time:

> I was rather self-directing in my work (play?) at the Labs. […] I was not developing a product that someone else had imagined. Nor did I know at any point in any of the work whether I might be developing a practical, useful, or exploitable product. I was asking the general question regarding what one might be able to do with computers.
>
> I worked, as you probably know, with Stan Vanderbeek, who experimented with any and all technology that he could get his hands on. I was very much in touch with Bill Etra, and peripherally with Nam June Paik. I also participated in some of the activities

> of EAT – in fact Billy Klüver and the gang used Vanderbeek and me as an example of the artist-technologist pairings that they intended to foster (although Stan and I were introduced to each other by a mutual friend, Peter Neumann). (K. Knowlton 2011, personal communication)

Divergent technologies – such as video versus computers – also seemed to function as natural barriers against exchange between artists. Manfred Mohr, one of the pioneers of creating generative drawings through computer code, explains:

> As far as I remember, there was not too much of an interaction between these disciplines. […] In the 60's it was also very expensive to have a personal video camera (even the size was unpractical) so only a few artists had a camera. […] Both, the video artists and the computer artists ignored or better looked down on each other. […] Video artists were scared if somebody talked about a programming language. […] I knew artists like Fred Forest in Paris very well, but he was never interested in what I was doing. […] Or, I knew Larry Cuba in SF, we interacted sometimes, he was more on the programming side and did all the films for Whitney. […] So, I do not think there was too much influence, because the technology and ideas (to use it) in both disciplines were so different in getting results [...] filming reality or calculating reality! (M. Mohr 2011, personal communication)

The relationship between technology, science and art in the 1960s sketches out a striving for new ways to conceive of cultural exchange, be it in the avant-garde sector of the art world or in the forward-looking enclaves of the information technology sector. It is interesting to reflect on these changes and the people who engaged with them instead of adhering to the conventions of their time. What personalities are drawn to take on the uncertainties of new tools, with as yet unidentified aesthetic potential, unknown values in the marketplace, and a lack of acceptance by both the expert field and the general public? What motivates artists to take on such challenges? What is the cultural context in which these transgressions of the status quo take place?

The post–World War II period in the United States experienced a confluence of factors that conspired to determine its status as a world political and economic leader: a flush economy that was buoyed by global demand; an expanding middle-class with disposable income and leisure time; an educated youth with purchasing power; and a proliferating media industry that stimulated and catered to growing consumption. It was the period of the ascent of the 'military industrial complex', and expanding institutions, both public and private, whose authority was undermined by their penchant for misstating facts (the federal government, for instance, frequently underreported the United States involvement in the Vietnam War). The 1950s and 1960s also saw a rise in disaffected populations that identified more with 'the outsider' than with the status quo – those who were determined to find alternatives to the American Dream. Grace Elizabeth Hale, in her book *A Nation of Outsiders* (2011), correlates this disaffection with the prominence of cultural productions, from movies to music, that featured alienated protagonists and dissonant plots, and argues that the 1960s youth developed a romance for this estrangement, identifying it with a sense of authenticity that the increasingly mass-produced mainstream society had devalued. Mainstream (white, middle-class, consumer) culture was seen to be antithetical to a life of self-determination and creative intentionality. She writes:

> The romance of the outsider spread throughout American culture because it provided an imaginary resolution for an intractable mid-century cultural and political conflict, the contradiction between the desire for self-determination and autonomy and the desire for a grounded, morally and emotionally meaningful life. (Hale 2011: 3)

The 'desire for self-determination and autonomy' is not peculiar to post-war counterculture; it has been one of modernity's driving forces. In an essay asserting the potential for uprising that is polymorphous, distributed and ephemeral, Hakim Bey coined the term 'temporary autonomous zone' (TAZ) (Bey 1991). In this touchstone text for technological activism, he reflects on 'pirate utopias' of the eighteenth century as an entry into considering the need for asserting a challenge to the status quo. In Bey's argument, the mobility and fluidity of pirates on the high seas is analogous to that of modern-day insurgents of convention who utilize information to challenge the status quo and to achieve autonomy, if only temporary and selective. Bey says: 'Liminal, and even evanescent, the TAZ must combine information and desire in order to fulfill its adventure (it's "happening"), in order to fill itself to the borders of its destiny, to saturate itself with its own becoming' (1991).

Throughout recent history, scientific, technological and economic developments have been accompanied by changing political philosophies that aspired for a redistribution of power, be it political or cultural. Much of the technological change has directly affected cultural production: automated printing, telegraphic communication, radio and television broadcasting; and more salient to our topic, video production/distribution and new media networks. The 1960s and 1970s saw numerous artists and art collectives challenging the status quo by adopting the technology and language of mass media, while presenting alternative content and/or methodologies to these media's productions (rather than rejecting the media outright in an effort to assume the moral high ground). Collectives such as Raindance, TVTV, Videofreex and Ant Farm are examples of this mode of working.[5] The Yes Men, Jon Kessler, JODI and Paperrad, to mention a few, are examples of contemporary artists who create zones of autonomy in a media landscape that is dominated by corporate interests. These 'insurgencies' into the media superstructure are not limited to the conceptual frameworks of the artworks; rather, they can entail the full spectrum of technological frameworks, including customized tools, social media marketing, and outsourcing and alternative distribution/presentation methods. The scope of these conceptually informed structural frameworks will be addressed in the following section.

2. Structural frameworks

The previously discussed conceptual aspects influenced or became manifest in the structural frameworks for the production and distribution of media and new media arts from the 1960s until today, meaning the specific technologies and tools used and/or created by artists. These technological structures cover a broad range – from the Sony portapaks of the late 1960s to today's use of artist-written software – and the following overview will outline approaches to artistic tool making with a focus on tools for making and distributing cinematic/videographic media art.

2.1. Industry-developed versus artist-developed tools

When it comes to artists' use of tools for making and manipulating mediated images, a major distinction to be made is that between those technologies that have been developed by the artists themselves and those created by the industry. While it implies a certain generalization and the boundaries are blurry, one could argue that artists creating their own tools tend to be more invested in exploring new forms of creation and achieving independence from existing distribution structures, while artists using industry-developed technologies tend to be more interested in exploring conditions of 'seeing', as well as distribution and its effects.

Over the past few decades, the spectrum of industry-developed tools and technological platforms that artists have used for image making and distribution has ranged from video, satellites, CCTV (closed circuit television) and surveillance cameras, webcams and cameras embedded in mobile devices, to YouTube, game engines and image-capturing tools for games and virtual worlds.

The late 1960s and early 1970s were an important period for artistic experimentation with newly developed media tools such as the portapak, and many of the explorations at the time were directed towards reconfigurations or 're-mediations' of traditional systems of media distribution and control, which obviously constitute political power. Theorists such as Herbert Marcuse and Jean Baudrillard examined the effects and use of mediation in capitalism, and Marcuse, in particular, argued that any form of intervention in mediated power systems had itself to employ media.

In the late 1960s and early 1970s artists and activists used the portable recording power of Sony portapaks for establishing alternative media networks, and addressed issues of control over media distribution with regard to documentation and representation. Paper Tiger Television, Global Village, and Downtown Community TV Center (New York City); Experimental TV Center, Media Study/Buffalo, and Visual Studies Workshop (upstate New York); Video Inn and Western Front (Vancouver); and Electronic Café International (Los Angeles) were among the cooperatives and collectives that established and used public video production facilities, media training initiatives and cable access for the creation of alternative media networks. Their goal mostly was to support the broadcasting of alternative content and the linking of artists and communities. The power structure of media, anti-racism, gender-activism and support of underrepresented communities were among the topics that these cooperatives of artists and activists examined. Their practice finds its continuation in the activist software tools and Web-based projects that currently strive to engage and link communities.

In the late 1970s, artists started using satellites, at the time mostly as a tool for connectivity, without paying that much attention to the technology in the context of surveillance. The 1970s also were the time when artists began to explore the CCTV cameras that were increasingly employed in monitoring and surveillance systems during the 1970s and 1980s for spaces such as banks and military installations. (The first CCTV system was installed by Siemens AG in Peenemünde, Germany in 1942, for observing the launch of V2 rockets.)

The use of tools for (moving-) image distribution has reached a new level through sites such as YouTube and Flickr, which have been hyped as a supposed 'second generation of Web-based services' under the umbrella term Web 2.0. Coined by O'Reilly Media in 2004, the term describes 'a business revolution in the computer industry' based on building 'applications that harness network effects to get better the more people use them.' As a corporate concept, Web 2.0 provides contextual 'warehouses' that allow for the filtering and networking of content provided by users, whether photos (Flickr), videos (YouTube) or personal profiles (MySpace). Users effectively grant extensive rights to the content they contribute to these social networking sites, which raises numerous questions about authorship and the preservation of information. In terms of tools for the distribution of moving images, YouTube is an interesting phenomenon. Originally developed by individuals, it became a traditional corporate technology. While YouTube provides people with a large-scale distribution platform for sharing and filtering content that seemingly democratizes access and levels the playing field, rights to the user-generated contents are largely corporately owned. Artists have made use of YouTube's possibility for instant, large-scale viral distribution in different ways, for example by posting videos that invite the public to remix or contribute to them.

Other forms of industry-created image-making and distribution tools that provide large-scale user agency and have been extensively used by artists are computer game engines and level editors. A major factor in the current success of computer games is the fact that they allow users to expand and modify their virtual worlds by means of level editors – tools for developing game levels, or customizing game content through the creation of modifications ('mods') or patches. These mods are self-programmed extensions that change the 'behavior' of a game world or character. Artists have used level editors or game engines – the core software of a computer game that runs all its components, such as real-time graphics, audio, collision detection and physics – to create mods for commercial games or stand-alone scenes that often critically examine the politics and aesthetics of their commercial counterparts.[6]

Moreover, the image-capturing tools originally provided by game developers to allow players to record and replay game sequences in order to analyze them, enabled the development of a new cinematic form – 'machinima' – the shooting of films within computer games or 3D virtual worlds, such as *Second Life*; in these worlds characters and events can be controlled by either humans, scripts or artificial intelligence. Artists such as Eddo Stern and Cory Arcangel have recorded and modified sequences from existing computer games to create linear, digital movies. Stern's *Sheik Attack* (1999–2000) – entirely compiled from sampled computer games, graphics and music – for example, puts viewers into the perspective of an Israeli commando on a mission inside Lebanon during the days before the Six-Day War in 1967. Level editors and tools for creating machinima obviously constitute a shift from tools for recording and broadcasting representations of reality (from CCTV to webcams) to those enabling the creation and recording of simulations.

The artistic use of industry-created tools comprises a variety of approaches, with a large portion of projects exploring the broadening access and distribution possibilities, the aesthetics of the 'camera eye' and 'mediation' as well as the politics of image control.

In parallel to their use of existing tools, artists developed their own in order to enable forms of creation that were not possible before or to achieve independence from corporate distribution models. Examples would be artist-created apparatuses for movie making, video synthesizers, and softwares for image manipulation. It seems obvious that digital technologies, with their inherent modularity and possibility for reconfiguration, have also significantly broadened artists' playing field for the creation of tools for manipulating 'moving images'. One can certainly see this contemporary 'tool making' – for the purpose of capturing, modifying and remixing images – as a continuation of artists' experimentation with synthesizers, switchers and mixers in the (analog) age of video. At the same time, these digital tools also pick up on the often neglected history of digital image manipulation that is up to 20 years older than video technologies and developed in parallel with the latter.

Since the digital medium does not rely on the ultimately linear structure of the film frame or electronic image, but transforms the image itself as well as image sequences into discrete units, each of these units can potentially be remixed in new constellations, be it through software tools or interaction by the viewer. The potentially interactive nature of digital media led to new forms of artistic exploration of interactive cinema by artists such as Lynn Hershman, Graham Weinbren and Toni Dove. Artist-created tools, whether they take the form of hardware or software, are obviously not only used in the area of moving image, but also applied in collaborative drawings, interactive interfaces and art activism.

2.2. Artistic uses of tools

Software and hardware tools for manipulating 'moving images'

The 1960s and 1970s were a period of significant developments with regard to tools for the manipulation of the computer and 'video' image in an art context. It is debatable whether artists were more attracted to either the digital or the video image because of the technological 'production' of the image itself – electrical signals producing an image consisting of interlaced or progressive scan lines in video vs. raster or vector graphics created by arrays of pixels and through the use of geometrical primitives and mathematical equations. Artists' choice of medium also seemed to be fueled by the fundamentally different conditions of representing reality as recorded (video) vs. calculated (computer), as the previously quoted remark by Manfred Mohr indicates.

The beginnings of video art are often traced to Nam June Paik's use of his Sony portapak to shoot Pope Paul VI's Procession through New York City in 1965, Warhol's screening of underground video art around the same time and the French artist Fred Forest's use of his portapak in 1967. (On his website, Forest points to Wolf Vostell's use of a TV set in his work *Deutscher Ausblick* from 1959.) Video provided artists with the possibility of instant playback in connection with the possibility of editing or modifying the video image with various tools. Artists became active players in the development of video synthesizers and related devices that allowed them to generate and manipulate TV-compatible signals (Dewitt n.d.), and the Video History Project website features a list of many of the tools.[7]

At roughly the same time, Michael A. Noll, a researcher at Bell Laboratories in New Jersey, created some of the earliest computer-generated images – among them *Gaussian Quadratic* (1963) – which were exhibited in 1965 as part of the exhibition 'Computer-Generated Pictures' at the Howard Wise Gallery in New York. Bela Julesz, whose work was also included in the exhibition, and the Germans George Nees and Frieder Nake, were among the other early practitioners of the medium. The works of Vera Molnar and Charles Csuri remain influential in their investigations of the computer-generated transformations of visuals through mathematical functions.

In his book *Expanded Cinema* (1970), Gene Youngblood quotes Noll's statement on the computer as a 'creative' tool and medium:

> Most certainly the computer is an electronic device capable of performing only those operations that it has been explicitly instructed to perform. This usually leads to the portrayal of the computer as a powerful tool but one incapable of any true creativity. However, if 'creativity' is restricted to mean the production of the unconventional or the unpredicted, then the computer should instead be portrayed as a creative medium – an active and creative collaborator with the artist [...] because of the computer's great speed, freedom from error, and vast abilities for assessment and subsequent modification of programs, it appears to us to act unpredictably and to produce the unexpected. In this sense the computer actively takes over some of the artist's creative search. It suggests to him syntheses that he may or may not accept. It possesses at least some of the external attributes of creativity. (Youngblood 1970: 192)

Expanded Cinema also contains detailed descriptions as well as images of the tools for motion graphics developed by John Whitney – tools that perfectly capture the digital medium's roots in the military-industrial complex. Norbert Wiener's science of cybernetics was inspired by the guidance and control mechanisms of antiaircraft artillery, and it was an M-5 Anti-aircraft Gun Director that John Whitney (1917–96) – widely considered 'the father of computer graphics' – used as the basic machinery for his first mechanical, analog computer in the late 1950s. Whitney would later use the more sophisticated M-7 to hybridize both machines into a twelve-foot-high device, which he used for his experiments in motion graphics. The machine consists of multiple rotating tables and camera systems, and facilitated the preprogramming of image and motion sequences in a multiple-axis environment (Youngblood 1970: 208–10). Whitney is often credited with 'inventing' the motion control camera. For his short film *Catalog* (1961), a catalog of 'special' effects, he used old analog military computing equipment including a twelve-foot-high device that could process only pre-existing information; images had to be already drawn, photographed and pasted together before the computer could perform its operations. Whitney's films *Permutations* (1967) and *Arabesque* (1975) made him a pioneer of computer filmmaking. *Permutations*, an abstract work composed of the rhythmic patterns of colored dots, was constructed entirely off the black-and-white monitor of a large computer system (IBM 360, IBM 2250 Display), and the color was added later by editing with an optical printer. Charles Csuri, whose film *Hummingbird* (1967) is a landmark of computer-generated 'animation', began creating his first digital images in 1964 with an IBM 7094 computer. The output of the 7094 consisted of 4" x 7" 'punch cards' with holes, which contained information for driving a drum plotter, specifying when to move the pen and pick the pen up or put it down, as well as where a line ended, and so on.

As with Whitney, Ivan Sutherland is often credited as the father of interactive computer graphics. In 1963, Sutherland developed his Sketchpad – the predecessor of the graphic user interface, which allowed users to draw with a light pen – on the TX-2 computer at MIT's Lincoln Laboratory. The term 'computer graphics' itself was supposedly coined in 1960 by William Fetter, a graphic designer working at Boeing Aircraft Co. (Fetter states that the term was mentioned to him by Verne Hudson of the Wichita Division of Boeing.) In 1969, the Association for Computing Machinery (ACM) created a Special Interest Group in Graphics (SIGGRAPH), which addresses all aspects of computer graphics. Although these early computer-generated images resembled abstract drawings and seemingly replicated aesthetic forms of expression that were very familiar from traditional media, they captured essential aesthetics of the digital medium in outlining the basic mathematical functions that drive any process of 'digital drawing'.

The history of conceptual filmmaking and computer and motion graphics are inextricably interconnected. In his book, Youngblood points out the potential of the computer as a form of 'conceptual camera' that would calculate and store approaches to the representation of reality:

> Computers can be programmed to simulate 'conceptual cameras' and the effects of other conceptual filmmaking procedures. Under a grant from the National Science

> Foundation in 1968, electrical engineers at the University of Pennsylvania produced a forty-minute instructional computer film using a program that described a 'conceptual camera', its focal plane and lens angle, panning and zoom actions, fade-outs, double-exposures, etc. A program of 'scenario description language' was written which, in effect, stored fifty years of moviemaking techniques and concepts into an IBM 360-65 computer. (Youngblood 1970: 185)

The fact that Youngblood gives equal attention to the 'Videosphere', 'Cybernetic Cinema' and 'Computer Films' captures the major developments in the moving image at the time, but may suggest more of an interconnection between these areas of artistic practice than actually existed. When it came to artistic impulse, collaboration and exchange, the world of video and 'computer films' did not necessarily overlap. On the level of tool development (synthesizers in particular), fusions definitely occurred. Donald McArthur's 'Computer Systems Approach to Video Art' (1975; 1977) outlines a proposal to the New York State Council on the Arts, submitted by a team from the Experimental TV Center, as well as Jeffrey Schier and the Vasulkas, which proposed the development of a digitally controlled 'system for synthesizing, processing and controlling video images with greater flexibility, reproducibility and precision than is presently possible.'

While the actual cross-fertilization of conceptual and technological goals of video and digital art in the 1960s and 1970s may have been rare, the discourse surrounding cybernetics and the digital seemed to provide metaphors for understanding video and analog media, as this passage from *Expanded Cinema* illustrates:

> Television is the software of the earth. Television is invisible. It's not an object. It's not a piece of furniture. The television set is irrelevant to the phenomenon of television. The videosphere is the noosphere transformed into a perceivable state. […] 'Television', says video artist Les Levine, 'is the most obvious realization of software in the general environment. It shows the human race itself as a working model of itself. It renders the social and psychological condition of the environment visible to the environment.' (Youngblood 1970: 78)

Software-based image manipulation was also already pursued in the early 1960s. In his essay 'Portrait of the Artist as a Young Scientist', Ken Knowlton describes his time at Bell Labs in the 1970s and 1980s and the development of his signature 'mosaic style' of creating images (2002). Knowlton developed the BEFLIX language, an acronym for 'Bell Flicks' and, according to him, 'arguably the first computer language specifically for bitmap movie making.' Knowlton also worked on L6 (Bell Labs' Lower-Level List Language), which – in collaboration with Stan Vanderbeek – led to the development of TARPS, a Two-Dimensional Alpha-Numeric Raster Picture System; the System in turn resulted in EXPLOR (EXPlicitly provided 2D Patterns, Local neighborhood Operations, and Randomness). Another noteworthy tool of the 1960s was Ron Baecker's GENESYS –

a 2D animation system programmed at MIT – in which all images were made up of dots. The animation was not created by the dots changing in 'real time' but through the movement or replacement of the images. Most of these movie-making systems and softwares ultimately are 'computer animation languages', often based on raster images that allow for different forms of image processing.

In the 1970s, artists such as Douglas Davis, Liza Bear, Willoughby Sharp, Sharon Grace and Carl Loeffler as well as Electronic Café International (Kit Galloway and Sherrie Rabinowitz) began using satellite technology as a tool for experiments with live, networked performances that anticipated the interactions now taking place on the Internet and through the use of streaming media.[8] The focus of these projects ranged from the application of satellite technology for extending the mass dissemination of a television broadcast to the aesthetic potential of video teleconferencing and the exploration of real-time virtual space that collapsed geographic boundaries.

The real-time aspect of the electronic image, the implication of the viewer into the image system, and the relationships between the camera eye and space also were major concerns of artists using CCTV. In Bruce Nauman's *Live/Taped Video* (1970), which consists of two monitors stacked on top of each other at the end of a corridor – one showing a video tape, the other one a live (CCTV) image of the corridor, shot from approximately a nine-foot height at the entrance of the corridor – visitors would see themselves walking down the corridor from the back, getting further away from, rather than closer to, themselves as they approached the monitor. Using CCTV as a commercially available tool, the project playfully probes the camera eye's conditions of seeing and only subtly references surveillance (which it undermines).

Similar issues were investigated in Dan Graham's famous unrealized concept for a *Time Delay Room* (1974), which became the basis for several installations that followed the same structural setup, among them *Present Continuous Past(s)* (1974). Two connected rooms of equal size each contain two video monitors with different views: one monitor in each room presents a live 'surveillance' view of the audience in the 'outside', adjacent room, while the other shows the audience 'inside' the room but with an eight-second delay. (An eight-second delay is supposed to be the outer limit of the neurophysiological short-term memory that shapes our perception of the present; meaning, we can see our perception and behavior in the present as direct continuation of our perception and behavior eight seconds earlier without being aware of a time lapse.) Viewers experience themselves as part of a social group of observed observers and, switching between rooms, might encounter themselves with an eight-second delay. Both Nauman's and Graham's pieces investigate the technological tool of CCTV with regard to aesthetics, perception and feedback loops rather than the politics of surveillance per se.

Compared to these works from the 1970s, contemporary projects that use surveillance cameras as a tool are more concerned with the politics of control and access, and often fall into the activist category. The Surveillance Camera Players would stage performances in front of CCTV cameras, commenting on access to the act of watching and being watched.

The Institute for Applied Autonomy's Web-based project *iSee* creates maps of the positions of closed-circuit television surveillance cameras in urban environments, and enables users to quickly create customized 'paths of least surveillance' from point A to point B, allowing them to find routes through the city that avoid surveillance cameras.[9] In both cases, the cameras being used are not bought for art installations, but belong to the public authorities.

The fact that the context for CCTV and surveillance cameras has dramatically changed over the past couple of decades is partly due to the ubiquity of the camera tool, which can be embedded in mobile devices and stream images live over the Web, creating a new kind of panopticon. This is not meant to say that artists use the 'live' camera tool only in a surveillance context. Artist Jenny Marketou, for example, has created a series of projects – among them *Flying Spy Potatoes* (2005) and *99 Red Balloons: Be Careful Who Sees You*

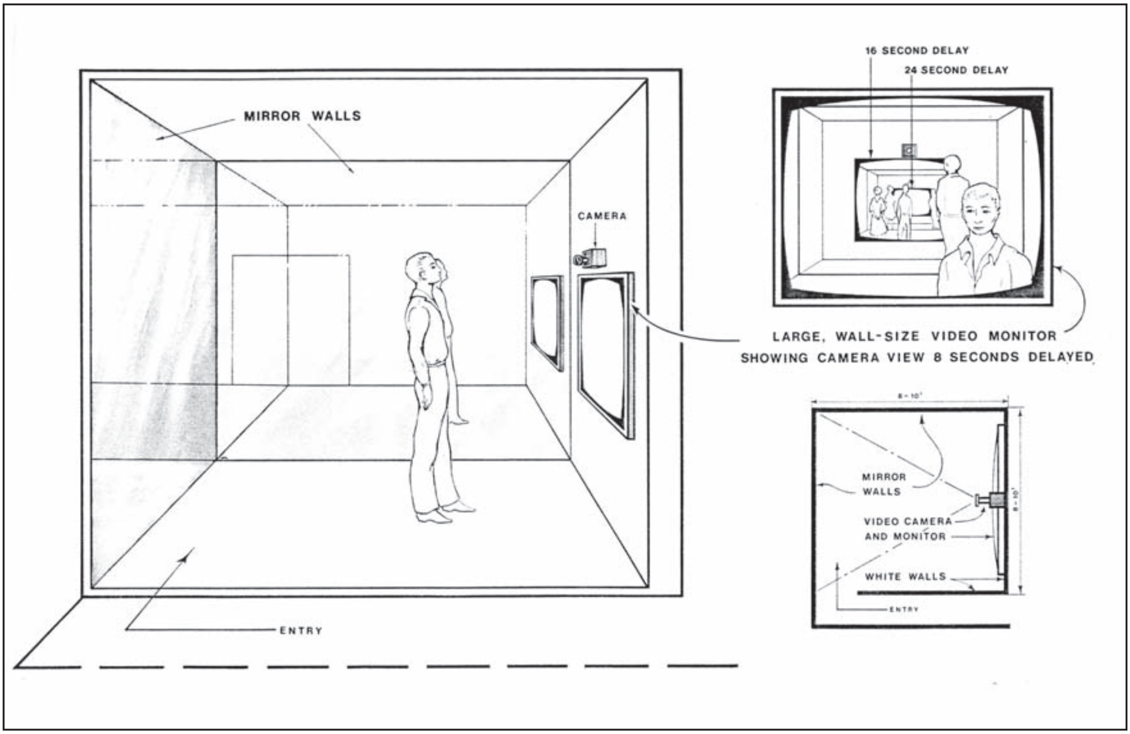


Figure 1. Sketch for Dan Graham's *Present Continuous Past(s)* (1974). (courtesy. Dan Graham Studio)

When You Dream (2005) – that involve large helium-filled balloons equipped with wireless cameras and address the darker aspects of surveillance with aesthetic playfulness. Within a gallery environment, the inflated balloons are attached to the floor and floating, so that the public is moving through a forest of balloons. The video cameras hidden inside the balloons continuously capture the surroundings, and visitors' movements through the installation are recorded as ephemera, traces, forms and patterns, which are broadcast live on TV monitors inside the exhibition space. In the live-action, street-game part of the project, visitors are invited to take balloons on a walk, thereby building a connection between the exhibition space and its context, and becoming both surveillant and the object of surveillance.

The live broadcast references the technologically networked condition of contemporary society, and also uses visual representations of the presence or absence of the body to create a psycho-spatial engagement with space. Projects such as Marketou's raise questions about the dynamic possibilities of doing and looking, and the role that technologies of surveillance and recording play in art and culture. The relationship between the recorded image and the spectator is transformed into spectacle. Spectacle implies that something already perceptible is transformed into a representation; at its root lies a separation, a detachment from reality. The duality of playful exploration and mediated reproduction engages the spectator in an experience that is simultaneously pleasure and displeasure.

Webcams are yet another distribution tool used by artists to explore issues ranging from surveillance to instant, 'global' distribution and the status of the live image. Wolfgang Staehle's projects involving live streaming of webcam imagery – from *Empire 24/7* (1999), a live image of the Empire State Building that updates Andy Warhol's artwork of the same name; and *Fernsehturm* (2004), an image of the TV Tower in Berlin; to views of the Hudson River valley – raise fundamental questions about the nature of the 'live' (yet mediated) image and its place in the context of art. Encountering a live, streamed image on the wall of a gallery or museum space constitutes a radical change of context that poses essential questions about representation and the nature of art itself: what role do the aesthetics of processing and mediation play in our perception of an artwork? Does the 'live' image render representation in art forms such as photography and painting obsolete?

Another major strand of experimentation with the moving image – enabled largely by artist-created tools and systems – is that of interactive cinema. Lynn Hershman and Graham Weinbren, both of whom made use of interactive laser discs in their work, as well as Toni Dove, are among the artists who have created and explored tools for the creation of interactive cinematic narrative for decades. Credited as the earliest interactive narrative film is Lynn Hershman's *Lorna* (1979–84), which unfolds on the television screen and is navigated by viewers via a remote control. The television is both the system of interaction and the only means of mediation for Lorna, a woman who leads a completely isolated and lonely life in her apartment. The disruptions in the nonlinear narrative mirror Lorna's unstable psychological state. Depending on the viewer's navigation, Lorna's story has three possible endings: escape from the apartment; suicide; or the end of mediation by shooting the television. Graham Weinbren and Roberta Friedman's *Erl*

King (1982–85), one of the early classics in the genre of interactive narrative video, also used a combination of custom-made hardware components and artist-written software. *Erl King* allows viewers to control its narrative by touching the screen and exploring the metaphorical connections between two texts, Freud's *Burning Child* dream (1900), and Goethe's poem *Der Erlkönig* (1782). The project's mix of custom-made and off-the-shelf hardware include a 1982 SMC-70 computer (z80 processor running at 8MHz with 64K of RAM with 250K dynamic [cache] storage), CP/M operating system, custom-built video switcher, three laser disc players, Carroll touch screen, CRT monitors and laser discs.

The possibilities of interactive narrative are also at the core of Toni Dove's digital video installations and performances, *Artificial Changelings* (1998) and *Spectropia* (1999–present). *Artificial Changelings* is the story of Arathusa, a nineteenth-century kleptomaniac, and Zilith, a woman of the future who is an encryption hacker. The installation consists of a curved rear-projection screen and four sensor-controlled zones on the floor in front of it. By stepping onto the interactive floor pads in the zones, viewers/participants influence and control the narrative: in the zone close to the screen, viewers find themselves inside a character's head; stepping on the next zone induces a character to address the viewer directly; the third zone induces a trance or dream state; the area most removed from the screen results in a time travel that lets the viewer emerge in the other century, switching from the reality of one character to the next. Within each of the zones, movements of the viewer cause changes in the behavior of video and sound. The sci-fi hybrid *Spectropia* uses the metaphor of time travel and supernatural possession to connect narratives that, respectively, take place in 2099 and in 1931, after the stock market crash. In 2008 and 2010, *Spectropia* was performed as a live-mix cinema event, a scratchable movie in which live performers orchestrate on-screen characters by means of a system of motion sensing that serves as a playable cinematic instrument, creating a narrative form that combines characteristics of feature film, video game and VJ mashing.

Dove's interactive cinema employs and expands another noteworthy and influential artist-created tool, David Rokeby's *Very Nervous System* (*VNS*) (1986–90)[10] and its successor softVNS. *Very Nervous System* is a prime example of the 'tool as artwork', and received the PetroCanada Media Arts Award (1988) and the Prix Ars Electronica Award of Distinction for Interactive Art (1991). *VNS* was the third generation of Rokeby's interactive sound installations, in which he uses video cameras, image processors, computers, synthesizers and a sound system to construct a space in which body movements generate sound and/or music. Rokeby summarizes the impulse behind the work as follows:

> I created the work for many reasons, but perhaps the most pervasive reason was a simple impulse towards contrariness. The computer as a medium is strongly biased. And so my impulse while using the computer was to work solidly against these biases. Because the computer is purely logical, the language of interaction should strive to be intuitive. Because the computer removes you from your body, the body should be strongly engaged. Because the computer's activity takes place on the tiny playing

fields of integrated circuits, the encounter with the computer should take place in human-scaled physical space. Because the computer is objective and disinterested, the experience should be intimate. (Rokeby1986)

VNS developed into different versions of the (software-based) softVNS – a real-time video processing and tracking software for Max consisting of a set of external objects for Max/MSP that allows users to process video in real time.

In *Artificial Changelings*, Dove started working with Max, Nato and Rokeby's VNS (which at the time, 1998, was a SCSI hardware box) and began developing the idea of using controllers – floor pads that were on/off switches mixed with the dynamic control of video motion sensing for video scrubbing. Together these form the interface to responsive narrative behaviors within a layered scene structure: each scene has three layers of video that can be dynamically controlled and switched with regard to both image and audio. For *Artificial Changelings*, the program was a very large Max patch with many subpatches which, although it allowed for a mutable emergent experience, was quite 'fixed' as a program once it was completed. According to Dove, it did not have the flexibility of a proper tool.

For the development of *Spectropia*, together with Luke DuBois, Dove and her collaborator took the motion-sensing interface and the layered scene structure from *Artificial Changelings* and expanded on it. The tasks of many of the hardware components in *Artificial Changelings* were taken over by software: the laser disk changed to QuickTime files; audio processing was done by software; VNS became software; and

Figure 2. Screen shot from Lynn Hershman's *Lorna* (1983). See also Color Plate 14. Installation image from *Lorna*. (copyright Lynn Hershman 1983).

Figure 3. Toni Dove and R. Luke DuBois performing *Spectropia* at Roulette, New York, May 4, 2012. (copyright Toni Dove).

the Intel machines switched to Jitter for motion sensing. Luke Dubois developed the system into a reuseable tool where scenes can be determined by playlists. Many segments are gradually modularized, so they can be broken apart and reconfigured. Certain kinds of scenes can have particular behaviors and can be adjusted for audio volume, frame rate, or time code. Dove describes the intent behind the development of her tools as follows:

> I would say an authoring system that started with *Artificial Changelings* has been developing gradually into a tool that will probably be the basis of my work for some time to come. I wanted [it] to be simpler on the programming end – to be able to more or less use existing program modules clustered – and to move into the physical world a bit more with the robotics of the screen architecture and to focus more on the performance and presentation end of things. I would say the last 10 years has been a research period to explore possibilities that I saw in mutable narrative structures. Now I have a vocabulary to work with – and a big part of that is the customized program. (T. Dove 2011, personal communication)

Another form of the (interactive) 'remix' of image sequences occurs in so-called 'database cinema' where software is used as a tool for assembling and processing elements from a media database. Artists such as Jennifer and Kevin McCoy, Lev Manovich and Thomson & Craighead have repeatedly explored the possibilities of the database as a cinematic and cultural narrative. As opposed to the non-linear narratives by Hershman, Weinbren and Dove, database cinema tends to focus more explicitly on the 'construction' of image sequences and the language of cinema than on the possibilities of narrative. Manovich's *Soft Cinema*, begun in 2002, for example, uses custom software as a tool for assembling elements from a media database, and editing movies in real time on the basis of the instructions given by the authors and their software. The project strives to investigate the effects of software and information technologies on subjectivity and the construction of architectural space in cinema.

The use of industry-produced game engines, level editors and capture tools for creating machinima finds its extension in the more customized manipulation of games. Artist Cory Arcangel, for example, has done numerous projects that are based on the hardware re-engineering of Nintendo game cartridges and also involve custom code. In *I Shot Andy Warhol* (2002), Arcangel reprogrammed the chip for the 1980s Nintendo video game *Hogan's Alley*, and inserted easily recognizable iconic personalities into the game, resulting in a new manifestation of pop art genre. In *Super Mario Clouds* (2003), he manipulated an old Super Mario Brothers Nintendo video game and erased all visuals but the clouds. At his website, Arcangel posts the source code for this intervention and goes through it line by line,[11] thus making it available as a tool for everyone interested to do their own modifications.

When it comes to digital tools for remixing of images, one also needs to consider a range of VJing softwares, such as Justin Manor's *Gestural VJ Software*[12] or Amy Alexander's *CyberSpaceLand*[13] which generates real-time visuals in a performance that makes use of tools such as a changing array of functional hand- and foot-operated VJ toys, an air mouse and air keyboard, FIFOSY (Foot Operated Software) and a performable search engine.

Another category of performance-related software and hardware tools is aimed at the tracking of a performer's movements, which in turn can generate or drive visuals, crossing the border between recording and data visualization. An interesting software tool within this larger context is Paul Kaiser's and Sally Eshkar's *Loops*[14] which addresses issues around memory, recording, and preservation. *Loops* is based on Merce Cunningham's dance solo for his hands, and the *Loops* artwork and software tool creates an abstract digital portrait of Cunningham's movement that runs in real time and never repeats. The motion-capture software allows users to watch parallel videos of his performance (shot by multiple cameras) and to study the digital files directly, so that Cunningham's motion can be analyzed from any angle and distance, playback can be speeded up or slowed down to any rate, and joint angles and their correlations can be measured. The Loops software, which has been released as an open source tool that can be repurposed, is also meant to function as a preservation tool that creates a cultural memory of an ephemeral artifact. For the 2009 'Boston Cyberarts Festival', several artists were commissioned to work with the Loops software tool.

The possibilities opened up by digital technologies have by now created a vast territory of artist-created DIY tools for image capture, recording and manipulation that is hard to map. Digital tool making has moved from the industry, the research institution and the engineer's/artist's studio into a broader environment of high schools, universities, workshops and teenagers' bedrooms.

Over the years, the hardware and software tools for manipulating the moving image seem to have become increasingly refined, developing from systems aimed at the exploration of the different ways in which an image could be animated and composed to more complex investigations of the construction of narrative and image spaces that go beyond traditional notions of the frame or image sequence.

Tools/machines for the creation of drawings and media production

Throughout the twentieth century, artists have created hardware and software tools that function as drawing machines, raising questions about gestural expression, and automation of the creation of art and media, as well as authorship and agency. Jean Tinguely's *Meta-matics* (1959), for example, were tools as meta-artworks that automatically generated a series of drawings, which both anticipated computer-generated graphics (in their geometric patterns and oscillations) and referenced human gesture (in their irregularities and interruptions). Tinguely's machine tools connect to contemporary generative art in which a process – driven by software, hardware, or other procedural invention – is set into motion to create a work of art. Automated drawing tools are often linked to concepts of biological systems, and artificial life and intelligence. Artist Roman Verostko, who has worked with software-driven pen-plotter drawings since the 1980s, continuously investigated, together with his wife Alice, 'the form-generating power of algorithms executed with computing power'. The couple continuously found themselves returning to comparisons between biological processes and coded procedures. A project that explicitly explores the software-driven drawing tool in relation to artificial intelligence is Harold Cohen's *AARON* (1973–present), a program that strives to simulate the cognitive processes underlying the human act of drawing, and continuously generates drawings exploring possibilities of color, form and abstraction, as well as 'automated aesthetics'.

The previous projects find their extension in a variety of artistic tools that establish a framework for the production of media content by their users. Some of these works explicitly allude to or transform the standards of commercial software for drawing or image manipulation. An early example would be Andy Deck's *Open Studio*,[15] a multiuser online 'drawing board' that offers its user a palette of options for 'spray-painting' with their mouse. The experience becomes closer to a live, graphic jam and constitutes a break with the single-user computer drawing applications. The focus of users may shift from the creation of their respective visuals to 'responding' to the other people that occupy the space of the virtual drawing board with them.

A classic of artistic graphic design applications is Adrian Ward's *Signwave Auto-Illustrator 1.1 (2001)*,[16] developed on the basis of his earlier project *Autoshop 1.0.*[17]

Figure 4. Reactable interface. (photo. Massimo Boldrin).

Both applications obviously allude to and parody AdobePhotoshop™ and Illustrator™, respectively. *Auto-Illustrator* is both a humorous critique of the conventions and standardization of commercial graphic design applications, and at the same time pays homage to the beauty and elegance of generative graphic design. Using a familiar tool palette – including pencil, brush and text tools – *Auto-Illustrator* extends the regular options by offering sliders that can automatically create a rectangle in a shabby or precise childish or adult design, for example. The filters allow users to generate 1970s boxes or architectures, parody sportswear logos, or insert instant Murakami eyes. While automating creativity in a generative process, *Auto-Illustrator* explores the interrelationship and agency of the author/user/software. Ward states, 'While some consider technology totalitarian, others forge ahead by expressing their creativity as technological tools, treating technology not as a system of control, but a system of growth' (Ward 2002: 96). Without neglecting the amount of control that technology in general can exert, programming certainly offers unprecedented possibilities for shaping technology. Code is not only an artistic 'medium' comparable to paint or clay; it also allows artists to write their own paintbrushes and chisels.

Interfaces

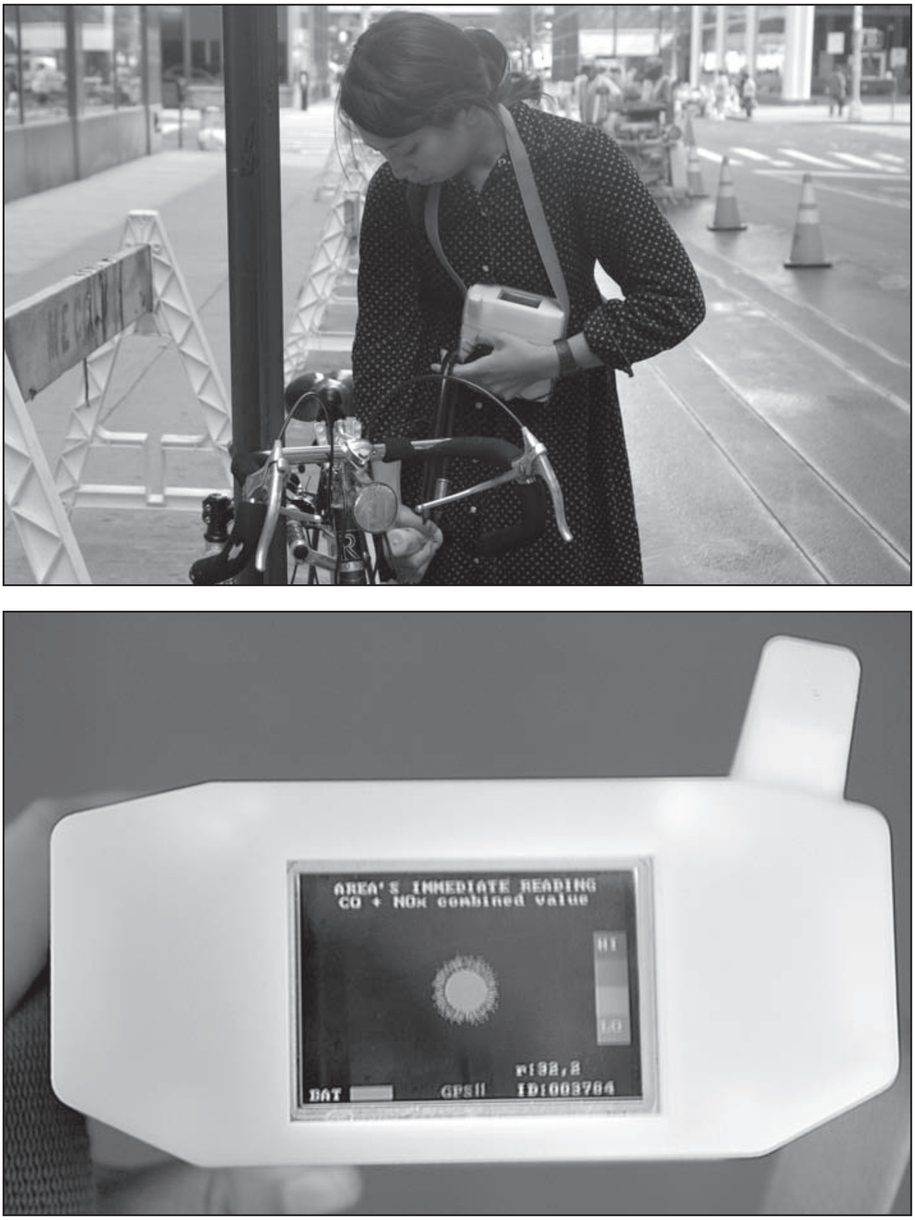
The previous tools for drawing and 'media production' to some extent overlap with the creation of interfaces, the boundaries between machine components or between humans and machines. Software and hardware interfaces, created by artists, designers or researchers, can function as tools and establish a framework within which users can interact – a framework that might itself constitute an artwork in opening up or critically investigating possibilities of creation. This is not meant to say that all interfaces are artworks. Many of them are technological tools that can be employed in the creation of art. Projects such as those done by Hiroshi Ishii's Tangible Media group at MIT are perfect examples of this category.[18] The group's vision for Human Computer Interaction (HCI) is anchored in the concept of 'Tangible Bits', seamless interfaces between humans, digital information and the physical environment that make bits manipulable, and give physical form to digital information and computation.[19] The *Tangible Video Browser* (2002/03), for example, provides a tactile interface for viewing digital videos. The project's interaction mechanism consists of tokens that act as both containers of a set of videos and controllers for selecting videos and navigating within them. Placing a token on the tabletop interface enables access to the set of videos, while depressing, releasing and rotating the token enables navigation.[20] The more current 'musical instrument' *Reactable*[21] can be seen as a continuation of the design principles of the Tangible Media Group.

An example of a software tool as artwork would be W. Bradford Paley's *TextArc* (2002), a data visualization tool that represents an entire text – for example, a novel – on a single page. The texts processed by the project are publicly available through the Gutenberg library. The text appears as a concentric spiral on the screen, with each of its lines drawn in a tiny, illegible font size around the outside. In a second spiral, each word is represented in a more readable size, and a pool of words appearing in the middle of the spirals forms the main organizing structure. In the central pool, words that appear more than once are located at the average position in which they are found in the spirals' text, and frequently used words appear brighter, standing out from the background. If users select words, thin lines appear and connect the word to its positions in the text. *TextArc* allows users to filter a text in various ways and exposes patterns of content. As an artwork and tool, *TextArc* visually creates a new spatial model for the book. The narrative itself moves to the background while the patterns of its construction become a focus of attention.

Tangible Video Browser and *TextArc* are just two instances of interfaces that function as media tools for enabling new forms of 'reading' text and video. In addition to these visually oriented projects, a broad range of (software and hardware) media tools functions as musical instruments, taking forms as diverse as sensor-equipped objects or Web-based interfaces for composing.

Software tools for reconfiguring Web platforms

The development of alternative models for media systems and tools – often referred to as 'artware' in the 1990s – is another subcategory of new media arts. These tools often operate as proposals for the restructuring or critique of existing media systems. Among the projects in this category are artistic expansions of the software utilities that are used by Internet 'media consumers' on a daily basis, such as Web browsers and search



Figures 5a–b. Preemptive Media's (Beatriz da Costa, Jamie Schulte, Brooke Singer) *Area's Immediate Reading (AIR)* (2006). Prototypes of portable air quality measurement kits to monitor various air pollutants, accompanied by data visualizations of the findings. AIR is a process-oriented, socially based artwork that integrates the community into the creation and presentation of the work. (courtesy. Preemptive Media CC share alike).

engines. Particularly throughout the 1990s, numerous new media art works have either reconfigured existing browsers and search engines or created applications that expanded these tools' functionalities. Since the emergence of Web 2.0 – the new 'generation' of Web-based services relying on user-generated content – this practice seems to be less common, which may be due to the fact that Web 2.0 technologies to some extent allow for reconfigurations by the user. Sites such as Twittervision[22] publish their API in order to allow people to modify the application, and artists are frequently making use of these possibilities.

An iconic project in this rubric was the British group I/O/D's *WebStalker*,[23] which single handedly established browser art as artistic practice. The *WebStalker* expanded the functionality of existing browsers in a way that questions the paradigms of the conventional information display and Internet 'architecture'. In his essay 'A Means of Mutation' (1998), I/O/D's Matthew Fuller described the *WebStalker* as 'not just art' but also a tool and form of cultural practice that could have an impact outside the relatively narrow confines of the art world. In his essay 'Visceral Facades: taking Matta-Clark's crowbar to software' (1997), Fuller establishes a connection between the *WebStalker*'s approach to information architecture and American artist Gordon Matta-Clark's technique of literally 'splitting' the existing architecture of buildings, an application of formal procedures that would result in a revelation of structural properties. Matta-Clark's as well as the *WebStalker*'s 'anarchitecture' are as much statements against certain social conditions as they are aesthetic acts oscillating between reconstructions of the destroyed and destructions of closure. Other well-known projects in the browser category include Maciej Wisniewski's *netomat*™,[24] a meta-browser abandoning the page format of traditional browsers and treating the Internet as one large database of files that can be searched by typing in keywords or questions, JODI's *Wrongbrowser*,[25] Nullpointer's *Web Tracer*,[26] or Mark Napier's *Shredder*[27] and *Riot*,[28] all of which address specifics of the browser in very different ways (from aesthetic to political).

The area of search engine reconfigurations has been equally prolific and has produced a wide array of projects. Andy Deck's *Culture Map*,[29] for example, was an early project that gave its users a comparative view of the contents of the Web according to certain topics. As a piece of 'meta-cartographic information art', as Deck refers to it, the project critically examines how people find information through the categorical entry points and key themes of search engines and throws light on the bias of the engines themselves.

Hardware and software tools for activism

The critical investigation of media tools extends into the area of media activism from which numerous software and hardware tools have originated. Artists such as Natalie Jeremijenko,[30] Preemptive Media[31] (Beatriz da Costa, Heidi Kumao, Jamie Schulte and Brooke Singer) or Eric Paulos and his colleagues from the Urban Atmospheres group[32] have all created tools that nurture what is occasionally referred to as 'citizen science'. Their various sensor-based projects transform mobile devices into networked mobile measurement tools that monitor environmental factors such as air quality or contamination. By authoring, sharing, and remixing new or existing technologies, these works strive to raise awareness and give citizens more agency in contributing to decision making about their environment.

However, the same mobile technologies that ideally provide new platforms for communication and networking also potentially allow for users to be monitored and tracked, and artists have developed tools to critically explore the issues surrounding privacy and identity that emerge from tracking and surveillance capabilities.

The above-mentioned hardware projects are complemented by software tools, such as applets for flooding servers. An early example would be The Electronic Disturbance Theater's *FloodNet*[33] software, made available over the Web to support virtual sit-ins that disrupt the service of targeted websites. Participants in a *FloodNet* protest were asked to load a Java applet that requests target websites every few seconds, and overwhelms the targeted server. The denial of service created by these sit-ins is the virtual counterpart of the physical blocking of entrances to buildings.

Not surprisingly, the age of social media has seen an increase of independently developed software tools that protect people from the invasive online tracking, data mining, and consumer profiling conducted by corporations. Projects such as the *Disconnect* toolset[34] could be seen as activist software. The toolset includes Facebook, Google, Twitter *Disconnect* – all of them stopping the respective social media platform from tracking the webpage a user visits; as well as *Collusion*, which (similar to the project *Bynamite*,[35] now in hobby mode) allows for tracking the advertisers tracking you. Mozilla released *Collusion* as an experimental add-on for its Firefox browser.[36] Many of the tools developed in art activism critique the implications of existing media systems and platforms or enhance the public's social and political agency or involvement. This practice will hopefully expand its scope and gain momentum in the future. One of the 2012 commissions of the nonprofit organization Rhizome is a free and open source 'textbook/toolkit', developed by Jessica Parris Westbrook and Adam Trowbridge, that addresses the need to teach, contextualize, and share a wide array of contemporary media skills in the first year of college, and uses project scenarios integrating technology and studio practice(s) in contemporary meaningful ways. As the artists put it:

> We believe that, as companies like Apple turn from education and full operating systems to iDevice designed for consumption and as megacorporations like NBC Universal (Comcast GE) abandon support for any sort of open Internet in favor of intellectual property control, young artists should be introduced to the technologies and approaches behind the constant manipulative media stream they are subject to from birth and should have some agency in making digital art and design work free of corporate influence and constraints.[37]

Conclusions

Obviously, artists today are making use of a different tool set than they did thirty or forty years ago. The 'culture for the masses' of one-to-many broadcasting systems has been transformed into the digital 'culture by the masses for the masses' of the user-generated content of social media distribution platforms. Presumably, there always have been cross-influences between the conceptual and technological goals in the making of art and tools; technological developments associated with video and new media, respectively, have been conceptual impulses for the making of video and new media artworks as much as conceptual impulses have created and shaped the technologies in the first place. One still has to ask the question, is there anything that fundamentally distinguishes today's endeavors to create tools, reconfigure media production and establish new cultural systems of exchange from previous ones? One could argue that a fundamental difference lies in the nature and specifics of the technology itself. Previous media, such as video or television, mostly relied on a technological superstructure of production, transmission and reception that was relatively defined. The modularity and variability of the digital medium, however, constitutes a far broader and more scattered landscape of production and distribution. Not only is there a plethora of software and hardware that can be employed as tools but, due to the modularity of the medium, these soft/hardwares can also potentially be manipulated or expanded. The most powerful change in the creation of tools then and now may very well be the new level of connectivity enabled by digital technologies. While access to the technologies remains an issue in many parts of the world, the creation, support and distribution of tools is networked as it has never been before. The future and success of technological tools may very well depend on the effectiveness of the organized networks formed by the communities creating tools.

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Notes

1. One can witness the transition of production values in the work of artists such as Bill Viola and Pipilotti Rist, as their work from the early 1980s has a low-res image quality, while their work since the mid to late 1990s has become increasingly high-res, and increasingly polished in presentation. Other artists, such as Eija-Liisa Ahtila and Steve McQueen, have taken this parity with mainstream production values further, as their work utilizes both high-res image quality and the visual syntax of mainstream productions (McQueen straddles the art and commercial worlds, producing work intended for both).
2. This exchange of visual language has become even more complex with the advent of the Web, more specifically Web 2.0, where the user has become the content provider and the business model is based upon monetizing the creativity of these captivated users.
3. See Gere (2002) and Turner (2006).
4. Burnham recognized the parallels between software development/implementation, what we now call the back end of computing, and the increasing emphasis on the conceptual or meta-level of art-making practice as seen in the conceptually driven artwork of the late 1960s and 1970s.
5. Thorough discussions about these relationships can be found in Joselit (2008) and Pytlinski (2011).
6. See http://en.wikipedia.org/wiki/Game_engine. Accessed July 15, 2012.
7. See Experimental TV Center website, http://www.experimentaltvcenter.org/history/tools/tools_list.php3. Accessed July 15, 2012.
8. At Documenta VI in 1977, Douglas Davis organized a satellite telecast to more than 25 countries, which included performances by Davis himself, Nam June Paik and Charlotte Moorman, as well as Joseph Beuys. (In 1981, Douglas orchestrated another satellite performance that linked the Whitney Museum of American Art in New York and the Centre Pompidou in Paris.) Also in 1977, a collaboration between artists in New York (Liza Bear and Willoughby Sharp) and San Francisco (Sharon Grace and Carl Loeffler) resulted in *Send/Receive,* a fifteen-hour, two-way, interactive transmission between the two cities through the use of a CTS satellite. What became known as 'the world's first interactive satellite dance performance' – a three-location, live-feed composite performance involving performers on the Atlantic and Pacific Coasts of the US – was organized by Kit Galloway and Sherrie Rabinowitz in 1977, in conjunction with NASA and the Educational Television Center in Menlo Park, California.

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20. See 'Projects' section of the Tangible Media Group's website (footnote 18).
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The Art-Style Computer-Processing System, 1974

Tom Sherman

> As it is, our perception of things is a circuit unable to admit a great variety of new sensations all at once. Human perception is best suited to slow modifications of routine behaviour. (Kubler 1962)

A communication system is for sending and receiving messages. A communication system consists of two transceivers: two components that transmit and receive messages. A communication system is limited when the message is sent in only one direction: transmitter to receiver. This limited system can be expanded by integrating a processing system at the receiver end to provide access to the message. A processing system permits special treatment of the message at the receiver end of the communications system. The computer-processing system described in this text is specifically designed to manipulate the message transmitted to the two-dimensional surface of the video screen. The message source is a commercial television broadcast. The message is limited to display on the surface of the video screen. An analogy is formed between processing the video message and the act of painting. This processing system provides personal choice of how the message source is viewed, in the same way the painter chooses to view the environment through his or her method or style of painting. This system is labeled the ASCPS.

Style is a phenomenon of perception governed by the coincidence of certain physical conditions.

The ASCPS is constructed of information obtained from every major historically innovative treatment of the two-dimensional surface. The system contains the concise history of painting. By block encoding historically successful modes of sensing, the system contains a set of period visions. These period visions are methods of seeing the environment. They are rule-governed styles for processing messages. The rules are those instituted by schools of painting that dominated particular periods of history. At this time, period visions contained by the system are: Abstract Expressionism, Abstract Impressionism Action Painting, Arabesque, Art Nouveau, Automatism, Barbizon School, Baroque, Bio-Morphic, Cartoon, Classic, Color-Field, Cubism, Dada, Danube School, Divisionism, Expressionism, Fauvism, Futurism, Gothic (Late and International), Group of Seven, History Painting, Hudson River School, Impressionism, London Group, Mannerism, Neo-Classic, Neo-Impressionism, Optical, Orphic Cubism, Painterly Abstraction, Photo-Realism, Pointillism, Post-Impressionism Primitive, Rayonism, Realism, Renaissance, Rococo Romanist, Romantic, Social Realism, Super Realism, Suprematism, Surrealism, Synthetism, Tenebrism and Vorticism.

The vision circuit for each period contains additional processing characteristics. These simulate decisions of individual artists contained by schools of painting or period visions. The capacity of each period's vision-processing circuit depends on sensitive patterning of physical conditions marking the consistent vision. Fine adjustment control of contrast, brightness, color, and form open the end of each processing channel. The viewer fine-tunes a wide band of processed message, attaining authorship of the message. The commercial cable television system provides structure for immediate integration of the ASCPS in the home-viewing system. The ASCPS consists of a centrally located computer with remote control units functioning as switching devices, which afford access to the processing circuits of the system. Passing the message through a chosen period vision is accomplished by switching in the desired circuit by push-button selection on the remote control unit.

Application of the ASCPS

The message is the broadcast of a network news program. The information is in color with low interference. The viewer decides to process the message with the period vision labeled rayonism. Rayonism was an abstract Russian movement stylistically between Futurism and Abstract Expressionism. Mikhail Larionov, an instructor at the University of Moscow, published the 'Rayonist Manifesto' in 1913. This selection is made on the remote-control unit. While passing through the processing circuit, the message form is disintegrated to simulate the radiation of lines of force emanating from the objects in the news program. Important artists having this period vision are Mikhail Larionov and Natalia Goncharova. The viewer chooses to understand Rayonism through Larionov's vision. This processing circuit is switched in through a selection made on the control unit. Larionov's vision is non-objective. Visually, the news program is processed into a pure abstraction, with objects becoming new forms as they disintegrate into radiating colors. Fine-tuning controls permit control of color and contrast with Larionov's radiations.

The ASCPS is introduced to provide the best possible system for the study of the history of painting. The system provides a previously unattained view of the artist's systematic attempts to attain efficient communication through the two-dimensional channel. The system simulates the collective visual experience of recorded history, and offers choice of vision to the one-way communication system of commercial broadcast television. The viewer, in implementing historically incoherent methods of sensing on a contemporary message, can introduce message equivocation; that is, uncertain knowledge about the transmitted message when the received message is known. Uncertainty of message increases with degrees of image latency, the time interval between image and response or understanding. Message latency is abstraction.

The ASCPS is a stochastic system. That is, its output is in part dependent on random or unpredictable events. Total randomness of message produces monotony, a sense of sameness. Period vision-processing circuits pattern and structure the message. The

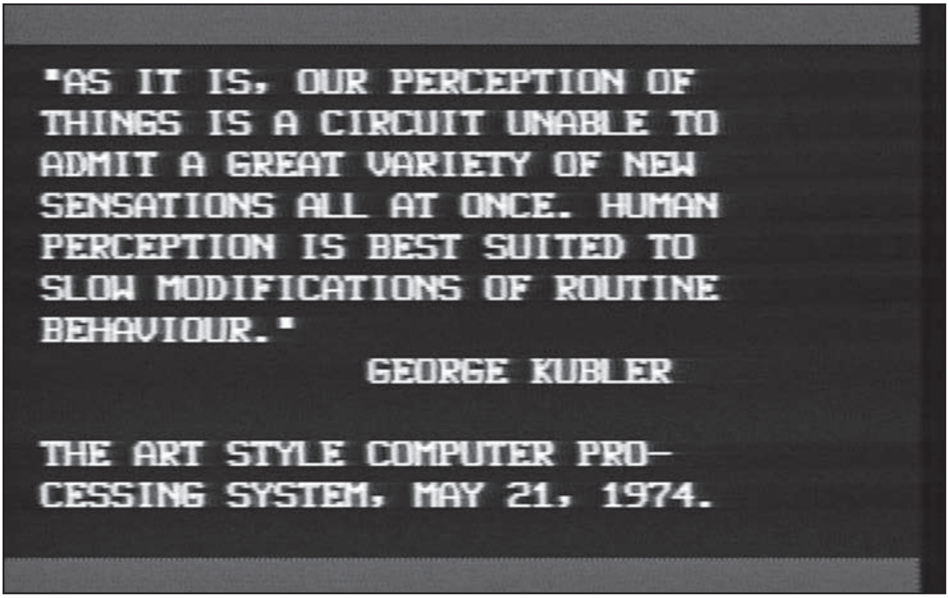

Figure 1. The Art-Style Computer-Processing System was presented as a text-based video artwork titled *Theoretical Television*. Still from *Theoretical Television* (1977).

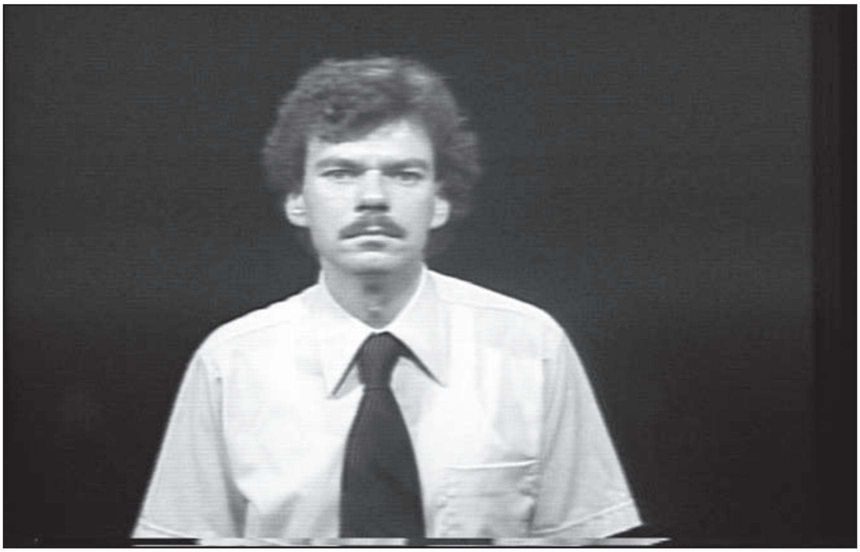

Figure 2. Tom Sherman, as he appeared in *Theoretical Television*. Still from *Theoretical Television* (1977).

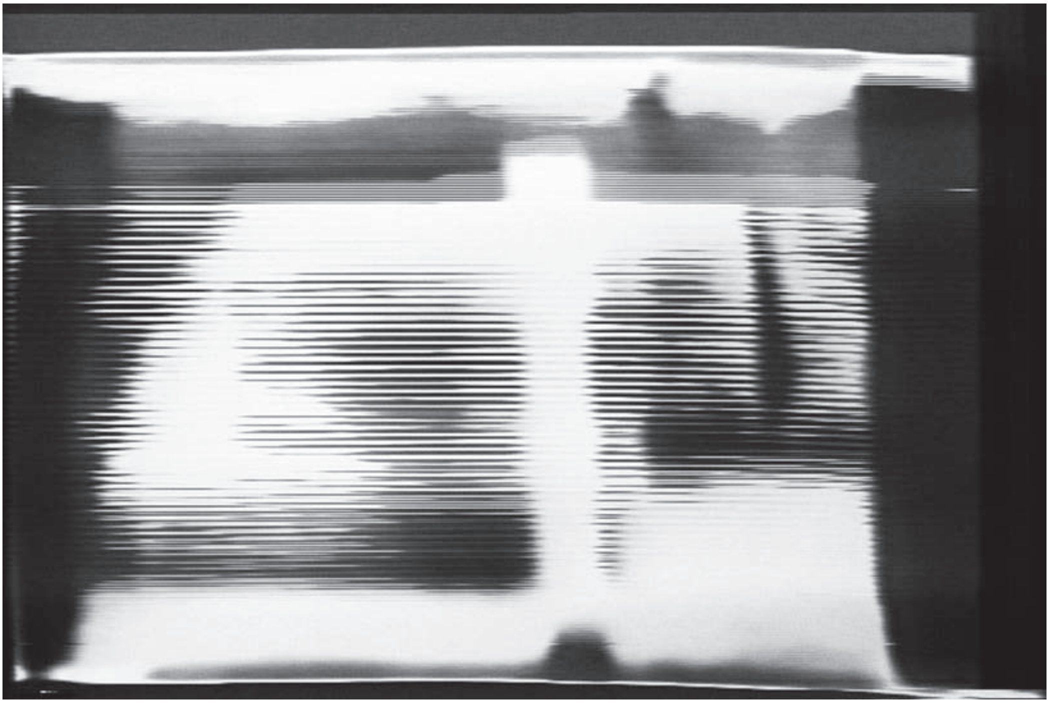

Figure 3: Image generated by Jane Wright using the Paik/Abe Video Synthesizer in 1974. Still from *Theoretical Television* (1977).

structure provides a familiar visual language allowing new sensations to be perceived through contrast. By processing an available random message – broadcast television – the two-dimensional output of this communication system becomes a highly structured moving image with a degree of unpredictability.

The completion and integration of the ASCPS into the existing cable television system effectively surrounds (contains) the history of painting. Expansion of the methods of communication depends on technological invention. Components of this video-processing computer system are being designed and tested by technological artists in scattered communities around the globe.

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Machine Aesthetics Are Always Modern

Tom Sherman

In 1974 I was introduced to video synthesis when Walter Wright brought an analog Paik/Abe Video Synthesizer to A Space, an artist-run space in Toronto. Nam June Paik and Japanese electronics engineer Shuya Abe had collaborated on a complicated video synthesizer that could distort standard representational video imagery into a wide range of visual effects. While playing with the Paik/Abe Synthesizer and watching many others put the machine through its paces, I noticed that people would 'tune' the image until a recognizable visual effect was achieved. In other words, a TV newscast, with the standard talking-head newscasters, could be fragmented through the Paik/Abe machine to look like the cubist news, where the newscasters' faces were viewed from what seemed like three or four different angles at the same time. These newscasters could also be drenched with red and yellow and made to look like devils in a living expressionist painting.

I then went on to write up a conceptual extension of the Paik/Abe Synthesizer called 'The Art-Style Computer-Processing System', the ASCPS, which was initially published in the *Journal for the Communication of Advanced Television Studies* (1974). I thus conceptually commodified the open-ended, full-spectrum video synthesizer as a device with a set of predetermined 'vision circuits', pre-set filters for generating art styles through the controlled manipulation and distortion of straight, representational video material. These vision circuits simulated decisions of individual artists exemplifying schools of painting or period visions like cubism, impressionism, fauvism, pointillism, etc. Devices like today's consumer digital video camcorders come with a selection of pre-set filters that transform video into nostalgic 'filmic' sepia tones (complete with 16:9 cinematic aspect ratio) or negative image (surreal positive whites substitute for negative blacks) or make dazzling expressionist statements by using wild paint programs utilizing chroma-key effects.

The emergence and refinement of categories or channels of distortion, these vision circuits, parallels the way spoken language and reiteration and transcription lead to the formation of ideas and concepts in spoken and written language. An idea is hashed out or roughed up in conversation and written down, refined and reiterated until it has a clear, unambiguous function in language. At first an idea is surprising (atypical), then familiar (prototypical), then old hat (stereotypical). Then it can be picked apart and reassembled into something new, again and again.

Machines often do a poor job of generating description or making analogies to describe something that has been experienced. Automated description can be fuzzy and inadequate. Sometimes an automated, clumsy description can lead to fresh new perspectives. Sometimes machines are actually designed to twist an experience through contorted reproduction. An optical system that inverts figures may generate insight through transposition. Proportion and symmetry may be better understood when an image is turned upside down or inside out. Though unlikely, unearthly combinations can also distort the 'logic' of earth-bound nature. Illogical things happen in nature on occasion, usually due to the excessive interventions of humankind or extreme weather. Oil fires rage on bodies of water. Trees and houses and animals fly through the air in a tornado. With machines capable of mixing or composing images from scratch, toads, frogs, fish and cats and dogs and aliens can be seen flying through the air in what could be categorized as distortions or aberrations of the logic of the natural world.

Literacy plays a factor in how an effect or distortion is read. Those who implement, program or cause effects have a different reading of these effects than those who experience them without knowledge of how they were caused. An effect may have more impact on a relatively illiterate audience. Or sometimes knowing how difficult an effect is to produce can make one more appreciative.

Artists use machines, hardware, software, firmware and wetware to assist in co-determining and implementing aesthetic choices. The balance of this text is an inventory of the fundamental strategies and methodologies of machine-assisted art-making. Before taking an inventory of the building blocks of 'machine aesthetics', it is necessary to consider the nature of contemporary aesthetics.

Aesthetic strategies

Aesthetics are tied up historically and philosophically with perfection and beauty. Historically, aesthetics are the perfect balance between content and form, and proportion is the name of the game. When form became pregnant with meaning (formalism being the defining characteristic of modernism) – and later when ugly became beautiful (beginning with Pop Art) – it should have become obvious that classical aesthetics were toast. Aesthetics had evolved into a general, indiscriminate set of rules internal to the object being governed by aesthetical analysis. Even chaos is appreciated as an aspect of contemporary aesthetic philosophy.

Whether or not the formal treatment of particular content is appropriate or inappropriate or crazy, the most important thing is to identify the rules the artist is applying to the task at hand and to see if he or she is being consistent in applying these rules. Each artifact or object of thought can be seen as a kind of spaceship, a craft that travels through space and time. If this spaceship is poorly constructed, it will fly apart or get spread thin over time, until it disintegrates or simply disappears. The internal logic of a work is the structure that holds the ship together. Content, form, proportion, intent and context are all important, but it is the care and consistency of concentrated intelligence, the record of decisions in the act of making and displaying, that defines the work of art and determines aesthetic integrity.

Amplitude

To begin talking about aesthetic strategies, let's talk about amplitude. How much of any given thing is to be applied to any particular context? Volume and scale are major factors in gaining the attention of, or simply overwhelming, audiences. Youth is extremely impressed with volume. Crank it up if you want to get their attention. Control is easy to maintain if you can subdue your audience with mind-numbing volume. Scale is also effective. Large objects or displays diminish the resistance of audiences. More is always better unless someone cries 'less is more'. But, generally, no one believes less is more anymore. The media environment is too noisy for effective minimal understatement.

Besides high amplitude and excessive scale, which are both useful for challenging perceptual systems, what are the prevalent strategies for creating lively or vital artifacts or objects of thought? The question is how can we extend the present to the breaking point, to the point where objects transmute into something else? Let's begin with the natural, common-sense, apparently logical, prevalent aesthetic strategies. These strategies may be employed with sonic or visual material, and/or with audio-visual material, i.e., time-based media.

Juxtaposition

The combination or joining of unlikely elements is juxtaposition. Seemingly arbitrary combinations, the more unlikely the better, have the advantage of grabbing and holding an audience's attention. There is real bite in 'oppositional juxtaposition', the combination of opposite, totally unlikely things; combinations making no sense at all; combinations charged with surprise and wonder. The energy of total incongruity radiates at the junction of opposites.

In moving pictures, jump cuts generate energy by slamming incongruous images together. Transitional elements or phrases (the content-in-between) are crowded out in favor of abrupt, instant changes of image or sound. Jump cuts make the discontinuous continuous.

In audio, juxtaposition can include the sharp attack of an abutted sound. Visual images can also be positioned to attack. Repeated, sequenced full-frame image change through successive jump cuts will also create a sense of retinal friction and perceptual fatigue. Full-frame radical difference can really give the image 'hop' or 'chop'. It can saw away at the perceptions of the audience, making the perception and experience scream with the full demands of constant change.

Slamming incongruous images and sounds together is a strategy designed to generate novelty. The audience can sense they have never experienced a juxtaposed concoction before.

Machines are willing players in such a strategy, as they never second-guess juxtapositions, no matter how radical. Machines simply execute commands.

Figure 1. Tom Sherman performs in *H5N1* with Nerve Theory at the Palace Theater, Hamilton, NY, November 2, 2007. See also Color Plate 12.

In fact, collaborating in such a strategy with a machine or system is much more likely to generate fresh combinations of images, sounds and ideas. Machines have no problem with incomprehensible relationships. In fact, they encourage illogical combinations. Machines never make value judgments about whether image/sound relationships are inappropriate or intriguing. The machine has no problem putting any combination together, except when it is challenged or overtaxed technically.

Random or stochastic elements

Machines can be designed to update themselves; to learn, so to speak. Randomness, permitted to occur naturally or introduced stochastically (randomness strategically generated by a system in an act of conjecture), can be harnessed as a source of novelty or variation. Although true randomness is nearly impossible to generate, pseudo-randomness (imperceptible order) will do for all practical purposes, including machine-assisted art-making. For artists, 'randomness' is one way to get lucky. Random or stochastic elements are essential to so-called generative systems, systems that develop or transform their behavior autonomously. The right percentage of stochastic input (an advantageous ratio of noise) is necessary in initializing autonomously developing systems. This is the domain of control engineering – cybernetics, really. Positive and negative feedback loops are balanced for control, and noise is introduced to encourage unpredictable variations of machine behavior to develop and prosper. Systems driven by stochastic input are thus creative to a certain extent. Such efforts in the automation of creativity in the arts and cultural sectors are similar to the use of expert systems or artificial intelligence to assist professionals in other fields.

Like an alchemist's recipe, the correct pinch of the stochastic will permit a generative system to breathe and escape the confines of human control through relatively unfettered innovation. This is the conceptual territory of autonomous organization or emerging order. Small changes or twists in system behavior are set into motion until a level of complexity is attained that yields full-blown creativity. Revolutionary change. Things somersault or flip out completely and go off into a completely new category of behavior, escaping associations with the comfort and predictability of human decisions.

Transmutation

The future is an unattainable abstraction until suddenly we are living in it.

Artifacts or objects of thought are transformed by gradual twists and turns until they give way completely, transmuting suddenly into something unforeseeable and previously unimaginable. It is as if there is a perceptual inertia holding things and ideas in place. We hold on to the reality we know, resisting change until our world snaps into a different planet and we realize the rules have changed completely.

Perhaps we can observe the incremental progress of magical, time-based transformations through morphing? Although morphing is mostly employed to gradually and seamlessly fill in every single blank interval between point A and point B, it also forms an analogy of our perceptual awareness of change. Morphing is revealing, but the actual shape of change is often not as significant as the sense of pleasure cast in witnessing the transitional flow. To morph is to uncover the magic used to potentially glue unrelated things together, combining something we know with something completely foreign (something yet to emerge up the road), and witnessing the transition from one object to the next in exquisite detail. We extend the present, dragging the known, in memory, into the unknown future.

We make the mysterious process of transmutation obvious, and in doing so extend the present, especially if we can recycle the 'moment' of transmutation through replay (recycling), extending the present, experiential sense, to infinity in memory.

It is our life's work to hold onto the present until the future arrives. Machines that permit us to reveal, replicate and initiate the nuts-and-bolts realities of transmutation are capable of forming graspable analogies of miraculous complexities like metamorphosis and cosmic evolution. Again, we can mess with the 'logic' of the natural world.

Parallelism

Artists combine and run two or three or four (multiple) divergent elements in parallel, setting up perceptual and conceptual counterpoints. There is an ongoing obsession with contrapuntal composition across the time-based arts; that is, running multiple independent phrases, event sequences, melodies, narratives, above and below (and beside) each other. The strategy seems to be about the construction of complexity, shifting relationships and associations structurally, engineering density and weight, and challenging the listener or viewers to the point of overload. Parallelism is good for generating open-ended texts, as closure is difficult when information is configured in arrays or stacks, or multiple channels in shared time.

Divergent elements running in parallel highlight the wonder of a continuous timeline, fostering delight in those moments of transition and transformation. There is fluidity and an elusive quality to the experience. Audiences are confronted with a psychological process of internal navigation between the continuous moment of perception and experience itself (the conscious awareness of perception). Figure-ground relationships

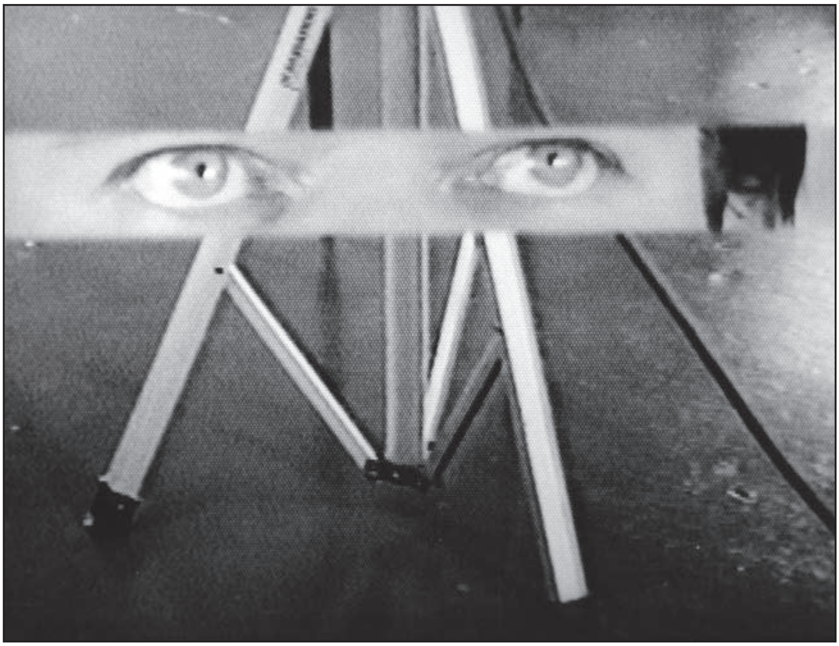

Figure 2. Still image from Tom Sherman's *Exclusive Memory* (1987) video.

oscillate during the slippery cascade from perception to experience to the description of experience. One goal of parallelism is to make description difficult, if not impossible, except in recollection following an experience of parallelism. The experience of the work cannot be characterized in description. The work is only comprehensible during the experience of the work.

Associations are established and analogies formed through repetition and meta-language, between elements and what they signify singly and collectively. Parallel analogies generate metaphors. Parallel, contrapuntal compositions initialize and animate dynamic transitions. Audiences are challenged – tested really – by twisted, interrelated patterns of sound and image and ideas. Order emerges and dissipates. If associations are perceivable, analogies are constructed and metaphors emerge during the experience of the work. This is the construction of perceptual, not conceptual, narratives. Narratives are not always stories. All timelines hold sequences of events and are therefore abstract narratives.

Phase shifting

Parallelism can be pushed into orderly counterpoint, generating rhythm and syncopation; the displacement of one beat with another, typically caused by stressing the weak beat or element. When something is in phase, it is synchronized or correlated; when out of phase things are unsynchronized and not in correlation. In compositions involving dense parallelism, phase shifting can create meta-rhythms, patterns on top of patterns – stacking or weaving, depending on your preference of descriptive analogy.

Phase shifting gives the impression of progression or movement. Evolution and devolution can be shown to occur at different rates, bending the direction of parallel threads. A sense of velocity is determined by factors of acceleration, moving into or emerging from congestion and compression. Congestion and compression signify pent-up energy and a buildup of charge with the anticipation for discharge and change. When the compression and density of the environment or pathway are considerable, the sense of stalled progression resembles that of motion in a holding pattern.

An experiential environment of counterpoint is a training ground for pattern recognition. The audience's engagement lies in the challenge. Overload generates pattern recognition. As perception is challenged, the uncertain space and time between changing figure/ground relationships yields novel and intriguing experiences. With things happening in the gaps, there is an increase in complexity and layering and density. There is no downtime between events.

Phase shifting results in alternating currents, pulsations, oscillations, modulations.

Modulations can fill in the gaps between parallel events – to vary the amplitude, frequency or phase or to pass from one musical key or visual scene to another by means of intermediary chords or notes or images that have some relation to both keys and images…to pass gradually from one state to another…

Parallelism and phase shifting also generate collisions of divergent forms and objects, and a friction between disparate elements. With overlap, shading and coloring, there is hybridity. There is also weight, drag, commotion, and the implication of difference or diversity.

Where associations are clear and the elements emerge as language, where meaning is manufactured symbolically, analogies accrue and metaphors emerge. There are pre-symbolic, symbolic and post-symbolic (or sub-symbolic) states of language. Language can flip from one state to another depending on complexity, density or distortion.

Percept after percept after percept is laid down in phenomenon and stimulus until, finally, consistently patterned language, and concept, emerges. Then the language falls apart again. It degenerates. Percepts re-emerge and generate patterns. Generation, degeneration, regeneration ensue. A percept occurs below the threshold of named experience, before or underneath consciousness. Perceptual language, if redundant and consistent, can be identified as pattern, and if there is sufficient order and redundancy, concepts emerge.

Distortion

Ambiguity in language (degeneration) can be engineered through distortion. An object of sound or image may be twisted, chopped up or otherwise degraded to the point of abstraction. As a compositional strategy, the resolution of a distorted, abstract passage of language may be achieved by gradually revealing the original, clear, undistorted image or sound. In other words, a distorted, ambiguous, unclear image or sound may be gradually cleaned up or straightened out, restored to its original recognizable form. Or the reverse may be undertaken. An image or sound is established or profiled in its clear, unadulterated form, and then it is progressively distorted or degraded. Restoration or distortion not completed or done halfway may relate to morphing: the process of transformation. Signal-to-noise ratios must also be considered when thinking about distortion. Background can overcome objects in the foreground, or the defining edges or demarcations between foreground and background can be rendered fuzzy (deliberately imprecise).

Distortion can also be the transitional reality between clear objects of thought, the mysterious spaces between the obvious, recognizable aspects of language. The sampling and recycling of such unrecognizable passages, the meaningless stuff in between, may be a strategy for discovery, with the goal being the total (100 per cent) use of language. There is always lots of missing material in between the recognizable aspects in any language. Beefing up transitional grammar or stretching the hiss, noise and pop, foregrounding the glitches is a way of maximizing the full character and variegation of streams of language.

The location of distortion is elusive. Is it at the edges or in the margins, at the periphery? Can distortion originate in the core of an object, in the middle of a phrase, like the rot in the center of an old apple? Is distortion an approximate condition, a fuzzy rendition? Distortion is the decay, disintegration or destruction of the known. Distortion therefore generates or grows the unknown.

Figure 3. Tom Sherman's *Faraday Cage* (1973), and electromagnetic-free sculptural installation at A Space, Toronto, May 1973.

Distortion is sometimes due to misunderstanding or misinterpretation, the result of mis-telling or poor translation. Machines are sometimes guilty of distorting things because they are poor scribes or translators. Some machines are simply unable to pass on a signal without messing it up. This was one of the primary gifts of analog technology. A machine that doesn't see very well cannot capture a scene and relay it to another without distortion. An impressionist painter, like Claude Monet, had a kind of blunted sight from squinting while gazing into water reflecting white-hot sunlight. The Impressionists, the first modernists, were the fathers of special effects. They looked into the light and cast objects, lily pads and haystacks, into the sunlight-saturated perceptual fields before them. The Impressionists were the first special-effects artists. But the late nineteenth century was a long time ago…

Figure 4. Tom Sherman and Bernhard Loibner perform *The Disconnection Machine* as Nerve Theory at Elektra in Montreal, November 10, 2001.

'Special effects'

'Special effects' are no longer special because audiences are not buying distortion the way they once did. Effects are not so special anymore, now that people know how they are done. The mystery is gone and effects are now ordinary and predictable. We now live in an era of regular or 'ordinary effects'.

Special effects have become standard fare: standardized visual tricks, cheap disorientation, canned alternative states. Effects represent psychological states, the electronic or digital approximations of chemically induced distortions or insights. A fragmented, split-apart image implies schizophrenia. The flowing psychedelic tie-dye color scheme is the signifier for a trip via LSD. An unfocused, light-saturated image denotes an impressionistic experience. Hefty applications of additive color, camera images drenched with digital paint, trigger expressionistic, emotive states.

Special effects are iconic in that they often represent and profile the climax, the exemplary look of an affected image. An analogy in the natural environment would be a sunset. A full-blown, beautiful sunset is a special effect of nature. The layers of the atmosphere distort the sun's light at the horizon, offering a colorful summation to the day's end. The gorgeous sunset represents and crowns a full range of dusk-to-dark experience. A sunset is an iconic signifier of the transition from daylight to night. As a dense, extreme, spectacular summation of the day's light, a sunset is saccharine beyond words.

There are degrees, types and categories of distortion across various spectra of image and sound. The history of art, especially the modern era, is organized by a series of categories of image distortion. Broad perceptual categories like impressionism and expressionism immediately come to mind, as do cubism, futurism, rayonism, pointillism, tenebrism, vorticism and optical art. Modern art has organized itself in a catalog of period visions: ways of seeing that involve reducing or complicating vision and representation through psychological, cultural and technological filters. These image affectations are applied to contemporary images to 'color' pictures or sounds with emotional tone, to indicate artistic intentions, or to express nostalgia for earlier times. Music and sonic information are treated in similar ways, as synthesizer modules yield Moog-like signature sounds or Max patches are used to emulate earlier hardware for generating and shaping music into various textures and colors of sound.

Artificial perception

In specific reference to video synthesis and processing, all such manipulations of moving images can be categorized as artificial perception. While the makers and users of machines that generate and shape signals and images possess the literacy to understand their work as technique, audiences must relate to machine-manipulated moving image and sound streams as representations of perceptual states. The content of moving-image synthesis and processing is the altered formal characteristics of the messages. The morphology of the signal, analogous to the plastic form of abstract painting, becomes the content of the work. This echoes the Greenbergian story of art, where form is the content of the work. Clement Greenberg's theoretical tenets capped 90 years of modernism, from Impressionism to modernism's apocalyptic demise as Pop Art emerged in 1962. The implosion of modernism as advertising swamped art and eroded the control structure that kept feminism; gender issues; sexual politics; environmental movements; aboriginal, racial, cultural differences; all that is postmodern at bay throughout the nearly century-long modern period.

Postmodernity shipwrecked the heyday of analog video synthesis, as the synesthetic thrust of image/sound abstraction was labeled as electronic painting and, worse, video wallpaper. By the mid-1970s, content, not form, was king again, and the tyranny of the camera as a purveyor of representational art had really begun to roll. Abstraction was not central to the multiple political revolutions of postmodernity. The chaotic pluralism of the postmodern period was not about to be dominated by the rigid exclusivity of machine aesthetics. Modernism's best chance for a twenty-first-century rebound lies in analytics: the formal, mathematical analysis of image and sound stemming from AI research. Whether analytics are used for security, as in applications of face-recognition systems, or in design as attempts to scientifically construct beautiful images, analytics will likely form the spine of the new modernism: an all-encompassing, universal credo that operates counter to the unmanageable sprawl of postmodern plurality.

Machine aesthetics are always modern.

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Electronic Video Instruments and Public Sector Funding

Mona Jimenez

Much has been written about the confluence of factors that led to the field of independent media, and more particularly, to the emergence of the media arts in the United States. In the 1970s, the 'media arts field' could be thought of as a loosely connected network of people who used media for creative and noncommercial purposes. Within the field were pioneers who worked to broaden the technological tool set available to artists, both through the invention of individual video instruments and through interconnecting those instruments – custom electronic tools – in a modular way in artist-centered studios.

Creative people who wanted to reinvent TV met up with talented technical innovators in many different places: university computer science, arts and communications departments; media and visual arts centers; collectives; schools; and public television stations. Development of custom electronic imaging tools was funded as research, as a form of programming, as part of artist residencies, as a means to performance, and as a way to innovate broadcast television. Electronic tools were commissioned by artists, and were also designed and/or built by artists and technologists using private funds or grants. Some designs were purposely developed with the intention of being freely distributed and grew out of nonprofit settings; others were proprietary and conceived of tools for personal expression or as commercial products.

The stories of the proliferation of new video tools in the late 1960s to mid 1980s do not fit neatly into a single narrative; rather, one finds an amalgam of people who were moved to innovate in numerous institutional sites across the country. Despite the differences in place and motivation, one finds substantial exchange occurring among the sites (and no doubt more will be found), and there were larger societal transitions affecting all that impacted both the formation and waning away of these unique technological experiments, not the least of which were changes in where and how capital flowed for arts, culture and education.

There were actually only a handful of public and private sources that enabled most custom tool development, and interestingly enough, both inventors and artists relied heavily upon the resources related to educational and public television – just the type of television that was considered predictable, stifling and exclusive. There were a few funders willing to invest in infusing experimentation into these settings, most notably the Rockefeller Foundation.[1] Universities also were expanding and were investing in educational television, seeking new ways of teaching with video and computer technology. Institutions for public arts funding were new and also branding themselves in relation to educational television. Resources seemed to coalesce at exactly the right time.

In the words of Jon Burris, 'While early video might be categorized, it can't be generalized [...] video provided the nexus for the realization of a panoply of concerns, both internal and external to the medium' (Burris 1996). The same might be said about tool development. Experimenters came from film, dance or electronic music; from computer science, engineering or physics; some had built televisions in high school, hooked televisions up to oscilloscopes at parties, or put magnets on televisions in art galleries. For some, hacking into broadcast equipment or facilitating access to a broadcast studio was a political act; for others, the tools offered a way to achieve an aesthetic effect or to reveal a process; for still others, they saw a potential means to a living by making or using the tools. And for some, these reasons and others coexisted.

In many cases, 'creator' and 'technologist' did not have separate meanings; roles merged intentionally. Creators gained confidence with technical skills and technologists found their creativity encouraged. Often the sites of invention were places where peer-to-peer learning and a do-it-yourself ethic were highly valued. (Albeit mostly benefiting men; women were present and, depending on the setting, were accepted to a greater or lesser extent, a phenomenon typical of the time.)[2] The circulation of artists and technologists within the emerging field of media arts encouraged cross-fertilization and the replication of design ideas and philosophies of custom imaging tools, along with the machines themselves and the artworks produced through their use.

We know that the curve of the development of custom video instruments between the late 1960s and the mid-1980s is one of a quick peak and sharp fade. Funding for the centers and activities of tool development to some extent follows a very similar curve. However, the full picture of the factors that led to the end of the heyday of custom tool development – which could include such factors as changes in technology, an emphasis on distribution rather than production, and the reorienting of the art establishment – is beyond the scope of this essay. Rather, the essay attempts to describe and elucidate three public sector settings – universities, public television stations and media arts centers – within which custom tools were invented, revealing what tools were developed, who developed them, how they were funded or supported, and their use. The three main geographic areas of tool development that have been identified thus far in the United States were on the West Coast (San Francisco Bay Area), the Midwest (Chicago area) and the East Coast (New York State and Boston).

Universities as sites for the development of video instruments

While media artists claimed a space in opposition to television, many media makers and tool designers had roots in university systems or in stations that were part of educational television networks. In addition, university resources were key to tool development and to the popularization of custom video tools and the artworks produced through their use; university-sponsored workshops, exhibitions and residencies were funded both locally and through university networks, such as New York State's University-Wide Committee on the Arts. Also, in many cases, universities where video tool development was taking place also had audio synthesizers on campus, or the video designers were in a region where key resource people for audio synthesis were attached to university settings.

By the time the first portapaks hit the docks in the US in the late 1960s, the development of New York State's educational television system was well underway, thereby formalizing the state's role in the use of the medium for social goals. By 1956, state-funded closed-circuit networks had been set up in several public schools and public universities. The first community-licensed television station had been established in the Albany, New York area in 1953, and by the 1960s localities across New York State received aid to establish stations, develop instructional television, equip schools with production equipment and establish video libraries. By the late 1960s, the SUNY (State University of New York) system and New York State Education Department were spending over $6 million on educational television. In addition, stations were financed locally by a fee-per-student charge (Halligan 1995). Federal aid through the Public Television Facilities Program added to the budgets of public television stations. Gerd Stern notes that two shifts cemented the notion of television in the public interest: the creation of the Corporation for Public Broadcasting (CPB) and the Public Broadcasting Service (PBS), and the deliberate use of the 'public' by the laws that established them (Stern 1977: 144–45).

In New York State, the development of educational television was concurrent with the consolidation of the SUNY system and the four university centers: Albany, Binghamton, Buffalo and Stony Brook. Under Nelson Rockefeller's tenure as the Governor of New York (1959–73), state university centers were expanding dramatically with building projects. (The Governor also pushed through the New York State Council on the Arts, the first of its kind in the country and predating the National Endowment for the Arts.) Custom video tools were designed at three of the four SUNY university centers.

In 1968, artist and educator Ralph Hocking was hired directly by the president of SUNY Binghamton, G. Bruce Dearing. In Hocking's words, Dearing's instructions were to 'define my place in the University' (Hocking 2006: 1). In his position as an assistant for learning resources, he developed a proposal for 'The Use of Television as an Educational Medium' (Culler 2011: 202). The idea evolved into Student Experiments in Television (SET), which Hocking started in 1969. SET became the first step in what was to be Hocking's goal 'to support as much unconventional machinery as possible while urging the usage of whatever we had for the development of video art' (Hocking 2006: 1).

Hocking eventually affiliated with the cinema department and began teaching. Hocking's grounding within the university and his ability to gather resources paved the way for his founding of an independent media arts center in 1971, the Experimental Television Center (ETC). ETC was the site for the development of numerous video tools, as will be described further below. The success of ETC was due in part to Hocking's contacts in the university system that brought necessary expertise to ETC from areas outside of media. For example, Paul Davis from the SUNY Binghamton School for Advanced Technology brought computer expertise that helped integrate computers with video at ETC. In

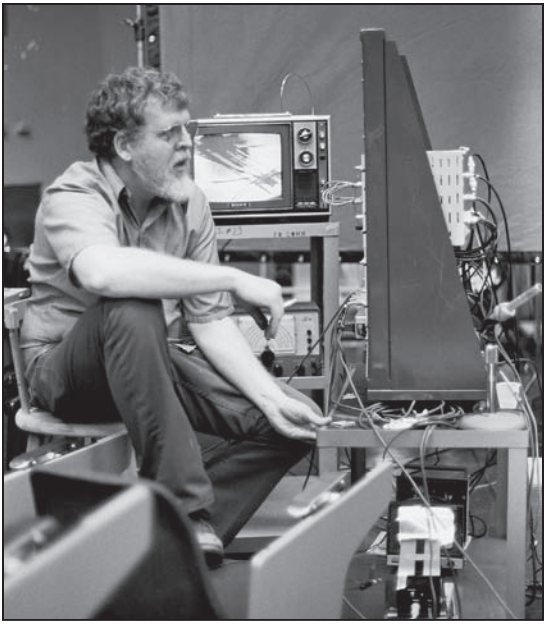

Figure 1. Ralph Hocking at Student Experiments in Television, Binghamton, NY (c. 1970). (courtesy. Experimental Television Center).

Figure 2. A workshop at Media Study/Buffalo led by artists Jane Veeder and Phil Morton (c. 1980). (photo & courtesy. Jane Veeder).

addition, Dr. Don McArthur, a physicist and professor at both SUNY Binghamton and nearby SUNY Cortland, had a long-term association with ETC, working on interfaces for the cumbersome computers of the 1970s, and inventing the first analog/digital device at the Center: the Spatial and Intensity Digitizer. Also, numerous students and former students from SUNY Binghamton were dedicated staffers and volunteers for ETC.

Some of the basic concepts that found their way into the design of custom video tools – real-time processing, modularity of toolsets, and external control of video signals through waveforms and other signals – had their roots in electronic music. While the music department at SUNY Binghamton did not place an emphasis on electronic music, the school did own a Moog Modular Synthesizer for a time. At Cornell University in nearby Ithaca, NY, Bernie Hutchins, an electrical engineering professor, was publishing *Electronotes: Newsletter of the Musical Engineering Group*. *Electronotes* demystified circuit building of voltage control devices; voltage control was a concept in audio synthesis whereby audio signals from one device impact the signals of another, creating rhythmic and sonic effects. *Electronotes* is widely cited by video tool designers and builders as disseminating information about the basics of design of electronic devices. (The inventor of the Moog Modular Synthesizer, Robert Moog, had graduated from Cornell in 1965 with a Ph.D. in engineering physics.) Thus, in addition to those at SUNY Binghamton, university-based resources were available in close proximity to ETC for aspiring tool designers.

Shortly after Hocking founded Student Experiments in Television and the Experimental Television Center, similar efforts began at another flagship SUNY University Center. SUNY Buffalo English professor Gerald O'Grady established the media arts center Media Study/Buffalo in 1973. O'Grady's projects were firmly based in the potential of educational television, albeit an alternate view of television. O'Grady's process was the opposite of Hocking's: the nonprofit Media Study/Buffalo was established first in 1973, followed later in the year by the Center for Media Study, an academic program for film and media art at SUNY Buffalo.[3]

Buffalo had been the home to both Robert Moog and to Harald Bode, a seminal designer of electronic audio instruments, so electronic instrumentation was not unknown in the city. O'Grady hired video artist Woody Vasulka and filmmakers Paul Sharits and Hollis Frampton as inaugural faculty at the Center for Media Study. Both Woody Vasulka and Hollis Frampton undertook projects in hardware and software development while they were teaching at the Center for Media Study.

Before coming to Buffalo, video artists Woody Vasulka and Steina Vasulka had been involved with what Woody Vasulka dubbed 'the alternative industrial subculture' of tool designers (Vasulka 2008: 430). (Vasulka himself was an industrial engineer.) The Vasulkas knew designers such as Eric Siegel, who had built his Processing Chrominance Synthesizer in the late 1960s, and George Brown, the inventor of the George Brown Video Sequencer (1972) and the George Brown Multi-Level Keyer (1973). Siegel's synthesizer was the first tool that could add vivid colors to a black-and-white video. George Brown's sequencer could program clean switches between two video sources, and the Multi-Level Keyer could key and mix as many as six sources, allowing image layering in a sequence and at a rate determined by the artist – a feature not present in available broadcast tools.

Woody Vasulka later became a designer and builder himself, working with Don McArthur and Jeff Schier in 1976–77 to develop the Digital Image Processor based on the LSI-11 computer platform. This project led to the development of the Digital Image Articulator the following year.[4] Both were ambitious digital tools built on the new generation of microcomputers, incorporating multiple analog to digital convertors that could act upon video in real time, among other image-processing capabilities.

Vasulka and Hollis Frampton created a Digital Arts Lab at the Center for Media Study, where Frampton worked on the development of the computer animation software IMAGO. The software was never finished, but Frampton's investigations and writings added much to the theories and philosophies of artist-generated software development. The Digital Arts Lab appears to have been a lively interdisciplinary setting, and also produced a prototype real-time frame buffer (frame capture device) through the efforts of Bob Coggeshall and others (Vasulka 2008: 229).[5]

While all of the tool development projects at SUNY Buffalo were essentially prototypes, Frampton, Vasulka and their collaborators were part of the community of designers in New York State, and no doubt influenced and were influenced by their colleagues in the state, as well as those on the national and international scene. In addition, Media Study/Buffalo played a role in networking tool designers, particularly through the conference 'Design/Electronic Arts', held in 1977. Organized by John Minkowsky, the conference networked the designers from the media arts with those in computer graphics, animation, computer modeling, media, neuroscience, electronic music, information science and media communications.[6]

Custom circuit design, voltage control and modularity were in the air in another part of the state university system, SUNY Albany. In 1966, Joel Chadabe had established the Electronic Music Studio, part of SUNY Albany's music department, and in 1968 Chadabe designed and commissioned Robert Moog to build the Coordinated Electronic Music Studio (CEMS) System, a custom electronic music device based on the Moog Modular Synthesizer (SUNY Albany 2011). SUNY Albany student Phil Edelstein was working in the Electronic Music Studio and in the new state-of-the-art Performing Arts Center and met filmmaker Tom DeWitt, who had been based in San Francisco. Edelstein and DeWitt utilized university resources to develop Pantograph, a system of reading visual images to create sounds, and Pantomation, a motion capture and performance tool.[7] Pantomation used the concept of chroma key to simultaneously overlay sequential captures of tiny points on a video display over live video of the same scene, thus tracking, for example, a performer's movement gestures.

After-hours access to the Electronic Music Studio provided a workspace, and Edelstein's association with the computer science department opened up access to additional computers and expertise. Pantomation was funded with public arts grants that were funneled at least initially through the local public television station, but the device would likely not have seen the light of day without university support.

In the Midwest, Dan Sandin, inventor of the Sandin Image Processor (IP), was also university-affiliated and that affiliation was what made his invention possible. Sandin was trained as a physicist and was an artist exploring photography. He was hired in 1969 in the art department at the University of Illinois, Circle Campus to 'bring computers and cybernetics into the art curriculum'. In 1972, Sandin received a $3,000 instructional development award to build the Image Processor through a program initiated by Vice-Chancellor Paul Lipson, who was interested in innovative approaches to using technology in education (Sandin 2003: 4).

Sandin recalls his first exposure to the Moog Model 2 Synthesizer was through electronic music composer Burt Levy, also a university professor. Sandin posed a question to colleague Russ Dobson, who directed a computer center for physicists at the University of Illinois at Urbana-Champaign:

> '[W]hat would it mean to do the visual equivalent of a Moog synthesizer?' [...] I posed this question for an afternoon of chatter and it became fairly clear that one could just take the Moog Model 2, increase its bandwidth to handle video instead of audio, and many of the processes that are done in television and the kind of processes I was interested in doing in photography could actually be done with Moog-style modules […]. (Sandin 2003: 2)

The result was a device based on principles of analog computing that could create effects such as keying, solarization, colorizing, and image patterning through the physical patching of discrete modules, numbering fifteen or more. Sandin made the plans for the IP available through a packet of schematics and instructions compiled by collaborator Phil Morton called the 'Distribution Religion'. The IP was integrated into a studio developed by Sandin and Tom DeFanti called Circle Graphics Habitat (later named the Electronic Visualization Center), which provided studio space and a common ground among artists, students, scientists and technologists. Tom DeFanti developed an early graphical system, the Z-GRASS, which was utilized alongside the analog IP.

The significance of the university resources that enabled his invention and influenced his open-source ethos was not lost on Sandin:

> [A]lthough I think universities don't have this attitude so much now, but at the time it was fairly clear that state-supported institutions were here to develop and disseminate information for the general good and I was in the art department, so it seemed to make sense that I could actually get away with this. People in other circumstances, other technologists working at the time, just like artists working at the time, were trying to figure out how to eat and not have a second job […]. (Sandin 2003: 5)

State University of New York

FILM AND VIDEO

UNIVERSITY-WIDE CELEBRATION OF THE ARTS

Sponsored by the University-wide Committee on the Arts

APRIL 26-29, 1974
State University College at Fredonia

As you know, a University-wide Celebration of the Arts will be held in Fredonia this spring. The dates are April 26-29, and we expect a large crowd of students and faculty for the weekend's programs. This poster describes all the special activities planned in film and video; most notably, workshops for students.

DATE CHANGE

First, we want you to know that the dates have been changed from April 25-28 to April 26-29. This is so no one will have to travel on Sunday, when it's impossible to buy gasoline.

FIRST SCREENING OF NEW WORK BY FOUR ARTISTS

The University-wide Committee on the Arts is proud to announce that new films by four State University of New York film artist teachers will be shown at the Celebration. For the first time, the University as a system has some excellent film artists on its faculties, and we have arranged for showings of new works by four of these filmmakers:

HOLLIS FRAMPTON has made 40 films. His *Zorns Lemma* was the first independent avant garde work of feature length to be included in the New York Film Festival at Lincoln Center, and his recent seven-part work, *Hapax Legomena,* was called the best work completed in 1972. He is one of three filmmakers to be honored by a retrospective showing at the Museum of Modern Art. Mr. Frampton is at the Center for Media Study at State University at Buffalo.

LARRY GOTTHEIM is currently chairman of the department of cinema at State University at Binghamton. His film, *Barn Rushes* has been widely exhibited and is in the collection of many museums. *Horizons* was shown at the London International Film Festival last fall.

KENNETH JACOBS is a distinguished film and mixed media artist who was the first filmmaker-in-residence in the State University of New York system, and founder of the cinema department at State University at Binghamton. *Tom, Tom the Piper's Son* is a formalist classic and is included in the collection of Anthology Film Archives. He has directed shadow theatre and other environmental pieces at many campuses throughout the country.

PAUL SHARITS founded the film program at Antioch College. His film, *Razorblades,* was made on an American Film Institute Production Grant. He has also been awarded by both the National Endowment for the Arts and the Humanities, and his most recent film environmental work was exhibited at New York's Bykert Gallery. Mr. Sharits is at the Center for Media Study at State University at Buffalo.

These films will be shown on Saturday afternoon, April 27, and Sunday afternoon, April 28.

VIEWING OF EXPERIMENTAL TAPES BY VIDEO ARTISTS

Two video exhibits will be featured at the Celebration. The first will be a multi-monitor video matrix, featuring new tapes specially prepared for simultaneous presentation by Woody and Steina Vasulka, currently located at the Center for Media Study at State University at Buffalo. The Vasulkas have been artists-in-residence at the National Center for Experimental Television in San Fransisco and at the Television Laboratory in New York. They founded The Kitchen, the focal point for the exhibition of creative video tapes in America.

The second exhibit will be the video synthesizer built by Nam June Paik for the Experimental Television Center in Binghamton, New York. Ralph Hocking, director of the Center, will demonstrate the capabilities of the synthesizer, which is one of four in existence.

STUDENT WORKSHOPS IN FILM & VIDEO
SATURDAY & SUNDAY MORNINGS, APRIL 27 & 28.

Students from all campuses are invited to take part in workshops based on showings of student work in film and video. Six film artists will be on hand to conduct informal discussions and critiques of the films. They are Hollis Frampton, Larry Gottheim, Irving Kriesberg, Kenneth Jacobs, Paul Sharits and Willard Van Dyke. Mr. Kriesberg is at Empire State College as painter and filmmaker, and Mr. Van Dyke, a well-known documentary filmmaker of the 1930's, is head of film at State University College at Purchase and is formerly Director of the Film Department at the Museum of Modern Art. Video artists who will conduct the workshops are Woody and Steina Vasulka and Ralph Hocking.

Students interested in showing films are asked to fill in all requested information on the application blank below and send it before March 22 to Patricia Kerr Ross, 99 Washington Avenue, Albany, New York 12210. *It is very important that we receive your application promptly. Do not send your films.*

Films to be shown may be either 16 mm, 8 mm, or Super 8. Video tapes may be one-half inch or one inch. We are interested in showing only the films and tapes of students who will be at the workshops. Please do not send works of students who do not plan to attend the Celebration. We will try to show as many works as possible during the weekend. Places in the workshop will be assigned on a first-come basis with an attempt to have a wide representation from campuses throughout the University.

Persons not showing films or tapes, but interested in taking part in the workshop, are also asked to send in an application so we will have an idea of how many participants to expect. If numbers become too great, we will give first priority to those students showing films and tapes; and again, because of limited space, all workshop participants must be registered for the Celebration.

OTHER CELEBRATION EVENTS

During the four days of the Celebration, many events in all arts areas will be scheduled:

University-wide Student Art Exhibition
Exhibition of Models for Large Sculpture
University-wide Dance Workshop with informal performances by many campus groups
Dance concert by Brockport Resident Dance Company, Brockport and Purchase students, and Bottom of the Bucket, But . . . Dance Theatre
Performances in music by the Cleveland Quartet, the Creative Associates, violinist Paul Zukofsky, and many more faculty artists
Student music ensembles, ranging from soloists to chamber orchestras and choruses from throughout the University
Mozart's "The Magic Flute", performed by State University College at Fredonia students
Four theatre productions from campuses, directed by both faculty and students, not yet selected
Workshops in theatre for student actors, designers and technicians
Poetry readings by John Logan, Louis Phillips, Al Poulin and others
Workshops for student poets
Forums open to all participants on topics of broad interest to University faculty and students
Other events.

HOUSING, MEALS AND COSTS

All students will be housed in Fredonia dormitories, apartments and homes in town, and at the College lodge, where sleeping bags and bedrolls will be necessary. Faculty will be housed at local motels. Lunches and dinners will be provided for all participants. Registration fee is $5.00 per student, $35.00 per faculty, and will cover housing and meals and all events. Registration forms will be sent to campuses very soon, and places at the Celebration will be assigned on a first-come basis, with priority given to performers, exhibitors and workshop participants.

Film & Video Workshops Application Form

NAME: ______
ADDRESS: ______
CAMPUS: ______ PHONE NUMBER: ______
FILM: 16 mm ___ 8 mm ___ Super 8 ___ Running Time ______
VIDEO TAPE: 1/2" ___ 1" ___ Running Time ___
Any specialized requirements (example: tape or cassette player) ______

Please send this form to Patricia Kerr Ross before March 22, at State University of New York, 99 Washington Avenue, Albany, New York 12210. This is **not** a registration form for the Celebration itself. You will receive that later to reserve housing, etc.

Figure 3. The University-wide Committee on the Arts was a source for university support of the media arts, in this case encouraging exhibition in rural New York State (1974). (courtesy. Experimental Television Center).

As will be evident in what follows, the impact of university support was felt beyond the walls of higher education, and supports for tool development at universities, public television laboratories and media arts funding are not wholly distinct. University resources enabled tool development in concert with television labs (for example, in short-lived college-based studios established by the public television–affiliated project National Experiments in Television), and influenced facility development in media arts organizations (for example, the close collaboration between the Rhode Island School of Design and the nonprofit Electron Movers). In any case, the labor provided by university professors, and administrative and technical staff was significant to realizing and promoting new video tools.

The TV Labs[8]

Three TV Labs were sites of tool development: the National Center for Experiments in Television (NCET) at KQED, San Francisco; the New Television Workshop at WGBH, Boston; and the Television Laboratory at WNET, New York. The story of funding of the

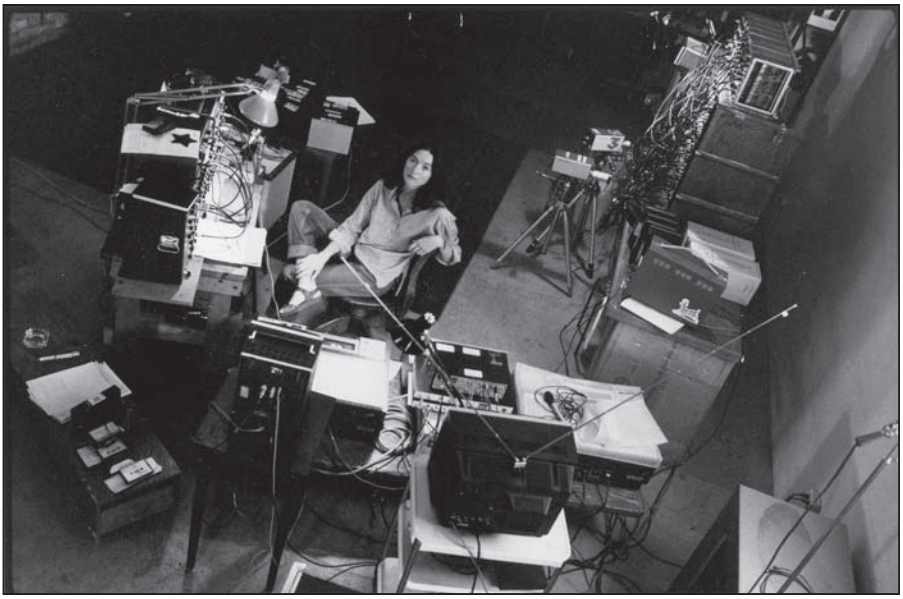

Figure 4. Artist Jane Veeder working in a studio she shared with Phil Morton in Chicago, IL. Veeder and Morton were among the artists who worked closely with Dan Sandin and Tom DeFanti at Circle Graphics Habitat at Circle Campus, the University of Illinois (c. 1977). (courtesy. Jane Veeder).

Labs is interwoven with the support of the Ford Foundation, the Rockefeller Foundation, the National Endowment for the Arts (NEA) and in the case of the WNET Lab, with the New York State Council on the Arts (NYSCA). While previous histories of the TV Labs have started with KQED, an inspiration for the TV Labs may have been the Public Broadcast Laboratory (1966–1968), a program produced by National Educational Television, or NET, the first national public television entity. Public Broadcast Laboratory presented the early work of Nam June Paik and fit in with NET's culturally and politically radical roots, which are not well known (Ouellette 2002: 189–90).

The Rockefeller Foundation's first forays into funding artists' television were to the Bay Area Educational Television Association (BAETA), the precursor to KQED, and to WGBH. Each grant was for 'an experimental workshop' in TV production. The year 1967 seems a pivotal one for the development of the open television environments that led to tool development: the Beck Video Direct Synthesizer and Templeton Mixer at KQED; the Paik/Abe Video Synthesizer at WGBH; and the Rutt/Etra Video Synthesizer at WNET/Thirteen. In 1967, Howard Klein, newly hired at the Rockefeller Foundation, had met the video artist Nam June Paik, who had made an impression and led him to a greater awareness of the emergence of new ideas about video and contemporary art. Klein reportedly advised the arts director Norman Lloyd 'we really should support artists' research in television' (Sturken 1987: 6).

The $150,000 grant was the first of a total of $445,000 in funding that went to KQED for NCET activities between 1967 and 1975.[9] NCET was known for its orientation to process, not product: it existed alongside more conventional uses of television by KQED. NCET's founders saw value in discovering what television tools could do, rather than on producing television programs. Painter William Gwin, who was in residence at NCET for three years, describes his alignment with the sentiment of NCET and its director Brice Howard as 'saving this wonderful medium from the obnoxious purpose it's always been put to […] a kind of willful pride in stepping away from a television station's facility and trying to think of ways to function on this much more primitive level' (Gwin 1978: 11).

In 1970, KQED had managed to get to the top of the pack in public television production, being named one of the seven stations in the public television system to achieve national production center status. While KQED's official web history does not mention NCET, the 1971 entry may reflect the influence of NCET's programming: 'Survey of viewers reveals KQED, once regarded as "dull, stuffy, and boring," is now seen as "involved, educational, liberal, radical, and psychedelic"' (KQED 1971). Also, in 1969, the Corporation for Public Broadcasting (CPB) funneled funds into NCET for 'internships' where personnel from other parts of the PBS system came to learn a new way to make television (Gill 1976: 12).

Almost immediately, NCET leadership 'realized that experimental television could not proceed without new tools to expand the medium's visual palette' (Seid 2010: 132). William Gwin recalls that until tool designers came to NCET, even broadcast tools were in short supply; artists could use CV portapaks, 1" machines, a simple black-and-white keyer, and a Sony special effects generator and could alter images by 'debeaming' the color studio cameras; in other words, taking them out of alignment to create color shifts.

In 1970, Stephen Beck was invited to NCET to develop his Direct Video Synthesizer.[10] Beck was an electrical engineer who had been designing circuits and feeding them into the red, green and blue inputs of a color video monitor. Beck had been touring colleges in the Midwest producing visual effects with a performance troupe SAL-MAR. While a student at the University of Illinois at Champaign-Urbana, he had built a prototype for a video synthesizer and he was looking for a place to continue the work:

> I must have written over a hundred letters to whoever I could think of, trying to think how I could get some support […]. I wrote to ABC, CBS, NBC. I wrote to PBS. I wrote to Zenith. I wrote to all the TV companies […]. The one fellow who answered me from [the Corporation for Public Broadcasting] told me about a place called the National Center for Experiments in Television in San Francisco. I came out to meet the National Center for Experiments in Television in April, 1970 and we really hit it off. They were blown away by this film that I showed them of my video experiments with the video synthesizer […]. I got a telephone call about two weeks later and they said, 'We'd like you to come out here. We don't understand what it is you're doing but we love it and we'd like you to come out here and do more of it.' (Beck 1977: 7)

'More of it' became the Beck Direct Synthesizer. Although Beck's work with dancers and bands involved the distortion of a television image, the synthesizer was not designed to interrupt or distort a video image, but rather as a generative device with circuits that 'give me the means of shaping and sculpting and forming the electronic current flow, which, when translated into the video picture, takes on quality and shape and texture and form, movement and color – the basic visual ingredients I work with' (Beck 1977: 50). Beck's device was never intended as a means to finished television programs, which perfectly aligned with NCET's goals of open-ended experimentation. Beck held the philosophy that 'controlling your own TV set is really what video synthesis is all about' and envisioned a home setup that would allow the user to 'play' their set as one would an instrument (Weinstein 1977).

Also Larry Templeton, a KQED engineer, was frequently in the NCET Studio and in 1970 created the Templeton Mixer, which has three modules: a colorizer, an 8-channel keyer and a mixer.[11] The device could be used manually and could take control voltages, such as from the Buchla Audio Synthesizer, which was introduced into the studio at the same time. Also, while not technically an electronic tool, a 'video sculpture', the Videola, was created while Don Hallock was part of the NCET team.

Funding from the NEA for tool development came regularly in large chunks, albeit for a brief time, and in the late 1960s and early 1970s through the TV Labs. From its beginning as the National Council on the Arts, the agency had in its mission to support 'education and training in the field of moving images' (NEA/NCA 1965: 31), and Public Media funding area was created shortly afterwards.

Direct Video: An Electronic Artform for Color TV

S. C. Beck

National Center for Experiments in Television, San Francisco, Cal.

Introduction

Within mankind's tools are latent properties which often remain unutilized. Television is no exception. As an electronic system its range of impact and complexity are astonishing, more so than its usual content indicates. It is possible, however, to go one step further than television might seem to permit and remove the TV camera, replacing it with electronic circuits which can be manipulated to effect the formation of an image on a video monitor. This is direct video synthesis, an electronic means of evoking images from within the television system. It presents the videographer with a method of using television as a medium of personal expression. (Fig. 1 to 4)

Genesis of the Direct Video Synthesizer

I was led to color television in the search for a precise, electronic means for expressively controlling light. Many graphic displays which are available seemed costly and neglected a common piece of display hardware -- the color television set. Hence arose the notion of a visual synthesizer, designed to display directly in a color video format. It remained, however, to formulate an aesthetic model upon which to base the engineering of image-forming circuit modules which would constitute the synthesizer.

Aesthetic Model

The synthesized image is built up of parallel (in time) layers of image information. An image is modeled to consist of elements of form, motion, texture, and color. (A mathematical development of form as points, lines, planes, and perspective illusions serves as a precondition for electronically realising this element in two dimensions.) The temporal change of geometrical relationships between elements of form gives rise to motion. Texture arises in several manners; for example, as brightness gradients over elements of form, or as aggregates of microforms, and also dynamically. The spectral distribution of reflected and radiant energy of forms evokes color from our perceptions.

Implementing the Model: Outline of the Synthesizer

Mapping from the aesthetic model into real electronic control of video images is summarized here:

1) sequences of pulse-width modulated signals are developed which define two dimensional contours of form over the monitor surface;

2) waveshaping and amplitude modulation of these signals allows control of the brightness gradient, yielding texture;

3) proportional distribution of these signals as excitation for the primary pigments of emitted light, red, green, and blue, produces a gamut of colors with hue, saturation and luminance specified precisely.

I have constructed a prototype synthesizer (see Figure 5) utilizing this process which consists of circuit and control modules that function directly on a scanned raster basis. A controlled-voltage parameter approach has been employed to direct the image element producing modules. Thus, a computer can be used to generate control voltages, but, more importantly, the videographer has intimate control of the image through various physical-to-control voltage transducers. (I hope to include bioelectronic transducers also.)

Operation

By patching desired modules together at the control panel of the synthesizer, as in Figure 6, and supplying appropriate control voltages to control ports a given passage of images may be executed. Some modules generate and manipulate forms, while other modules impart differing textures to forms, or independently control the various layers of the total image. Camera signals may be processed through the synthesizer also. (Fig. 4)

The synthesizer accepts video sync and drive pulses as "Backdoor" inputs and delivers parallel RGBY (red, green, blue, luminance) outputs to the video encoder. This makes it possible to use the synthesizer with various video formats by substituting sync generators and encoders, an important element of flexibility. The present version produces NTSC compatible color video.

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Figure 5. 'Direct Video. An Electronic Artform for Color TV' by Stephen Beck was published as part of a report by National Experiments in Television (c. 1973). Copyright Stephen Beck, all rights reserved, http://www.stevebeck.tv. (courtesy. Stephen Beck and the Experimental Television Center).

The first NEA grant to explicitly support TV Lab-based experimentation was in 1968 when the KQED-TV Experimental Television Project (the early name of NCET) was funded at $70,000 for ‘programming exercises’ created through a project ‘to explore in depth the nature of television as an art, rather than as a derivative expression of other arts’ (NEA/NCA 1969: 47). In 1970, this project was continued through two-year funding for the NCET.

By the late 1960s, the Rockefeller Foundation had its hand in TV workshops on both coasts. Between 1967 and the founding of the WGBH New Television Workshop in 1974, support for video art was provided by the Foundation through artist-in-residence programs. In the period 1967–70, the Rockefeller Foundation provided $575,000 for these residency programs. With the addition of grants in 1974–76, WGBH was granted at total of $1,165,000 for the New Television Workshop.

By 1969, WGBH was already in the business of tool development. That year Nam June Paik showed up in Boston with engineer Shuya Abe and hand-drawn plans for a custom machine for integration into the broadcast studio. Station records show that the station invested their own funds into the construction of what was later known as the Paik/Abe Video Synthesizer (WGBH n.d.). The story goes that Paik was looking for a more direct way to control his effects, rather than relaying instructions to WGBH staff. According to David Atwood, a television director at WGBH, an early version of the Paik/Abe Synthesizer (1969) used a conglomeration of devices that included modified television sets, oscilloscopes and low-end cameras. In 1970, Paik and Abe returned from Japan with what became the studio version of the synthesizer (Betancourt 2011).

The synthesizer was at its essence a mixer and colorizer, like nothing the engineers at WGBH had ever seen. Atwood says:

> The Synthesizer was a collection of the cheapest electronics around, the bare minimum. It was a miracle that it even made an image. But it was open to be used by anyone. And unlike the pro gear in the care of experienced engineers which would yield precise video results, the Synthesizer was electronically organic. Duplicating an image was illusive, in fact, impossible. It was capable of making stunning, breathtaking abstract imagery, but the next day, even the next hour or minute, that exact image was gone forever. (Atwood 2002)

New York’s WNET/Thirteen (also known as the Educational Broadcasting Corporation) was the last of the three public television–based Labs to receive Rockefeller funding, in an amount equivalent to KQED and WGBH. The Rockefeller Foundation also provided funds to selected artists to work in the TV Lab. The Lab’s first artists-in-residence in 1972 were Ralph Hocking and Nicholas Ray, coming from Binghamton, New York, and in 1973 the studio was opened up to Tom DeWitt, Jonathan Price and Bill Etra, Jud Yalkut, Steina and Woody Vasulka and Bill Gwinn, Ron Hays, Shirley Clarke, Ed Emshwiller and Nam June Paik.

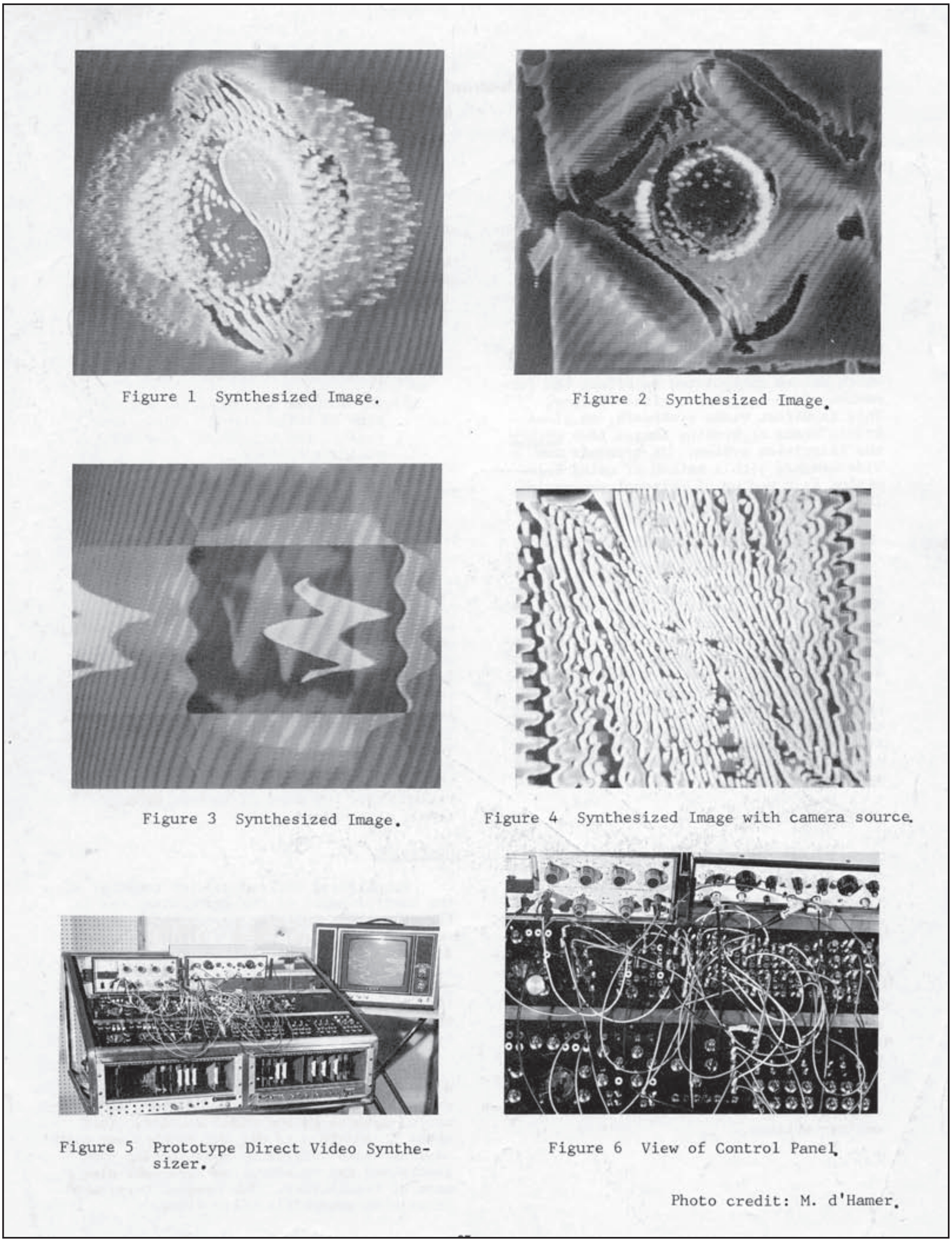


Figure 1 Synthesized Image.

Figure 2 Synthesized Image.

Figure 3 Synthesized Image.

Figure 4 Synthesized Image with camera source.

Figure 5 Prototype Direct Video Synthesizer.

Figure 6 View of Control Panel.

Photo credit: M. d'Hamer.

Figure 6. Images from 'Direct Video. An Electronic Artform for Color TV' showing the capabilities of the Beck Direct Video Synthesizer (c. 1973). Copyright Stephen Beck, all rights reserved, http://www.stevebeck.tv. (photos. M. d'Hamer; courtesy. Stephen Beck and the Experimental Television Center).

The New York State Council on the Arts became involved with WNET in the funding cycle of 1970–71 with a grant to the Lab of $60,000, and continuously made grants to WNET through the early 1980s, although it is difficult to gauge to what extent later grants served artist experimentation, as opposed to other educational or production projects, particularly for documentaries. It is also possible that the Lab received funding from the NEA.

The first NYSCA grant to WNET included an artist residency for Nam June Paik. Afterwards, for three years running, Paik received NYSCA funding relating to the Paik/Abe Video Synthesizer. In 1971–72, ETC received a grant to build a Paik/Abe for the WNET Lab. In 1972–73, WNET's grant included more for the synthesizer's development, and in the 1973–74 cycles, for 'the interface of a digital computer with the Paik-Abe video synthesizer' (NYSCA 1974).

By 1973, when Tom DeWitt was in residence at the Lab, the studio consisted of color cameras and decks, a Grass Valley switcher, a Paik/Abe Video Synthesizer and new device called the Rutt/Etra Video Synthesizer (Edelstein 2012). The TV Lab's primary contribution to tool development is its funding of the development of Rutt/Etra Video Synthesizer. Legend tells us that NYSCA funded the invention of the Rutt/Etra, and based on NYSCA annual reports, it was likely part of the 1972–73 award to WNET, which included 'equipment improvements to expand the technical capability of the Laboratory' (NYSCA 1973).

Steve Rutt was an entrepreneur and boy genius in electronics whose company, Rutt Electrophysics, was making strobe lights, controls for electroplating, and power supplies for silver recovery from black-and-white photography. (His talents came in handy when the band the Fugs lost power at the 1968 Yip-Out in New York's Central Park. Rutt ran the concert from his Lincoln sedan, which had a generator in the trunk and a wall plug embedded in its front grill.)

Bill Etra was an artist with film and photography training who was working with video, strobes and lasers to create immersive environments and video works, and had been studying synthesizer designs, in particular those of Bill Hearn, the inventor of the Vidium. Louise Etra was also collaborating artistically with her husband and played a role in conceptualizing the features of the Rutt/Etra. Etra reports that his entrée to the TV Lab was through a daily delivery of coffee and donuts to WNET chief engineer John Godfrey to soften him to the idea of a residency for Etra, leading to a demonstration to Lab Director David Loxton of Etra's 'ton of lasers and magnets' (Rutt and Etra 2007). He was later brought in to mediate between artist Shirley Clarke and Godfrey, which led to being paid as an artist-in-residence at the TV Lab and to the facilitation of Rutt's subsequent visits.

As Steve Rutt recalls:

> So, we had built these strobes, and we brought them over [to WNET], and I believe Doris Chase was the artist we were working with at that point […]. And Bill was showing me the Nam June Paik synthesizer, which at this point consisted of a couple of racks, six-foot racks full of oscillators, and television sets with big deflection yokes around them hooked up to the oscillators and [to] a colorizer that Abe had made. And

> it did all kinds of cool patterns and feedback, which is something that I hadn't played with […]. Bill, I think, made a casual comment at one point, he said, 'Do you think we could build something better than this?' I was...'Yeah, I guess.' I didn't really know what it did at that point, I hadn't quite registered how it worked […]. Some amount of the time later Bill comes over and asks, 'What do you think it would cost to build one of these things? Cause I have three thousand dollars that I got from Channel 13 to build one.' To make the long story short…thirteen thousand dollars later we completed the first unit. (Rutt and Etra 2007)

The synthesizer was emblematic of a strand of custom devices built on the concept of scan modulation, whereby one impacts a television's internal scanning mechanisms. One effect, although by no means all the Rutt/Etra could do, was to reduce or enlarge all or part of an image and move it around in the video frame. The synthesizer they delivered to WNET was the foundation for later models, and a second broadcast quality version was sold to the Lab a few years later. Rutt Electrophysics, with a team that included Louise Etra, Marcia Rock and Sid Washer, went on to refine and market the Rutt/Etra and to sell a total of seventeen machines to art schools and production houses, a few internationally.

Tool development was lightly described in the station's report on TV Lab activities:

> A grant from the New York State Council on the Arts enabled us to set up a specialized facility for research and experimentation, which would eventually serve as a permanent home for artists. We were able to purchase – and in some instances, create – the equipment that transformed WNET's studio into one that housed one of the most sophisticated collections of video hardware and visual electronic graphic devices in the country. (Merjan n.d.: 4)

The Paik/Abe Video Synthesizer and the Rutt/Etra Video Synthesizer were machines that were relatively widely duplicated compared to, for example, the Beck's Direct Video Synthesizer, which was dearly guarded by Beck. Templeton's device also had a longer reach. Templeton was hired in 1972 to design and build imaging devices for the Rhode Island School of Design (RISD) in Providence, RI. RISD had a long-standing collaboration with NCET that introduced faculty and students to image processing, and the collaboration inspired the development of a media arts center, the Electron Movers, organized by Alan Powell, Robert and Dorothy Jungels, Dennis Hlynsky and Laurie MacDonald. By 1974 Templeton's Quantizer/Colorizer had become part of the toolset for artists at Electron Movers (Powell 1987).

Rockefeller Foundation support for the TV Labs ended in the mid-1970s, and the Foundation tried to convince the Corporation for Public Broadcasting to take a role in continuing the experiment (Sturken 1987: 10). In addition to NCET's involvement at the Rhode Island School of Design, Rockefeller made an investment in NCET collaborations at at least two other universities – Southern Methodist University (SMU) in Dallas, Texas,[12] and Southern Illinois University in Edwardsville – and may have spawned other Labs or even other tool development, as it did with Electron Movers.

The full picture of how shifts in funding affected the success or demise of the TV Labs, considering numerous other factors, is beyond the scope of this essay. Interestingly, TV Lab director David Loxton noted that at WNET, while avenues soon closed off for studio use by video artists, they opened for independent documentary–makers, a shift he very much favored. Starting in 1973, broadcast of documentaries became acceptable 'under the guise of experimentation' (Boyle 1997: 153).

Funding to media arts centers[13]

As the history of the development of custom video tools is elaborated, more evidence of hardware and software development in media arts organizations may be found, along with additional sources of funding. The Experimental Television Center stands out as the primary site of tool development within media arts centers both through ETC-initiated projects and by serving as a fiscal sponsor to tool designers.

There is abundant evidence that NYSCA prolifically funded custom tool development during the 1970s and into the 1980s. (By far, the majority of ETC's funding for tool design and building projects came from NYSCA, and NYSCA funding ETC for tool development exceeded that of any other media arts center in New York State.) The National Endowment for the Arts was also a significant supporter of tool development, but their role is more difficult to document. NEA annual reports are not as granular, and few applications and grant reports survive. Funding tapered off in the 1980s, consistent with the Reagan era of public sector cutbacks, but also no doubt due to shifting priorities by both funders and organizations.

NYSCA and the NEA funded not only the development of specific tools, but also workshops, conferences and exhibitions that brought attention to the tools and the artworks they enabled. Outside of New York State there was likely some funding at the state and local level for experimental media studios, education, exhibition and networking. For example, Electron Movers commissioned the building of already existing devices from tool designer George Brown; the commissioning was supported by artist fellowships to Alan Powell and Dennis Hlynsky from the NEA and the Rhode Island Arts Council, respectively (Powell 1987).

In the 1969–70 NYSCA funding cycle through the Film Program (TV/Media did not exist yet), the first reference to support appears for experiments by artists in broadcast television. NYSCA funded artist Aldo Tambellini to carry out an educational program for elementary students that sounds suspiciously like one that could have been held at National Center for Experiments in Television:

> Working with schools within the broadcast range of New York State's five non-commercial television stations (in Buffalo, Rochester, Syracuse, Schenectady, and New York City), [Tambellini] is meeting with students and teachers to discuss the unique properties of television and with station personnel to challenge prevailing concepts of what constitutes 'proper' television. In each city students and station engineers will ultimately cooperate in the production of videotapes that conceivably – in their use of patterns, sounds, and images – may influence television in much the same way that underground films have affected ideas of what is 'acceptable' in the motion picture. (NYSCA 1970)

Gerd Stern attributes NYSCA's willingness to launch into funding experiments with video and television as a particular interpretation of the agency's mission by its leadership – to fund both established and emerging art forms, including the 'embryonic art form embodied in the consciousness of television technology' (Stern 1977: 144). He maintains that it was not just changes in television technology – including the introduction of color, satellite transmission and portable video recorders (the 'portapak') – that led to NYSCA's interest in television and video, but also the use of television for social and political aims.

The Film Program expanded dramatically in 1970–71 – from $65,000 in 1969–70 to $1.5 million in 1970–71 – and became the Film, TV/Media and Literature Program under the direction of Peter Bradley. Twenty-one TV/Media groups were funded in the 1970–71 cycle. NYSCA was anxious to invest in new projects, and the agency had a legislative and political need to make grants state wide. In 1970, Ralph Hocking found himself making a pitch to Russell Connor, one of two TV/Media Program Associates at NYSCA:

> Nam June [Paik] kept telling me that there was this New York State Council on the Arts place where they give you money. I said, 'You're out of your mind, man […]. He says, 'No, call Russ Connor, call Russ Connor.' I said, 'OK'. I called Russ Connor, he said, "I'll meet you at this apple and cheese bar on 57th Street on Tuesday.' Jesus, man, this means I have to go to New York. [laughter] So I went down there. I walked in and he's sitting there, you know, waiting for me to show up. And we started talking about this. And he said, 'Yeah, you can get some money.' I mean it was amazing. And the first year I applied I got $50,000. And I had no organization. I had nothing. (VSW 1989: 6)

The money (the equivalent of over $250,000 in 2012 dollars) was funneled through the Binghamton area public television station WSKG and Hocking was open for business to provide portapak access, workshops and an artist-in-residence program.

> I opened a studio above a drugstore in Binghamton, bought some equipment, hired three people and had no problem finding people who were interested on many levels. This was all about using the machines, experimentation, and unquestioned trust but not about collectivizing, directed outcomes, or other business, educational, or tribal goals. (Hocking 2006: 1)

Figure 7. Alan Powell (standing) and Dennis Hlynsky (face in circle) in *The Video Room*, an installation at the Everson Museum in Syracuse, NY, by the Electron Movers, Inc., a Providence, RI–based media arts group that commissioned video tool development (1975). Graphic by Dennis Hlynsky. (photo. Laurie McDonald; courtesy. Electron Movers).

However, NYSCA's artistic and social goals were evident in the tone of the 1970–71 annual report on TV/Media. Bradley reported that in addition to funding cultural programming at public television stations ($60,000 to establish the Television Laboratory at WNET), NYSCA would 'insure [sic] that the tools contemporary television technology can offer for individual creative expression […] will be liberated from the control of the existing TV establishment.' Connor even went further, taking the same oppositional stance to mainstream TV while firmly acknowledging video experimenters:

> Artists with electronic skills have transformed old TV sets into the dazzling 'light machines' that have appeared in galleries and museums, and some have developed video colorizers and synthesizers which permit electronic 'painting.' A relative few have penetrated the engineers' citadels of broadcast television to create experimental videotapes with the full palette of the switching consoles. A larger number, working since 1967 with half-inch portable video systems from Japan, have explored the potential of videotape to reach out and open circuits of communication within a variety of small communities – giving substance to attitudes and concerns which monolithic broadcast television has ignored to a point of near obliteration. (NYSCA 1970)

In the 1971–72 annual report, the language is much more staid: gone are impassioned proclamations about community media and creativity, replaced with more pedestrian language about NYSCA's accomplishments, with Connor describing 'new and effective uses of the video medium' such as closed-circuit TV and cable. NYSCA had funded 37 groups in TV/Media and Bradley noted the change: 'The Council's activity as one of the few sources of aid for such research and development, and the growth of interest in TV's unexplored potential combined to increase requests for assistance far beyond [NYSCA's] means' (NYSCA 1972). The first NYSCA grant explicitly for tool development was a grant of $12, 248 that ETC received to enable Ralph Hocking, Nam June Paik and Shuya Abe to build the Paik/Abe Video Synthesizer for the WNET TV Lab.

Figure 8. The Experimental Television Studio (1975). (courtesy. Experimental Television Center).

ETC did not knock on NYSCA's door the next year. Sherry Miller Hocking recalls how ETC was adjusting to nonprofit funding:

> We were fairly naive at that stage in the game, in terms of putting an organization together, running it, hiring people, all those kinds of basic things. Comes the second year, and we were informed that we need to write another grant application for this second year of funding. And we didn't write it, because we didn't need any money; we still had money from the $50,000. So we went for two years the first year, because we didn't get the fact that you submit grant applications every year for general operating expenses. It took us three years to figure that out. (VSW 1989: 17)

As the years went by, the formalization of the application was taking place on both sides; ETC became more skilled at grant writing and NYSCA became more formal in its requirements. In the early 1970s, ETC's focus began to shift from community access centered around portapak video and cable access distribution to a center that supported the creation of contemporary art. Hacking and modification of commercial equipment were supplemented by research, and development had the goal of providing 'a more flexible set of imaging tools to artists' through a residency program in the ETC studio (ETC 2011). Early tools in the system included a Paik/Abe Video Synthesizer and a Raster Manipulation Unit that was invented circa 1972. By 1975, ETC is reporting to NYSCA their progress on the Spatial and Intensity Digitizer being developed by Don McArthur, luminance keyers, and a colorizer designed by David Jones (ETC 1975b: 2–3).

NYSCA continued to provide core support to ETC during the 1970s and 1980s for both hardware and software development, and for research and for artist access. For example, in the 1975–76 NYSCA cycle, ETC received funds for Walter Wright to create a software program called Interpreter. Although the software was never completely realized, it did reach an audience at the 'Design/Electronic Arts' conference, held in Buffalo, New York in 1977. By the time of the conference, ETC had added oscillators and a computer to allow voltage control of the other devices to the Center's tool set, and through the late 1970s and early 1980s, Richard Brewster, Dave Jones and McArthur created custom interface boxes to the computers. NYSCA support allowed Richard Brewster and Dave Jones to develop Analog Control Boxes that gave artists banks of analog sources for generating waveforms that could process video in real time. NYSCA funding also supported the circulation of machines and artworks; for example, through a series of workshops and performances led by artist Walter Wright.[14]

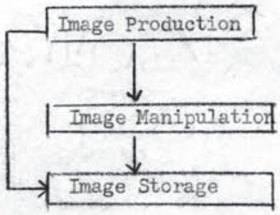
Dave Jones had been active with the Center for many years, inventing and building fundamental devices such as keyer and colorizers. In the early 1980s, NYSCA funded the Four Board Project. The idea was to standardize the production of Jones's designs and printed circuit boards that could be made accessible to other artists and organizations to establish their own studios. Final versions of the Jones Keyer, the Jones Colorizer and the Jones Sequencer, as well as a bank of oscillators, were built by Matt Schlanger. During the

Request for Assistance
Experimental Television Center Ltd.
Program: Operating Budget

page 2

Equipment Budget:
The request for equipment is minimal. The following is an overview of the Center's function in terms of production area for artists and in terms of research and development. The Center will maintain support of the production space for artists because it is extremely important to the development of the art; we have decided not to ask for funds to develop a complete post-production system since other centers in the State already possess such systems. We intend to encourage people to utilize available services in this area. The Center has further decided that increased support for research and development into new video tools is critical to the evolution of the art.

Present Condition:



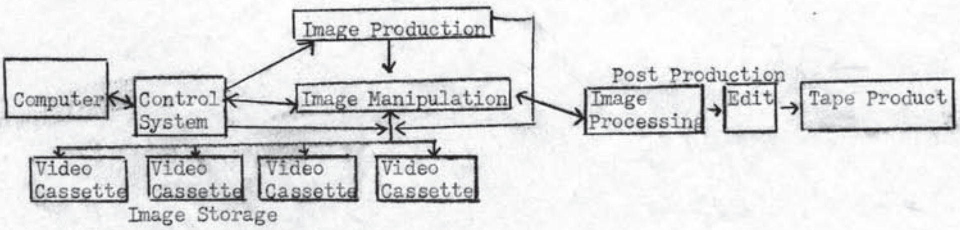
cameras
oscillators

Paik/Abe Synthesizer
Jones Gray Level Colorizer
Seg and Keyers

1/2" recorders: Sony, Panasonic, JVC
1" recorder: IVC

Our studio and portapack cameras are work out. The studio recording decks produce an acceptable first generation recording, but the portapack decks are also worn out. The Panasonic editing system without signal processing precludes third generation color copies; thus, a copy of a color edited tape is not possible. Most of the other equipment is usable.

Ideal Future:



With this system the Center could support all production, post-production and development needs. Equipment necessary for this system includes: 4-6 color portapacks ($42,000), 4 Sony studio color cameras and 2 3/4" editing systems ($60,000), 4 computers ($20,000), teletype machines, image processing and video cassette storage bank ($15,000-20,000).

Figure 9. An equipment request from the Experimental Television Center to the New York State Council on the Arts (1974). (courtesy. Walter Wright and Experimental Television Center)

same period, Jones and Peer Bode were working intensively on real-time image capture, resulting in the Jones Buffer and software programmed for the Amiga computer, which was added to the studio in the mid-1980s. The last NYSCA grant to ETC to support a particular project for tool development appears to be in 1989–90, when Megan Roberts and Ray Ghirardo designed an interface between a computer and analog audio and video that worked with three-dimensional arrays.

In its annual reports after 1970–71, NYSCA was quiet about this prolific period in ETC's history and on the subject of video tool development. In the report for 1977–80, the first mention is made of tool development or ETC in six years, when Media Program Director John Giancola reported 'the Experimental Television Center in Chemung Valley is well known as a place where electronic artists may re-design the electronic equipment' (NYSCA 1980).

In 1980–81, the Media Program sums up the past ten years and seems to recognize the role of custom tool development along with other innovations:

> Electronic media play a large part in our culture and the speed of technological advances in the field make it apparent that they will remain an important part of our culture in the future. With this in mind, the Council is called upon to have an open-minded and far-sighted approach to the electronic arts. The Council began its support of electronic arts in 1970 with a program that was largely based on improving the availability of small format video equipment. As the field grew, support categories grew with it and by 1975, the Council funded an array of electronic activities that included computerized editing systems and novel equipment designs such as synthesizers and colorizers. A world of television viewing and radio listening now exists that goes beyond the confines of the broadcast industry. (NYSCA 1981)

NYSCA's support was significant for several other New York State organizations that were involved with tool development. Innervision Media Systems of Central New York, located in Fayetteville, New York, received NYSCA funds between 1974 and 1978. In NYSCA's reports covering those years, Carl Geiger is mentioned three times as doing technical development or research. Geiger built his own video synthesizer during those years, which incorporated concepts of the day: real-time processing, modularity, and external control of video and audio through analog and digital voltage control. A unique invention by Geiger, which he realized in collaboration with programmer Rod Fountain, was HARPO, a computer language. The software and its hardware interface were essentially for multitrack voltage control: an artist could record layers of patterns and store them in the computer, and play them back to generate images or trigger changes in a video signal.

NYSCA is attributed with funding the development of Woody Vasulka's project for the Digital Image Processor (La fondation Langlois n.d.). As mentioned above, NYSCA supported Pantomation, which was conceived and built by Tom DeWitt and Phil

Edelstein in the Capital region of New York. NYSCA funds in the 1975–76 cycle were channeled through WMHT-TV, the public television station in Schenectady, NY, for the system. NYSCA's support for the media arts hit its peak in those first years in the beginning of the 1970s, and significantly declined as the decade progressed.

Public sector funding of tool development is just one part of the picture. The 'alternative industrial subculture' deserves much more study both to identify and document the tools, and to have insight into how these tools were conceived, brought into being and used. In addition, an analysis of the decline of public funding in each of these sectors is needed. New scholarship will complement that of authors such as Deirdre Boyle, Martha Gever, Chris Hill, Marita Sturken and Martha Rosler, who have considered shifts in such areas as the formalization of video art and marginalization of community television, the history of investment in the media production and distribution, the expansion and commodification of media and communication, changing definitions of media making and art making, and the morphing of radical notions of institutional change.

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Notes

1. For a discussion of the impact of the Rockefeller Foundation and program officer Howard Klein on the media arts, see Marita Sturken (1987). Consult Sturken's research in 'Marita Sturken Papers, 1958–1987 MSS.209' – http://dlib.nyu.edu/findingaids/html/fales/sturken/.
2. The roles and participation of women in video tool development deserve more attention; Deirdre Boyle has noted dismissive attitudes of some men toward women in the video scene in these early days of the second wave of feminism (Boyle 1997: 11). Only one woman, Louise Etra, is attributed with a design role in video tools of this era, although it is likely that, for example, Steina Vasulka played a central role in conceptualizing the features of tools that were commissioned by her and Woody Vasulka. Women built their own Sandin Image Processors and other devices, trained others in their use, maintained systems, and wrote technical manuals, in addition to interpreting the tools through use. See also Kathy High's essay 'Mods, Pods and Designs: Designing Tools and Systems' in this book.
3. The development of Media Study/Buffalo and the Center for Media Study from administrative, curatorial and artist perspectives are found in Gerald O'Grady (2008).
4. See David Dunn (ed.) (1992), *Eigenwelt der Apparatewelt: Pioneers of Electronic Art*, Linz, Austria: Ars Electronica; and the Steina and Woody Vasulka fonds at the Daniel Langlois Foundation for Arts, Science and Technology, http://www.fondation-langlois.org/html/e/page.php?NumPage=439. Accessed July 28, 2012.
5. See also Bob Coggeshall (1982), 'Digital Arts Lab' [video], http://wn.com/digital_arts_lab. Accessed July 28, 2012. For a discussion of Frampton's process in the creation of IMAGO and its detritus, see Andy Uhrich (2012), 'Pressed into the Service of Cinema: Issues in Preserving the Software of Hollis Frampton and the Digital Arts Lab', *The Moving Image*, 12: 1 (Spring), pp. 18-43.
6. See Minkowsky's essay '"Design/Electronic Arts": The Buffalo Conference', March 10–13, 1977' in this book.
7. See 'Finding the Tiny Dot: Designing Pantomation' in this book.
8. For the purpose of this essay, the term 'TV Lab' is used to describe a program whereby artists were invited into a broadcast studio to experiment and create new works for television. For a summary of the major TV Labs through 1976, see Johanna Branson Gill (1976).
9. The figures and recipients named in this section are drawn from Sturken's breakdown of Rockefeller Foundation funding by year (1987). In addition, Steve Seid (2010) gives a wonderful rundown of the activities and output of NCET. Seid co-curated with Maria Troy an exhibition 'Videospace: The National Center for Experiments in Television, 1967–1975' at the Berkeley Art Museum in 2000; see http://www.bampfa.berkeley.edu/exhibition/videospace. Accessed June 8th, 2012. See also Ann Turner et al. (1973), 'The National Center for Experiments in Television', in *Radical Software*, 2: 3, pp. 46–51, www.radicalsoftware.org/volume2nr3/pdf/VOLUME2NR3_0047.pdf. Accessed June 12, 2012.
10. See David Dunn (ed.) (1992), 'Stephen Beck', in *Eigenwelt der Apparatewelt: Pioneers of Electronic Art* exhibition catalog, Linz, Austria: Ars Electronica, pp. 122–25. Beck's philosophy can also be found in Stephen Beck (1975), 'Image Processing and Video Synthesis: Electronic Videographic Techniques', vasulka.org/archive/Artists1/Beck,Stephen/ImageProcessVidSynthesis.pdf. Accessed June 8, 2012; and (n.d.), 'Beck Direct Video Synthesizer', http://www.rdlx.com/ncet/pdf/beck_direct_synth_videospace.pdf. Accessed June 8, 2012.
11. For information on the Templeton Mixer, see 'The Templeton Mixer' on the NCET website, http://www.rdlx.com/ncet/mixer/tempmix.html. Accessed June 8, 2012. Gwin found the joystick interface to be especially useful for art-making (Gwin 1978: 6). Tapes by Gwin, Beck and others are distributed by Electronic Arts Intermix via http://www.eai.org/artistTitles.htm?id=486.
12. The DeGoyler Library at Southern Methodist University has a small file on the collaboration in their special collections.
13. A study of when the terms 'media arts' and 'media arts centers' came into usage would be an interesting topic. For the purpose of this essay they are nonprofit arts centers that had as a primary part of their mission providing access to video, audio or computer equipment for artists and independent producers.
14. For a description of Wright's synthesizer workshops and his role at ETC, see Charles Hagen and Laddy Kite (1975), 'Walter Wright and his Amazing Video Machine', in *Afterimage*, April, pp. 6–8.

TV Lab: Image-making Tools

Howard Weinberg

> 'The tools have changed – but it's the interaction of the fingers and the surface and the eye and the mind,' Ed Emshwiller, the science fiction illustrator/cinematographer and artist-in-residence at TV Lab, says as he draws with charcoal on paper during the credits of a *VTR* (*Video and Television Review*) program about his early video animation work at WNET/Thirteen's Television Laboratory (1972–84).[1]

In *Scape-Mates* (1972) artist and science fiction illustrator Ed Emshwiller combined live-action with computer-animated images in a virtual 3D landscape. Using the Scanimate, an early analog video synthesizer, and the superimposition possibilities of chroma key, Emshwiller choreographed, colorized and transformed dancers' bodies and abstract forms in an imaginary sculptural space that opened the way for artists to explore television.

The idea that everyone can make television, so commonplace today in a YouTube world, was revolutionary in the early 1970s. The tools of broadcast television, like those of the Hollywood film industry, had become so expensive and so cumbersome that only the highly trained members of craft unions normally had access to them. CBS News President Fred Friendly famously described making television as 'writing with a one-ton pencil'.

Nam June Paik and the Rockefeller Foundation would change all that with the establishment of the Television Laboratory at Channel 13 in New York. Experimentation was in the air and other efforts to link artists and public television stations occurred in San Francisco and Boston. Howard Wise Gallery in New York had mounted the first gallery exhibition of video art, 'TV as a Creative Medium', in 1969, the same year that the first Paik/Abe Video Synthesizer was built at WGBH public television in Boston. Russell Connor, who hosted Museum Open House at WGBH, organized the first museum exhibition of video art, 'Vision and Television', at Brandeis University. Invited to join the New York State Council on the Arts (NYSCA), Connor used public money to support art and technology centers such as the Experimental Television Center in Binghamton, New York, where another Paik/Abe Video Synthesizer was built for use at WNET's TV Lab.

John Godfrey, the TV Lab's chief engineer and video editor, worked with Emshwiller, Paik and other artists. Godfrey had been a speech and drama major at Indiana University, where his introduction to editing was to physically cut two-inch videotape. The new ½" videotape introduced a few years prior to TV Lab meant increased portability but problems for engineers who had to meet FCC broadcast standards. Godfrey said:

> I was able to figure out a way to get unbroadcastable stuff broadcast, and so consequently that's why I got assigned to Paik's show in the '70s to do that, that's why I ended up getting assigned to the TV Lab.

Working with pioneering video artist Nam June Paik, Godfrey cocreated Paik's seminal *Global Groove* (1973) at the TV Lab, using the Paik/Abe Video Synthesizer. TV Lab presenter Russell Connor, who participated in *Global Groove*, described the synthesizer in a *VTR* program:

> Shuya Abe, a Japanese electronics engineer, designed and built one of the first video synthesizers that in effect, allows artist to paint electronic pictures. Paik envisioned it as a video piano at which the artist could play and compose the new music of today.

The Paik/Abe Synthesizer's ability to deliver real-time manipulation of imagery and video signals appealed to the live performance mind-set of Paik and others who came from a music performance background. The Paik/Abe made it easy to create complex imagery, but it was difficult to repeat each specific creation using the analog tool. That perhaps explained Paik's tendency to embrace 'mistakes' as something new and different. Dimitri Devyatkin, who collaborated with Paik on *Media Shuttle: Moscow/New York* (1978), said, 'I loved how Nam June would always say, "a mistake is not a mistake, even if something looks like a mistake, hold on! Don't erase it. Maybe something good is going to come out of it."'

Girish Bhargava, who collaborated with choreographer Twyla Tharp and director Don Mischer in editing *Making Television Dance* (1977) for the TV Lab, similarly recalls Paik's influence:

> I'm working with Nam June Paik, trying to switch some things and I say, 'Shit! I made a mistake.' Nam June Paik says, 'No, no, no, no, no! This is genius, genius, genius! This is fantastic! Don't touch it! I love it! Leave it alone, this is perfect!'

Exploring the new technology of computerized editing, Bhargava was able to freeze an image of Twyla Tharp dancing and leaping into the air against a black background. He faded that image and merged it with video of her continuing to dance. 'She kept leaving impressions all over the screen as she continued dancing,' he said. What Muybridge did for horses, Bhargava did for dancers: he allowed us to appreciate movement by fixing it so that we could see more. He also used the video equivalent of an airbrush to soften and blur images of dancers for artistic effect, thanks to the capabilities of the synthesizer that he, Paik and Godfrey had discovered.

'The Paik/Abe Synthesizer, if it was perfect, it wouldn't work. And so it was its imperfections that made it work and made it interesting,' said Godfrey. He recalled:

Figure 1. Nam June Paik and Merce Cunningham talking at the Leo Castelli Gallery, New York, during an installation of the video *Merce by Merce by Paik* (c. 1977). (photo & courtesy. Ruth Bonomo).

> The video artists would come into the Lab and I would turn on the Paik/Abe synthesizer and the thing would go bloop like a lava lamp and immediately they would say 'I want to use that'…and I would say, 'NO, you can't. Let me change it.'

Though Paik had envisioned the tool, Godfrey controlled its use – in effect giving each artist his own electronic palette. Paik said, 'I think John was the invisible director of the show because he would stand there and say he'd give Stan Vanderbeek this, Ed Emshwiller this, and me this, and he had a really big influence in making the piece.'

With a $3,000 grant from the New York State Council on the Arts (NYSCA), Channel 13 commissioned and purchased the first Rutt/Etra Video Synthesizer for the TV Lab. This public seed money had resulted in Steve Rutt, an engineer, and Bill Etra, a television director and artist, creating the synthesizer, but their estimated expenses were $13,000. So they decided to sell their next one for $10,000. They made a total of 17 Rutt/Etra Video Synthesizers (the later ones were more elaborate), and sold them to clients as far away as Venezuela and Australia. Etra explained their appeal, 'There was a desire to have control over images and sound and have people impressed by it'.

In a segment for TV Lab's *VTR* series, Bill Etra demonstrated the precision of the Rutt/Etra by squeezing and moving an image of himself on a monitor:

> This machine controls the height of the image through zero. With the image at zero, it zooms images, if you're careful with it; and you can adjust the brightness as you zoom. It does the horizontal position of the image off the screen in both directions; the vertical position of the image off the screen in both directions, there I go, okay.

As much as Rutt and Etra wanted to manipulate video and still images, they also wanted to use oscillators and other forms of electrical feedback to create abstract imagery without cameras. They were aware that such 'electronic abstractions' – the first computer graphics made with an oscilloscope – had been pioneered in the early 1950s by Ben Laposky, a mathematician, artist and draftsman in Cherokee, Iowa.

In order to be able to move an image and control it, Etra knew that Rutt would first have to build a better black-and-white television monitor. The display had to be sharper than that of current television sets in order for them to wrap and twist images. Godfrey said: 'The Rutt/Etra Synthesizer, while it was not associated with a colorizer and multiple devices to add effect on effect, which in essence was the Paik/Abe Synthesizer, the Rutt/Etra Synthesizer was an exacting form of one of those monitors'.

The sharper the image, the better to videotape the monitor and incorporate the material into a TV Lab program. There was no direct output from the Rutt/Etra to tape. But once taped, the pictures would be fed into the WNET switcher. Godfrey enjoyed controlling feedback:

> The switcher that I purchased for the TV Lab had two effects banks. And so you could have one picture on one effects bank, and another picture on another effects bank. We had two cameras so that you could actually have two cameras intermixed in different ways and since that set was basically a chroma key set, we could set it up that way. We could set it up with the output of the switcher then fed back into the Paik synthesizer so even if I switched from one bank, one chroma key, one camera over the synthesizer to another bank keyed over the synthesizer, if you saw that on a separate monitor, it wouldn't be what went out on the air because it would be the second camera keyed over what the first camera was seeing, which is what was going out and going over to the synthesizer and coming back giving you the feedback.

As much as people wanted control, they didn't want to cede control to Big Brother or to a network broadcaster. Symbolic of this was the use of the Telestrator to draw on the television screen with a light pen. Invented for public television science programs in the 1950s, the Telestrator was used mostly by commercial television sportscasters to analyze plays in the 1970s.

Whether the impulse to adapt such a tool was as Top Value Television (TVTV) co-founder Allen Rucker said, 'to upset the apple cart of then broadcast television […] to screw with the system', or just use it because it seemed to be a simpler form of the electronic animation that was developed by Dolphin Computer Image in Denver, I shared the impulse when I asked political cartoonist Pat Oliphant to use the Telestrator at Children's Television Workshop in 1975 to draw a cartoon profile on a television screen for the title of *The Robert MacNeil Report*. It was a difficult tool to use. But it could be employed as an aside, an annotation, an accent marker to call attention to an absurdity – as when it scrawled 'CBS News' in the upper-left-hand corner of the frame with an arrow pointing to the sound man and correspondent as the camera panned to show the field producer talking on the phone with New York. More often, TVTV would simply superimpose text on the screen or use text in a crawl at the bottom of the picture – easier to do though it looked less handmade.

Control that seemed to be out of control had a perverse appeal. Video experimenters Steina and Woody Vasulka were an awkward fit as artists-in-residence at the TV Lab, for they were less interested in creating programming than in inventing startling imagery. Steina was enamored of effects that feedback could create:

> John [Godfrey] told us it was possible to send the signal [to WNET headquarters on West 58th St. from the TV Lab studio on East 46th St.], and bounce it back. We got this beautiful, enormous feedback. The effect was wonderful, and we used it in a tape called *Vocabulary* [1973]. But we didn't give them credit.

Godfrey is driven to understand every last detail of the new equipment he encounters:

> I love new equipment because I love to figure out new ways to put equipment together, and this is really what that was, I was putting together pieces of equipment in a new way to create something new in a medium that wasn't controllable that you now could control.

The most important piece of equipment used at the start of the TV Lab was the Sony Video Rover, or 'portapak'. Allen Rucker, cofounder of TVTV, recalled:

> The novelty factor with early video was a really important contributing element to our ability to get places because we could go into places with these tiny cameras. And sometimes we had these low-light cameras, too. People would think that we had a toy, or were just having fun, or you know, we were just kind of good time people. They didn't consider anything professional until they turned on their PBS station and saw it and they went, 'wait a minute, I remember those people'.

TVTV edited their first program, *The World's Largest TV Studio*, about the 1972 political conventions, at the Egg store, a TV studio that was part of CTL Electronics. C.T. Lui, the owner, who supplied early portable video equipment to Nam June Paik, TVTV and others, said:

> It was edited on B/W one-inch Sony EVO-320F machine, using Sony SEG-1 for keying the B/W graphic, I still have all the machines today. After the tape was done, we gave

Figure 2. Engineer John Godfrey (l) and post-production assistant Ruth Bonomo (r) and the control room from the TV Lab era (c. 1972). (photo & courtesy. John Godfrey).

> the tape and machine to TV Lab for them to copy onto their two-inch machine for broadcasting.

The digital time base corrector (TBC) invented by CVS (Consolidated Video Systems) and purchased by the TV Lab in 1973 was the essential piece of equipment that allowed the broadcast of unstable videotape created with ½" prosumer portable cameras. Or as Godfrey put it, 'A time base corrector can take poor quality, unstable videotape and turn it into poor quality, stable videotape'. He explained:

> All videotape machines have a mechanical error. Mechanical error is translated into electronic instability. To be able to have, under the rules of the FCC, a locked solid color video picture it was necessary to stabilize that error electronically to within 2.5 nanoseconds. 2.5 billionths of a second was how stable that had to be. Initially with black-and-white it only had to be one hundred nanoseconds, which was quite easy. It didn't have to be stable. But with color it needed to be much more than that. So they invented the time base corrector for the broadcast tape machines, but it was only good enough to handle, they could only store about a microsecond, a millionth of a second, in a picture in delay lines and so forth to be

> able to stabilize the mechanical error. AMPEX then came up with a great idea; of course the machine cost $165,000.

Not something an individual artist could afford, but a vital piece of equipment for an experimental lab. Godfrey continued:

> Now that was 1977, if you can imagine, but that had in it a time base corrector with 32 of these things, so you could correct one microsecond of error per line. […] But that was still an analog time base corrector, in other words the signal was stored in a glass delay line, in essence a piece of light went down and reflected back and that was your delay. Actually it wasn't light, it was electronic and crystals and so forth, but anyway, along came the digital revolution and the digital revolution occurred because of the microsizing of transistors. Being able to make transistors smaller and smaller and smaller, being able to make the LSI, large-scale integrated type of circuits and so forth allowed the invention of the digital time base corrector, which allowed large amounts of physical error to be able to be stored and then spit out in time. You actually had to do another little thing there and that is you couldn't spit it out delayed, you actually had to send an advanced sync signal so the thing played earlier than you wanted it so when it played you could spit it out in time correctly. Later on, when they got frame stores and all that, they discovered another thing that they didn't think about. That is now, you're going to get audio out of sync because the video is delayed one frame but the audio isn't and so you could end up with all sorts of problems. […] So the digital time base corrector allowed much more unstable video to be corrected and it was due to the integration of the large-scale integration of transistors and so forth.

Stabilizing and transferring ½" black-and-white videotape was easier than correcting ¾" (U-Matic) color. The time base corrector first had to synchronize the color on U-Matic videotape with the horizontal signal, Godfrey said:

> [B]ut that made it off frequency, so then you had to inject that error into the time base corrector […] so that you could then correct it along with the horizontal jitter of the tape. It was very ingenious. They came up with a circuit. I made the circuit. I put it in, and it didn't work […]. I saw something wrong and I have no idea what it was, but I rewired a resistor during the damn thing, and it worked.

The TBC meant that documentarians capturing reality with portapaks and artists tweaking the video signal with custom tools in the studio could have their work stabilized for broadcast. It was the beginning of the digital revolution.

'The idea that we could take this equipment and apply it to journalism: that was the radical idea,' said Michael Shamberg, now a Hollywood producer, who was a *Time* magazine correspondent when he and others founded TVTV:

November 28, 1972

Mr. Ralph Hocking
Community Center for Experimental TV
164 Court Street
Binghamton, New York

Dear Ralph:

I would like to confirm that we will be seeing you and Nick Ray at the Lab for the week of December 11th.

I am assuming that you will be bringing 16mm color film and that your main intention is to put this material on our film chain and then through Nam June's synthesizer and record on either 1" or 1/2" (Panasonic), whichever you prefer.

As we mentioned earlier, please do not forget that John Godfrey will be leaving for vacation Wednesday afternoon. I will arrange to have another man present for the Thursday and Friday so that you can continue working but would strongly advise that you schedule your experimental ~~tape~~ stage while John is still there, since he is the only one who really knows the system well enough to show you all the alternatives and options.

I guess the only money that might change hands would be the cost of any tape stock you would take with you at the end of the session.

Looking forward to seeing you both soon. Please call if you have any questions or need any help.

Yours,

David R. Loxton
Director
Television Laboratory

DRL:fh

The Television Laboratory at wnet|13
304 West 58th Street New York City 10019 581-6000|212

Figure 3. Letter from David Loxton to Ralph Hocking (1972).
(courtesy. Experimental Television Center).

> For people who had grown up with television, it was very exciting because you had the quality and texture of television with people from your own generation involved in the things that were happening in the culture, and they could see that on television, so that was sort of a radical idea. You could make your own television.

The time base corrector made it possible to broadcast the ½" video, but it was the cheapness of video compared to film that made it possible to 'hang out with people' and videotape them 'doing interesting things'. (See Color Plate 7.)

TVTV co-founder Megan Williams noted that the newness and relative smallness of the portable video equipment allowed her and colleague Paul Goldsmith to go to a small Republican political event and videotape freely: 'They really related to us as another couple, attending the party with this cute thing. You know, the portapak. It was like we were entertainment'.

The shooting ratios could be astronomical. But if you shot 100 hours for every one hour you hoped to broadcast, your chances of getting something interesting increased. The technology changed the mindset of its users. It still wasn't commercially economical, but the ability to capture reality and 'spontaneous behavior' with portable video that had begun with the *cinéma-vérité* movement in film only increased the number of people attracted to the form of documentary.

Shamberg, however, said he got tired of 'this sort of intruding in other people's lives' and wanted to explore fiction and comedy. While he and TVTV brought their offbeat journalistic perspective to the mainstream Republican and Democratic political conventions in 1972 to get noticed by the TV Lab, Jon Alpert, his wife Keiko Tsuno and her cousin, went where few reporters could go – to Cuba. They brought passion and the first portable color video camera from JVC in Japan to Cuba in 1974. John Godfrey resized images, flipped images, and developed inter-format editing to help Alpert and company create a documentary from some forty hours of footage they had shot.

Having benefited from Godfrey's expertise and the experience of other artists-in-residence at the TV Lab, Alpert noted that the independent video community began sharing the evolving technical knowledge. A lot of it was 'weird experimentation,' said Alpert:

> There was only one track of audio on the early videotape. So if you wanted to have natural sound and then put a narration over it, you couldn't really do it. I can't remember who discovered this: but if you placed a piece of paper between the videotape and the erase head, you could rewind the tape and try to audio record again, because the paper would block the erasing, you would only partially erase the audio that's on the tape and you could create a second audio track; and depending on the thickness of your piece of paper you would erase more or less and so we would be experimenting with different thickness of paper.

Oscillating frequency shifts caused difficulties in getting a clean edit and made it impossible to play tapes on different machines that were standardized in name only. Alpert said they called Sony and learned how to use a frequency meter to realign the editing deck with each edit. They shared this information with other video-makers so that playback of tapes became more flexible. 'We felt like the Wright Brothers', said Alpert. 'When you had a tape and you finally figured out how to edit the thing and the edits were clean and people could actually watch it, it was like the miracle of flight'.

Artists are the test pilots of technology that will affect mass culture. Tom DeWitt, whose TV Lab programs *Cathode Ray Theatre* and *VTR-CRT* mixed visual music, pantomime and satire with soundtracks composed by Laurie Spiegel, demonstrated a process he called 'Pantomation' at the TV Lab in December 1976. DeWitt (who has changed his name to Tom Ditto), described the creation:

> In 1976 Phil Edelstein and I were in artists-in-residence at the TV Lab, and we also worked together at the Electronic Music Studio at the University at Albany. We had proposed a synthesizer project called 'The Design Device', but funding from NEA/NYSCA came in at half of our budget. We then proposed to take the PDP-8L at the TV Lab and modify it for a tracking chroma key system that was technically a subset of The Design Device but would be employed more specifically for combining dance and pantomime with video synthesis.
>
> Phil had determined that the PDP-8L was not working due to a failed logic chip inside its accumulator, and he offered to fix it. Nam June Paik who had obtained the computer for his work was sufficiently frustrated with it to let it go, and control was transferred pending Phil's repair, which he effected by bringing the computer to Albany. Once we had it working, Phil, George Kindler and I set out to make a set of peripheral circuits and program the computer so it could follow a chroma key signal originating from a color tag held by a dancer. We worked through the fall semester, and over Christmas break brought the apparatus, now called Pantomation, down to NYC and installed it for a few days at the TV Lab.
>
> On New Year's Eve as the midnight hour approached, we brought up the system in a scene of my AFI-funded pantomime *Outta Space*. James Sappho, who I credited as James Snafu so as to dodge a possible violation of his actors' union contract, appears as the Magnetic Robot who tosses the hapless astronaut, Zierot le Fou (that's me), down into Submission Control. Zierot was displayed on the Rutt/Etra, allowing the Pantograph to push his image around according to the position of the Robot's hand movement. Moments before 1977 rolled in, we had achieved what likely was the very first use of motion capture in the history film production. Champagne was not in the budget, but we celebrated as if it was.

Figure 4. In the TV Lab studio – (l–r front) David Loxton, Nam June Paik, Charlotte Moorman, and John Godfrey; (l back) Knut Olberg (c. 1972). (photo & courtesy. Brownie Harris).

Figure 5. The logo for the forthcoming documentary *Nam June Paik & TV LAB: License to Create* by Howard Weinberg (2013). (T, l-r) Bill Viola, synthesized image of Nam June Paik, Michael Shamberg; (T, t-b), Don Mischer, Charlotte Moorman playing cello in *Global Groove*, Steina and Woody Vasulka; (V, l-r) Jon Alpert, a circuit board, John Godfrey, Twyla Tharp, Nam June Paik, image from the Vasulka's *Vocabulary*, Jim Day, distorted image of President Richard Nixon from *Global Groove*, Russell Connor. (courtesy. Howard Weinberg).

Motion capture, a process of integration between mime and computer animation, is the basis of James Cameron's *Avatar* (2009) and Microsoft's Kinect.

Inspired by Chris Marker's experimental film *La Jetée* (1962), animator Eli Noyes wanted to tell a story using still frames in rapid succession. An artist-in-residence at the TV Lab in 1976-1977, Noyes made his first animated video, *Glove Story,* by shooting 'short bursts', 'poses' and 'moving shots' on video, then using the newly invented video disc recorder to freeze single frames that he found with time code. John Godfrey then transferred each frame, one at a time, for ten or fifteen seconds' duration, onto another tape for editing. 'It was very clunky, hard to do, but a thrill', said Noyes.

Noyes became intrigued with chroma key at the TV Lab's Studio 46, and made his next video animation, *Fitcher's Feathered Bird,* of a Grimms' fairy tale, by merging his hand-drawn backgrounds with actors in the studio in real time and then sandwiching another layer of imagery on top of the taped output in post production. 'It was the beginning of virtual sets', said Noyes.

Kit Fitzgerald, whose early training was as a painter, recalls:

> I remember the day that the first Quantel digital effects box came in and John Godfrey and I lifted it out of the box, put it on the rack, plugged it in and began to play with it. Well, look where digital effects are now – in terms of music, video, commercials, even narrative film: they are using the vocabulary that we as artists, largely at the TV Lab, began to write in the 1980s.

The Quantel Paintbox, launched in 1981, was a dedicated computer graphics workstation for broadcast television. It revolutionized TV graphics. Suddenly, there were page turns on news programs and lower-third identifications (captions) were inserted on the fly into live news shows. By the end of the decade, computer software programs were doing what the earliest Quantel hardware alone had done. The excitement of painting with light continued to fascinate artists. Fitzgerald said:

> Video is a medium that has so much depth and so many possibilities [...] Our tools are constantly changing. It's what's wonderful about where we are in the twenty-first century. The production, post-production tools are now in the hands of many more people, but that doesn't make it any easier. We as artists are constantly going deeper into it. We need the distribution as much as ever. And we also need the place to bump into each other. And that's what we are missing now that we are doing so much work in cyberspace. We need the physical space. We need the conferences where we come together in Europe or Japan or in the United States for a week and talk about these ideas. And, you know, really hatch new ideas for work.

Notes

1. All quotes are taken from interviews in the soon-to-be-released video documentary *Nam June Paik and TV LAB: License to Create* (producer/director Howard Weinberg). See http://www.howardweinberg.net/progress/tvlab.html.

The New Television Workshop at WGBH, Boston

John Minkowsky

The inception of the New Television Workshop can be most appropriately dated to 1969 with the broadcast of *The Medium Is the Medium*, a compendium of six original works commissioned from invited artists that represented the debut of video art on broadcast TV in the United States.[1] The idea for the program came about by way of the groundbreaking exhibition, then in its planning stages, of 'Television as a Creative Medium', at the Howard Wise Gallery,[2] and WGBH was selected to produce it.

Perhaps the key reason that the Boston public station had been so chosen was a longstanding commitment to experimentation that established it as an environment open to the unorthodox. This can be largely attributed to Fred Barzyk who, fresh out of college, joined the staff as a producer and director, and soon introduced something of a subversive element within the station. To demonstrate that symphony broadcasts could be accompanied by more provocative visuals, he convinced a number of other WGBH directors to surreptitiously create a series of short pieces collectively entitled *Jazz Images*,[3] imaginative interpretations that have been considered some of the first music videos and precursors to video art.[4] This was in 1961, and that same year Barzyk invited the popular New York radio raconteur Jean Shepherd to travel up to Boston to create a sequence of short works of indeterminate length, *Rear Bumpers*,[5] that aired after the station's official sign-off time. The post–late night format of *Rear Bumpers* would be used again for later series of video art.

Experimentation of the latter type would not have been possible without the measured support of the WGBH programming and administrative staff, and this is confirmed by the fact that, by the mid-1960s, WGBH was looking to attract a younger audience from among the large college population in the Boston region. They gave Barzyk carte blanche to develop a series especially for this purpose, and he engaged a young British teacher of English at Tufts University, David Silver, as the 'star' of the series *What's Happening Mr. Silver?* There was no fixed format for the program, and it could range from interviews with countercultural figures, thematic shows on violence or new technology, or mock news/variety programs. Some of these were controversial, but none more radical than a live episode entitled *Madness and Intuition*, in which Barzyk adopted John Cage's stochastic methods of music composition for TV production. *Madness and Intuition* garnered a National Educational Television award, a good deal of national press, and an investigation by the US government, which was under the misapprehension that the show might represent a security threat.

A number of well-known video artists produced works at the Workshop over the years. Nam June Paik created many of his earliest tapes, Peter Campus nearly all of his, and William Wegman, Ros Barron and others made a number as well.

Paik became one of the first Rockefeller Foundation artists-in-residence at the station, and it was with this support that he traveled to Japan to collaborate with engineer Shuya Abe on their eponymous video synthesizer. The prototype was then shipped to Boston and installed at WGBH for use by NTW artists, most notably Ron Hays who, probably more than anyone else, came to master this idiosyncratic machine and created the 'Music Image Workshop' program to further explore the creation of visual accompaniment to works of classical music.

By conventional standards of tool development, it was the Paik/Abe Video Synthesizer that provided the New Television Workshop its prominence (and much information about this tool is readily available elsewhere), and it received its premiere broadcast in a live three-hour marathon, *Video Commune – The Beatles From Beginning to End*, in August 1970. The long-format live broadcast also became part of the repertoire of WGBH when, in 1972, Dorothy Chiesa produced and David Atwood directed *The Very First Half-Inch Videotape Festival Ever* over a four-hour block on a Saturday afternoon. The format resembled that of a convention, where all manner of individuals – artists, social activists, psychiatrists and teachers – using the new portapak system were interviewed about and presented excerpts from their works, which were rescanned by studio cameras to make them broadcastable. Chiesa also oversaw the creation of a special facility in nearby Watertown where artists could borrow portapaks and work with editing equipment outside the pressures and expense of the broadcast studio itself. Every attempt was made to air works when possible, but the Workshop also showed a commitment to pure experimentation – and failure.

Another revolutionary programming innovation at the New Television Workshop was the experimental broadcast of double-channel simulcasts between 1968 and 1970, which, to be properly experienced, required the viewer to bring together two TV sets, one tuned to Channel 2 and the other Channel 44, both owned and operated by WGBH. How many people actually viewed these dual-screen presentations as conceived remains an open question, but two particular productions are especially noteworthy. The first is *CITY/Motion/Space/Game*, a complex collaboration from 1968 by producer Rick Hauser with Rockefeller artists-in-residence choreographer/dancer Gus Solomons, Jr., playwright Mary Feldhaus-Weber and composer John Morris. The other – and final — two-channel work was Stan Vanderbeek's 1970 *Violence Sonata*, equally elaborate in its mix of pre-filmed and taped material, live studio scenes with an attendant audience, telephone call-ins, and an overall air of theatricality.

The New Television Workshop was extremely eclectic in its consideration of what, in fact, represented 'new television', and encouraged a Dance Video Program, initiated by Nancy Mason, that brought in prominent choreographers to create new works especially for the television medium – something rare in those days. There was also a focus on the production of original dramas under the auspices of Fred Barzyk with Olivia Tappan, and these were often coproductions with David Loxton at the Television Laboratory at WNET in New York. And there were a number of regular slots for presentation of artists' video, including 'Artists' Showcase', another end of the evening placement of works of variable length produced by Dorothy Chiesa, and the long-running national series, 'New Television', the creation of Susan Dowling, who also became director of the Workshop when Barzyk decided to concentrate on other projects.

As a result of this diversity of approaches, NTW lasted until 1992 – nearly a quarter-century.

It should be apparent that the variety of innovative forms of presentation of artists' video at WGBH – variable length programs, live broadcasts of long-duration, double-channel transmissions with elements of interactivity, a free-form series aimed at a young audience, and a commitment to small-format, non-broadcast video – was one of its most cogent features and, in this respect, a strong case could be made that Fred Barzyk and those with whom he collaborated considered the station as a singular and expansive instrument – or tool – in and of itself, upon which they could perform, reshaping the airwaves from the rigid presentational modes and seemingly immutable and redundant formulae of conventional broadcast into something more fluid and responsive to artists' needs. Fred's most profound contribution was to make malleable an otherwise rock-solid medium and, in the process of doing so, redefine viewers' conception of what television was capable of. At this, Barzyk, and those who came under his influence, were virtuosos upon the most expensive and influential tool of the twentieth century.

A final show of Barzyk's skills was his ability not only to gain the support of – or grip in his vision – the institutional structure of WGBH, but also to convince it of the lasting worth of the works that were produced at the New Television Workshop. Within the station's new facility that opened in October 2007 is a first-rate preservation archive housing 'in excess of 750,000 assets, 2/3 of which are media items (audio, video, film)',[6] including Quad originals and outtakes, that incorporates virtually all the productions of the New Television Workshop. Such a vast treasure trove, accessible to scholars, students and others, exists in no other location,[7] and it is the New Television Workshop's indisputable legacy.

Notes

1. The artists participating in *The Medium is the Medium* were Aldo Tambellini, Thomas Tadlock, Allan Kaprow, James Seawright with Mimi Seawright (Garrard), Otto Piene and Nam June Paik.
2. Records indicate that *The Medium is the Medium* was first aired on March 23, 1969, weeks before the Howard Wise Gallery show actually opened on May 17.
3. Two of the *Jazz Images* shorts are especially memorable: the first a piece in which a toy kaleidoscope was placed in front of the camera lens, pointed at crumpled tin foil on a turntable, and rotated in time to the music. Only the broadcast comedian Ernie Kovacs had, prior to this, undertaken a similar experiment in abstraction to fill a few minutes of the innumerable hours he often was on the air each week. See John Minkowsky (1986), 'An Intimate Vacuum: Ernie Kovacs in the Aura of Video Art', in *The Vision of Ernie*

Kovacs exhibition catalog, New York: The Museum of Broadcasting, p. 38. The second work in the series showed overhead shots of a pair of hands, recorded upside down and vice versa, peeling potatoes, again to the tempo of the music.

4. See 'A Video Chronology, 1959–1974', in Douglas Davis and Alison Simmons (eds) (1977), *The New Television: A Public/Private Art: Essays, Statement and Videotapes Based on 'Open Circuits: An International Conference on the Future of Television'*, Cambridge, MA: The MIT Press, p. 280.
5. Some of the *Rear Bumpers* episodes were straight headshots of Jean Shepherd recounting his famous semi-autobiographical stories, but the majority were ventures in a more experimental vein and created especially for the series. For example: a stage manager is trying to locate Jean for a taping session and finds a room in which there is only an audio tape recorder playing back Shepherd's voice and a large portrait of him mounted on the wall. This piece was shown at a memorial service for Jean, Barzyk has noted, for its poignant evocation of the radio artist in his original milieu.
6. Keith Luf, archivist at WGBH, personal communication, October 3, 2008.
7. For a sampling of the Archive's bounty, visit http://main.wgbh.org/wgbh/NTW or http://openvault.wgbh.org. Many other productions from the Workshop are also available on request on-site.

The National Center for Experiments in Television at KQED-TV, San Francisco

John Minkowsky

What was to become the National Center for Experiments in Television was initiated as a one-year pilot program, 'Experimental Projects', proposed to the Rockefeller Foundation by KQED's first president and general manager, James Day, and his successor, Richard O. Moore. Brice Howard, the director of cultural programming at WNET in New York, was invited to take a leave of absence in order to helm the project and he accepted, arriving with a headful of ideas about what television, freed from the conventions of regular programming and at the service of personal expression by artists, might be capable of. He coined the terms 'videospace' and 'the videospace mix' to connote an original process that would consider the TV screen as a canvas upon which to shape electron flow.

Five artists from different disciplines – William Allen, painter and sculptor; William Brown, novelist; Richard Felciano, composer; Joanne Kyger, poet; and Loren Sears, filmmaker – were brought in beginning in August 1967 for this first year, and each was allotted two days to work in the KQED studios (the only equipment then available to them) with the assistance of station producer/director Robert Zagone. Nearly all of the work of the Experimental Projects program was made in black-and-white, a decision of Howard's because he felt 'if you move too fast into chromatics […] you start to get soothed and mystified into thinking the things you're doing are much better than they are'.[1] Nevertheless, given these constraints, some remarkable pieces were the result of that first year, most notably Kyger's *Descartes* (1968)[2] and Felciano's *Linearity – A Television Piece for Harp and Live Electronics* (1968).[3]

On the basis of a report Howard wrote after the pilot program's completion that he later revised for his aesthetic 'manifesto' *Videospace* (1972a),[4] the Experimental Projects was redubbed the National Center for Experiments in Television and would continue through 1975. Beginning with Willard Rosenquist as artist-in-residence and Paul Kaufman as scholar-in-residence (and later codirector), a core group of additional artists would quickly begin to accrue, notably Stephen Beck, William Gwin, Don Hallock, Warner Jepson and William Roarty, along with Rosenquist and Felciano, most of them remaining for the duration and often working in collaboration. As the Center began to amass a ragtag collection of equipment of its own, ties to parent station KQED became increasingly tenuous. But as Howard believed from the outset that the core purpose of NCET was to give artists complete freedom without any consideration for broadcast demands, this divorce was in complete accord with his vision. The environment at the Center, the surviving artists recall, was very informal.

Many works of exceptional beauty and grace were produced at the Center during those years, tapes that developed with slow, meditative delicacy that have been referred to as 'time paintings'. Very few were ever aired on TV, nor are they in distribution and, therefore, have rarely been seen, and many were, until recently, scattered and in dubious condition.[5]

But the Center was also actively engaged in tool and instrument development from the outset; the most significant of these efforts are described below.

Stephen Beck – Direct Video Synthesizer and Video Weaver

In 1971, a young electronics engineer from University of Illinois at Urbana, who had also been involved in the Electronic Music Studio there, traveled to the Center to show some films he had made using a tool of his own devise, a Direct Video Synthesizer (DV #0), that created moving color abstractions on a cathode ray tube using electronic waveform generators as input. Invited to join up, Beck spent the next several years refining his instrument through its next incarnation (DV #1), employing circuitry to create and manipulate color, form, motion and texture, and Beck's many experiments and completed tapes evidence his increasing mastery over the machine. Moving from analog to digital technology, Beck next created his Video Weaver, so named because its highly geometric, interlacing patterns resembled nothing so much as the warp and woof created by the artisan's loom, now electronically manifested.

Beck's Direct tools were among the first – and best known – of what might be called 'synthesizers' proper, insofar as they generated images entirely by means of internal circuitry, as compared with those like the Paik/Abe that were predominantly 'processors' of camera-based images (although Beck's machine could also make use of camera input), and were extremely important in defining new directions for artists to explore in video.

That being said, Beck's tools had little impact upon the creation of works by others at the Center, because no one but their inventor was permitted to use them. Stephen's rationale for his proprietary interest was pragmatic; after having hand-wired a vast number of circuit boards, he feared that an inexperienced user might inadvertently cause malfunctions that would require countless hours of diagnosis and repair. Additionally, there are no replicas of these machines – unlike those of Dan Sandin, Nam June Paik and Shuya Abe, and others – with which other artists might have experimented.

Lawrence Templeton – The Templeton Mixer

Despite the great and justified acclaim given to Beck's synthesizers, it was a more modest tool that served the greater number of artists at the Center, and gave them access to imaging abilities previously unavailable.

Lawrence Templeton was an engineer at KQED when he took it upon himself to also serve as circuit designer and instrument builder at NCET, constructing in 1970 what would become the central tool at the Center. As described by Don Hallock:

> The Templeton Mixer consisted of three modules: the colorizer, the keyer, and the mixer […]. The keyer module samples the brightness range of a source image and can separate that source into eight distinct zones according to relative brightness […]. Color, or other image sources, can then be inserted into each of these zones. […] The colorizer module supplies four different variable color sources. Each joystick control selects color from the spectrum by swinging the stick around a circle. The degree of deviation from center controls color saturation, and the top knob can be rotated to control color brightness. […] All the functions of each of these mixer modules can be preset, varied manually in real time, or changed by control voltages derived from a separate source – the Buchla Box audio synthesizer, for instance.[6]

And by William Roarty's account, The Templeton Mixer sought to expand the modes of conventional broadcast image processing and to make the controls for them directly accessible to artists in a flexible form that allowed for immediate response to developing concepts.[7]

The first version of the Mixer was roughly the size of an upright piano, but within several years Templeton had designed one of equal power that was extremely portable. The Templeton Mixer was the primary tool with which all the artists, except Beck, worked, whether on tape or in live performance. As of this writing, only one of the three built is still in existence and operating.

Don Hallock – The Videola

Don Hallock's Videola is a complex electro-optical instrument bearing some resemblance to a giant kaleidoscope capable of being viewed, in its large-scale format, by about a hundred audience members simultaneously.[8] By means of mirrored surfaces housed within an elaborate trapezoidal wooden frame, it transforms a flow of video images that may be prerecorded or performed live, from a monitor at its narrowest side, into large, free-floating, constantly evolving spheres of immense beauty. Mandala-like objects, these globes, when experienced, have been known to induce in viewers something on the order of meditative states of mind.

Given that this was one of the most significant examples of video installation of that period, the Videola – like so much of the Center's other work – remains all but unseen. It has only been publicly installed twice: the first time at the San Francisco Museum of Art in 1973 in its full-scale version; the second as a reconstructed version of smaller dimensions at the Berkeley Art Museum exhibition, 'Videospace', curated by Steven Seid and Maria Troy, in 2000.[9] Sections of it remain in storage with no immediate plans for future presentation. (See Color Plate 15)

The National Center had occupied, by Don Hallock's calculations, seven different locations throughout its eight-year tenure, and the last of these was in Berkeley. A major reason for this final move was financial, as NCET was losing funding support by 1974. In its ultimate year, Paul Kaufman tried to take it in a different direction, reinventing NCET as a home for a humanities project. The last major production of the Center was a pilot for a projected public TV series, *Ecotopia*, adapted from Ernest Callenbach's environmental-utopian novel, but when that failed to come to fruition, NCET folded its tents.

It is sometimes said that the National Center was too insular to have much impact on the Bay Area community, let alone the national scene. This was never strictly the case, as other San Francisco artists like Skip Sweeney at times collaborated with those at the Center, and early participants who worked briefly at NCET included visual artists Bruce Nauman and Benedict Tatti, and poets Robert Creeley and Charles Olson. As regards its national impact, it is also important to remember that it did have a regular program where groups of other broadcasters and art school representatives were brought in for a working tour, out of which developed a number of satellite centers, most notably at Southern Methodist University created by David Dowe and Jerry Hunter, and at the Rhode Island School of Design by Bob Jungels.

And Howard's term 'videospace' has become part of the vocabulary of the field still in use today.

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Notes

1. Brice Howard, interview, August 1978.
2. Kyger's *Descartes and the Splendor Of: A Real Drama of Everyday Life* (1968) makes spectacular use of video feedback, as well as other available studio techniques. It is a six-part poetic interpretation of the philosophical dualism expounded in Descartes's *Discourse on Method*, interweaving the quotidian and exotic, accompanied by an original poem written by the poet especially for the tape. Kyger is the performer, representing housewife,

mother-goddess, and other figures, including herself as poet. The complete text of her poem is available in Kyger (2002: 69–73) and Phillips (2008: 146–49).

3. Felciano has described *Linearity* as a work 'in which the television's extensive processing and memory capacities were employed. Incorporating instructions for cameramen and control room, the score is composed in two passes, the first of which lays cues for the second, which overlays it. The result can be broadcast but not performed on a concert stage' (http://www.fishcreekmusic.com/fcm_felciano.htm. Accessed November 5, 2008. Current website with similar information is www.richardfelciano.com.). To elaborate, the solo harpist performed Felciano's composed score and, while viewing this first pass on a video monitor, played in relation to the cues provided (as did the recording and mixing crew, who also followed these instructions). As almost the entire work consists of close-ups of the musician's hands, the strings of the instrument create linear visual patterns of their own.
4. See also Howard 1972b.
5. An ongoing attempt at preservation to rectify this matter has been undertaken by Steven Seid, Curator at the Pacific Film Archive at University of California, Berkeley beginning in 2000, when he mounted the exhibition 'Videospace' at the Berkeley Museum of Art to highlight the activities at NCET. I am also working to extend this effort of correcting and transferring to DVD additional works from those years.
6. See http://ncet.torusgallery.com/index.html where further information can be found about this particular tool and other of the Center's activities.
7. In addition to Don Hallock for the above description, I am indebted to William Roarty for access to his unpublished master's thesis, 'Videographic Image and Process Explorations' (1977), which provided a great deal of information about the Templeton Mixer, as well as Larry Templeton and Rick Davis for clarification about the Mixer's specific architecture.
8. The Videola might be more properly considered as an instrument than a tool, yet I find this distinction rather arbitrary, and in most cases the terms are interchangeable. With few exceptions, experimental video tools like synthesizers are, in fact, instruments when in the hands of artists.
9. For a full description, see exhibition catalog (Seid and Troy 2000).

The Experimental Television Center: Advancing Alternative Production Resources, Artist Collectives and Electronic Video-Imaging Systems

Jeremy Culler

The Experimental Television Center's role in building studio 'control systems' and providing educational resources to the public was extensive, beginning officially when Ralph Hocking applied for charted status as a nonprofit educational corporation in 1971.[1] Hocking incorporated the Center so that he could apply for grants and finance the rising cost of maintaining and acquiring equipment, purchasing parts and supplies, and paying rent and employees (S. M. Hocking 2010). Crucial grants received from the New York State Council on the Arts (NYSCA) and the National Endowment for the Arts (NEA) also enabled the Experimental Television Center to offer alternative television production resources to students and faculty at the State University of New York at Binghamton and to community organizations throughout New York and Pennsylvania to develop a research program for advancing new electronic image–processing devices and expanding the boundaries of television and video production; and establish an artist-in-residence program at the Center (ETC 1972).[2]

Once incorporated, the Experimental Television Center began to make the tools of television and video production accessible to artists and educators from local organizations and post-secondary schools in the community. In order to do this, they developed an in-house research program that promoted 'the design and construction of [new] electronic image generation and control devices' and provided 'significant new methods of image formation' using audio and video synthesizers (Hocking and Hocking 1981). Directors Ralph and Sherry Miller Hocking note that the philosophical orientation of the research program at this time was to nurture 'an interactive and practical relationship between the arts and sciences' (Hocking and Hocking 1981). This type of relationship aided their efforts in promoting collaborative projects among artists, educators, and electrical engineers. It also helped the directors to design an analog/digital hybrid studio at the Experimental Television Center (see Color Plate 21), incorporate 'manual and pre-programmable control' systems that were fully accessible and user-friendly, and built advanced versions of existing electronic devices, such as the Paik/Abe Video Synthesizer (see Color Plate 22).[3]

In 1972, the Experimental Television Center incorporated a new version of a Paik/Abe Synthesizer into its television studio and established an artist-in-residence program. The new version expanded on one built earlier for WGBH's public television studio by integrating a digital computer and manual control systems.[4] In a proposal request for further development of the synthesizer, Paik and Hocking reasoned that 'the incorporation of a [digital] computer into one of the Paik/Abe Video Synthesizers' was needed in order to 'produce a system [that could] be made available immediately to artists throughout the State who work at the Center'.[5] The new hardware, which included a colorizer with video feedback options, magnetic scan modulation, and nonlinear mixing, also offered to those in the Center's artist-in-residence program a manageable device built specifically for hands-on artistic experimentation.[6] ETV artists-in-residence also received personalized instruction, unfettered access to analog/digital image-processing equipment, and a distinctive image vocabulary – all of which benefited residency recipients Peer Bode, Barbara Buckner, Gary Hill, Ken Jacobs, Shigeko Kubota, Nam June Paik, Aldo Tambellini, and many others.

In addition to collaborations between artists and engineers, the Experimental Television Center also encouraged social networking as a way to advance innovative methods of video image processing, diagnose technical issues, and build new devices. Dave Jones and Don McArthur were among those at the Center who, like Nam June Paik and Ralph Hocking, understood the value of social networks, video collectives, and collaborations between artists and engineers. On May 15, 1975, Jones and McArthur participated in the first 'Tele-Techno Conference', which brought together representatives from Media Bus, Portable Channel, MERC, Innervision, and the Experimental Television Center to discuss Sony portapak maintenance issues, modifications to editing and transfer systems, and new commercial hardware and experimental equipment.[7] Parry Teasdale of Media Bus, who typed out the agenda and subsequent notes, recalls that:

> [T]he call lasted 81 minutes and had to be ended before the complete agenda had been taken up. This was due partly to the time taken by introductory niceties and partly to the time necessary to cover such subjects as Porta-pak [sic] maintenance tips which shouldn't take as long in the future. (Teasdale 1975a)

At the end of the conference call, the group decided to reconvene on June 13 to address those items on the May 15 agenda that were not covered due to time constraints (Teasdale 1975a). During the June 13 conference, participants talked about computer/video interface systems, experimental equipment designs, and issues with new hardware (Teasdale 1975b). In order to share ideas about esoteric hardware and test equipment more effectively, Teasdale called for a 'test equipment pool' to be circulated among the participants (Teasdale 1975b). The goal was to cull test equipment inventories from each organization and share information on locating hard-to-find items (Teasdale 1975b). Although there is some question as to the success of the test pool, since Teasdale's letters indicate little participation, the initial lack of response did not carry over to the conference meeting (Teasdale 1975b).[8] Rather, the success of the actual phone conversation, which is evident in Teasdale's conference notes, led the group to replace the third scheduled telephone conference on October 3 with an actual meeting at the Maple Tree Farm on October 10 and 11, 1975 – an event referred to as the 'Lanesville Techno-Conference'.[9] Unlike the conference calls, this event enabled participants to pool their resources in person, and start work on the design of a standardized plug-in circuit board and power supply (Teasdale 1975e). The collaborative project was intended to help facilitate exchange, as Teasdale explains in his 'Lanesville Techno-Conference' notes:

> Such a circuit board/power supply system would provide all those people working with that system a way to exchange entire experimental circuits through the mail. It is hoped that by thus standardizing certain fundamental design processes experimental circuit development will be accelerated. Ken Jesser, who presented the idea, is persuing [sic] the project (Teasdale 1975e).

Other major attempts at standardizing equipment and facilitating information exchange took place at the Experimental Television Center, which, by the 1980s, had become nationally recognized for its pioneering research and artist-in-residence programs. The directors of the Experimental Television Center designed its research and artist-in-residence programs to provide unfettered access to image-processing devices and control systems in their studio. While offering personalized instruction, they insisted that artists and educators experiment, explore and develop image-processed video as a personal form of communication and expression. Ralph and Sherry Miller Hocking's mission to promote a kind of investigatory process, which allows artists to discover the potential of 'manual and pre-programmable' control systems integrated into the Experimental Television Center's studio, is evident in the Center's DVD anthology – a five-disc set of one hundred artists who have worked at the Center's studio from 1969 to 2009. Rather than promoting contrived television production methods, the directors of the Experimental Television Center encouraged individualized experimentation and exploration, using, as Ralph Hocking notes, its studio 'as a learning place and not a production house' (Hocking and Hocking 2009). In this manner, artists and educators were able to expand the boundaries of television and, consequently, the idea of 'image-processed video' as a genre of video art. Indeed this expansion was dependent on the success of the Center's research and artist-in-residence programs, which benefited greatly from alternative production resources, grants, social networks, community research and screening centers, and a production and postproduction studio. These resources were especially crucial for artists who relied on noncommercial technologies, such as the Paik/Abe Video Synthesizer, in order to advance electronic image–processed video as a sustainable method of artistic and aesthetic expression.

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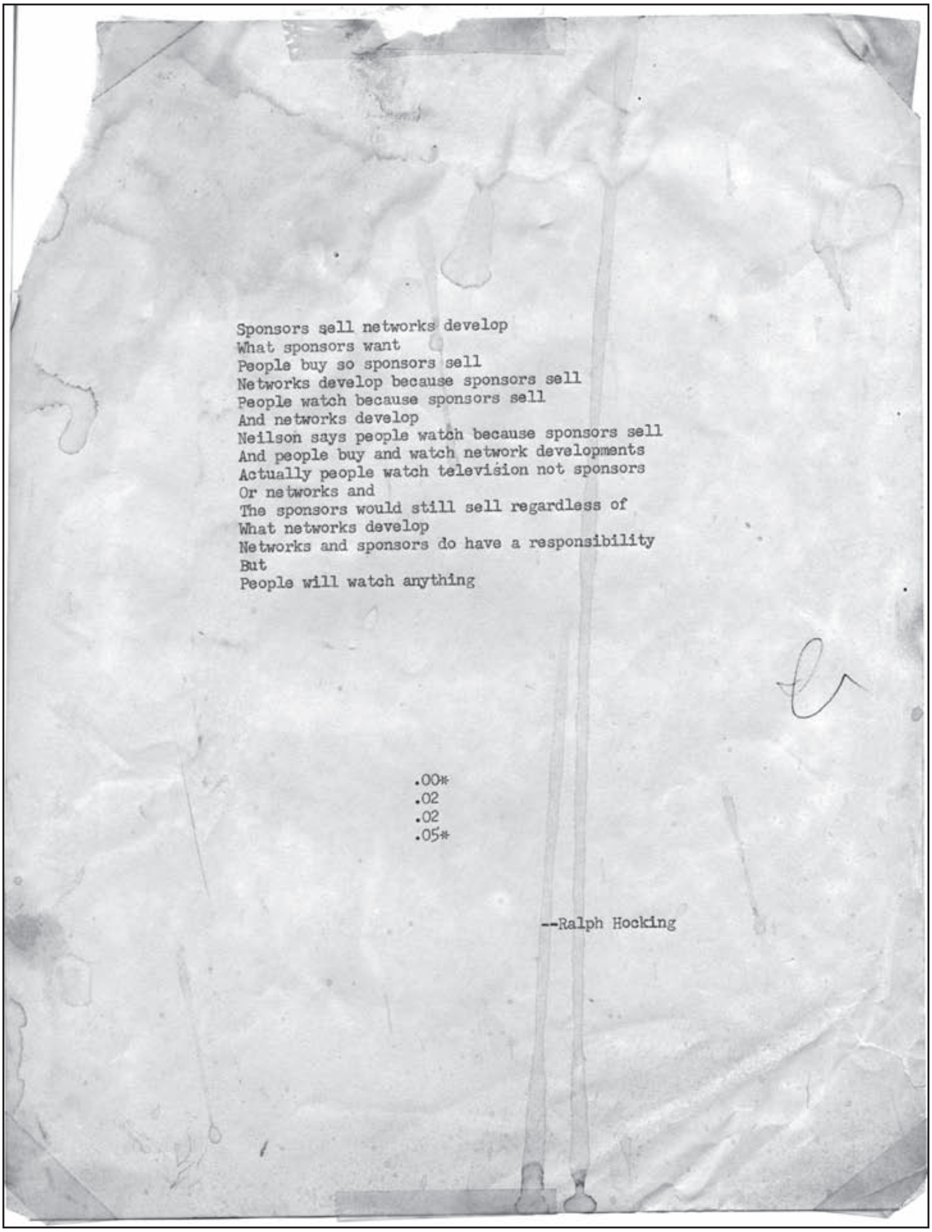
Notes

1. At the time Hocking applied for charted status, the Center was known as the Community Center for Television Production.
2. The Experimental Television Center's operating budget for 1970–71, which totaled $52,372.67, was offset by a $50,000 grant from the New York State Council on the Arts (ETC 1972).
3. According to Sherry Miller Hocking, this was the second Paik/Abe Video Synthesizer constructed by Shuya Abe under the direction of Nam June Paik and the Experimental Television Center. The first was built for the Television Lab at WNET. Ultimately, three were made at the ETC (S. M. Hocking 2010).
4. In a letter to Nam June Paik, Hocking wrote that he was 'most impressed' with the Paik/Abe Video Synthesizer and would like to place an order for one of the machines. He also noted, 'I hope it will be ready in the near future since our Center has an immediate need for creative tools for the video artist'. Hocking subsequently commissioned Nam June Paik and Shuya Abe to expand on an earlier version of the Paik/Abe Video Synthesizer at WGBH, a version Nam June Paik used during his residency at the public television station. One of the reasons for the expansion was that the WGBH version was not easy to use. See R. Hocking (1970); S. M. Hocking (2010); and Hocking and Paik (n.d.).
5. In a request for assistance letter, Nam June Paik wrote the following: 'Actually I have done some computer research at Bell Labs as a Residential Visitor in 1967/68 under the guidance of Michael Noll. However I did not incorporate a digital computer into the design of the Paik/Abe Video Synthesizer at WGBH in 1969 because at that time most computers were not movable, and time sharing through telephone lines made the output speed inadequate for on-line operation. However the rapidly advancing computer technology made the introduction of a digital computer into video art quite plausible and economically and artistically viable'. In the last paragraph, Paik ended by noting the following: 'The Experimental Television Center in Binghamton presents a favorable place for this investigation because the Center has two highly qualified people, Don McArthur and Walter Wright, who have had considerable experience with computers and computer programming. The incorporation of the computer into one of the Paik/Abe Video Synthesizers will produce a system which will be made available immediately to artists throughout the State who work at the Center' (Hocking and Paik n.d.).
6. Subsequent versions of the device incorporated a sync generator, which allows various camera signals to be synchronized. In a May 11, 1974, letter to Ralph Hocking, Shuya Abe enthusiastically explained that the new Video Synthesizer to be made for the Experimental Television Center would include several extra facilities, such as a three-to-five audio generator, one keying circuit, two mixers and switchers, a sync generator, and a voltage-controlled variable delay line (Abe 1974).

7. The ‘Tele-Techno’ notes (dated June 4, 1975) are not transcribed from the audiotapes made during the telephone conference. They are, as Parry Teasdale of Media Bus wrote, ‘notes from the first Tele-Techno Conference held Thursday, May 15. They aren’t a transcription of the audiotapes made at the time and I haven’t used those tapes in the preparation of these notes (in fact, we had […] “technical difficulties” here and erased some of the tape but between Dave Jones in Binghamton, and us, the whole tape could probably be put together if anyone really needs it)’. Participants included Parry Teasdale, Chuck Kennedy, Chuck Heuer, Kevin Kenney, Carl Geiger, Dave Jones and Don McArthur (Teasdale 1975a).
8. In his notes on the second ‘Tele-Techno Conference’, Parry Teasdale wrote that he had yet to receive test equipment inventories and schematics to duplicate and circulate. In a letter dated October 5, 1975, he indicated that he received some, but that participants of the third Conference meeting should bring them to be exchanged in person (Teasdale 1975b; 1975c).
9. The following people and institutions participated in the Lanesville Techno-Conference: Bill Claghorn from the Adwar Video Corporation; Carl Geiger from Innervision Media Systems; Chuck Heuer from Portable Channel; Ken Jesser from Media Study/Buffalo; Dave Jones and Don McArthur from the Experimental Television Center; Kevin Kenney from the Media Equipment Resource Center; Paul Lamarre from Textronix; and Chuck Kennedy and Parry Teasdale from Lanesville TV (Teasdale 1975b; 1975d).



Sponsors sell networks develop
What sponsors want
People buy so sponsors sell
Networks develop because sponsors sell
People watch because sponsors sell
And networks develop
Neilson says people watch because sponsors sell
And people buy and watch network developments
Actually people watch television not sponsors
Or networks and
The sponsors would still sell regardless of
What networks develop
Networks and sponsors do have a responsibility
But
People will watch anything

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--Ralph Hocking

Ralph Hocking, *Sponsors Sell* (1972).

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(Artists will be at gallery during 1 - 5 P.M.)

Video art is highly visible in the art scene and futurists are forecasting the emergence of Cable TV and Video Cassettes as a major social asset. This artistic and social situation is a triumph for Nam June Paik who has prophesied, conceptualized and relentlessly strived to establish TV as an artistic medium for no less than a decade. Art in America and Newsweek called him "Pioneer" of this medium and Radical Software called him "The George Washington of underground video." We would like to quote proudly Nam June Paik's statement in his 1965 Bonino catalogue which showed Videotape as an art object for the first time in the world.

"Cathode ray tube (TV screen) will replace canvas ..."

The success of Mr. Paik's second one-man show at Bonino (1968) brought him invitations from the Museum of Modern Art in New York, The Institute of Contemporary Art in London, and Kunstverein, Cologne, Germany. He then moved into the midst of Public Television System and gained recognition and esteem of hard-boiled professionals while working also as consultant to burgeoning underground video groups. In the coming show celebrated cellist Charlotte Moorman and brilliant artist-engineer Shuya Abe, the technical director of the California Institute of the Arts (mixed media lab) join Mr. Paik as equal partners.

1) PAIK-ABE Video Synthesizer (sponsored by WGBH-TV, Boston and Community TV production Center at Binghamton, N. Y.)

a full fledged industrial machine which greatly increases the potentials of electronic painting on the color picture tube while reducing the color TV production cost by 80%. After two years of research by Shuya Abe the synthesizer meets the complicated broadcasting standards of the FCC.

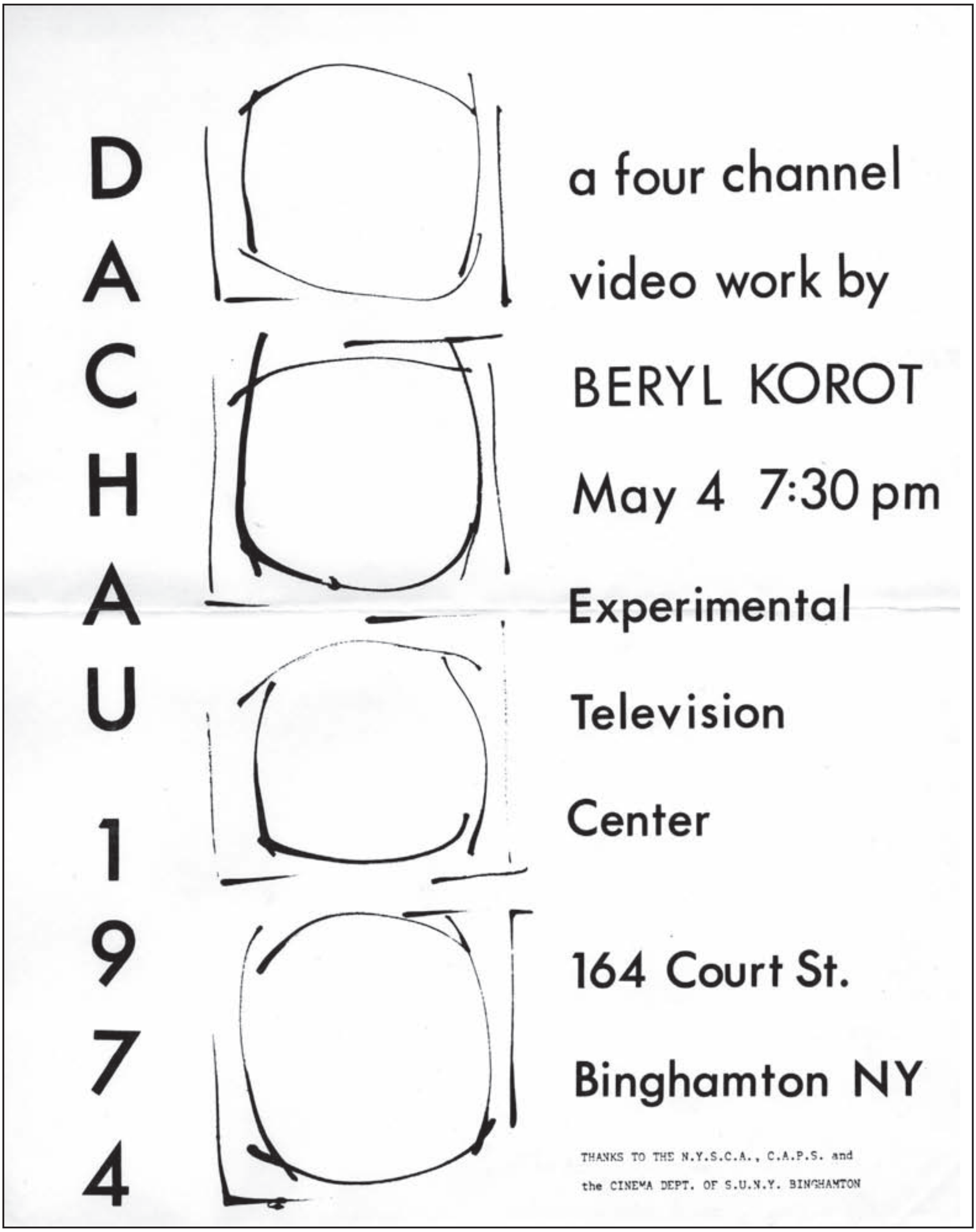
2) Liberation of TV from TV box is the theme of a video environment which Mr. Paik created for the liberated cellist, Miss Moorman. (TV eye glasses, TV cello, TV bows and TV bra) 20 TV screens (mini to maxi) beam the hot performance of a legendary female pop singer. This portion guarantees a 50% share for woman in this whole exhibit.

3) 57th Street Video Gazette is a daily video news coverage of what is happening on this colorful street in collaboration with the Alternative Media Center of New York University.

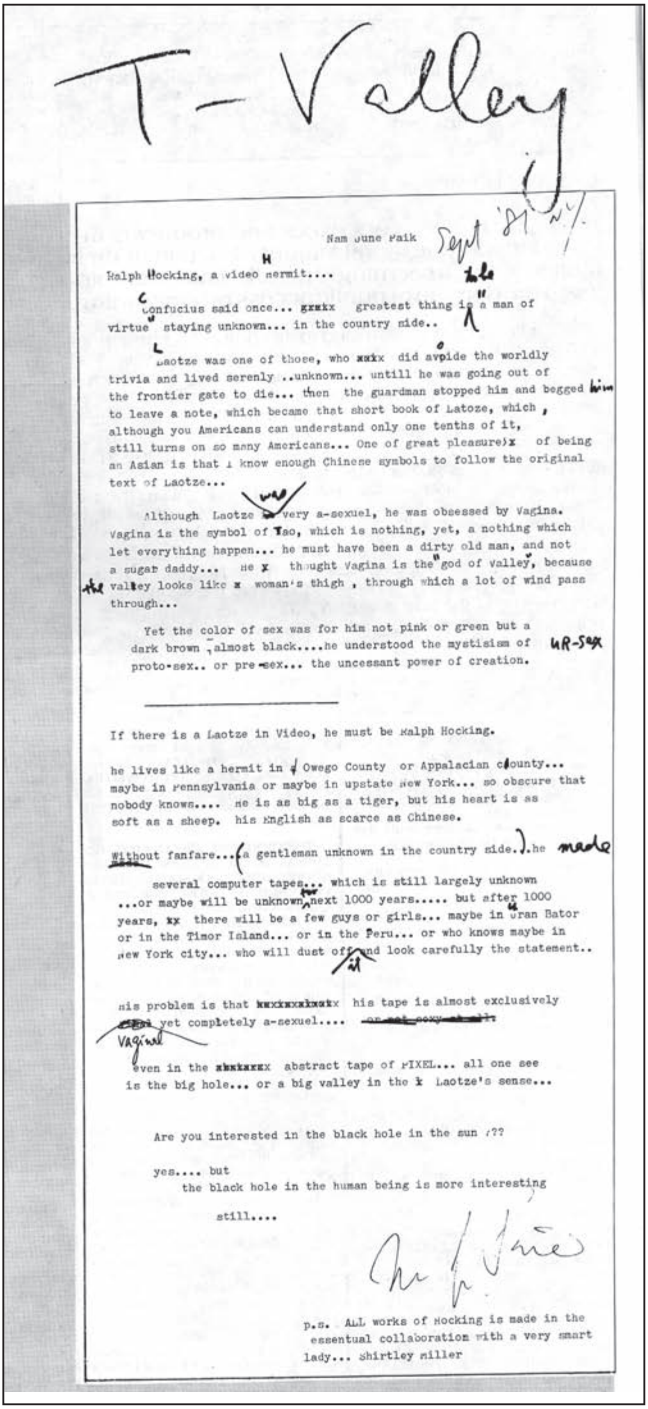
4) Excerpt from Paik's production for WGBH-TV during the past three years.

PLEASE NOTE: The New American Filmmakers Series of the Whitney Museum also will show Nam June Paik's videotape a.o. from Dec.3 to 15.

Press release for the 'Paik-Abe Video Synthesizer with Charlotte Moorman' exhibition held at the Bonino Gallery, NYC, November 23 through December 11, 1971. (courtesy. Nam June Paik Studios).



Beryl Korot exhibited the multichannel work *Dachau 1974* at ETC in May 1977 as part of the 'Video by Videomakers' series cocurated by Peer Bode and Sherry Miller Hocking.



T-Valley

Nam June Paik Sept '81 N.Y.

Ralph Hocking, a video hermit....

Confucius said once... ~~gzmkx~~ greatest thing is "a man of virtue" staying unknown... in the country side..

Laotze was one of those, who ~~xxkx~~ did avoide the worldly trivia and lived serenly ..unknown... untill he was going out of the frontier gate to die... then the guardman stopped him and begged him to leave a note, which became that short book of Latoze, which , although you Americans can understand only one tenths of it, still turns on so many Americans... One of great pleasure ~~x~~ of being an Asian is that I know enough Chinese symbols to follow the original text of Laotze...

Although Laotze was very a-sexuel, he was obsessed by Vagina. Vagina is the symbol of Tao, which is nothing, yet, a nothing which let everything happen... he must have been a dirty old man, and not a sugar daddy... He ~~x~~ thought Vagina is the "god of valley", because the valley looks like ~~x~~ woman's thigh , through which a lot of wind pass through...

Yet the color of sex was for him not pink or green but a dark brown , almost black....he understood the mystisism of UR-sex proto-sex.. or pre-sex... the uncessant power of creation.

If there is a Laotze in Video, he must be Ralph Hocking.

he lives like a hermit in Owego County or Appalacian county... maybe in Pennsylvania or maybe in upstate New York... so obscure that nobody knows.... He is as big as a tiger, but his heart is as soft as a sheep. his English as scarce as Chinese.

Without fanfare... (a gentleman unknown in the country side.) he made several computer tapes... which is still largely unknown ...or maybe will be unknown for next 1000 years..... but after 1000 years, ~~xx~~ there will be a few guys or girls... maybe in Ulan Bator or in the Timor Island... or in the Peru... or who knows maybe in New York city... who will dust off it and look carefully the statement..

His problem is that ~~xxxxxxxxxx~~ his tape is almost exclusively Vaginal yet completely a-sexuel.... ~~or not sexy at all:~~

even in the ~~xxxxxxx~~ abstract tape of PIXEL... all one see is the big hole... or a big valley in the ~~x~~ Laotze's sense...

Are you interested in the black hole in the sun ,??

yes.... but
the black hole in the human being is more interesting
still....

Nam June

p.s. ALL works of Hocking is made in the essential collaboration with a very smart lady... Shirtley Miller

'T-Valley'. Text by Nam June Paik. (courtesy. Nam June Paik Studios).

Community Center for Television Production presents

THE VASULKAS

Sponsored by New York State Council on the Arts

The Vasulkas are well known for creating video tapes for experimental television. Their work has been discussed in the Village Voice, The East Village Other and in the current issue of Backstage. The Vasulkas' unique contribution to the art of video lies in their special use of the hookup between audio and video signals. Often the shapes on the screen are formed by the signals of the sound synthesizer producing the audio track, and vice versa, the sounds are produced by the video signal. The Vasulkas are committed to investigating the possibilities of different frequencies of light and sound as it relates to the art and technology of television. The result has a dream-like quality that speaks to the mind of the individual viewer.

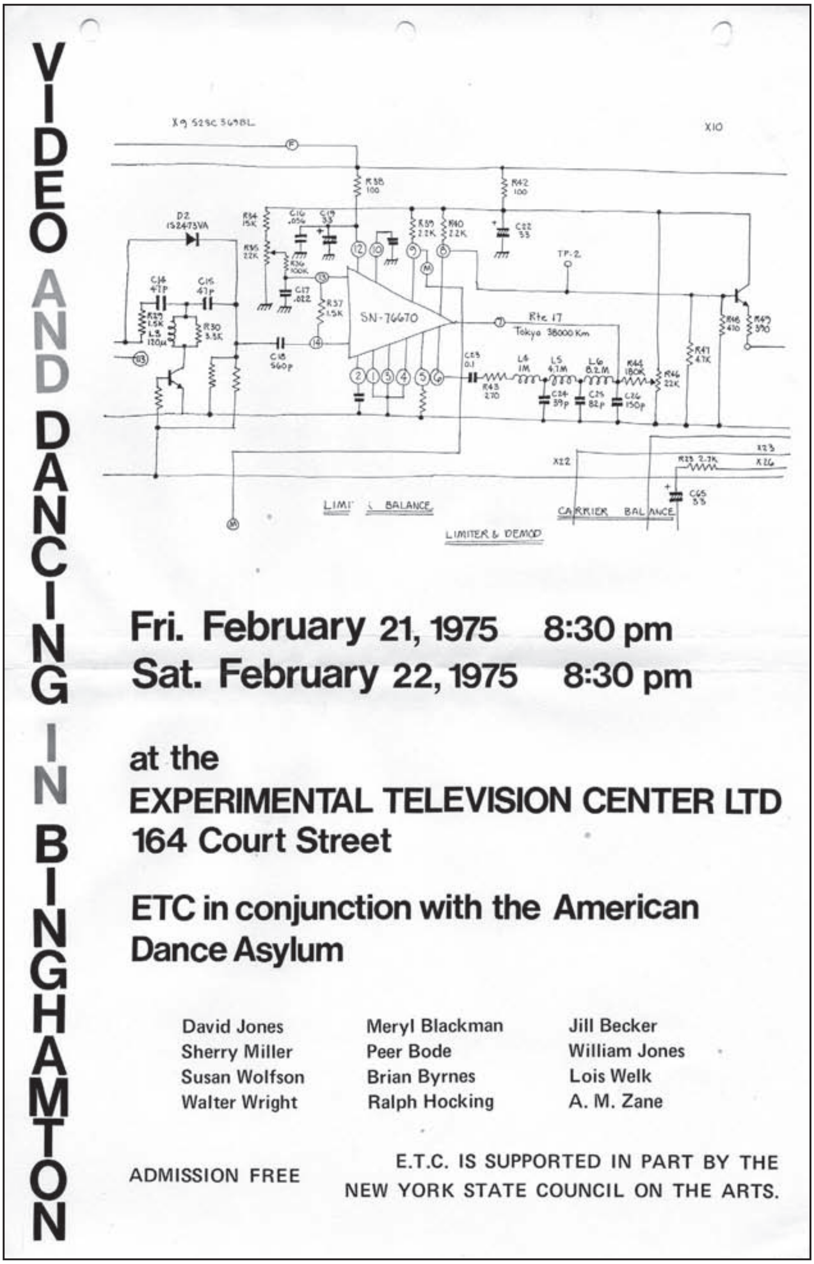
164 Court Street   Binghamton

October 28

Workshop 1-4 p.m.   Showing 8 p.m.

no charge

Woody and Steina Vasulka held a workshop at the Community Center for Television Production (later Experimental Television Center) in 1971.



Poster for the intermedia performance *Video and Dancing in Binghamton* sponsored by Experimental Television Center and The American Dance Asylum, with Bill T. Jones, Lois Welk and Arnie Zane. Video by Meryl Blackman, Peer Bode. February 21 and 22, 1975.

VIDEO SYNTHESIS

WORKSHOP/PERFORMANCE

BY

WALTER WRIGHT
ARTIST IN RESIDENCE AT THE
EXPERIMENTAL TELEVISION CENTER

MONDAY, APRIL 7th at 3:00 P.M. Lecture Hall 6

TUESDAY, APRIL 8th
and
WEDNESDAY APRIL 9th - 1:00 - 5:00 P.M. & 7:00-9:00 PM.
in Cinema Studio B 93

This program is supported in part by the New York State Council on the Arts with cooperation from the Cinema Department and Educational Communications of SUNY-Binghamton.

Walter Wright presenting a Video Synthesis Workshop /Performance at Binghamton University, April 1975.

SECTION 2

PEOPLE AND NETWORKS

Introduction

Sherry Miller Hocking

The final section of Volume 1 of *The Emergence of Video Processing Tools: Television Becoming Unglued* presents a number of voices from different generations, reflecting on individual practice, collaboration and the networks which evolved to support the art. As we have seen throughout the book, artists work in many different ways, from the strict individualist with a singular vision, to collaborative networks of artists and technologists. While collaborations such as LoVid, the Vasulkas and Ralph and Sherry Hocking may share some similarities, they are each shaped differently by personality, context, individual predilections and personal interests. Are there any common threads we can discern about this method of practice?

Artists also define their art in a variety of ways. Some work with moving images as visual art; others see the work as sculpture, interactive, immersive or performative. Some define organizational structures which they have had a hand in building as a creative artwork. The Vasulkas founded The Kitchen at the Mercer Arts Center as a place where their work and that of a network of other video and audio artists could be screened or performed, and alternate production methods explored. Artists who were listed as working at The Kitchen by the Vasulkas around 1972 in 'A Proposal for a Grant' were Dimitri Devyatkin, Rhys Chatham, Andy Mannick and Michael Tschudin. Also mentioned is a collaboration with technologist George Brown and his development of a switcher.[1] Ralph Hocking created ETC to provide artists with access to imaging tools. ETC residencies were scheduled on the basis of submitted written proposals. The organizational structure Hocking created was experimental, in much the same way that he views his art; one selects the inputs and then selects and applies processes to see what the result might be.

Some artists see the work as process, as performance, as interaction between artist and system and as a conversation with the tools. In this way, the system and the artist are both actors within the work. In a sense, the artist also collaborates with the machine.

Much of the history of image-processed video has also concerned itself with the ways in which ideas and tools live in the world. Is the artwork a commodity or a process? Is it a thing or a code? An object or a method? Do artists and technologists have responsibilities to communicate their designs to others? How do these ideas live in the work – freely or as monetized items of commerce?

In this section, we find artists have as many questions as answers, possibilities as solutions.

Working together as LoVid, US video artists Kyle Lapidus and Tali Hinkis are interviewed by curator Michael Connor. Their collaboration reveals their love of machines and their notions of what collaboration entails. LoVid were the final artists to work in residence at the Experimental TV Center before the program ended in 2011, and wrote the farewell response to signage by Nam June Paik which had hung in the studio since 1970. Finally, in 'Memory Series – Phosphography in CRT 5", Mexico, 2005' Mexican artist Carolina Esparragoza, provides a formula for tracing nostalgia.

Marisa Olson's 'The Rhetoric of Soft Tools' looks at contemporary hackers and makers, and argues for the notion that software functions as a tool. Carolyn Tennant and Jeremy Bailey have a conversation exploring Bailey's humorous critique of the people who create imaging tools and the subsequent overuse of visual effects. Bailey's work is both an investigation of self-reflexivity and critique of the tool demonstration seen as performance.

Timothy Murray discusses an 'ongoing shift away from art as commodity and from artist as creative genius to open networks of artistic production and conceptual collaboration'. Questions arise about how certain tools may emphasize, facilitate or conflict with impulses toward the decommodification of artworks and information-sharing about tools and artworks; these impulses were promoted in the time of early tool development and, in some cases, persist today. Michael Century's 'Virtuosity as Creative Freedom' looks at three pivotal case studies of systems where creators have shared their ideas and design about machine and software development. And artist and tool designer Dan Sandin, along with musician Phil Morton, drafted the seminal text 'Distribution Religion', which advocates reproducibility of the Sandin Image Processor designs as an early example of information-sharing and belief in open source as a philosophy, reflecting changing notions of intellectual property. Ralph Hocking's *A Toy for a Toy* reveals his unconventional relationship with Nam June Paik.

In 'Woody Vasulka: Dialogue with the (Demons in the) Tool', curator and art critic Lenka Dolanova traces the philosophical approaches and definitions of the medium investigated by Steina and Woody Vasulka as they collaborated with tool designers and utilized the tools in their video works. An original text by artists Steina and Woody Vasulka, 'Early' describes the 1970s scene in New York City, and the beginning of the media arts center, The Kitchen, founded by the Vasulkas. Jean Gagnon contributes an insightful essay, 'A Demo Tape on How to Play Video on a Violin', about the performative work of artist Steina Vasulka. Founder and director of the Experimental Television Center, Ralph Hocking, contributes 'Application to the Guggenheim Foundation, 1980', which provides a snapshot of his arts practice and tool development. Finally, Sherry Miller Hocking reflects on the various meanings of collaboration, how it arises and how it can be sustained.

Notes

1. See http://www.vasulka.org/archive/Kitchen/KBD/KBD.pdf . Accessed November 6, 2012.

From Component Level: Interview with LoVid

Michael Connor

In 2005, I included LoVid in a project I cocurated (with Jackie Passmore) at the 'Futuresonic Festival' in Manchester. After that project, I transported one of their noise-generating objects back to the United States in my carry-on luggage. I had the opportunity to discuss the duo's practice in layman's terms several times on that journey, with fellow passengers, as well as customs officials (ranging from curious to vaguely alarmed). The latter were particularly interested in the meaning and purpose of the strange wires embedded in this object.

And so I explained LoVid to my interlocutors in terms something like these. They are a family of four (now five), fixtures at New York noise performances and new media events. Kyle has a striking head of long hair and a lovely bushy beard (now shaven). And their work revolves around a rethinking of the role of technology in the art-making process. They deconstruct the materials of media, rethinking our relationship with wires and screens.

Upon my release several years later, I caught up with LoVid in their studio at Smack Mellon in Brooklyn, to further discuss their creative process and their critical stance towards technology.

Michael Connor: I'd like to start by talking about your collaboration. How did you begin working together as a duo?

Tali Hinkis: The first time Kyle and I met, back in 2000, I was working with an Israeli singer called Victoria Hanna. I was supposed to do my first video performance with her; all I had was prerecorded footage on VHS tapes, and I wanted to mix between the tapes. The first time I met Kyle, I told him about my project, actually asked if I could film him, and then he promised me he was going to build me a video mixer. [to Kyle] No? Is that not true?

Kyle Lapidus: You mainly just said you were going to film me throwing things into the air and maybe catching them.

MC: I'm sorry, throwing things into the air?

KL: She wanted to videotape me throwing things in the air and maybe catching them. And then she was going to end up with all these VHS videotapes that she was going to mix live for the performance. But I didn't have a mixer at the time.

TH: And I had no idea how to do this.

KL: Somehow I promised Tali that I would make her a mixer.

TH: You said, ‘Oh it should be easy! I can just do this in a weekend!’

MC: What gave you such confidence?

KL: I probably just wanted to impress Tali…

TH: You had already been soldering for years.

MC: And was it successful?

KL: Well, we’re still here! [laughter] I did not end up building a video mixer for that performance. We ended up borrowing one from Madame Chao, but I threw things in the air, I did sometimes catch them, and…

MC: How did you get from there to being an artist duo called LoVid?

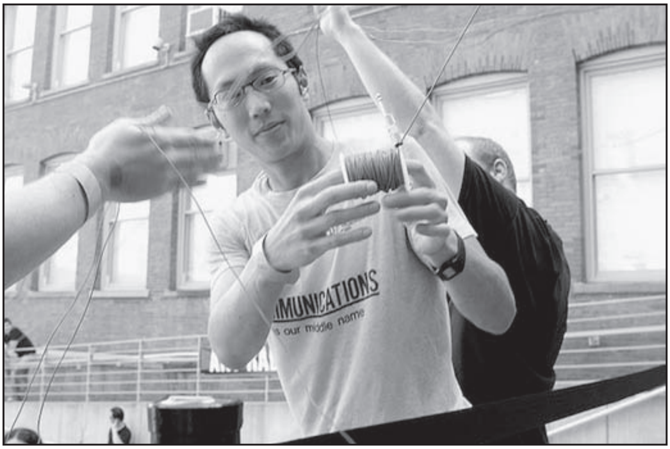
TH: We’d always collaborated with other people in art making in different ways, and it just kind of worked.

KL: When we started LoVid it was more of a one-off performance project; one performance among a number of other collaborative projects. We kept doing things with LoVid, and as we did, we started to do slightly different things from what we’d originally started doing. We developed a kind of shared artistic language. It became larger than just one project.

MC: Your philosophy towards tools – the fact that you build things from the ground up, from a very handmade level – seems to be an important part of that artistic language. Can you tell me a bit about why you choose to make your own tools?

KL: A tool influences what you can do creatively. Someone has built it with certain ideas and constraints; they made certain sacrifices and decisions along the way. When it comes to tools, everything that enables you constrains you, and everything that limits you empowers you. We work with low-tech devices which have fewer built-in features because they have our own limitations. That’s why we work from the component level.

TH: One of the earlier pieces we did many years ago at ETC [Experimental Television Center] that we like to mention in this context is called *Quilt*. It’s a video composed out



Figures 1a–c. *Help Carry a Tune* by LoVid (2007). (photo. Alexis Scherl; courtesy. LoVid).

of a lot of different signals that are carefully assembled onto the same screen. If you were using digital technology, you could make it in five minutes.

I remember the experience of being in the studio for two days, trying, calculating, and getting it to that point where it looked almost perfect, with just enough weirdness to it that comes with live analog signal.

KL: In that piece, we were mixing between the multiple channels of video using some of [video engineer] Dave Jones's equipment. It's all analog, and all the lines that are supposed to be straight are really not straight on-screen. They kind of wobble a little bit, but it still cuts the video into the individual squares of a quilt.

MC: Was that the first time you built a video work from component level?

TH: When we made the piece, we were doing a residency at ETC, using their studio. That residency inspired us to develop our own instruments.

KL: Up until that time we were using commercial off-the-shelf devices: second-hand audio and video mixers and processors that we found in thrift stores or on the Web. We would make a small adjustment here and there, solder a part or whatever. At ETC, we got excited about being able to build the whole thing ourselves.

TH: When you work from scratch, you really are beginning with nothing and building video. It was a very physical experience, walking across the studio, running cables back and forth for maybe two days until we were like: wow it's there!

MC: Have you ever made tools that other artists use?

KL: We haven't really. A few people have talked to us about…

TH: We've actually specifically decided not to do that.

KL: I don't know if we strictly decided not to do that.

TH: There was maybe a point when we started making tools; we were excited and interested in having something that can fit in a VJ set or whatever. But then we started defining the tool making as a part of our artistic practice – as a part of what we do, rather than just technological instruments. [to Kyle] Can you imagine at this point to be commissioned to make…?

KL: I don't think it's necessarily a goal of ours that we are pursuing but I am not 100 per cent opposed to it.

TH: We are more interested in making the process of the performance more transparent to the audience, or allowing them to participate. This is what we've been doing with our live patching performances and visual scores, as well as 'Wireful Interventions'.

MC: I'm curious about 'Wireful Interventions'; it's a more participatory work?

KL: In a lot of our pieces, the electronics – particularly the wires – are left exposed and visible. We don't want the electronics to be closed, hidden and remote, but exposed and encompassing, maybe giving you a hug and a little shock. We want people to hold the wire and physically interact with the electronic components. That's the idea of 'Wireful Interventions' – other people get an experience of the components and of the material of electronics that otherwise is not accessible.

MC: What is the learning curve for someone who encounters these electronics for the first time as part of an intervention?

TH: One 'Wireful Intervention', called *Video Fingerprinting*, was a performance with eight guests. All they did was touch the cables; they didn't have any knobs. It was supposed to be very intuitive. It was interesting because –

KL: – it uses their body's electrical signals, just from their skin –

TH: – just amplified by the instrument.

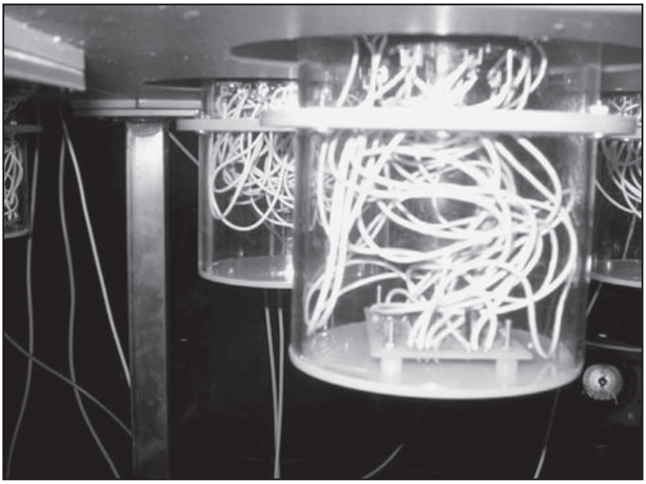
MC: And what is the 'instrument'?

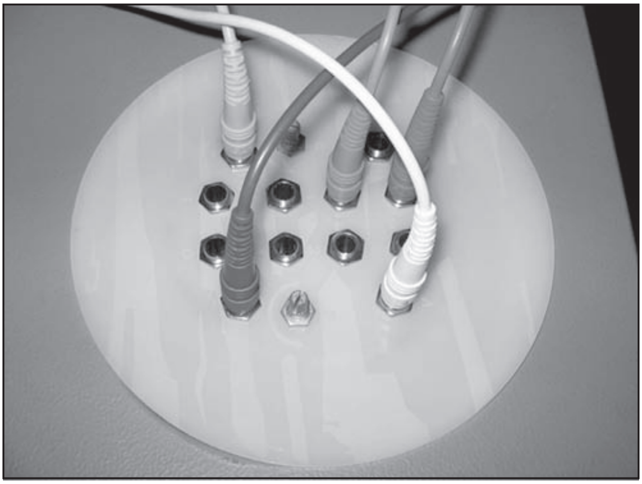
TH: The instrument is the *Sync Armonica*, which is an audio-video synthesizer – it generates audio and video signals.

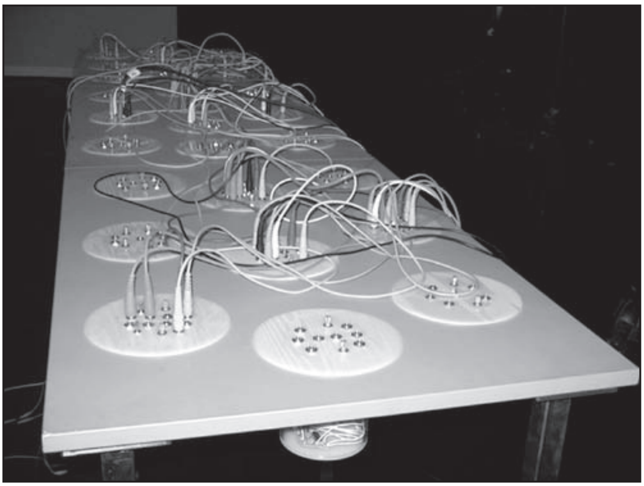
KL: And it's analog. It was our first video synthesizer, and we still use it. We've built other synthesizers since then for various reasons. The *Sync Armonica* is still too big for us to fly with, so we built *Coat of Embrace* as a portable and, in fact, wearable version of it for when we travel. It has many of the features and capabilities of the *Sync Armonica*, but was conformed to our bodies in a different way.

MC: I love the visual appearance of *Coat of Embrace*, the two wearable boxes.

KL: They were kind of modeled after medieval coats of arms that you might find on a suit of armor or a shield.







Figures 2a–c. *Sync Armonica* (2005) (photo & courtesy. LoVid).

TH: They have these characters. Kyle's the Monkey, I am the Dragon. Their faces are very colorful and tactile, and there are knobs and switches in the front.

It almost feels like we're playing the accordion because we're reaching in the front twisting knobs; there are maybe ten to fifteen knobs on each. Their backs – which are against us when we are playing – are transparent, so you can see all the wires, circuits and connections.

MC: When you turn that knob what are you actually doing?

KL: Each knob or button is attached to a module that might control a level or a frequency or a rate of change. Or sort of the threshold of something, the limit of something…

TH: …or a combination, how one thing influences another thing.

KL: Each module contributes in a different way to the larger patch, to the structure of what ends up coming out. And depending on which one you are controlling, you affect it in a different way.

MC: Is the synthesizer like a musical instrument?

KL: It feels a little like an instrument, but it also feels a lot more comfortable. I played classical instruments for many years – mostly the clarinet and harp. The clarinet's design was developed over long periods of time according to a bunch of different people's bodies; what was convenient for them, what tone or other characteristics they wanted. All those design decisions were made in order to appeal to a consensus opinion or to other people that were not me. As a result, my body grew around playing the clarinet. You can see it here in my thumb – I have an indentation where my bone actually grew around the instrument. Tali and I make instruments that are designed around our own bodies.

TH: We made each instrument to work for us, but we still needed to grow around it. It's not as physical as Kyle's thumb, but psychological, or maybe spatial and experiential. My intuition and my sense of space change with the instrument.

MC: Do you feel like the instrument is more akin to an independent entity or is it more of an extension of yourself? (See Color Plate 11.)

KL: The first instrument that we actually made (in collaboration with Douglas Repetto) was called the *Dragon Slayer*. That was built into a fish-like creature. Then we did other instruments like the *CoAdNe* and *CoDeAn*, which were designed to be really like creatures with their own personality. *Coat of Embrace* feels like it's an extension of our creature rather than its own distinct being. It has its own personality, but it almost feels like it's our mood.

TH: When I'm using the *Coat of Embrace* I can't really tell who's in control… You have no idea what's going to happen and you are so much in the moment. It's not clear if the audience is doing it, or electricity, or us.

When I was a kid I played the piano – nothing like Kyle, but one of the things in our collaboration and in my personality that was always very frustrating for me is that in an instrument there is that predictability.

MC: You can't always predict the outcome of your performances?

TH: The *Coat of Embrace* is the most moody and picky instrument we've ever made. It plays differently in certain places; it actually refuses to play in places it doesn't like. We can rehearse a piece and then when the audience is there, 30 minutes later in the same location, it will look completely different. Or it will just start with five minutes of black-and-white. So it's interesting to perform; it's always a little scary and thrilling.

MC: You've been moving more towards making objects. What kind of relationship do these works have with the live performances?

TH: A performance has a unique energy; specifically, performances with live video as opposed to prerecorded video – the unpredictability of it, the fragility and all that. We are very interested in the preservation of that experience – whether it's the ephemeral signal of video, or the participation of the audience – how to preserve it, what stays after the performance is over.

KL: We really wanted to make things that could be experienced live, even if we might not be present. That's how we got into these hardware-based installations or objects, which generate a live signal rather than displaying a prerecorded video loop.

MC: So is that piece on the wall an example of one of these works?

KL: The piece on the wall here is part of a series of live video objects that we produced with help from ETC's Finishing Funds program.

MC: What is this piece called?

TH: It's debatable; it depends on who you ask. I call it *Freedom Confined.*

KL: I call it *Asymptotic Freedom Confined.*

MC: Can you talk me through some of the conversations that took place as a part of making this work?

KL: We have ideas that often come from another piece; this one came out of our history of the universe piece [*Inverted h-Barn*]. We were thinking about how time is quantified, and from research for that project we got into all these ideas about particle physics.

TH: We created a few short clips with our synthesizer, kind of like sketches –

KL: But it started with the idea; we were thinking about quarks and their properties. Quarks are subatomic particles, so they make up protons and neutrons.

TH: The way it works is that Kyle has all this science stuff, and then we talk. Then I say, 'How about a dripping? A video that would drip?' So we have a dialogue.

KL: At the time we had the *Sync Armonica* set up in our bedroom. We used it to work around various ideas and aesthetic elements.

MC: Does it make a lot of noise?

TH: Yeah. So far, we've been lucky to live in an apartment with thick walls.

MC: What time of day do you usually do this?

TH: Late at night.

KL: It's convenient that we make noise because the neighbors don't recognize it as music, so they don't complain about it.

MC: [laughs] So the kids are asleep, you are sketching on the synthesizer, and you are talking about quarks.

TH: Kyle's going quarks, and I'm like 'more pink, and less of those, a little bit more of the edgies, wiggly…'

MC: And you dump this to video as you do it.

KL: Once we find something we like, we make some recordings.

MC: And then you build modules that could recreate that pattern, and that becomes the brain of a live video object?

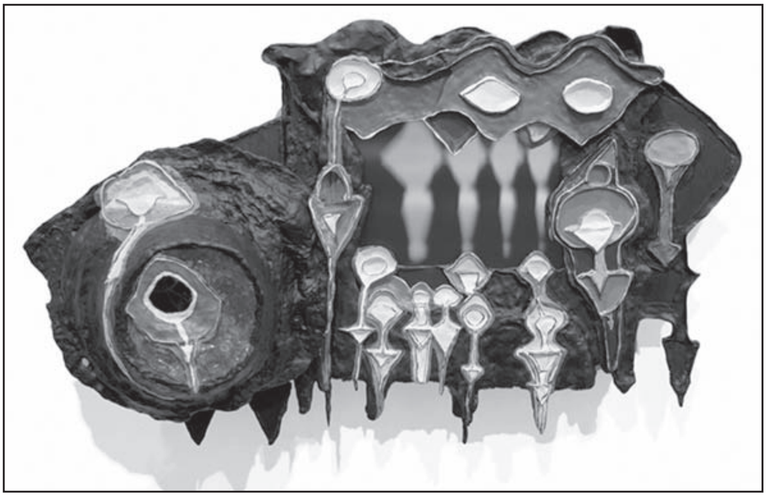


Figure 3. *Freedom Confined* by LoVid (2008).
(photo. Yoni Maron; courtesy. LoVid).

KL: Before that, there's another level of sketching involved, relating to the form of the object, the skin.

TH: We actually made a SketchUp model, so once we have this video sketch, there is also a 3D sketch for the object –

KL: That's a contentious area, too.

MC: [laughs]

TH: Kyle really likes it when we have a plan, and we stick to it. And I always want to go in any direction. And what ends up happening is that we kind of pull until we meet in the middle, so there's a dialogue.

MC: So how did the skin change from the original 3D SketchUp model to the finished form?

TH: The original SketchUp was supposed to be much cleaner looking. Something you could almost have someone else produce for you or do on a laser cutter.

MC: Which could be an artifact of the tool SketchUp…

KL: Absolutely.

TH: And I don't really like working that way. I like to spend a lot of time on materials; I like detail and handmade things. It's very important for us to continue to get the handmade feeling into the media work. I needed to have an intimacy with the object. I needed to touch it.

We always talk about these objects as being a crossover between the media and the physical world, as if you're kind of reaching into this other world and grabbing a piece of it and bringing it over here. It really is a manipulation of physical material into video, and back again.

MC: Earlier, you mentioned Dave Jones: to what extent is your work with video synthesizers inspired by the previous generation of live video artists?

KL: We're very inspired by that generation –

TH: – of live video pioneers.

KL: Vasulkas, Dave Jones, Dan Sandin, Rutt and Etra; all those people from that generation who were artist/engineers, building video synthesizers and making video with them. So a lot of people would ask us at the end of performances, why –

TH: – what's the point of doing these performances with these old tools? Hasn't this already been done? But the motivation is completely different.

The early pioneers were largely interested in the advancement of technology. When we meet them, they often say 'the analog stuff was really great but now everything I want to do I can do on a computer'. A lot of the pioneers had – and still have – this utopian idea of making a mega tool that can create a visual opera.

KL: And the mega tool would do exactly what you want, everything you can imagine wanting it to do.

TH: Now, there is a more critical stance towards tools. A number of artists of our generation are working with hardware and rediscovering it. We know this history, so we ask what really is the difference between the generations. One difference is that our motivation is not to create this new mega tool –

KL: – and definitely not perfect.

TH: We started working with our handmade technology because we were drawn to the particular aesthetics and fragility of both the A/V output and the instruments that make it.

KL: We love to have personal relationships with our machines. It's easier to grab onto jagged edges than a polished surface. People who grow up with technology are more interested in the nooks and crannies, and more likely to seek them out.

TH: Making tools has become an integral part of what we do. We don't separate technical from conceptual or aesthetic – they are all driven by the same ideas. It's a different way of looking at 'functionality'.

KL: We don't want something that 'does'; we want something that 'is'.

TH: It's a matter of defining how we perceive this complex, attractive, and frightening relationship between nature and technology.

Memory Series – Phosphography in CRT 5", Mexico, 2005

Carolina Esparragoza

The goal of the project is to create images from cartoons aired between 1970 and 1980. These cartoons are alive in the memory of a generation that – unlike their parents and grandparents – grew up in front of the television screen.

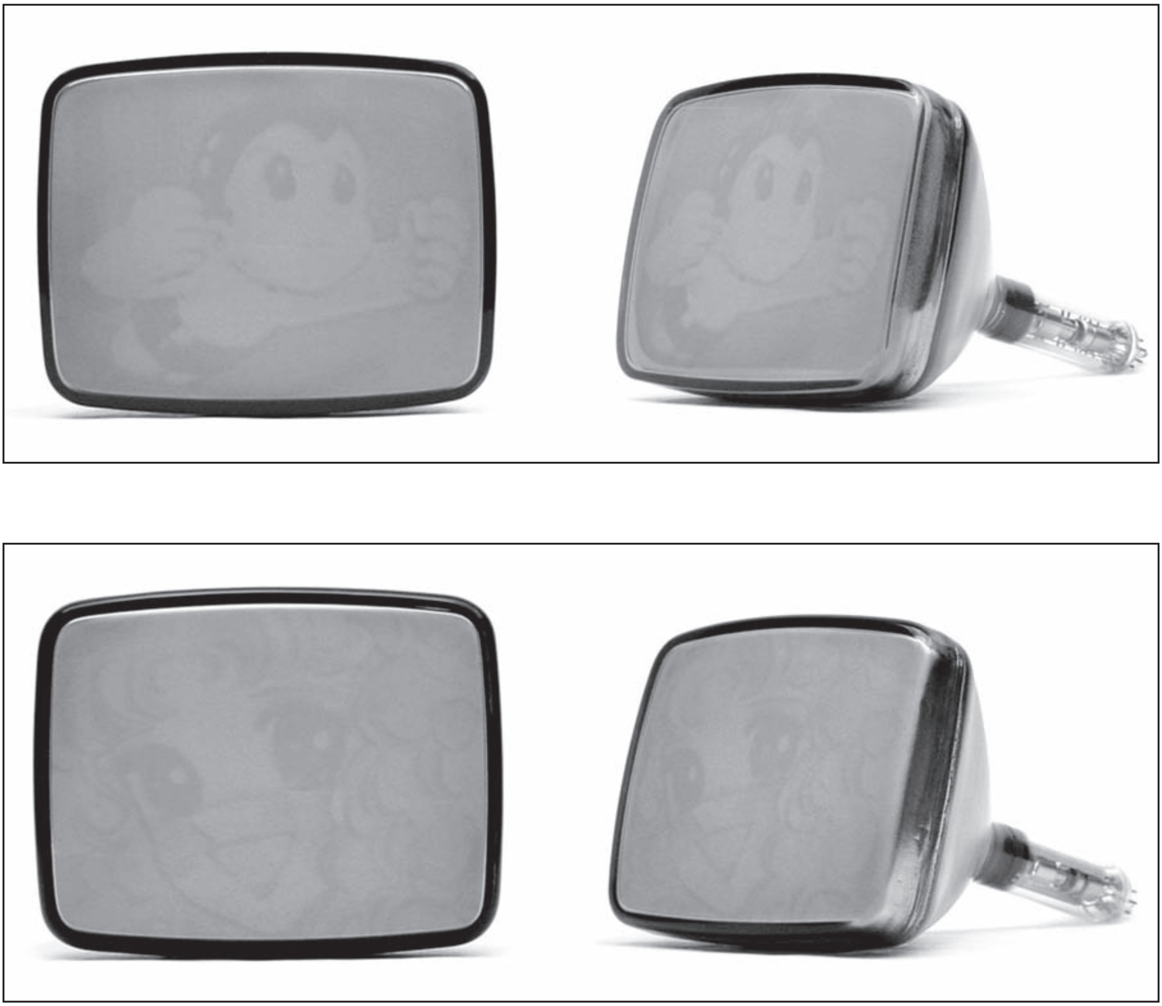
The images from the cartoons are captured in nine black-and-white 5" televisions through a 'phosphographic' process that creates a permanent imprint in the screen. This procedure utilizes the screen as a canvas and the beam of electrons that activate the phosphor coating as a drawing tool.

A brief survey of the generation of television images shows that 75 per cent of the television apparatus is composed by a large valve called a Cathode Ray Tube (CRT) – commonly known as a kinescope – that has a funnel shape with its wider side facing out: the screen. The interior of the screen is coated with a layer of phosphor that reacts to electron beams coming from the narrower side of the CRT. The electron beam renders a scan pattern that activates the phosphors and creates a luminous image.

According to this simple principle of generating monochromatic images, this procedure was entitled 'phosphographic process'. A black-and-white still image is reproduced in the television set for thousand of hours. The black area blocks the light, while the white area allows it to reach the phosphor. As a result, the phosphor coating inside the CRT gets burned, physically altering the screen.

This is how the image is slowly captured, creating a permanent drawing with different shades without modifying the functioning or physiognomy of the television set. A surplus of thousands of television shows, a memory; a remembrance that attests to the nostalgia of a generation.

Only three elements are used to produce these series of work: a TV set, a VCR and electric energy. Each element in the series requires approximately 10,000 hours of light exposure.[1]



Figures 1a and 1b. Stills of Carolina Esparragoza's *Memory Series – Phosphography in CRT 5"* (2005). (photos & courtesy. Carolina Esparragoza). See also Color Plate 9.

Notes

1. This project was supported by the Centro Multimedia del Centro Nacional de la Artes, México.

The Rhetoric of Soft Tools

Marisa Olson

Let's think about tools in general. One popular understanding of them is that they are a middleman, a means to an end. We think of tools not as having *telos* (an ultimate aim or intended form), but as the by-product of an idea and precursor to a form. The wrench gets the water flowing in our plumbing system, for example.

Recent discourse around new media has prompted us to think a bit more critically about tools. Both Christiane Paul (2008) and Lev Manovich (2001) (mainstays on many a media studies syllabus) have written field-defining books that focus on new media's role and potential classification as either 'tools' or 'objects' made with those tools. Speaking in broad strokes, a new media artifact can then be either the program that makes possible an image, video or website (a 'tool'), or it can be the image, video or website itself (an 'object').

I have since wondered: what about those tools that are objects? And vice-versa? What about those artifacts that are not only de facto encapsulations of their conditions of production and consumption, on a most basic level, but that also comment critically on network conditions and other postinternet factors of making? In fact, my first endeavor when signing on as editor and curator at Rhizome[1] was to spur a rethinking of their mission statement not only to support immediately recognizable 'new media art', but also to support broader forms of practice and a broader range of works that 'engage critically' with media culture; something I would come to call 'Postinternet' (Olson 2012).

The 'production' of tools implies the manipulation of cultural production in ways that inevitably encapsulate the social conditions of the 'producer' and 'consumer' of the cultural object. After all, tools are clearly objects in the case of artist-made tools – even if they are as seemingly immaterial as a broadcast through air, a software plug-in, or an Internet search function.

As in communication, tools operate by directly or indirectly performing the processes of describing, analyzing and synthesizing. In the case of synthesis, tools not only perform the classic rhetorical function of combinatory and referential production-via-inference, but also the mathematical and scientific functions of making connections between ports. In tool-based synthesis, the very modes of input and output described by these tools are recreated as part and parcel of the analytic process.

Writing self-reflexively in their titular font, the collective Dexter Sinister's artist statement/manifesto, 'A Note on Type' (2011), describes 'Meta-the-difference-between-the-two-Font', their typeface developed in 2010 by using MetaFont, a computer typography system programmed in 1979 by Donald Knuth, author of 'the multi-volume computer science "bible"', *The Art of Computer Programming* (2011). As they explain, 'MetaFont is both a programming language and its own interpreter, a swift trick where it first provides a vocabulary and then decodes its syntax back to the native binary machine language of 1s and 0s' (Knuth 2011). Knuth intended MetaFont as a helper application for teX, the computer typesetting system he created 'to facilitate high-quality typography directly by authors' (Knuth 2011).

This tool to support a tool to support a system used by artists was further revamped by Dexter Sinister to create a self-reflexive, creative tool of their own. Both Dexter Sinister's statement and the font in which it is written are discrete art objects. Using Knuth's modification of an extant software program, the artists further worked the algorithm into a typography system that is both tool and object.

We can call such systems 'soft tools': devices without the physical force of the sickle and hammer, which are no less effective in their ability to create objects soft or hard. Quite simply, consider the meaning of the prefix 'soft-' in the word software. There is here a significant syntactic affinity in the relationship between soft tools and 'soft power'.

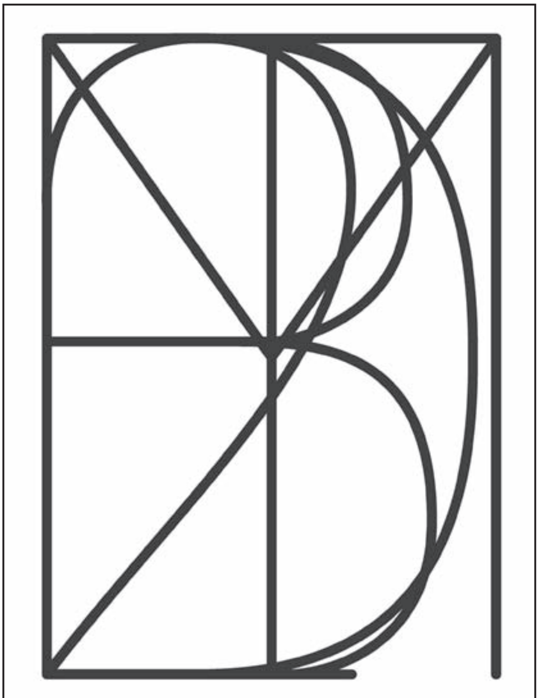


Figure 1. Dexter Sinister, *A Skeleton, A Script, Or A Good Idea In Advance Of Its Realization* (2010) (Risograph Print With Multiple Passes).

Developed by political scientist Joseph Nye (1990), the concept of 'soft power' is a strategy to co-opt and attract foreign actors' attention to one faction's way of thinking. Soft power is a strategic tool, whereas hard power is a tool employing the tactics of brute military force or monetary coercion. Returning to the example of the wrench, hard power employs material objects (tanks, currency) in trying to force an outcome. Soft power is more programmatic and exercises itself largely through psychological operations (psy-ops), and the exportation of ideology and cultural values, often through popular media such as film and television. The worldwide popularity of American music is one manifestation of soft power.

What we are calling soft tools operate similarly. While they may actually have a *telos*, or an end goal in mind, the tools themselves are programmatic in nature. Codes, algorithms, APIs, software generators, fonts, logos, video-processing devices and patches, and so on: these ephemeral tools are not hard media, though they do very often produce tangible effects and ephemera.

Artist Cat Mazza has been working for several years with her soft tool KnitPro.[2] This generative application has been put to multiple uses. Internet audiences can upload corporate logos to receive a knitting pattern, which the user is encouraged to employ in the name of protest. A common example illustrated on the KnitPro site entails Disney logos hand-knit into garments, in order to comment on the physical sweatshop labor (frequently performed by poorly treated, undercompensated women) overlooked at the site of Disney-product consumption. Mazza also initiated a participatory project in which a variety of users were invited to knit patches of what would then be knit into a larger 'Nike Protest Blanket'. More recently, the artist has been shaping these projects into re-creations of historical wartime initiatives and other governmental programs, thus invoking the collaborative, even familial, context of community textile-making.

Mazza's work is a good reminder of the fact that conditions of production and reception are always bound up in any work and its transmission. Her work can also serve as a prompt to consider the reception of soft media. Michel de Certeau's writings on the sociology of material culture, specifically his theories on the consumptive experience, harken back to the aforementioned spectrum of strategic and tactical operations, soft power and hard power. In fact, *The Practice of Everyday Life* (1984) begins with a critique of the frequent assumption that media consumers are powerless, passive spectators. Taking the example of TV viewers, de Certeau fleshes out an argument wherein 'consumption' is in fact defined by an act of making he likened to the classical Greek notion of *poesis*. Spectators are not passive, but take in a proliferation of images and make something of them. Soft tools are productive of *poesis*.

De Certeau says of this soft form of making: 'the latter is devious, it is dispersed, but it insinuates itself everywhere, silently and almost invisibly, because it does not manifest itself through its own products, but rather through its ways of using the products imposed by a dominant economic order' (De Certeau 1984). This is exactly what we mean in pointing to soft, seemingly invisible, methodological tools. And let's not forget that the

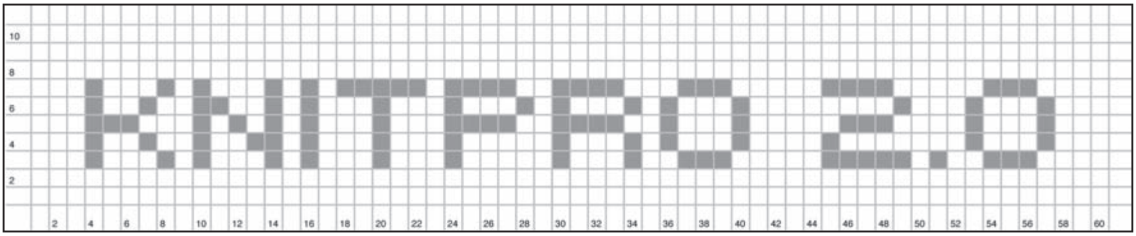


Figure 2. Cat Mazza's *KnitPro 2.0* (2004).

builders and users of soft tools are themselves always already consumers, whether they are digesting an inherited visual language or a dominant operational protocol.

The artists MTAA have also made performative algorithm-based work resulting from the reception of extant material. The duo's work often incorporates the interpretation of historic avant-gardes and software experimentation, as in their endurance-based performance project, *One-Year Performance Video (1YPV)*.[3] This is one in a series of computerized 'updates' of seminal 1960s and 1970s video art pieces. In their introduction to the project, they raise the question, 'Is there meaning in replacing On Kawara's Zen-like devotion to his date paintings with an automated script which functions in a similar way?'

In the case of 1YPV, MTAA updated Sam Hsieh's *One Year Performance 1978–1979*. Rather than spending a year in a cage, as Hsieh did, the artists spent a short amount of time in their studio, which they'd dressed to resemble living quarters. They shot clips of themselves performing daily tasks such as working, sleeping, even going to the bathroom. The clips reside as soft bits of data, stored in a computer to be automatically strung together and looped according to temporal data collected from viewers (so we see them sleeping at night, for instance). MTAA deferred the endurance portion of the project to their algorithm (a soft tool), and made viewers of this expanded theater project (who could clock viewing-time online) responsible for receiving a year's worth of the piece.

More recently, MTAA have begun another series of software-based performance works, entitled *Autotrace*. Using the Adobe Illustrator software's Live Trace (soft) tool, the artists upload a (soft) art historical remnant (jpeg) of an extant work to create automatically generated (soft) vector images, which then may or may not be produced physically. In fact, MTAA makes a soft digital copy (memory) of the image produced available to Internet audiences, who may themselves decide upon downloading and possibly printing. The spotlight here is on the rhetorical act of using soft tools to iterate what begins as a soft image. In their first public demonstration of this tool, entitled *Autotrace #2 (Nocturne; performative)* (2008), the artists plugged in a jpeg of Joan Miro's *Nocturne*, which was then converted to a bitmap image and randomly sampled to determine the shape of the final vector image. Despite its dependence upon an original, the (soft) image-object became further and further removed from its original authorial context, and greatly removed from the process we might classically call 'mimesis'.

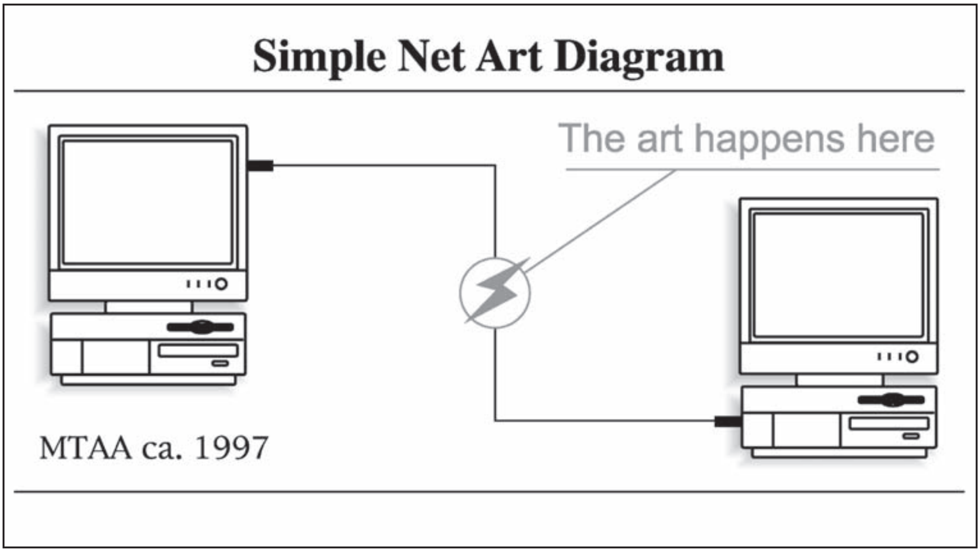


Figure 3. MTAA's *Simple Net Art Diagram* (1997).

There are, in these vector images, suggestions of the form represented, but they are simultaneously extracted from the original representations – if there is such a thing.

This line of thinking brings us into the territory of the mechanical reproduction, about which Walter Benjamin famously wrote with an emphasis on photographic media, including film. The concept behind mechanical reproduction's oft-recited 'withering of the aura' relies on a crucial separation of the 'authentic' object from its ritualistic use. Benjamin argues: 'To an ever greater degree the work of art reproduced becomes the work of art designed for reproducibility. From a photographic negative, for example, one can make any number of prints; to ask for an "authentic" print makes no sense' (1968). His good news is that 'the instant the criterion of authenticity ceases to be applicable to artistic production, the total function of art is reversed. Instead of being based on ritual, it begins to be based on another practice – politics.'

We can read between these lines to surmise that even as this authorial shift takes place, there is still a material separation between the mechanically-reproduced image-object and the use to which it is put – a sort of softening of the reproductive process. The image itself can be seen as soft, immaterial and existing outside of time or physical space, regardless of the transmitted visage's intended materialization. It resides in the unique conceptual 'place where it happens to be'.

Reinforcement of this idea may be found in Baudrillard's *Simulations* (1983), where he speaks of this new system of representation as one in which 'signs of the real [are substituted] for the real itself [...] concealing the fact that the real is no longer real.' This fact results from the newly rendered disauthenticity of the reproduction, as much as from

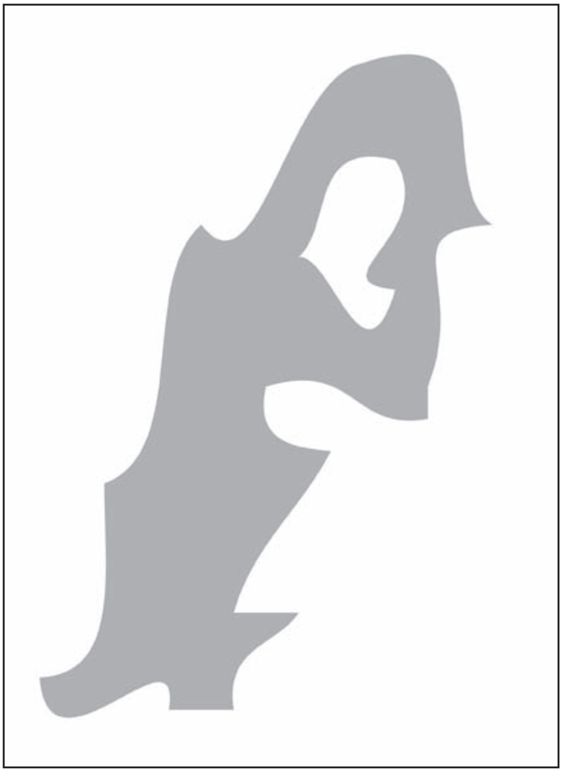


Figure 4. MTAA's *Autotrace #2 (Nocturne; performative)* (2008).

a new consciousness in which the space of flows between the perception, transmission and reception of images has become conceptual, soft.

Jeremy Bailey is often confidently self-deprecating in offering hilarious parodies of new media vocabularies. In his video *Transhuman Dance Recital #1* (2007), the artist pokes fun at the newfangled freedom of the roaming ambiguity that may result from the softening of tools, or of reality itself. (See Color Plate 8.) Sarcastically visualizing what a body dematerialized by code might look like, his pseudo-autobiographical character claims to have 'transcended [his] human form', thus freeing himself from the 'imitative constraints of the natural world', with his head floating atop a roughly sketched, blobby, digital, octopus-like form that clings to his movements as he speaks to viewers about this purported liberation while fluidly dancing with an animated smiley-faced blue triangle. Bailey's work serves to remind us of the persistence of viscerality, of the reality in corporeality. We should recognize that the softening discussed in this essay is widespread, but so too is hard reality. I would not seek to argue otherwise.

In *Whatever Your Mind Can Conceive* (2008), Kristin Lucas gives viewers reality TV–style documentation of her visit with Dr. Ron Abbott outside of artist collective Eteam's International Airport Montello (IAM).[4] Lucas had been invited to respond to one image from a larger collection of images documenting creative activity at IAM. What we actually see is the product of that creative interpretation visualized as a problematic physical reaction, manifesting in rashes, lesions and other unwanted physical symptoms. 'Dr. Ron' attempts to diagnose the artist using soft tools such as Internet-based questionnaires programmed to spit out potential diagnoses. Meanwhile, Lucas gives us a similarly soft, rhetorical, visceral response to a reproduction while reminding us of the significance of flesh. In fact, we might see her performance as invoking Maurice Merleau-Ponty's (1968) concept of a phenomenological 'flesh' that binds human subjects. One effect of this conceptual flesh lies in making people concomitant to each other's experience. Unlike the stage makeup on Lucas' face, this flesh is soft in the sense that we discuss here, and it becomes the channel by which her interpretation is almost virally communicated to other humans – further interpreters of her work. Lucas's work signifies most powerfully in its interpretation of the contemporary world of ideas – specifically visceral fear, scientific discovery or 'infomatic' paranoia. It is this interpretation itself that is the pivotal work, the resulting embodiment of which acts as aftermath or evidence of the (soft) concepts' execution. (See Color Plate 2.)

Whether or not concepts or interpretations are written across the body, or across a corpus of material work, we are left with the question of how to read them. In the process of freeing the reproducible from its material shell, Benjamin virtually debunks traditional aesthetics. He reminds us that, although the term once applied to the sense experience of things (i.e., touch or taste), we found ourselves in a critical world in which taste was a matter to be displayed (as in 'good taste'). In this scenario, our system of aesthetics is based upon possession or a material accumulation that Benjamin likens to Fascist land-grabs and related political hierarchies (Benjamin 1968).

So how are we to experience the relative goodness of a work, soft or hard? First, we can imagine that both De Certeau and Benjamin would claim that our experience of a creative concept or its dissemination is now enabled by the softening of the author-producer construct, and even the weight displaced upon image-objects. By debunking our entrenched notion of aesthetics, this new understanding of the rhetorical act executed with soft tools allows both producers (the artist and her viewer) to speak in different, multiple or even competing voices. And any rhetorical analysis of those utterances must reside in the process of interpreting what the artist says, and how the artist does so.

In my essay, 'Lost Not Found: The Circulation of Images in Digital Visual Culture' (2010), I discuss the practices of Internet artists known as pro-surfers, whose work could in part be characterized 'by a copy-and-paste aesthetic that revolves around the appropriation of web-based content in simultaneous celebration and critique of the Internet and contemporary digital visual culture [...] work heavy on animated gifs, YouTube remixes, and an embrace of old-school "dirtstyle" web design' tactics, each of which can function as soft tools while being launched into orbit as soft objects. In an attempt to hold pro-surfing up to the vocabulary yielded by photo and film theory, I go on to argue that:

> [T]he work of pro-surfers transcends the art of found photography insofar as the act of finding is elevated to a performance in its own right, and the ways in which the images are appropriated distinguishes this practice from one of quotation by taking them out of circulation and reinscribing them with new meaning [...]. (Olson 2010)

The work found on the blog of the original pro-surfer collaborators, Nasty Nets[5] (of which I am a founding member), exemplifies these practices. In it, 'images are taken out of circulation, often without attribution or a hint of origin, unless that is part of the story being told' by the image. Some of this material is posted and revered as readymades, while other samples get remixed or reconstituted in new image-objects. In these cases, the material's lack of context becomes part of its narrative. At some point, Nasty Nets cofounder Guthrie Lonergan conceived of and programmed a soft tool called Pic-See[6] to be employed by fellow surfers in the scraping of images from open image repositories. Rather than having to wade through a site's code to pin down the URL for an image, Pic-See is a soft tool that makes these addresses immediate while combing the images from the websites in which they are embedded. This enables the redeployment of the images in new contexts or platforms.

While Lonergan created his own soft tool, this kind of Internet art often relies on the use of pre-existing tools: applications ranging from video editing software, to software defaults and intuitive design systems. Once upon a time – in fact, right around the time that camcorders and similar hardware were made available to the public – we might have located these tools somewhere on the spectrum between amateur and prosumer devices. Critic Ed Halter recalls in his Rhizome essay, 'After the Amateur' (2009), that the corporate products that created the consumer class referred to as prosumers were:

> Technology marketed for amateurs [which] generally did not require as much skill or training as professional equipment. Most amateur gear produced what would be considered a lesser image quality by professionals – in the case of motion pictures, a smaller strip of film than the industry-standard 35mm, thus capable of only lower resolution. (Halter 2009)

The contemporary moment in image production does not require advanced skill either (which is not to argue that so-called amateurs are not skilled), but it leaps from the preceding context in which Halter said '[p]rofessionals pursued careers. Amateurs pursued hobbies. Professionals made images for public consumption. Amateurs made images for private use.' The proliferation of soft tools allows artists whom would previously be demoted as 'amateurs' to share with a wide public soft objects whose production is able to shrug off normative constraints as to ideal forms or resolutions.

Even when they index outside sources or the borrowed *vérité* of other people's worlds, the voices channeled by these soft tools are not inauthentic. They are simply functional outside of the aforementioned rubric of classical aesthetics.

Let's briefly return to the world of rhetorical theory from which that construct evolved. In Plato's *Gorgias* (1959), Socrates articulates a specific relationship between theory and practice. Ideally, practitioners and their consumers should have a balance of both. A doctor should understand the broader function of the body *and* be able to apply the craft of medicine in a holistic manner. But, whereas medicine is regarded as a *technē* (a 'real' art), cookery is degraded as merely the *empeiria* ('experience') of something: a knack. Medicine cares for the body; cookery only pretends to. Socrates moves to argue that rhetoric (defined broadly by Aristotle as 'the power of persuasion', we now understand rhetoric as encompassing a broad range of visual and communicative practices) falls into the lowly category of cookery – a non-art under this rubric.

Cory Arcangel's series of generative drawings entitled *Hello World*[7] might help us rethink this limiting notion. The productive work here lies in the interface between Arcangel's artist-made program (a soft tool) and the receiving printer (a hard tool) by which the renderings are output. The series title nods to a well-known computer program, among the simplest of the sort, meant to test and display the working status of a computer system. Whereas a computer on this system might normally announce its status by printing the phrase *Hello World* (or in networked contexts by displaying a screen-based pixel arrangement conveying the same message), Arcangel's soft tool manipulates this function by calling upon his computer to print seemingly abstract line drawings.

Interpreting this work under the rubric expressed in *Gorgias*, we might say that the (soft) program is a recipe, the (soft) algorithm is the chef – the rhetorician – and the skilled execution of the algorithm is the cookery itself, the soft rhetorical act. Without meaning to oversimplify Arcangel's drawings by boiling them down to a culinary art, we can say that the resulting 'dish', the drawing, performs a visualization, a *result* of the rhetorical act, whereas the act is the true locus of the work.

These drawings were exhibited in Arcangel's 2011 solo show at the Whitney, where the curator, Christiane Paul, said that the show's title, 'Pro Tools', 'references the popular software of the same name, which enables users to compose, record, edit, and mix music and sound' (Paul 2011). Each of these soft tools and processes has what we might consider a material impact on the final product, but without ever removing an object from the Pro Tools platform. Paul goes on to say that, 'While none of the works in the exhibition actually make use of the [eponymous] software, the name captures Arcangel's practice of recording, composing, and remixing.' In other words, the body of work on display privileges the rhetorical sensorium of soft tools over those objects resulting from their use. Process itself is on display.

By way of investigating a similar relationship between rhetoric and object, we might consider the process by which film form tries to 'suture' a viewer to film, marrying projection of the film's print to the viewing process, thus making her forget who's doing the looking. Here the thinking world separates between experience, the representation of experience, and the point or value of the experience. The questions I would now pose are: Can we have work made with soft tools that recognizes the distinction between hard and soft objects, while preserving the vast richness of the creative experience or narrative immersion? Can soft tools channel knowledge and craft through lived experience? I believe that they can, and that in doing so they benefit from the conditions of reproduction boiled up by postmodernity.

In consideration of the ways in which soft tools enable a productive warping of the 'author' concept and provide the opportunity to speak in a variety of voices, we might look to activist performance group the Yes Men's response to a media ecology aptly described by Fredric Jameson. In the 'Video' chapter of *Postmodernism* (1990), Jameson articulates a transformative moment in which our separate notions of 'the media' (as in mass-communicated channels) and 'artistic media' fused. He puts us on the road to understanding what Henry Jenkins would later call 'media convergence' (2006) – in part the soft melding of tools into each other (i.e., the marriage of phones, cameras and camcorders) in increasingly dematerialized applications.

It is within this media ecology that the Yes Men were able to copy, paste and 'identity correct' the code of Dow Chemical's corporate website, presenting viewers with an idealized, if misleading, reflection[8] of the prior site. Exploiting this digital re-presentation, the artists were also able to generate misleading e-mail addresses nonetheless convincing enough to secure them a spot on *BBC News*. In the ensuing interview, a Yes Man posing as a representative of Dow Chemical was given a platform to relay the historical details

Figure 6. Film still from the Yes Men's *The Yes Men Fix the World* (2009).

of a ruinous event known as the 'Bhopal disaster'. Following this oration, the (mis) representative claimed that Dow would finally be taking hitherto eschewed responsibility for the accident, going on to explain how they would direct corporate resources toward compensation of generations of victims.

The Yes Men are among a cadre of independent media activists whose motto is 'by any media necessary'. By virtue of this series of scandalous events (in which they were later found out, and in turn secured a separate BBC interview), they were able to use soft tools to imitate hard power in a way that could potentially yield soft power in the transmission of idealized cultural values to the world. Rather than mediate between representation and reality, the Yes Men used soft tools (including the voice) to re-present the realities of the Bhopal disaster in a way that told the story they wanted to tell. It also turned contemporary cynicism about the realness of representational media in their favor, shifting unbelievability onto Dow, who were subsequently moved to release a statement that no, they were *not* going to take responsibility for Bhopal. Excavating a bright side to Flaherty's documentary-related edict that 'sometimes you have to lie to tell the truth', the Yes Men took the model of parody (voicing participation and critique simultaneously) afforded by the contemporary media environment and ran with the soft (which is not to say less effective) strategy of subversion. If there is a moral in the group's modified reflection of the world in their attempts to change it, it is that soft tools give us a soft reality free for the morphing and fresh for rhetorical change.

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Notes

1. See Rhizome's website, http://www.rhizome.org. Accessed July 30, 2012.
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7. See Cory Arcangel's website, http://www.coryarcangel.com/wp-content/uploads/2010/08/Hp-Pen-Plotter-Hello-World.zip. Accessed July 30, 2012.
8. See the Yes Men's work on the Dow Ethics website, http://www.dowethics.com/. Accessed July 30, 2012.

Jeremy Bailey and His 'Total Symbiotic Art System'

Carolyn Tennant

In his performance videos, Jeremy Bailey employs comedy as a means to scrutinize the methods of contemporary media artists whose practice involves creating image-making tools. The work that Bailey critiques, and the ever-growing and ubiquitous use of new technologies, is infrequently the subject of critical dialogue and seldom the topic of analysis in electronic art. Although he came of age with a generation of new media artists, and his practice involves a research-based methodology, Bailey's videos are ingrained with a reflexivity rooted in the history of performance video. An example can be found in the short video *Full Effect* (2005), in which Bailey offers a relentless commentary on the abuse of visual effects. The video begins with a close-up of the artist who explains to the viewer, 'I've been having trouble expressing how I feel.' As the video progresses, computer filters are used to impart emotion, with each addition further abstracting his face: 'Do you think you can understand me now?' When a new effect is added, Bailey's anxiety increases, and he demands, 'How about now? Now do you understand?'

While this video illustrates the affected use of technology in media art, Bailey's three-part series *Video Paint* focuses his attention on the creation of tools as an electronic art practice. Using self-parody to disarm the viewer, Bailey cunningly blurs the lines between performance and tool demos. In doing so, he brings to the fore the connection between performance and tool building, revealing the influence of hardware and software tools on performance video, 'It's important to acknowledge that video art history was not always segmented', he says, referencing how video was a tool utilized by artists from disparate backgrounds:

> With a lot of contemporary work that relies on computers or software, you don't see that same self-reflectivity as in earlier video art. Today's electronic artists that demonstrate their tools don't really critique where their body fits in, or where they fit in as artists. […] It's almost as if all of that is shifted into the machine, and the artist disappears, and you should be watching the machine and not the person performing outside of it. […] Where's their ego? Where is their identity in the work they're creating?

Bailey's appreciation for the complex histories of electronic art stands in contrast to the type of work that has become the subject of his review. Discussing the history of the tool demo within the broader context of video art, Bailey points to the Vasulkas, Dan Sandin and others, whose work involved the research, development and ultimately the demonstration, of tools. 'Obviously this still exists today, but the language shifts and it becomes more about the tool and less about using that tool', he says. 'In the electronic art world there are so many people who haven't paid attention to that video art history'.

In 2004, Bailey demonstrated the first iteration of a software application designed to track and translate a user's movements into screen-based graphics. In *Video Paint 1.0* he demonstrates the ways this tool visualizes a user's gestures. Waving his arms awkwardly in front of the camera, his body becomes hidden by streaks of little multicolored lines. 'I think of it as painting', he says, 'Only it's much, much better'. Compared to the tedium of traditional painting – priming the canvas, washing the brushes, not to mention the expense – Bailey explains this newly created tool will offer users 'absolute freedom of expression'.

After twenty seconds or so, the work disappears entirely and a new painting begins. Bailey explains that the previous piece is stored on a hard drive, and that the rapid refresh rate allows him to become a painting factory: 'an absolute expression factory, in fact!'. As he continues to demonstrate how the body becomes the paintbrush, Bailey's gestures turn into a frenzied combination of karate kicks and modern dance. 'You have this liberating experience, a fusion of paint and dance really', he says, out of breath, 'but much, much more creative than painting'. In each painting, the words 'LOVE' and 'WAR' appear at random, mixed in with the abstract mass developing on-screen. At the video's conclusion, Bailey addresses their significance. 'These are things that actually mean something. For once, art that means something'! he says in earnest. 'We are liberated. Liberated from the tyranny of the canvas. The future is here'. While Bailey's straight-faced delivery is unwavering, these bombastic claims reveal the satire at work:

> This character I've created is a stereotype of what I think is wrong with electronic artists. While obviously they're not all this way, my character is ignorant of the world around him. He is hyper-focused on progress – creating the next best technology. He also refuses to think about the meaning of the images he creates. He divests himself of that responsibility, which becomes that of the machine. Whatever meaning is created is an expression of the computer and no longer the artist.

Since unveiling his prototype, Bailey has continued to advance the capabilities of the software program while further developing the character of its inventor. Although his character approaches tool-building as a way to assist a community of artists, the conviction that aesthetic progress occurs in sync with, and because of, the upgrade is not unlike the commercial forces that drive industry. Unlike his character, however, Bailey does not consider the tool inventive or even a necessary technical development – an assumption that only adds another layer of humor to the performances. 'He thinks what he is doing is really great, but it always appears slightly behind. Well, more than slightly and that's partly because I don't have the so-called skills myself!', he laughs. 'I think most of the stuff is pretending to be more important than it really is'.

Just as *Video Paint 1.0* functions as a proof of concept for both the character and the tool, *Video Paint 2.0* (2005) offers Bailey an opportunity to expand his argument and to question the political context of this type of electronic art. Bailey narrates three video journals that chronicle the development of the *2.0* upgrade, and which cleverly incorporate the clichés of industrial videos: the stock music, the graphics and the wipes. As his character walks viewers through the software's features, however, the context for the demo becomes increasingly absurd. The character is superimposed over video that ranges from the banality of *The Cosby Show*, to the politically charged Al Jazeera broadcast of the fall of the Saddam Hussein statue at Fardus Square; in the final demo, the software is demonstrated over streaming footage of the beheading of United States contractor Nick Berg in Iraq.

> At the time that I made *Video Paint 2.0*, I was really concerned that electronic artists weren't taking responsibility for what they were doing and they weren't paying attention to the meaning they were creating or the context that they were in. I chose to have the character paint in front of three videos, which are background images that I consider to be particularly offensive because he does not acknowledge them as anything more than aesthetic material. Even though he says he wants to 'get political,' he never says anything except he's trying to be political as he paints in front of Saddam Hussein's statue. But it *is* political for a white guy to dance in front of Bill Cosby and to use the color of his skin to determine the pigment of the brush. And of course it's also super offensive to take someone's final moments and paint in front of it, and worse yet, to paint over it so you can't even see what's occurring. I was thinking that this is what media does anyway. I'd watch CNN at the time and they'd talk about how it was immoral for them to show these kinds of footages, yet they would show them up until a certain point and then they would cut it off or they'd blur things out. […] We have a tendency to flatten images and not really look at what's going on within them. (See Color Plate 13.)

Video Paint 3.0 is an ongoing series of performances in which Bailey conducts live demonstrations of the tool's newest upgrade, which now features voice analysis that tracks and visualizes the user's volume and pitch. The enhanced interface includes an artificially intelligent avatar, David (a twinkling, smiling Star of David), which is meant to provide a face for the machine. With *3.0*, the user can now choose an alternative icon for the brush, and although there are several options, during the performances the avatar seems to prefer the Yasser Arafat icon. In the performance, the inventor discusses his attempts to attract younger users to the *Video Paint* software – 'One thing I've noticed is that young people like video games' – which has led him to include new features. A score in the top left corner of the frame counts up, although the calculation is arbitrary and has nothing to do with the painting. 'Who am I to say what a better painting is? I believe that we're all artists and we all have the ability to make great art,' he says, explaining that the constantly increasing score is meant to celebrate the user's creativity. After a given period a 'suicide bomb' enters the frame, the screen strobes, and the painting is lost. The only way to deactivate the bomb is by maintaining the color green, achieved by sustaining a high pitch. Including these gaming features makes the painting into an 'adventure', which will hopefully appeal to young users:

> I specifically used those icons in that piece to discuss the same issues and concerns of version *2.0*, which is the abstraction of what is actually occurring. By making it comical, or by abstracting it further, we might see it for what it really is – whether those are cartoon characters or bombs hitting people in other countries. […] We live at various levels of abstraction in our mediated lives. […] But that mediation occurs militarily, with these TV-guided predator bomb machines where there's not a human involved in it. Generally speaking, it's how we're treating more and more of our lives. We're always pulling back and abstracting it.

While it is not made clear in the video demos for *1.0* or *2.0*, during the live performance the source material for the *Video Paint* tool is revealed to be Max/MSP/Jitter, software now ubiquitous to interactive and electronic art. The program's distinctive graphical user objects, which could be concealed, are instead included on-screen. At some points within the performance, windows are opened that expose the distinguishing subpatches. Even as the character maintains control of the machine during these live performances, the demonstrations are intentionally rough, referencing just how awkward interactive performances can appear: 'Sometimes he makes uncomfortable mistakes but it's the machine that takes responsibility', Bailey says. 'The artist is simply the wrangler of the lion, so to speak, and in some cases he is mauled by the lion'.

With the *Video Paint* series, Bailey interrogates the same art world in which he is immersed, in effect reflecting his concerns back onto the new media community. The works also point to a background that is as influenced by performance video as it is by Bailey's experience working in interface design. Though he lacked any formal training, he supported himself during undergraduate school by designing interfaces for electronics, such as cell phones and skins for mp3 players. 'Somehow I was making a pretty good living designing buttons and interfaces that looked like alien spaceships, but ultimately were meaningless', he recalls. 'They started as a sketch of circles and triangles on a page, but there was never anything beyond an aesthetic pursuit'. Today, Bailey considers how a user's desire to customize an interface is a way to embed individuality within a mass-produced electronic device. Though this tendency to modify the look and feel of an apparatus exists, the fixed elements such as how the device is organized ultimately dictate a user's behavior.

Bailey sees this limitation at work with software tools as well, even those programs that offer the ability to customize and build new interfaces. While he may use a program like Max/MSP/Jitter because it is comparatively straightforward and affords a live environment, he is quick to remark that it is a software program that, not unlike Photoshop, is driven by the commercial upgrades.

> I feel like my creative process is dictated by the layout of the program that I’m working in. There’s a point where software upgrades dictate aesthetic progress. Artist tool-making today is involved in the exact same pursuits: thinking that to make something better means to progress the technology, and not to progress your thinking about that technology. This is fundamentally different than the way people were thinking about it during the 1970s. Today the tools are viewed as shifting whereas then they were viewed as static – this is what we have to deal with.

Bailey’s studies with pioneering video artists Colin Campbell and Tom Sherman have clearly influenced his appreciation for the histories of video art. He is keenly aware of the political context that informed early electronic artists engaged with the research and development of video tools. When the parameters of play were dictated by industry designs, and when more advanced image-making tools were unaffordable, the solution for artists was to make their own tools. Artists and engineers worked in collaboration, adopting do-it-yourself strategies and developing pre-hacktivist tactics to build that which they could not afford. By creating access to the tools, and by sharing resources and knowledge so that others could build these machines themselves, artists involved in early image-making tools worked in opposition to the industry’s model. The collaboration between artists and engineers during this period was the inspiration for open-source, copy left politics, such as the ‘Distribution Religion’ of Phil Morton and Dan Sandin.

For Bailey, an ignorance of this history and the socioeconomic circumstances that drove early video art impairs the work of contemporary electronic artists who continue in the tool-building tradition. There is also a lack of appreciation for the performative aspects of tool demonstrations. While examples of early tool demos exist and are in circulation, contemporary viewers often read the documentation as purely demonstrations, and not inherently performative: ‘Many electronic artists are so formally organized that they ignore the subjectivity that surrounds their work, which is such a strange thing to be doing, especially in an era where subjectivity reigns supreme’. This concern clearly drives Bailey’s performances, the sense of irony increasing with each version of the *Video Paint* series: ‘To not acknowledge the performative aspect of the demo brings us to question what it means to build a tool or a piece of technology, or to use someone else’s tool or technology, in terms of art history’.

Bailey refers to the trend of collaborative tool building, which has increased in popularity within networked art. This type of work has grown in support and is increasingly exhibited, despite the lack of critical examination – presumably because of its seemingly altruistic aims. With the growing support and exhibition of collaborative tools, Bailey reconsiders the longstanding issue of authorship: ‘If you look at art history and postmodernism, there is a very clear break when the hand of the author disappears.

But if the computer is making the work, what is the reader trying to interpret – a bunch of machine language'? While he recognizes that the concept has evolved over the years, it is a topic that remains problematic when it comes not just to the tools, but to the work that is created by them.

> For me, the authorship of the tool cannot be separated from the tool's expressive output. If artist A creates a new tool, regardless of whether or not it has been made collaboratively, and artist B uses that tool, artist A is imbedded in the work.

Another cause for concern is the frequent commercial sponsorship associated with such projects, seemingly benign support that nevertheless affects the end product:

> The companies are creating the rules by which a community is going to play. It's as if someone handed me a ball but they decided that the ball was going to have spikes, or how big it was, and then I was forced to invent a game around that […]. That's a totally oppressive way of thinking about creativity in my mind.

If the context for media artists today is, as Bailey puts it, 'a quagmire of constantly shifting available technologies', what then is the impetus for those artists developing new tools today?

> I guess my question for anyone would be, what new meaning are you creating – not what new technology. Or what proposal for a new aesthetic are you creating? Outside of technological progress, what progress are you really making? […] Just because you can, should you? Should I be critiquing people for just trying things out and experimenting? […] It only becomes weird for me when the presumption is that you make tools regardless of whether or not something already exists, but because you think that people need more tools. Tool making for tool making's sake is a totally useless practice.

There is a near tangible aversion at work in the *Video Paint* series, leading one to ponder the origins of this implied hostility. What Bailey witnessed as an art student during the 1990s, a time when identity politics was the central discourse, has certainly informed the caricature. While he grappled with the concept of his own privilege, he became increasingly disturbed by the ways that his fellow students handled their feelings of culpability: 'A lot of the other white men were responding to that by privileging the voice of their machines,' he recalls. By transferring their power and by giving their machines agency, these artists were able to 'divest themselves from having to deal with the white guilt that they had built up or that had been imposed upon them.' In this way, when a privileged artist accords a higher power to technology by creating a relationship with the machine – or as Bailey's character might claim, a spiritual union with the technology – the artist takes up the position of the other:

> At that point it became my mission to demonstrate that it's not that easy, that there are still a lot of issues […] For these contemporary artists who let the machine act as the author, this is a compromising place to put oneself – in the hands of the machine. A computer is full of all this dead labor, and only certain people have access to it or the education to control it. And in this regard there is a privileged amongst white males because, in a lot of ways, those are the guys who are running the show.

As a critique of those practicing this mode of electronic art, *Video Paint* allows Bailey to call their bluff – but it's a risky strategy since it forces him to play their game and, by way of parody, to assume their persona. One could easily question what Bailey is doing differently, since he too must put in countless hours developing the type of technology that he analyzes. But Bailey's concerns are clearly directed at those who develop new technologies with little regard for their social, political and economic context. It is abstraction as a means of distraction:

> How can you have a war going on and meanwhile you've put hundreds of hours into a machine that draws the same way an abstract expressionist might have painted? […] Ultimately they're like these flaccid egos because all of their energy is inside the machine. It's like, 'Look at my code, look how beautiful it is.' I guess I think it's funny because it's so awkward. It's kind of like we're wearing blindfolds for the sake of the experiment.

Reference

Bailey, Jeremy (2008) 'Interview with Jeremy Bailey by Carolyn Tennant', May 15, Buffalo, NY; Experimental Television Center Archives.

Notes

All Bailey quotes are cited from interview (2008).

De-commodification of Artworks: Networked Fantasy of the Open

Timothy Murray

What might it mean to situate the open-source movement in computing and digital art in relation to the emergence of independent video? From machine to theory, the medialized networks of video and computing have capitalized on the optimistic discourse of the open, from tool to thought, while being haunted by the discourse of commodity fetishism and the vicissitudes of desire. With the development of alternative media tools in the 1970s, artists and theorists began to think about their creative gear differently, in a way that complemented the open-source movement and facilitated the more recent 'queerings' of tactical media. The rise of the portapak, the development of expanded cinema and the concomitant growth of UNIX, which initiated the later free software and open-source movements, prompted reflection on progressive intersections of theory and praxis. The convergence of the development of tools in video and new media contributed to the sharpening and elaboration of many parallel discursive and theoretical spaces under discussion in the academic arenas of critical theory and cultural studies. Particularly striking is an ongoing shift away from art as commodity and from artist as creative genius to desiring machines and open networks of artistic production and conceptual collaboration.

Speaking of interwoven developments in video and new media, the video artist Woody Vasulka argues in his essay 'The New Epistemic Space' that:

> We now have a new creative space, a system of aesthetic practice, and an audience ready for a new aesthetic discourse. We have moved from a relationship with technology in which we attempt to invoke the creative potential of a specific tool, to one with a technological environment invoking a new creative potential from human discourse […] new epistemic space. (Vasulka 1990: 465)

Enhanced by technological developments in video and new media, this new epistemic space has provided the dialogical envelope, something of a critically engaged artistic space, for important reconsiderations of commodification, fantasy, ideology and collaborative networking. From focus on networked video installations to the digital folds of Internet art, developments in video, new media and open-source technologies have played an energetic, sociocritical role in performing the tools of 'theory' that have been central to the development of this emergent epistemics, in space newly configured by algorithms, speed and connectivity.

Key is a shift in artistic thinking about technology. Since the late 1960s, a creative and expansive web sought to free the artwork from both its subservience to the mastery of creative genius (almost always male, if not white) and its dependence on an expansive system of commodity fetishism. While the tradition of artistic genius diminished the discursive power of the artwork as something capable only of the imperfect imitation of artistic insight, the system of artistic commodification effaced the multilayered labor of the artistic network for the speculative potential of the collector, gallery and museum. Speculation is a fundamental operative of this nexus as it functions to enhance the potential of art as capital, but not necessarily as thought. In contrast, the new epistemic space embraces the potential of speculation as a reflective means of expanding the horizons of the artists' and programmers' interdependence with electronic systems, programming codes, theoretical discourses and cultural networks. Notable in its indifference to the creator's craftsmanlike mastery of tools, as championed in artistic academies via the precise handling of the chisel or etching press, the new epistemic space takes its lead from 1960s experimentations in artistic installation, happenings and performance. Central to Wolf Vostell's 1961 *Dé-collage Performance* or to Nam June Paik's 1965 interactive installation, *Magnet TV*, the tools of video functioned, even at this early stage of their development, as the performative platform of an emergent network of flow, distribution and disruptive performance, one that John G. Hanhardt linked to Fluxus and the nouveaux réalistes. More recently, Owen F. Smith elaborated on the prescient role of Fluxus in setting the terms for emergent artistic practice in the age of new technology. In arguing that the tools and physicality of artworks, or 'the bounds of its materiality', cede their centrality to a 'networked whole' of thought and action, Smith goes so far as to draw an analogy between Fluxus and the emergent movement of open-source code in computer programming:

> What the modes of critical thinking found in Fluxus offer to art is parallel to what the open-source code movement offers to computer programming: the tools by which a previously exclusionary practice, whether it be the programming of code or the creation of art, and means of production not only become available to all but grow and remain vital through the work and ideas of many varied participants. (Smith 2005: 135)

What is exciting to ponder in thinking about the early days of video art is this flexible approach to the development of electronic tools that resulted in rhizomatic interfaces with a new epistemic movement.

The convergence of the development of tools in video and electronic media, both analog and digital, happened in conjunction with the opening and articulation of parallel discursive and theoretical spaces in the academic disciplines of critical theory, philosophy and cultural studies. Particularly striking in this conceptual arena is an ongoing shift away from thinking of art as commodity, and from celebrating the artist as author-genius, to championing open networks of artistic production and conceptual collaboration. The result is an ongoing devaluation of the individual artist for the potential of the collaborative media group, a reorientation of private aesthetic pleasure into public media fantasy, and a transformation of the aesthetics of beauty into the artistry of process. Developments in video and new media art thus provided the occasion and context for important reconsiderations of commodification, fantasy and collaborative networking. This essay proposes to trace many of the benchmarks of the rapid developments in video, new media and open-source technologies while considering their dialogical relation to the interrelated tools of 'theory' that have been at the center of this continually expanding epistemic space.

Artistry of process

A hallmark of early projects in video and electronic installation was the development of portable video tools and flexible media spaces for the production and distribution of new projects. Underground videomakers profited not only from commercially available products that provided artists with flexible portability, aided by affordable camcorders that fueled the imaginative momentum, but also from their own development of specialized devices that provided the flexibility for creative inventiveness, aesthetic novelty and structural intervention. In the same year when Gene Youngblood published *Expanded Cinema* (1970), Stephen Beck developed the Direct Video Synthesizer while working at the National Center for Experiments in Television (NCET) in San Francisco; Nam June Paik teamed up with Shuya Abe at WGBH in Boston to create the Paik/Abe Synthesizer; Eric Siegel built his Electronic Video Synthesizer – all of which laid the creative groundwork for the later devices of Sandin and the Vasulkas (whose tools continue to be fundamental to the range of experimental video production undertaken at the Experimental Television Center [ETC] in Owego, NY) (Sturken 1990: 110). The development of flexible tools for video synthesis accompanied the video artists' fascination with the technological capability of instant playback and real-time capture of public events which suited, as Deirdre Boyle puts it, 'the era's emphasis on "process, not product"'. Process art, earth art, conceptual art and performance art all shared a shift from emphasis on the final work to how it came to be' (Boyle 1990: 52).

Equally important to this rise in process-oriented work, whose processes were often highly political in nature, was not only the creation and availability of flexible tools, but also the changed mind-set about artistic practice and the milieu of cultural exhibition. From New York to San Francisco, emergent collectives provided studio space, economic means and artistic collaboration for a new generation of alternative video. Particularly significant is how video collectives, such as Videofreex, People's Video Theater, Global Village, Raindance, ETC, Paper Tiger, Ant Farm, and Optic Nerve helped to empower individual artists to grab back production and commodification from museum/media institutions. Founded in 1969 by David Cort, Curtis Ratcliff and Parry Teasdale, Videofreex produced *The Now Show*, whose brief life on CBS included interviews with Yippie leader Abbie Hoffman and one of the founders of the Black Panthers, Fred Hampton. In 1971, the

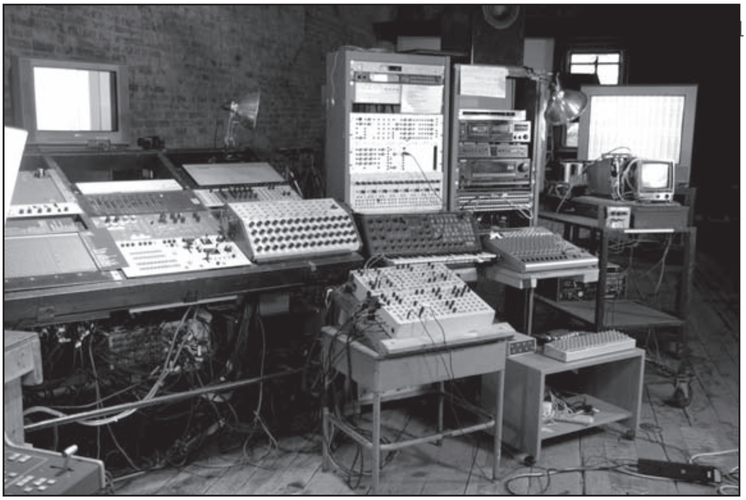

Figure 1. The studio of Experimental Television Center, Owego, NY (2007).
(photo. Olivia Robinson. courtesy. Experimental Television Center).

collective moved to Lanesville, New York, where they launched the first pirate TV station in the United States, and experimented with two-way, interactive broadcasting, whose interconnected cameras covered the region to combine with live phone-ins that enlivened a free-ranging open-video experiment. Similarly, People's Video Theater, founded in 1970 by Elliot Glass and Ken Marsh, produced tapes of 'man on the street' interviews, which were viewed at a local loft, or 'hardware station', where playback equipment permitted interactive feedback with participants. The 'video mediations' of People's Video Theater created, in Marsh's words, 'lines of communication between antagonistic groups whereby each can experience the information of the other without direct confrontation; therefore, working for and toward a resolution of conflict through dialogue' (Marsh 1970). In San Francisco, Ant Farm and Optic Nerve provided critical collective interventions in the emergent video culture arena: from Ant Farm's spectacular performance, *Media Burn*, in which Curtis Schreier and Doug Michels performed as astronauts who drove their custom El Dorado through a pyramid of burning TVs, to Optic Nerve's use of portable video to produce free-style documentaries on cowboys and beauty queens. On an even broader scale, Ralph Hocking founded ETC as a creative home of experimental video that fostered the development of innovative tools by Paik and others in a studio venue that until 2011 hosted the granting and creation of innovative projects by independent artist.

Then there was the proliferation of experimental means of distribution. To provide outlets for works on expanded cinema created by its collective, Raindance established *The Raindance Videolog*, a bimonthly assemblage of edited segments of its members' activity in alternate television. In 1981, Paper Tiger TV took to the New York City airwaves to profit from public access broadcasts of their searing live studio performances on national media issues by leading artists, cultural theorists and media activists. To open the series, Herb Schiller provided a suite of critical analyses of the *New York Times* and its hegemonic control of the news industry. These were followed by a wide range of provocative performances in which Martha Rosler critiqued *Vogue*, Tajima read Asian imagery in American film, and Joan Braderman took on the popular 1980s television series *Dynasty*. Providing an intellectual alternative to mainstream televised comedy spectacles, Paper Tiger expanded its airwaves in 1986 by developing a national series, Deep Dish TV, which was transmitted by satellite to over 400 local public access channels (Halleck 1990: 264).[1] Deep Dish thus led the way for current Internet conversations in the arts and humanities on social and subjective positionality (Boyle 1990: 51–69).

Underlying such a wide range of video practice was an experimentation that combined innovative form with political agendas to embrace the rise of feminism, the politics of race, the discourse of peace and ecology, the public presence of queer performativities, and the dismantling of hegemonies of patriarchal, Eurocentric power. One of the hallmarks of the many collectives that helped to launch the alternative video movement was the centrality in their loosely shared politicized agendas of the dismantling of the economies of speculation and the commodity status of works of art. Comparing the contextual specificity of video installation and networked media events with traditional art objects, such as paintings and sculptures, Margaret Morse notes how:

> An object that can be completely freed from the act of its production […] becomes displaceable and freely exchangeable, that is, commodifiable. In addition, this severance from the process of enunciation is what ordinarily allows a magical origin or aura to be supplied to objects of art. (Morse 1998: 154)

Alluding here to Marx's critique of 'commodity fetishism', Morse contrasts process-oriented electronic art and installation with the preservation and exchange of traditional art objects whose mystical values are determined by the artist-gallery-museum-collector nexus that distances itself from the processes of production, whether manual or mental.

In focusing on 1970s artistic installations in gallery or art environments, Morse closes her essay 'The Body, the Image, and the Space-in-Between: Video Installation Art' with mention of Dan Graham's 1970s closed-circuit installations that combined feedback systems and mirrored video monitors to intersect with and engage with public architectonic environments. One of the characteristics of Graham's early experimentations with installation was his investment in appropriating the public spaces of the shopping arcade and the corporate atrium; two environments of public space that were expanding in the 1970s in conjunction with the emergence of televisual and cable systems. Graham's 1979 installation in the atrium of New York City's Citicorp building, for instance, confronts viewers in the center of the city with video images of the exterior of an urban house, thus offsetting the corporate fantasy of Citicorp's glass-enclosed arcadia with iconic visions of suburban life and the domestic scene. In his installations designed for shopping malls, Graham inserted monitors behind shop windows whose feedback loops of the shoppers/viewers themselves solicited the viewers to position themselves as the subjects of desire and consumption. By establishing feedback loops within the architectonic realms of corporate capital and leisure commodification, Graham thus laid bare the thresholds of medialization while destabilizing the corporate mysteries of commodity fetishism.

The systematic encounters that Graham designed for architectural spaces were taken to even further extremes by other contemporary artists who were experimenting with telephonics and space. Preceding Graham's intervention in Citicorp's atrium, New York artist Douglas Davis incorporated live dual-directional telecasts into his artistic happenings. His 1972 piece, *Talk-Out*, for instance, involved a 3½-hour-long combination of live broadcast and cable television feedback. Through a live bidirectional feed, viewers were able to engage in a broadcast conversation with the artist about what they were watching. Such an insertion of meta-critical sensitivity into the media stream was breaking out across the globe. In an analysis of such 'dialogic electronic art', Eduardo Kac calls attention to the parallel French/Brazilian example of Fred Forest's intervention at the 1973 'XII São Paulo Bienal', for which Forest linked a bank of telephones to amplifiers that permitted participants to call in and 'speak freely' at a moment when the political regime had radically curtailed the possibility of free speech (1999). September 10–11, 1977, witnessed what seems to have been the first transcontinental satellite transmission of meta-critical performance. This occurred when Liza Bear and Willoughby Sharp (a pioneer of conceptual experimentations in earth art and video performance) joined up with Keith Sonnier to produce *Send/Receive*, which featured a 15-hour interactive transmission from the NASA Satellite CTS (via New York's MCTV) between San Francisco's ArtCom/La Mamelle and New York's Center for New Art Activities (Anderson-Spivy 2007; Schlote 1998: 77). These artistic interventions via electronic transmission spawned an ongoing flow of performative events. In France, Maurice Benayoun's 1995 3D *The Tunnel Under the Atlantic* permitted visitors to the Centre Pompidou (Paris) and the Museum of Contemporary Art (Montreal) to create a tunnel to each other by digging a two-way hole via 3D graphics.[2] Similar performances of 'live interaction' have flourished globally ever since, such as Ted Warburton's 2005 *Lubricious Transfer* that capitalized on Internet 2 to transmit live a collaborative dance performance between the University of California, Santa Cruz and New York University.[3]

What I find most interesting about this lineage of feedback loops and concurrent dialogic transmissions of meta-critical performance is how their legacy continues to disrupt the artist-gallery-museum-collector network, one that depends on the commodification of product for speculative economic gain at the expense of cerebral speculation about process. As viewers and interactive performers see their images replayed almost immediately through feedback loops in shopping centers or from within Internet transmissions from West to East, their narcissistic relation to video is disrupted by dialogue and reflection through what Graham calls the removal of:

Figure 2. Maurice Benayoun's *The Tunnel Under the Atlantic* (1995).

> […] self-perception, as in the mirror image, from the viewing of a detached-state image of self. Instead, feedback creates both a process of continuous learning and also the subjective sense of an endlessly extendible present time in flux, an interior time connected to an unfixed extendible present and continuous reexperienced immediate past. (Graham 1990: 180)

By liberating the viewing subject from some illusory identification with a utopian fixed position of narcissism (if not also ethnocentrism) – on which the traditional art commodity most frequently depends and for which Rosalind Krauss critiqued 1970s video art[4] – medialized subjectivity glides circuitously along the continuously retroactive time frames of fantasy and interconnected realities through which the subject is constituted within the media network, *in fantasy*, rather than standing distantly on the outside as some kind of detached representational source or receptor of creativity.

Breaking the univocal ontological foundation of creation's subjectivity and capital's mystical object, these complex medial tools function along the lines of the 'desiring machines' promoted by the French theorist, Félix Guattari. As their own techno-material of expression, they:

> […] break with the great social and personal organic balances and turn commands upside down, play the game of the other upon encountering a politics of ego-centering. [...] All machinic orderings contain within them, even if only in an embryonic state, enunciative nuclei that are so many protomachines of desire. (Guattari 1993: 25)

The interesting pioneering work of Graham, Sharp, Davis and Forest led the way for more recent interactive artists, such as Benayoun and Warburton, to insist on the complicated process, moreover, through which systems of fantasy are as social as they are subjective by reflecting their belief in what Graham terms the 'open possibilities of video as a present-time, architecturally deconstructive media' (1979: 170). These desiring machines of the medial process thus focus the video event on the concurrent conditions of production while deconstructing the ontology of a designerly product that is capable of separating itself from process for the fetishistic purpose of commodification.

Just such explicitly political sensibilities guided the 1984 Olympics project of Kit Galloway and Sherrie Rabinowitz. Working together as Mobile Image, their *Electronic Café-84* intervened in the corporate discourse of the Los Angeles Olympics with an environment of 'resocialization'. In response to the media environment of 1984, described caustically by Annmarie Chandler as 'the year the first Macintosh was released and the year people were reminded of the Orwellian, anti-utopian vision of a totalitarian communication order', Mobile Image set out to develop an electronic commons by establishing a network that for seven weeks linked five family restaurants across Celebrity City, a conglomerate of Korean, beach, Hispanic, and African communities that may not otherwise have been blessed by the Olympics (Chandler 2005: 167). Kit Galloway describes the project as a realistic, immersive social space that was 'democratic, dynamic, and accessible, more political and prompted and facilitated by community participation – totally different [from] what Internet cafés have come to be' (Chandler 2005: 171).

Bubbling to the surface around this time, well prior to the institutionalization of the Internet café, was a similar international appreciation of 'immaterial materiality'. The growing variety of electronic installations and emergent networks provided activist artists and philosophers alike with novel notions for understanding subjective and social processes. Some of this impetus derives from Yves Klein, whose experiments in the late 1950s and early 1960s continue to resonate in the new age of new media. On June 3, 1959, Klein presented his lecture, 'The Evolution of Art Toward the Immaterial', to the Sorbonne, in which he positioned 'immateriality' as what he had in common with multimedia artist Jean Tinguely. Klein's goal was 'to create an ambience, a pictorial climate that is invisible but present in the spirit of what Delacroix in his journal called "the indefinable"' (Klein 2006: 125–26) or what Klein termed in his essay 'the force of attraction' (2006: 122). Interestingly, Klein's featured example was from his monotone symphony of forty minutes of electronic sound, whose length was scripted 'to show the desire to overcome time' (2006: 135). A fervent desire to overcome the constraints of the commodification of time informed the 1985 exhibition at the Centre Pompidou in Paris, 'Les Immatériaux',[5] which was curated by the philosopher Jean-François Lyotard. This collaborative event brought together players in the early free software movement, video installation, and post-structural philosophy to reflect on what Lyotard calls the productive 'technological stain' of new media as it resists commodification and the corporatization of the information sector. For his exhibition, Lyotard enlisted the collaboration of a wide range of artists, musicians, architects and philosophers whose primary materials were immaterial emanations from electronic and digital sources. Highlighting conceptual and electronic artworks of an almost virtual kind, from sound art to work created on the French Minitel, Lyotard's show dwelt energetically on the philosophical imperative of 'immaterials' that challenge or question modern philosophical confidence in the subject's analytical control over objects (or commodities) in time and space. Equipping visitors with wireless audio guides that picked up different signals as they moved through the show, Lyotard injected the dialogics of discourse into the experience of art. Simon Biggs recalls how 'this allowed for a poly-valent narrative to emerge in the show, allowing the viewers to find their own chronological and hierarchical path through the work, thus also functioning to further simultaneously reveal and dematerialize value' (Biggs 2001). Particularly novel was the exhibition's performance of a remote-controlled discursive network through the use of Olivetti M20 microcomputers and first-generation word-processing software that linked in real time, well prior to the public Internet, a wide range of artists and intellectuals in virtual conversation, from Jacques Derrida, Bruno Latour and Philippe Lacoue-Labarthe to Michel Butor, Daniel Buren and Isabelle Stengers.

At that moment, when the vast majority of museum and art-historical communities continued to resist the artistic legitimacy of video art and even cinema, Lyotard's ambitious exhibition of light, sound, architectonics and discourse generated not only welcome enthusiasm, but also vocal debate among critics, curators and philosophers alike. Questioned by the skeptics was not merely the sort of extended sociopolitical community launched a year earlier by *Electronic Café-84*, but also the very terrain of the new epistemic space of the immaterial, and its paradoxical inscription in electronic technologies. Many art curators questioned the invasion of their highly serious and hermetic craft by the playful philosopher known for his enigmatically pagan interventions in art theory. Many participants from the art and art-historical communities also remained deeply suspicious, as they continue to be today, of the aesthetic merits of electronic art, not to mention the legitimation of the electronic epistemic space by philosophers, theoreticians, artists and curators. Finally, some philosophers shared a deep concern over the dominant threat of the emergent techno-culture, a concern that philosophers and humanists alike still voice today, and one which Lyotard himself pondered so eloquently in *The Inhuman: Reflections on Time*. The greatest concern voiced by Lyotard in this exciting book is that the corporate drive of techno-science might render its users indifferent to the nuances of the epistemic difference and divergence that empower it: 'I see in this arrangement a sign that techno-science conditions thought to neglect the differend it carries within' (Lyotard 1992). Yet, it was precisely the unrealized promise of information culture that Lyotard thought would breathe new life into an equally neglectful tradition of philosophy:

> Even the modest tinkerer with software has an attitude that's somehow 'artistic' – an attitude of a kind of astonishment. What that means is that metaphysics, as Adorno puts it, goes into crisis at much the same time as the rest of classical philosophy and

> that there's a way in which it is going under as a result of a decline in the capacity it can have for the creation of wide-ranging global systems that include the great and final issues for which we feel a need. (Lyotard 1985)

Fantasy of the open

Lyotard's sensitivity to the artistry of software, particularly as it might facilitate socially inscribed commentary on urgent and wide-ranging global systems, attests to the maturity by 1985 of the 'open source' movement. It is, perhaps, not coincidental that open-source coding emerged in the 1970s in parallel with the rise of portable video networks and installations that facilitated urgent social documentary. Under the umbrella of the rise of epistemic techno-spaces, the 1970s witnessed the rapid development of the open-source movement through a sharing of software and emergent collaborative networks that constituted a particularly politicized user public. UNIX started things off when it was first written in 1969 by Ken Thompson and Dennis Ritchie at Bell Labs. One of the key features of UNIX was its bundling with its source code. This led not only to the code's widespread documentation and dissemination, but also to the shared-use platforms, such as the pioneering Multics platform that permitted multiple simultaneous users to collaborate on one computer. These developments spawned an academic revolution of code sharing and tweaking through which software itself became the tool of choice for creative computing (Kelty 2008). Emergent software communities thus shared with the independent video collectives a flexible relation to tools as desiring machines of process.

Fueled by an energetic esprit of open artistic, academic, and even corporate, collaboration, these communities of virtual tinkerers countered the model of exclusivity favored by individual entrepreneurship and proprietary corporate patronage. As noted by Christopher M. Kelty in *Two Bits: The Cultural Significance of Free Software*:

> Free Software exemplifies this reorientation; it is not simply a technical pursuit but also the creation of a 'public,' a collective that asserts itself as a check on other constituted forms of power – like states, the church, and corporations – but which remains independent of these domains of power. (Kelty 2008)

Although the free software and open- source movements tended to be libertarian in spirit and were themselves often embedded in corporate enterprises, they also arose in debate with the commodity-centered aims of such enterprises. And while not directly opposed to commodity culture itself, on which the rise of personal computing was dependent, the resultant free software movement invested itself in the creation of what Kelty calls a 'recursive public', one that is:

> […] vitally concerned with the material and practical maintenance and modification of the technical, legal, practical, and conceptual means of its own existence as a public; it is a collective independent of other forms of constituted power and is capable of speaking to existing forms of power through the production of actually existing alternatives. (Kelty 2008)

The fantasy of the open as an emergent public horizon of invention, creation, and collaboration has fueled both the technical lingo of open source and the artistic discourse of emergent media practice. Speaking of the architecturally deconstructive nature of *Piece for 2 Cable TV Channels* (1976), Dan Graham stressed its reference 'to the (then) open possibilities of video' (Graham 1979: 170). Moving from an emphasis on present-time installation to the promises of emergent systems of televisual access in the 1980s, Francesc Torres wrote, in 'The Art of the Possible', that 'the idea of a pluralistic, open, horizontal mass communications system challenges the stability of the dominant political and ideological power in any given society' (Torres 1990: 205). And moving from the 1980s discourse of open access to the 1990s enthusiasm over the transition of video into digitalized new media art, Lev Manovich similarly celebrates the fantasy of the open: 'To use a metaphor from computer culture, new media transforms all culture and cultural theory into an "open source." This opening up of cultural techniques, conventions, forms, and concepts is ultimately the most promising cultural effect of computerization' (Manovich 2002: 333). Of course, the tools associated with such 'opening up' have since migrated from linked video monitors, public access studio, free software, shared computer and satellite transmission to the utopic expansion of the digital network itself. As Manuel Castells phrases it in 'The Net and the Self: Working Notes for a Critical Theory of the Information Society':

> [T]he materiality of networks and flows creates a new social structure at all levels of society. It is this social structure that actually constitutes the new informational society, a society that could be more properly named as the society of flows, since flows are made up not only of information but of all materials of human activity (capital, labor, commodities, images, travelers, changing roles in personal interaction, etc.). (Castells 2001: 47)

It should be acknowledged, however, that any celebration of the flow brings with it the cautionary reminder of how the social structure of televisual flow enhanced the movement of capital and the corporate institutionalization of advertising as a structural premise of television programming, which itself motivated the critique of many of the early pioneers of independent video. The tension between capital, labor, and changing roles of human activities, markers of Castells's society of flows, certainly continues today in the carryover from analog to digital media. Indeed, the very power of the flow has resulted in rapacious clawback by the corporations that have successively reasserted their monopoly control over the digital network via claims over intellectual property and copyright

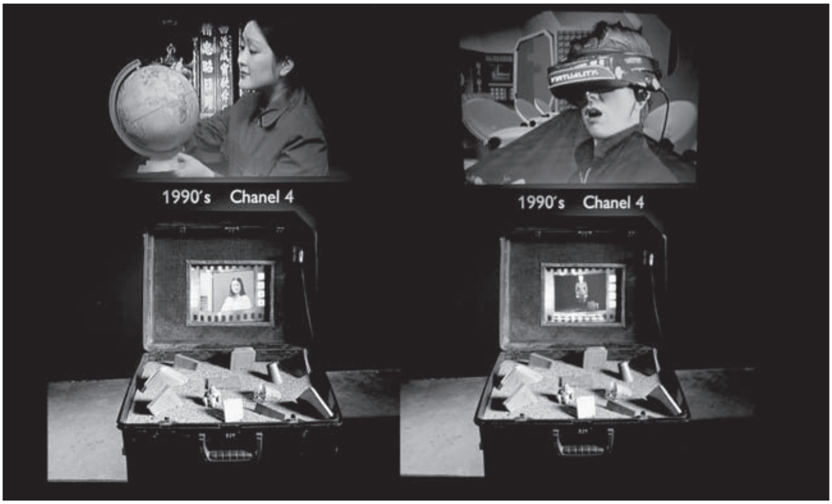

Figure 3. Jill Scott's *Frontiers of Utopia* (1995).

(these efforts have become particularly pronounced whenever the emergent social and cultural power of the network has exceeded the power of its corporate owners to control it). A strategy initially articulated by AT&T in its resistance to the open distribution of the UNIX source code, such corporate blockage of flow was perfected by Microsoft's legal maneuvers in the 1990s to protect the exclusivity of its brand. These maneuvers have since been adapted by the recording, publishing and film industries as a means of restricting the open flow of cultural data across the Internet, all in the name of protecting the economic rights of the individual artist. Behind the guise of copyright protection for the 'individual artist' stands a resurgent investment in commodity fetishism that mystically enshrouds the open promise of collaborate artistic invention in the corporate product of label, copyright, and marketing.[6]

But it may be far too simple to maintain that such efforts are motivated by an antiquated and paranoid notion of possessive individualism that runs contrary to the desiring machines of the networked epistemic spaces of video and new media. For don't the desiring machines of the network itself now constitute the fabric of what Alexander R. Galloway and Eugene Thacker call the new sovereignty of the information society? Based not on 'exceptional events but exceptional topologies' (Galloway and Thacker 2007: 40), the new sovereign system of networks enfolds, as Galloway and Thacker see it, the 'disembodied, immaterial notion of "information"' with the immanently material stuff of cybernetics, information theory, and systems theory that combine into networked configurations of communications media, biological systems and military technology (2007: 57). Armand Mattelart is equally pessimistic about such networking. He understands the hegemonization of the modern mode of communication by the deeply entrenched forces of global capital to have usurped cultural flow at its core.

> The capitalization of culture is also the capitalization of the most existential levels of subjectivity in the consciousness of the citizen-consumer, who is increasingly influenced by the specialized activities of the professionals and their techniques and devices. The commoditization of culture is, above all, the production of new kinds of subjectivity. It is precisely because of this qualitative leap in the management of subjectivity that cultural struggles and the stakes involved regain their strategic importance. (Mattelart 2001: 268)

Interestingly, a similar call for cultural struggle was voiced two decades earlier by the German media theorists and activists Oskar Negt and Alexander Kluge. They wrote as early as 1972 of a related procedure of retooled subjectivity that interpellates and encapsulates the cultural worker via an intrusive media web through which 'language, psychic organization, the forms of social intercourse, and the public sphere, all participate in the mystifying context of commodity fetishism' (Negt and Kluge 1988: 70). Negt and Kluge recommend something corollary to the fantasy of the open as the antidote to the commodity fetishism of media culture. They understand the protectionism of commodity fetishism to rely partly on a repression of the workings of fantasy through which proletarian (these days, we could speak just as easily of 'net citizenry') imagination is subsumed by the valorized interests of the media labels that so valiantly link citizens to the lifeline of global culture (think of Time Warner, Verizon, AT&T, etc.). The commodity is now the fantasy of the open network. But rather than spurn fantasy itself as merely the envelope of false consciousness, Negt and Kluge understand the suppression of fantasy to constitute the condition of its potential 'free existence' in contemporary society. Precisely because the workings of fantasy constitute 'the raw material and the medium for the expansion of the consciousness industry', sensuality and fantasy can be reclaimed as creative lifelines for the resurgent recycling of their own 'damaged situations' in the wake of organized conditions of commodity fetishism and the medialized web of alienated corporate reality (Negt and Kluge 1988: 78–80).

Galloway and Thacker propose a similar viral 'exploitation' of the new sovereign condition of the network through which 'the concept of resistance in politics should be superseded by the concept of hypertrophy […] the desire for pushing beyond' (Galloway and Thacker 2007: 98). Desire here fuels not the destruction of technology and its new sovereign network, but the goal 'to push technology into a hypertrophic state, further than it is meant to go' (2007: 98). The goal is thus, to return to Lyotard, to release the energetics of the differend from its stifling encryption in the repressive vaults of the new world sovereign, techno-science. It is not insignificant in the context of this linkage of fantasy/new technology/social empowerment that Arjun Appadurai has more recently called upon fantasy in the age of the electronic archive as a facilitating engine of the aspiration for those disenfranchised by immigration and class. Appadurai makes a compelling case for the effectiveness of imagination and fantasy for articulation of the public memories by the disenfranchised, particularly for those who have been left isolated by immigration from the orbit of the state and its official networks. Fueled by the empowerment of fantasy and the playful connectivity of the Internet, rather than remaining entrapped in state-sponsored coda of enlightened rationality, 'virtual collectivities build memories out of connectivity' in contrast to how 'natural social collectivities build [face-to-face] connectivities out of memory' (Maas, Appadurai, Brouwer and Morris 2003: 23).

Tactical media

It is precisely the remobilization of the fantasy of the open, whether emergent or hypertrophic, that characterizes many of the most successful ventures in new media activism since the 1990s. At issue is not simply rejection of ventures in global media: digital activists are not unaware of their paradoxical reliance on the very technological infrastructure they aim to discomfort. Rather, at stake is a return to critical reflection on the dynamics and performativity of process – from sensuality to fantasy – via the viral tools of the digital interface that lend critical and political energy to emergent networks and desiring machines from open source to open minds. Of particular note is the critical inquiry into technological interventions that bear on the politics of culture, and the concomitant development of artistic tools that enable a forcefully phantasmatic response to the corporate clawbacks of flow and the sovereign subversions of network.

As if calling upon the reserves of 1970s women's video, two feminist collectives of the nineties turned their attention to the potential of digital culture as an open scene of cultural intervention. In 1991, Francesca da Rimini, Josephine Starrs, Julianne Pierce and Virginia Barratt formed VNS Matrix. Partially in response to the cinematics of robotic futurism, their 'Cyberfeminist Manifesto for the 21st Century' proposed 'the virus of the new world disorder rupturing the symbolic from within [as] saboteurs of big daddy mainframe'. Appropriating the tools of the feminine body for the purpose of heuristic fantasy, they actively promoted their motto: 'the clitoris is a direct line to the matrix, the VNS Matrix'. Wide global circulation and translation of the VNS manifesto in the early days of the public Internet positioned cyberfeminism as a formidable viral discourse of the new digital world order. Thus began a chain of cyberfeminist actions that reappropriated the masculinist tools of technology for their fantasy value.[7] While Linda Dement scanned female body parts in the lesbian bars of Sydney to morph them into 'cyberflesh girlmonsters', Jill Scott's interactive installation, *Frontiers of Utopia* (1995), dwelt on the politics of the ideal society in the age of technology. Presenting her visitors with the pleasure of investigating interactive suitcases, Scott permitted the viewers to connect a magnetic key to icons in the suitcases that provided links to fictional video narratives by eight different female characters representing the range of feminist interventions in the twentieth century, from a socialist farmer and 'Emma' the anarchist, to a new-age programmer and a capitalist celebrating the marriage between desire and science.[8] Scott's design of an interactive dinner table à la Judy Chicago further enabled visitors to eavesdrop on conversations about the socioeconomic challenges confronting technology's female users. These challenges were transformed to the corporeal zone by the new media collective subRosa, which describes itself as 'a reproducible cyberfeminist cell of cultural researchers committed to combining art, activism, and politics to explore and critique the effects of the intersections of the new information and biotechnologies on women's bodies, lives, and work' (subRosa 1998). Ranging from the collection of essays, *Domain Errors: Cyberfeminist Practices!* (2003) to networked and interactive performance installations, subRosa reflects on the politics of biological and computer engineering as it impacts reproduction, choice, and genetic determinism.

The viral exploration of these same intersections of art, technology, critical theory and radical politics has been the aim since 1992 of the influential collective, Critical Art Ensemble (CAE), which also has collaborated with subRosa. A proponent of tactical media actions, CAE seeks to engage particular sociopolitical contexts, from tools to

Figure 4. Critical Art Ensemble, Paul Vanouse, Faith Wilding, *Cult of the New Eve*. (1999) (photo. Dorian Burr).

media, in order to energize 'molecular interventions and semiotic shocks' for the disruption of authoritarian culture. Their projects have ranged from the critique of the lack of access to US health care – *The Therapeutic State* (1992), distributed in hard and virtual form – to a parodic 1994 newspaper insert and website on *Useless Technology* that critiques the sociopolitical distraction of the allure of new tools from the Sony Hi-Fi Stereo VCR with VCR Plus Programming to MK21 Advanced Ballistic Missile Reentry Vehicles. Since 1997, CAE has been collaborating with Faith Wilding of subRosa, Paul Vanouse, Beatriz da Costa and others on critical interventions on biotechnology, from the genomic performance event, 'Cult of the New Eve', to the 'Molecular Invasion' science-theater workshop whose aim was to reverse-engineer genetically modified crops. Many cultural critics believe that the proof of the cultural threat of CAE's interventions came when its founder, Steve Kurtz, was arrested by US Homeland Security on charges of bioterrorism following the discovery of his artistic genetic lab after he called emergency services to his home upon the sudden death of his wife. The result was a failed but vicious three-year governmental prosecution of Kurtz, initially for bioterrorism as defined by the Patriot Act, and later, when the first charge didn't stick, for mail fraud (sending viral microorganisms through the US mail). At no time in recent American artistic politics has the fantasy of the open been perceived by the authorities as being so threatening or so under threat.[9]

That is, until even more recently. It is no secret that CAE's 1996 manifesto, 'Electronic Civil Disobedience', set the stage for a broad international network of activist hackers who have turned to the Internet as an open site for tactical media actions of political

Figure 5. Electronic Disturbance Theater/b.a.n.g. lab, 'The Transborder Immigrant Tool'.

resistance. The Electronic Disturbance Theater (EDT) openly acknowledges this debt in discussing its benchmark ‘Floodnet’ actions against the Mexican government’s repression of the Zapitistas. Relying on its development of software that more easily floods or attacks governmental sites with repetitive unwanted Internet hits, EDT has organized, since 1998, a series of mass-decentered electronic actions on behalf of the Zapatistas, whose virtual blockades and virtual sit-ins have temporarily choked the sites of Mexican financial institutions, the Mexican Embassy in the UK, and Mexican President Zedillo’s personal website. EDT challenges the notion that the Internet should be protected only as a site for state-sponsored corporate communication by insisting that it should be nurtured as an active space for open networks and marginal societies as well. Similarly, the collective ®tmark has capitalized on the Web to organize and fund acts of ‘creative subversion’ that disrupt and critique the growing resurgence of the legal linkage of tool and commodity. An original sponsor of the ‘Floodnet’ project, ®tmark has supported a broad range of projects that resist corporate claims to tools and commodities. Most infamous is its interference with an attempt to close down the Internet art site etoy.com, by the online company e-toy, whose claim of URL competition veiled the fact that this online toy company was created well after the launch of the art site, etoy.com. ®tmark also initially sponsored and published Gatt.org. This parodic website posed as the World Trade Organization in order to question the value of untrammeled free trade and financial globalization. It was through this URL that the activist performance collective the Yes Men launched its successful media announcement of the demise of the WTO.[10]

The extent of viral activism’s threat to the logic of corporate power has again become evident in the current investigation and prosecution of Ricardo Dominguez for projects undertaken between EDT and his creational b.a.n.g. lab in the Department of Art at the University of California, San Diego. Two interrelated actions have made him the subject of a current university and federal investigation for prosecution. On March 4, 2010, the day of a state-wide strike in protest of massive funding cuts and tuition increases at the University of California (UC), a participant in EDT launched a virtual sit-in on the website of the Chancellor of the University. For this action, Dominguez is being investigated for engaging in a felonious DDoS (Distributed Denial of Service) attack in denial of legal precedent that a virtual sit-in constitutes an expression of political speech. Related is the investigation of a member of EDT for launching Markyudof.com, which fictitiously declared the resignation of said Mark Yudof, the Chancellor of the University of California. The severity of these investigations, taking place across university-state-federal jurisdictions could well stem from the b.a.n.g. lab’s highly publicized and officially funded ‘Transborder Immigrant Tool: Mexico/US Border Disturbance Art Project’. This project capitalizes creatively on the technologies of Spatial Data Systems and GPS (Global Positioning System) that have enabled a new relationship with the landscape via applications for simulation, surveillance, resource allocation, management of cooperative networks and pre-movement pattern modeling (such as the Virtual Hiker Algorithm that maps out a potential or suggested trail for real hikers to follow). Following the logic of Appadurai’s appropriation for networked

Figure 6. Mixed Relations (Elle Mehrmand and Micha Cárdenas/ Azdel Slade) perform *Technesexual* (2009).

imagination and fantasy for social engagement, 'The Transborder Immigrant Tool' adds a new layer of agency to this emerging virtual geography that would allow segments of global society that are usually outside this emerging grid of hyper-geo-mapping-power to gain quick and simple access to a GPS. 'The Transborder Immigrant Tool' would not only offer access to potential immigrants traveling across the border to this emerging total map economy, but would add an intelligent agent algorithm that would parse the best routes and trails on that day and hour for immigrants to cross this vertiginous landscape as safely as possible.'[11] Under suspicion then is Dominguez's mobilization of imaginative interventions in art for the sake of rearticulating social structures, and resisting oppressive ones that rely on the digital tools of technology for their expressions and operations of authority and power.

In the case of Dominguez's collaborators, digital desire envelops the tools of activism not only in the algorithmic logics of power, but also in the erotic dynamics of digital desire. This is particularly evident in the projects of Zach Blas, Elle Mehrmand and Micha Cárdenas that bear the imprint of Dominguez's lab. These projects embrace the erotic energetics of queer performance to test the limits, to exploit the continual clawback of the openness of the digital network by the capitalist-sovereign system. Mixed Relations is a collaborative techno-performance group of two artists, Elle Mehrmand and Micha Cárdenas/Azdel Slade, who work with Dominguez in the b.a.n.g. lab at UC San Diego. Mixed Relations blends the tools of new technologies with the erotics of queer, transgendered and virtual performance. In their piece, *Technesexual*, Cárdenas/Slade, who is an emergent transgendered performer, embraces passionately with Mehrmand on stage while do-it-yourself (DIY) biometric sensors gauge the heart rates and temperatures of their aroused bodies. In a queer recycling of the desire of the open, the noise of the performers' biodata is computer-processed to produce live audio, including the sound of their heartbeats. All of this audiovisual data is transported live to the online community

Second Life, where the performers' avatars similarly, but not identically, embrace in a performative way that links the performers' physical bodies to that of their virtual avatars. This seeming doubling of liveness/virtuality, which is both mimetic and disjunctively virtual, is enacted in performance by the projection onstage of the simultaneous Second Life performance in an erotic fashion that confuses the source of digi-data. Do desire and its biodata stem from the performers or from their online avatars? Does their performance enhance the discourse of the 'posthuman'[12] by displacing the source of desire from actor to machine? Or, conversely, does *Technesexual* grab the human back from its dependence on digital encoding by performing the reliance of the online community on data generated by live sex? In performing the ambiguities of digital culture, *Technesexual* explores themes of 'affective tension and anticipation, techno-fetishism, and D.I.Y. cyborg bodies', in order 'to look at bodies in relation to each other, as well as in relation to the technologies which extend and multiply them, sonically, visually and physically' (Merhmand and Cárdenas 2009). Precisely what 'bodies' are subject of the look is also in question in this performance so marked by the 'indifferenciations' of queerness, embodied and online. The subliminal pull of the viral condition, the surge of accumulation, the continual surprise of informational texture and the layers of enunciational multiplicity across encoded real and virtual platforms are what lend a psycho-political urgency to these delirious distributions of new media performance.

The political urgency of the queering of technology is also what drives Zach Blas to adopt the theorizing of José Esteban Muñoz and others to bring digital practice into the queer arena of 'mutation and mixing: what may be called the new sublime of "destruction" […] a viral aesthetics' (Blas 2010b). Blas describes his project 'Queer Technologies: Automating Perverse Possibilities' as 'an interstitial organization that produces a product line for queer agencies, interventions and social formations. QT creates, mutates, and establishes flows of resistance within larger spheres of capitalist structurations through viral tactics of branding, mass production, and dissemination' (Blas 2010b). Riding the networked surge of the erotics of distribution, 'Queer Technologies' has offered up for consumption a performative line of sublimely viral products that include the transCoder, a queer programming anti-language; 'Gay Bombs', a technical manifesto that outlines a 'how-to' of queer political action through assemblages of networked activism; and GRID, an etymological reformulation of the initial coda for HIV/AIDS, which is a data visualization application that tracks the dissemination of QT products that have been 'shop dropped' as anti-commodity guerrilla performance activism in various consumer electronic stores such as Best Buy, Radio Shack and Target. The reformulated grid of 'Queer Technologies' is asserted by Blas to work 'toward producing another type of virality that emerges from the strange fusion of map and territory […] to constantly change and mutate with the dominant GRID to continuously infect capital' (Blas 2010a).

Even the tool of the Internet, not simply its corporate patrons and capitalist tools, has been subjected to the interventions of guerrilla hacktivism that prompt reflection on the sociopolitics of the network through parodic disruption for both political and artistic

Figure 7. Zach Blas, *Disingenous Bar* from GRID: Queer Technologies.

purposes. These projects have been as varied in material and context as are the early activist installations of video and the more recent queerings of technology. Two particularly artistic interventions might suffice to highlight the aesthetic ramifications and phantasmatic impact of these projects. In 1998, Mark Napier released the web interface Shredder 1.0 that transforms the web address entered in its location field into an aestheticized mix of text and image. By passing the code of a web page through a 'perl' script written by Napier, Shredder 1.0 rearranges the code of the site before loading it onto the web browser in a way that translates numerical information into abstract art. The same sites that set out to be accessed as closed systems of commercialization can be transformed into open objects of aesthetic transformation. However these aesthetics of translation pale in comparison to the infamous viral performance *Contagious Paranoia*, launched by 0100101110101101.org from the Slovenian Pavilion at the '49th Venice Biennale'. In the spirit of open source, the artists made public their Biennale.py source code so that it could be read and tested on infected computers. The activist dream, not foreseen by the artists, was that the Symantec Corporation detected the virus and then incorporated its response, Python.Blen, into its software, thus canonizing the artistic software tool in the viral defense network of corporate computing.[13]

While the inclusion of Biennale.py into the corporate archive of networked code simply may have been a mistake of artistic fortune, the activist clawback of the digital archive has been at the forefront of the fantasy of the open. Of particular significance is the digital grabbing back of the archive from restrictive and corporate forces in a way that has been informed by the accessibility of the network and conceptual tenets, contrary to traditionally 'closed' philosophies of access and orientation (the fixed object for the legitimate researcher) to an open structure of materials that reorient both the epistemic space of the archive and its organizational power. An early example is derived from the discomfort of the video artist Antoni Muntadas, with the incursion of censorship into the open network of the web. His response was the development of an open database of cases involving censorship of the arts, *The File Room* (1994), which was originally sponsored by Chicago's Randolph Street Gallery (a nonprofit artist-run space from 1979–98) and now is maintained by the National Coalition Against Censorship (Muntadas 1994a). Rather than limit his archive to cases prosecuted by governmental and corporate agencies, Muntadas staged the complex internalization of censorship by featuring cases implicated with the gallery/museum/library world as well. To counter what he calls 'the closed circle of power systems,' Muntadas directly aligns *The File Room* with the activist fantasy of the open:

> *The File Room* began as an idea: an abstract construction that became a prototype, a model of an interactive and open system. It prompts our thinking and discussion, and serves as an evolving archive of how the suppression of information has been orchestrated throughout history in different contexts, countries and civilizations. (Muntadas 1994b)

Just such a notion of the evolving archive now frames an evolving series of international projects whose purpose is to transcribe the archive itself into an event for ongoing thought and cultural critique. Indeed, something of a radical transformation in artistic understanding has shifted cultural energy away from the sole media artist and toward the collectivity of thought and performance whose life takes on new, expanded dimensions in the new epistemic space of the medialized archive. 'CTHEORY Multimedia', of which I am a curator, capitalizes on the artistic and critical openness on the web to organize archives of net.art projects whose themed organization addresses critical issues of networked culture. Arthur and Marilouise Kroker joined with me to curate a number of projects whose networked archives of international net.art intersect with one another through conceptual and artistic interfaces: *'NetNoise', 'Tech Flesh: The Promise and Perils of the Human Genome Project',* and *'Wired Ruins: Digital Terror and Ethnic Paranoia'* bring the openness of net.art into dialogue with the urgency of critical action. 'CTHEORY Multimedia's' current institutional host, the Rose Goldsen Archive of New Media Art at Cornell University, serves as a research repository of new media art and resources that emphasizes digital interfaces and artistic experimentation by international, independent artists. Designed as an experimental center of research and creativity, the Goldsen Archive aims to stage its archived materials by individual artists for critical and artistic conceptual experimentation and for the articulation of open archival strategies. This is a philosophy, having come full circle for the early days of expanded cinema and cable distribution, that is shared in collaboration with a broadening network of activist projects in archival media, from the ongoing projects at the Experimental Television Center, in Owego, NY, to online archival networks based at The Daniel Langlois Foundation in Montreal; the Asia Art Archive in Hong Kong; Database of Virtual Art in Berlin; ICC

Online Archival Zone in Tokyo; Media Art Net at the ZKM in Karlsruhe, Germany; Palazzo della Arte Napoli; Rhizome.org; and V2 Archive in Rotterdam.

It is also a philosophy that has made its way back into studios that are witnessing a resurgence of DIY tool-making for both art and activism. Fueled by the design and conceptual activism of Brooke Singer and others, Preemptive Media carries on the tradition of CAE and 'Queer Technologies' in projects of preemptive design. Its spin-off, The_Undesigning_Org, has launched a series of workshops and blogs on the concept of Undo! or the reverse-engineering of everyday products such as personal care and household products that return to the nineteenth-century tradition of amateur scene. Similarly the gaming lab for social change, TiltFactor, operated at Dartmouth College by Mary Flanagan, is the first academic center to create and research computer games that integrate social causes into their conceptual aims. Similar academic labs for DIY projects that move between and disturb academic and artistic boundaries are proliferating: Renate Ferro's lab, The Tinker Factory at Cornell University, which encourages students and faculty to collaborate around the principles of critical spatiality and tactical media;[14] the Institute for Multimedia Literacy, spearheaded by Anne Balsamo at the University of Southern California; and the Mobile Mapping Project of Kevin Hamilton, M. Simon Levin, Laurie Long and Piotr Adamczyk at the University of Illinois. These labs, which combine archival knowledge with DIY tool making, carry on the legacy of the early video collectives that combined the activism of openness and the mobilization of the productivity of fantasy for the sake of collective engagement in politically progressive encounters with the media.

Of particular significance is the digital grabbing-back of tools and materials from the restrictive and corporate forces of both analog and digital distribution. The viral combination of artistic and theoretical activism has been informed by the accessibility of the network and conceptual tenets contrary to traditionally 'closed' philosophies of art, product and access. Since the early days of video experimentation, an open structure of materials has reoriented both the epistemic space of electronic art and its organizational power. In the prescient words of Woody Vasulka, we have indeed 'moved from a relationship with technology in which we attempt to invoke the creative potential of a specific tool, to one with a technological environment invoking a new creative potential from human discourse […] new epistemic space' (Vasulka 1990: 465).

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Notes

1. Boyle provides a more extensive discussion of the early history of video collaboratives and guerrilla television in Hall and Fifer (1990), pp. 51–69.
2. Maurice Benayoun, *The Tunnel Under the Atlantic*, http://www.benayoun.com/projet.php?id=14.
3. Ted Warburton, *Lubricious Transfer*, http://people.ucsc.edu/~tedw/Lubricious%20Transfer.html.
4. Very much counter to the premises central to this chapter as well as to my understanding of the interrelated complexities of primary and secondary narcissism, Rosalind Krauss critiques video art for failing to 'account for narcissism as a form of bracketing out the world and its conditions at the same time as it can reassert the facticity of the object against the grain of the narcissistic drive toward projection' (Krauss 1986: 190). Maureen Turim positions the rise of theories of video narcissism in relation to notions of the apparatus as a carrier of overdetermined social conditions in 'The Cultural Logic of Video', in Hall and Fifer (1990: 336–38).
5. I discuss the legacy of 'Les Immatériaux' in French new media circles in 'Immaterial Archives: New Media and the Memory of Representation', *Sites: The Journal of 20th-Century Contemporary French Studies*, 4: 2 (Fall 2000), pp. 277–96. Tilman Baumgärtel similarly reflects on the place of this exhibition as a precursor to new media art, 'Immaterial Material: Physicality, Corporality, and Dematerialization in Telecommunication Artworks', in Chandler and Neumark (2005), pp. 60–70.
6. A wide-ranging discussion of the legal framework of copyright, and how Mark Tribe and I understand its cultural implications for what he calls 'open-source culture', can be found in the published transcript of the Columbia School of Law's 2004 symposium on "Metamorphosis of Artists' Rights in the Digital Age', *The Columbia Journal of Law and the Arts*, 28: 4 (Summer 2005).
7. The range of cyberfeminist theory and artistic action is charted in Fernandez, Wilding and Wright (eds) (2003); Mary Flanagan and Austin Booth (eds) (2002), *Reload: Rethinking Women and Cyberculture*, Cambridge, MA & London: MIT Press; and Jennifer Terry and Melodie Calvert (1997), *Processed Lives: Gender and Technology in Everyday Life*, London & New York: Routledge.
8. Jill Scott, *Frontiers of Utopia*, http://framework.v2.nl/archive/archive/leaf/other/.xslt/nodenr-141432. I discuss this work in more detail in *Digital Baroque: New Media Art and Cinematic Folds* (2008), Minneapolis & London: University of Minnesota Press, pp. 249–51.
9. For a perceptive account of CAE and the trial, see Joan Hawkins (2005), 'When Taste Politics Meets Terror: The Critical Art Ensemble on Trial,' THEORY TD007, www.ctheory.net/articles.aspx?id=482; as well as Rebecca Schneider's (2000) pre-trial account of CAE, 'Nomadmedia: On Critical Art Ensemble', *The Drama Review*, 44: 4 (Winter), pp. 120–31.
10. For an extensive analysis of these and other projects in tactical media, see Rita Raley (2009), *Tactical Media*, Minneapolis: University of Minnesota Press.
11. 'Transborder Immigrant Tool', http://bang.calit2.net/xborderblog/?page_id=2.
12. N. Katherine Hayles (1999) develops the notion of the 'posthuman' in *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*, Chicago: University of Chicago Press.
13. For a fuller account of this project, see http://www.digitalcraft.org/iloveyou/biennale_part_2.htm.
14. For an account of the institutional collaborations between the Rose Goldsen Archive of New Media and The Tinker Factory, see Renate Ferro and Timothy Murray (2009), 'Tinkering with the Archive: Pathways to Conceptual Thought and Digital Practice', *Digital Arts and Culture*, Irvine, CA: eScholarship, http://escholarship.org/uc/item/2565799j.

Virtuosity as Creative Freedom

Michael Century

Over the past half-century we have come to accept a reduced notion of freedom as personal choice, exercised by the sovereign individual in the marketplace, at the ballot box, and now, ever more, in the realm of the programmed languages of software for creative expression, entertainment systems, and, most recently, so-called 'social media'. A more expansive way to think of potential freedom residing in such tools for creative expression can be found in the political theory of philosopher Hannah Arendt, whose ideas have inspired a spate of recent commentary owing to the central place they play in Paulo Virno's *Grammar of the Multitude* (2003).[1]

In a 1961 article entitled 'What is Freedom?', Arendt suggests that we recognize that freedom is not just a matter of choice between two given things, or as she puts it, a matter of the will. Rather, she insists on understanding freedom as the capacity 'to call something into being which did not exist before, which was not given, not even as an object of cognition or imagination, and which therefore, strictly speaking, could not be known' (Arendt 2006: 150).

She locates in the history of political thought the concept of '*virtu*'– a Latin word she defines as the 'excellence with which man answers the opportunities the world opens up before him in the guise of *fortuna*'. Arendt renders '*virtu*' as virtuosity, seeking thereby to link it with the performing arts, where accomplishment is enacted in a public, social arena. To be free is not to will, but to act, for Arendt:

> The performing arts [...] have a strong affinity with politics. Performing artists – dancers, play-actors, musicians, and the like – need an audience to show their virtuosity, just as acting men need the presence of others before whom they can appear. Both need a publicly organized space for their 'work' and both depend upon others for the performance itself. Such a space of appearances is not to be taken for granted wherever men live together in a community [...]. If, then, we understand the political in the sense of the polis, its end or raison d'être would be to establish and keep in existence a space where *freedom as virtuosity* can appear. This is the realm where freedom is a worldly reality, tangible in words which can be heard, in deeds which can be seen, and in events which are talked about, remembered and turned into stories. (Arendt 2006: 155)

Arendt is speaking about performance in a way that could have made sense to the ancient Greeks – performance enacted by words and deeds, and unmediated by contemporary communication technologies. In what follows, I take inspiration from her fundamental insight, but depart from her by considering performativity in terms that include the full panoply of the media technologies that now define our communication environment. We are technological 'all the way down', following the techno-philosophy of Bernard Stiegler; there is no such thing as a pre-technological essence of humanity (Stiegler 1998).

To interpret virtuosity in terms of a culture of software and digital media, in other words, in terms of encoding and programming cultures, I now introduce four quasi-technical terms, properties of virtuosity in digital art understood in Arendt's sense of virtuosity – transparency, modularity, modifiability, recursivity.

By 'transparency' I mean the explicit visibility of the source coding underlying an expression, an idea that open-source and free software aficionados will instantly recognize. In terms of technical operations, this means not just using a system as it is given, but being able to locate and understand the underlying principles of design as shared openly with legible documentation.

'Modularity' is one of the properties of digital media we almost take for granted, as indicated for instance in the so-called 'object oriented' programming style. To differentiate a language into discrete components is to make it 'notational', as Nelson Goodman pointed out fifty years ago in one of the best books written on art in the twentieth century, *Languages of Art* (1968).[2] Modules of course do not just consist of libraries of code, but the entire galaxy of cultural heritage as digitized and annotated with metadata, formally defining and tagging contents in a structured, machine-processable manner.

'Modifiability' almost comes for free when you have transparency and modularity. But not entirely: the capacity to change something you like, to tweak or profoundly re-imagine it as something else, requires a mindset that is in principle actively engaged in culture as a producer/author, as opposed to passively engaged as a player/user. In computer culture modifiability has its roots in the Hacker Ethos; the capacity to modify is that of the tinkerer, the bricoleur (Himanen 2001).

'Recursivity' is a concept from social scientist Christopher Kelty's recent book on the 'cultural significance of free software'. A recursive public is one that is 'vitally concerned with the material and practical maintenance and modification of the technical, legal, practical and conceptual means of its own existence as a public' (Kelty 2008: 3). Crucial for Kelty is the construction of 'actually existing' alternatives to other constituted forms of power – think of open-source operating systems like Linux, for an obvious example, in relation to closed proprietary operating systems. The collectivity constituted by a recursive public in an arts or cultural sphere must contain within it a recurring and explicit attention to the conditions of its own potentiality. Usually we think of such techno-social collectives as having utilitarian goals, but here we will not be looking only at digital art-making tools in a narrow sense. The aim of software in this creative domain is to enable innovative expression, which demands the articulation of aesthetic goals in a codependent, co-evolutionary way with the capabilities of the tools.

I imagine that this may seem to some of you rather strange: computational virtuosity, you might object, should rather be defined in terms of the speed of supercomputers; the pixel count of super-high-resolution photorealistic graphics projected onto immense, immersive screens; with artificial intelligence wizardry; or with terabyte transmission rates. But these technically defined measures are precisely what I do *not* mean. I am trying to be true to Arendt when I develop a notion of digital art aiming for 'virtuosity as freedom'. 'Freedom' in this sense is a social process, which Fredric Jameson, unpacking Virno's reading of Arendt, expresses as 'an activity in which the end has become secondary and the production of an object a mere pretext, the process having become an end in itself'. Jameson allows that this virtuosity, as a process in the aesthetic realm, becomes 'activity of language-sharing and linguistic cooperation. [...] [Resituating labor] within some new space from which the opposition between private and public has disappeared, without the reduction of one to the other' (Jameson 2009: 429).

Vignette 1

The video art community in Chicago during the 1970s was strongly oriented toward live performance using real-time image processing and computer animation instruments. Known as the 'Graphics Habitat' at the University of Illinois, Chicago Circle, one of the binding elements of the community was the analog Image Processor (IP) created by Dan Sandin, a physicist who became an artist-engineer. Ted Nelson, an influential techno-utopian author of the time, highlighted the Graphics Habitat in his 1975 book on computer graphics – notably entitled *Dream Machines: New freedom through computer screens* (1974: 41) (Figure 1).

Note in the middle of the diagram the key digital components – PDP 11 computer, a high-resolution graphics monitor, various knobs and dials for real-time control over vector graphics. In the upper right appears a video camera pointed at the PDP 11 computer monitor which then feeds into Sandin's Image Processor, a video instrument modeled on the Moog Music Synthesizer.

Sandin's appointment was in the Art Department of the University of Illinois, Chicago Circle; his engineering collaborator, and later cofounder of the Electronic Visualization Laboratory, was Tom DeFanti. In the early 1970s, DeFanti sought to design 'habitable' interaction systems – what he called then a 'natural user interface' (a phrase picked up by Microsoft forty years later) enabled by various kinds of real-time controllers, that then fed into the Sandin IP, which we have just seen is all about live, spontaneous performance. The Habitat was a complex assemblage, a messy concatenation of analog and digital devices whose operation was beyond any individual's control (more like an ensemble of musical instruments and their players), and its characteristic mode was improvisation (DeFanti, Sandin and Nelson 1975).

Sandin and fellow video artist Phil Morton formulated what they called, curiously, The 'Distribution Religion' for the Image Processor. The ethics of the religion specifies, in Sandin's words, that it may be:

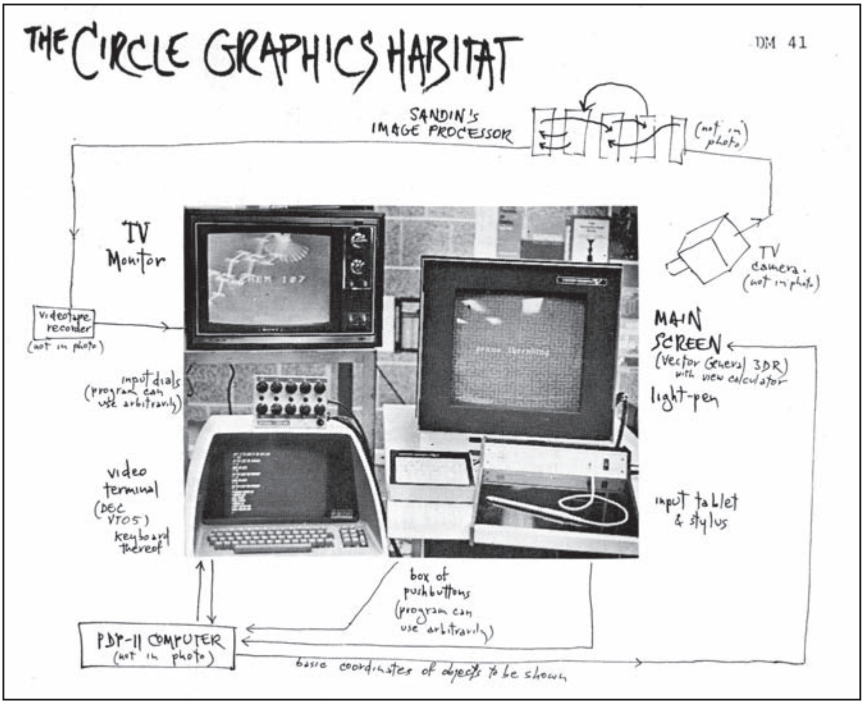

Figure 1. Sandin's 'Circle Graphics Habitat' from Ted Nelson's *Dream Machines. New freedom through computer screens* (1974). (courtesy. Ted Nelson)

> […] copied by individuals and not-for-profit institutions without charge. For-profit institutions will have to negotiate for permission to copy. I think culture has to learn to use high-tek [sic] machines for personal aesthetic, religious, intuitive, comprehensive, exploratory growth. The development of machines like the Image Processor is part of this evolution. I am paid by the state, at least in part, to do and disseminate this information; so I do. (Sandin and Morton 1976)

We can clearly see the IP as transparent, modular, modifiable, but it was recursive only in a limited sense. To be sure, the Habitat grew into a collectivity of video artists sharing this 'homegrown' approach to performing live electronic art, but it was an approach that led to a striking notion of self-understanding through what they called 'electronic visualization'.

In his own use of the IP, Sandin had an anti-notational bias. There was no explicit way of devising scores or notational schemes – therefore no way to build a repertoire or consciously build on other's discoveries; Sandin indeed actively discouraged the establishment of any kind of notational standardization. Here are his thoughts from an interview by Woody Vasulka, himself an important pioneer of experimental video art:

> My idea was just to explain the operating principles of the IP and demonstrate what the modules could do singly. Demonstrate some simple combinations to let them know what the playground was. […] I don't in general show people my standard patch that I've been using on the IP for years […] you just teach the operating principles and people go their own way. The most joyous thing about it is the fact [those who] have built the IP really discover new turf. They see images that I never could conceive of on the instrument. That's the definition of generality, that the device can do a lot of things. It can do whole classes of things the designer never intended it to do. (Sandin 1989)

Media theorist and historian Gene Youngblood described the performative heart of the Chicago Graphics Habitat in terms of a contrast between 'video' as something you watch, and 'electronic visualization' as something you do:

> It is a world you enter, it is something you become […]. Electronics are not just doing their subatomic thing; they are guided by a control structure configured by the user. The control structure is the imagination of the user encoded in the language of the instrument. (Youngblood 1987)

Waxing rhapsodic, and in the characteristic overblown rhetoric of the time, Youngblood concludes electronic visualization through computers furnishes 'the tools we need to practice the *autonomous construction* of social reality' (Youngblood 1987; my emphasis).

Vignette 2

The Max visual programming language, widely used around the world for music and interactive performance and installation, was initially developed at the IRCAM, a Parisian center for research on music and science adjacent to the Centre Georges Pompidou. The Institut de Recherche et Coordination Acoustique/Musique is an elite state-funded institution founded by Pierre Boulez 1977, with a grand goal to narrow the gap between technology and 'musical thought' (Boulez 1977). An early objective was live instrument-electronic integration: rather than requiring the human performer to synchronize to the static timeline of linear tape recording, the idea was to permit musicians to play in a natural, spontaneous way. A powerful digital signal processor called the 4X was designed at IRCAM and uniquely available for use on the premises. It provided resources for general musical sounds and for processing them in real time. The 4X was notoriously difficult to program, but, in spite of this, musical masterpieces did emerge by the late 1980s.[3]

The way this happened was by pairing composers who did not know how to program but had ideas for new music needing technological solutions, with engineers who knew a lot about music and also could figure out how to program the 4X. In Boulez's case, this resulted in a major new work, *Répons*, which was the subject of a *Scientific American* article in 1988, and the logic of the Max relationships are mapped out in Figure 2. *Répons* is a chamber orchestra piece in which the 4X transformed and spatialized the instrumentalists in a precise way, and it is a landmark in live electronic music.

In 1986 a second French composer, Philippe Manoury, began to work with an American mathematician and programmer, Miller Puckette, to create a series of live electronic works that would extend further the level of detail of the connections between performance gesture and computer response. Puckette this time wrote not just a tool, but a proto-language for controlling the 4X as sound generator. This was for a commodity computer, the still relatively new Macintosh. Gathering together ideas already published for 'score following' and real-time event scheduling, and using a graphical programming style, Puckette wrote what was in effect the first Max Patch for a composition by Manoury for solo piano and electronics called *Pluton*.

In this composition, the sound events are determined in advance, but all of their components are not set; they are waiting for information coming from the pianist in order to be executed:

> Everything that's produced by the 4X is derived in real time from the piano part, i.e., the moment that the pianist plays it, and it wasn't predetermined before. It's possible that sometimes there are some differences in the result according to the way some passages are played by the pianist. (Manoury 1987)

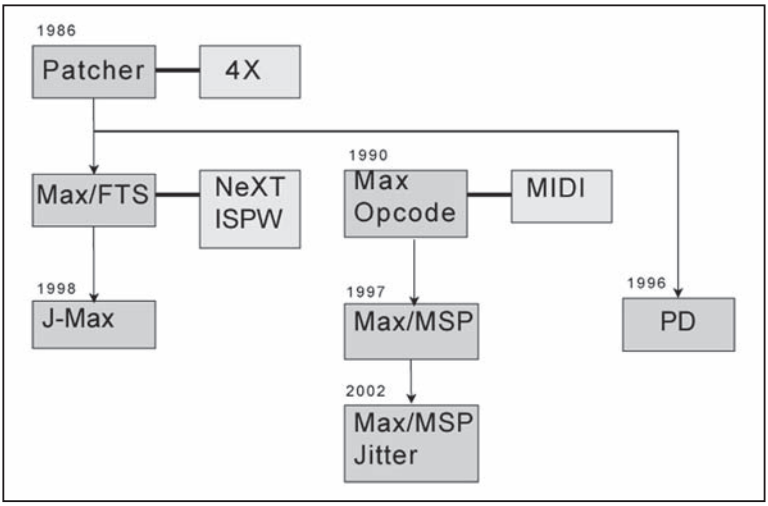

Figure 2. Max family tree.

This is not improvisation, but a precisely regulated interpretative freedom within constraints defined in a virtual score; virtuality in this context is understood as a continuum of expressive intensities.

The initial patch for *Pluton* was a one-off solution intended to support the creation of this particular artwork, and at the same time was the foundation of a general programming language. As Puckette wrote in an article for the *Computer Music Journal*, the 4X was the 'problem' Max had to solve; but also Manoury's musical ideas provided a second problem-set, defined in terms of specific aesthetic goals, not general technical capabilities (Puckette 2002).

Max became a general language for programming, and coordinating live performance and interactive art of all kinds, not necessarily limited to music, much less the avant-garde music that had been the occasion for its inception. It developed in phases, as represented in this diagram. It was brought to the market as a fully documented product with tutorials and developed a vigorous global user community. It expanded to incorporate signal processing within its own framework, then video; it was ported to Linux in an open-source version, Pure Data or 'PD'.

This development can be summarized as movement from a purpose- and device-specific solution to the problems of a particular work into a fully documented set of resources consisting of various levels of openness. Of particular relevance here are three levels of user participation: the least active is that of the performer or end-user of other peoples' patches; next is the level at which users create new patches consisting only of configurations of already existing objects in the language; the third level entails the creation of new objects that extend the capabilities of the language as a whole. There are thousands of these, growing all the time.

The programmer primarily responsible for popularizing Max in the software market, David Zicarelli, had this to say about the language in a 2002 article:

> Rather than solve a particular problem in a particular way, Max creates an ecology within which combinations of elements can form a solution. I like to think Max resembles an 'ecosystem' more than a language. It is not strong on restrictive syntactic or semantic elements. Instead, it pays a great deal of attention to supporting the development of basic elements and how these elements form arbitrary relationships. In Max, these relationships can be formed because the software specifies a wrapper for algorithms, devices, interface ideas, and technologies so they can all relate to each other in a common way. (Zicarelli 2002)

He goes on to define this ecosystem as a set of 'hierarchically related layers of incompleteness' (Zicarelli 2002).

Recalling the four principles I introduced at the outset of this discussion, Max is modifiable, in varying levels and differing degrees according to the artist's or musician's knowledge/capability; it is modular; it is to a degree transparent (some dialects more so

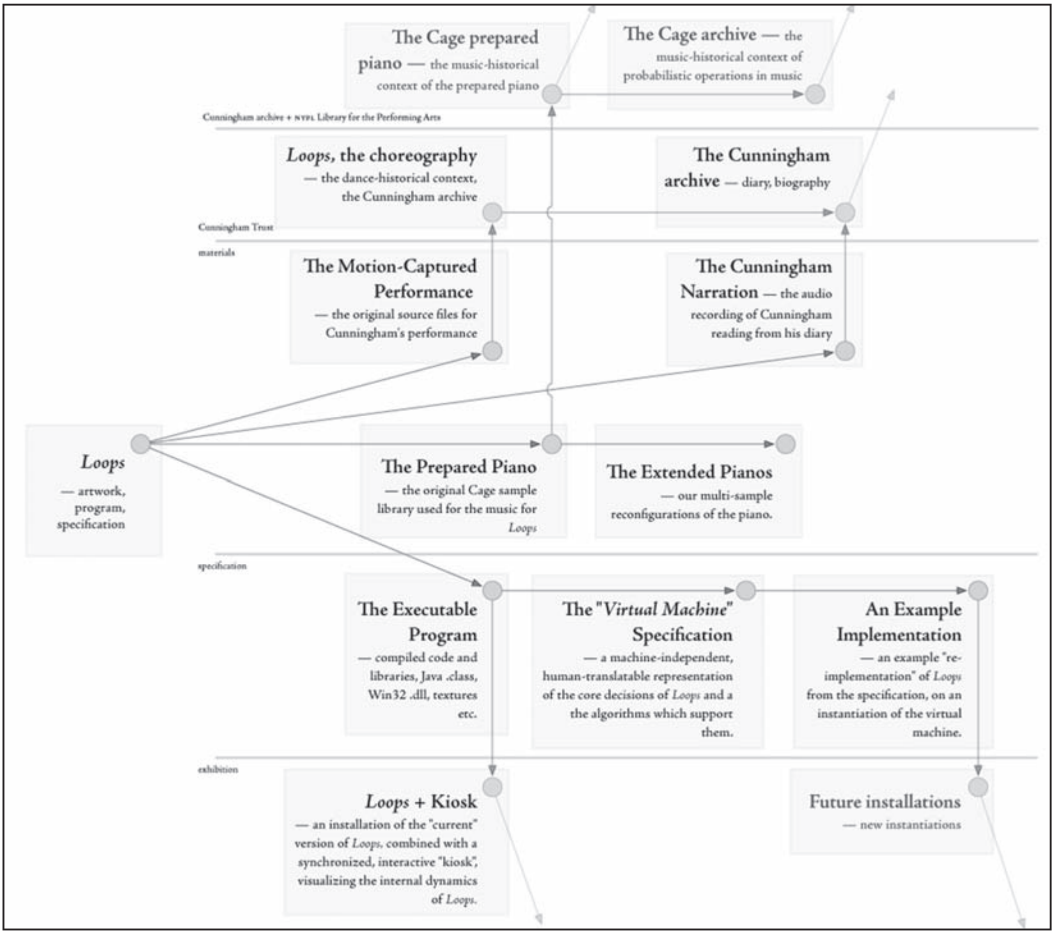

Figure 3. *Loops* Cultural Ecology (Open Ended Group, 2012)

than others; and it is recursive (especially where developers share new objects extending general system capabilities).

Vignette 3

Loops (2001–08) is a multiphase digital artwork created by visual artists Paul Kaiser and Shelley Eshkar with programmer-artist Marc Downie, who together comprise the Open Ended Group. *Loops* began as a motion-captured data set from the dancing hands of Merce Cunningham that when fed into a software system renders this dance of fifty moving points as a 3D computer animation. Cunningham made this choreography (for hands alone) in the 1970s. The data set functions in the animation like a score, but the 'notes' are never rendered literally. Sometimes the initial shape of the hands and their articulation in joints are still visible; sometimes the gestalt of hands dissolves. Nodes leave traces; colors change; lines of connection shoot out between nodes, giving a sort of cats-cradle complex; sometimes the points become articulate and isolated, closer to the original, unmodified motion-capture material. The animation is in effect an improvisation by an AI agent-framework designed by Downie. Three behavioral rules guide each of the computer agents: (1) peer pressure – a programmed desire to act just like neighboring points; (2) excitation – the degree of sensitivity to exciting (novel) news from neighbors near and far; and (3) boredom – the mounting impulse not to be stuck in the same pattern forever (Downie 2005).

In 2008, the source code for *Loops* and the initial Cunningham data set were released to the public under open-source licenses; i.e., people are free to download and further develop the materials, to invent new uses for the data and the code, so long as they preserve the work in the public domain and provide appropriate credit to the source. Furthermore, the authoring environment itself used to create the individual work, called Field, has been cleaned up and documented for use by other artists. The effort to move the project into an open-source public domain has been justified by the creators in terms of a desire to contribute to (and benefit from) a cultural ecology of transparency and reciprocity.

There are three components of this proposed digital cultural ecosystem:

1. Repositories of content, images, texts, samples, recordings
2. Preservation strategies[4]
3. Computational materials e.g., *Loops* motion-capture data, *Loops* source code, Field meta-authoring environment

The Open Ended Group (OEG) conceives a digital ecology as a field in which artworks can grow and thrive, transform, mutate, in 'an intricate system of balances and interdependencies that evolves (or devolves) over time' (Open Ended Group 2012). Marc Downie, musing about the potential of this project for the digital art world, raised the following questions:

> [W]hat if performance (or installation) of an artwork counted as distribution? What if works made with tools under GPL-like licenses triggered the code distribution clauses of the GPL as soon as the doors to the gallery opened? What if the audience had to be able to demand a CD of the source code for the piece on the way out of the auditorium? Critical thought about digital art would be transformed, new forms of scholarship would appear, the techniques of digital art, poorly taught right now, would practically teach themselves in self-assembling online forums. Fantasy, perhaps. [...] Like the *Loops* preservation project itself: a small gesture, but one that we hope becomes exemplary (Downie 2008).

At least one digital art festival took them up on the challenge, the 'Boston CyberArts Festival' in 2009, commissioning a half-dozen artists to create new works extending *Loops*.[5] Further institutional support for Field has also been forthcoming, from the Experimental Media and Performing Art Center (EMPAC) at Rensselaer Polytechnic Institute. EMPAC has not only commissioned new work by OEG, but has sponsored a research project funded by the National Science Foundation to enable visualization of very large data-sets using Field.

In each of the three cases here presented, the artists are 'virtuosos': performers who enact creative freedom within a common communication space of a particular kind – one that enables the growth of a sustainable 'cultural ecosystem', not just the hacking-together of particular exploits. The virtuoso artist is one who 'acts in concert' – not merely one with personal pyrotechnic skills.

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Notes

1. For further readings of Arendt via Virno, see Andrew Murphie (2005).
2. See in particular Chapter 3 of Goodman's book for his theory of notation.
3. For a critical ethnographic account of IRCAM in the 1980s, see Georgina Born (1995).
4. Digital art is littered with the wreckage of one-off hacks, created for a performance or exhibition, but obsolete within years or even months. See Lunenfeld (2000).
5. http://bostoncyberarts.org/festival/loops. Accessed July 22, 2012.

Distribution Religion

Dan Sandin and Phil Morton

DISTRIBUTION RELIGION

THE IMAGE PROCESSOR MAY BE COPIED BY INDIVIDUALS AND NOT-FOR-PROFIT INSTITUTIONS WITHOUT CHARGE. FOR-PROFIT INSTITUTIONS WILL HAVE TO NEGOTIATE FOR PERMISSION TO COPY. I THINK CULTURE HAS TO LEARN TO USE HIGH-TEK MACHINES FOR PERSONAL AESTHETIC, RELIGIOUS, INTUITIVE, COMPREHENSIVE, EXPLORATORY GROWTH. THE DEVELOPMENT OF MACHINES LIKE THE IMAGE PROCESSOR IS PART OF THIS EVOLUTION. I AM PAID BY THE STATE, AT LEAST IN PART, TO DO AND DISEMINATE THIS INFORMATION; SO I DO.

As I am sure you (who are you) understand a work like developing and expanding the Image Processor requires much money and time. The'U' does not have much money for evolutionary work and getting of grants are almost as much work as holding down a job. Therefore, I have the feeling that if considerable monies were to be made with a copy of the Image Processor, I would like some of it.

Put in your own method of returning energy to me here: ______________

Of course enforcing such a request is too difficult to be bothered with. But let it be known that I consider it to be morally binding.

Much Love,

Daniel J. Sandin
Department of Art
University of Illinois at Chicago Circle
Box 4348
Chicago, Illinois 60680
Office phone: 312-996-8689
Lab phone: 312-996-2312
Messages: 312-996-3337 (Department of Art)

NOTES ON THE AESTHETICS OF 'copying-an-Image Processor':

Being a 'copier of many things, in this case the first copier of an Image Processor, I trust the following notes to find meaning to future copiers of Image Processors:

First, it's okay to copy! Believe in the process of copying as much as you can; with all your heart is a good place to start - get into it as straight and honestly as possible. Copying is as good (I think better from this vector-view) as any other way of getting 'there.'

The more you 'buy' the 'copying' of Sandin's encoded intelligence in the I-P, the more you will learn about the man-and-machines. Don't try to make improvements; you'll make it only worse if you modify what already is best, even if it doesn't appear to be the 'best' to your mind's eye. It bothers me very much to see 'folk' laying onto Dan, suggestions of improvement (supposedly) without a thorough giving-in-to understanding of the I-P design. Please realize, that if you 'had-it' to do it you would not be building (copying) an I-P to begin with; you would have done it yourself along time ago...so get to work copying--as-usual.

Dan's evolutionary design of the I-P comes from a very high and thorough CONSCIOUS systems--design-intelligence-level. If you deviate in the process of 'copying' and then Dan makes an improvement on his I-P, you will most likely find it quite frustrating in updating your instrument due to your I-P being incompatible in detail to the original. If you get yourself in a jam, then you have to go to Dan and "$PEND' his time getting you out of it.

So...after all this: the Art of 'copying' is a good form to try on for a year or so while you get into building your Image Processor...enjoy.

PEACE/ASCESIS (love):

Phil Morton

BRIEF SYSTEMS LEVEL DESCRIPTION:

The IP physically is an array of a minimum of approximately 24 modules (aluminum boxes), representing approximately 40 electrical modules.

The documentation that follows is simply a description of how to build the aluminum boxes; the system is considerably more powerful than the sum of the boxes.

On paper a description of how the IP works is more difficult than I am prepared to do. It is best communicated on video-tape; send me a video tape of you best stuff and I will send you a video tape on the IP, and/or send blank tape and \$5/hr. (2 hours should do it.)

But in brief, the Image Processor accepts signals = $\pm$ .5 volts 75 ohm including video signals. These signals (images) are distributed into (usually) a number of processing modules and then (usually) mixed out into a standard color encoder (output module). Since most of the processing modules are voltage controllable and control voltages and images are interchangeable, fantastic combinatorial power is possible.

The 'classic' Image Processor contains 8 adder-multipliers, 3 function generators, 3 comparators, 3 amplitude classifiers, 4 oscillators, 3 differentiators, 9 references, 1 sync strip and camera input, 3 inputs, 1 sync generator, 1 color encoder and power supplies. These refer to electrical modules and not aluminum boxes. This constitutes a very powerful processing instrument and because of systems power level (inter-connect-ability), I recommend building approximately this much.

A Toy for a Toy

Ralph Hocking

Paik, what can I say about you? I have tons of your detritus dating back twenty-some years. I could show you – from old tv sets to the old clothes you left here at various times. I don't throw anything out, just build buildings to put it in. When you called the other day I asked you if you wanted this to be good or bad. You said bad. Predictable. I have been worrying for days, trying to come up with something bad. It hasn't been easy. Damn little of our relationship has been bad.

Figure 1. Ralph Hocking's damaged piano, front view. (photo. Sherry Miller Hocking) Please see Color Plates 16 and 17.

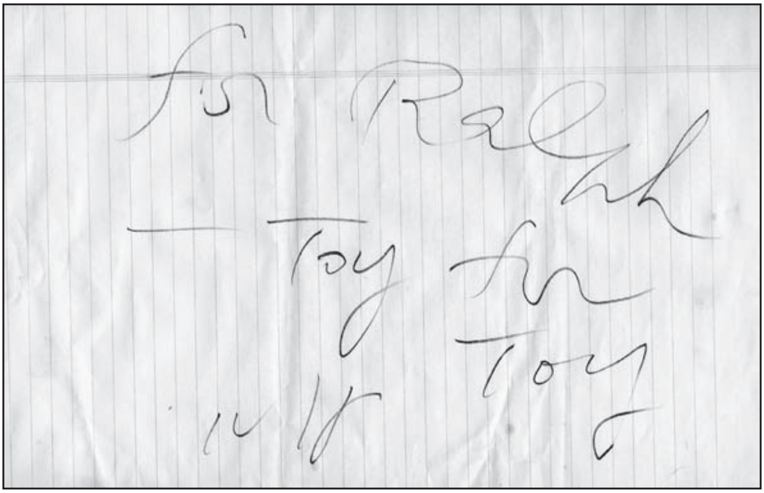

Figure 2. Note from Nam June Paik to Ralph Hocking. (photo. Sherry Miller Hocking)

I finally remembered the time you deliberately broke one of my machines in the name of ‘art’. During a performance at Binghamton University in the early seventies, you smashed a beautiful tiny grand-piano with a dancing lady on top. I had just gotten the thing and hadn’t had time to savor it. It was a player piano with a punched paper roll inside just like the big ones and showed great promise as an idea-irritant. It was even made in Japan. You asked to borrow it. I told you ok if you didn’t hurt it. Hurt it? You fucking destroyed it. I stomped out of your performance and wouldn’t speak to you for months. I was pissed. Art hell. Fluxes, Shmuxes. You can only push people from Ohio so far and then we become Ohioans. (Color Plates 16 and 17)

A package arrived one day and inside was a smashed violin. You outfoxed me. How could I stay mad? But I haven’t forgotten and I will never forgive you. If you die first, I am going to bury the piano with you. If I die first I will leave it to you hoping that you will be haunted by the fact of what you did. Just wait ‘til you die. Or I die. If we die. You’ll see.

– Ralph Hocking, letter to Nam June Paik,
Owego, New York, 1993

Woody Vasulka: Dialogue With the (Demons in the) Tool

Lenka Dolanova with Woody Vasulka

> So I think that what used to be the source of the poetic material in the past is now technological systems. They are increasingly populated by demons and they behave more and more like humans, and the more of what we call intelligence is assigned to them, the more demonological systems will arise, the more mystery and the more stories for the future imagination will be found there. This was predicted by science fiction, and if we believe in that we will have regained a poetic system in its glory. (Vasulka and Weibel 2008: 397)

> We are not here because we create the machines. We are here because the machines need us to live. (Kirby 1997)

Woody and Steina Vasulka have become legendary for devotion to their tools. They not only quote them in the surveys of their work, but literally share their living space(s) with them. The metamorphosing nature of these tools determines the character of the dialogue, their structure being directly related to the 'style' of their emergent work. While this essay is dedicated primarily to Woody's mind-set, it inevitably contains references to Steina's work, because although they claim that their work pathways split in the middle of the 1970s, both artists still share their living and working space as well as their tools. Also, an underlying theme of their work is the documentation of their coexistence with the tools; 'I would put it this way: the main key towards what appears to be a style or direction is usually embedded in the tools. It's the evolution of the tools which in our work we usually illustrate.' (W. and S. Vasulka n.d.: 15–16)

Introduction (out of frame)

Before they entered the United States in 1965, Woody and Steina met in Prague, where Woody studied documentary film at FAMU (Film and TV School of the Academy of Performing Arts), and Steina, who comes from Iceland, studied violin and music theory. Woody was introduced to technology in his native town of Brno, capital of Moravia; he often recalls the early collecting experiences during his boyhood wanderings through the local military airport – collecting which he has continued since then. After World War II, machines were perceived as suspicious a priori artifacts, inviting deconstruction. Peter

Rubin's video documentary *42 Miles from Big Brother* (1987) contains the unique takes of the Vasulkas and other allied collectors, searching in a cache in the Black Hole, a bazaar of discarded military and other equipment in the heart of Los Alamos, the town where the US government conducted research into the development of the first atomic bomb. In the commentary, Woody talks about the fact that he was almost born at a dump, because Europe after WWII was one big junkyard. You could find all sorts of things at the Brno military airport that would inspire the fantasy of a little boy, and thus Woody's passion for finding technological outlet components was born there. Woody considers it an almost subconscious process, presupposing a mutual kinship of the collector and the object, analogous to another of Woody's hobbies: mushrooming. Whereas picking up mushrooms – a typically Central and Eastern European pursuit – is related to a kind of natural survival instinct, collecting technology and its underlying codes is a process of collecting knowledge, necessary for survival in today's 'society of control' where codes dictate who gets access to information (Deleuze 1992: 3–7). Woody has participated in an effort to 'acculturate' technology; to convert the manipulation of codes into the craft of the individual.

Woody admits that only the process of working with video brought him the intense sensations that he experienced during his childhood dismantling of the residues of war machines (W. and S. Vasulka 1973). As with many others, Vasulka's interest in video was initially as a medium that suggested a greater amount of freedom concerning image processing and access to equipment, but also in the overall context of presentation and distribution. The Vasulkas' underlying aim is unfolding the potential, the 'intelligence', of their working material. At first in analog video, later in the digital sphere, their work always exhibited a strong desire to disclose the secret, to find the code, to 'grok' the medium. Belonging to the most important group of creators who formed an institutional as well as a theoretical 'frame' of video, the Vasulkas simultaneously try to challenge this frame, reaching an 'out of frame, or 'out of sync' condition. This article suggests how the dialogue with the medium is being transformed with each new experience of videomaking, and how the dialogue with the machine is necessary alongside the creators' dialogue with their own accumulating histories.

The desire to go 'out of frame' is also the desire to get rid of the supremacy of the human eye, the inherited modes of perception, and to reach an alternative (let's say 'non-camera' or 'non-human') point of view. Steina's 1978 work *Machine Vision* brings the possibility to see things 'differently', and suggests an alternative approach to image by disclosing new relationships between our perceptional models and outer reality. *Machine Vision* demonstrates the principle of a total point of view. It uses two cameras placed on opposite sides of a moving rod, panning and recording reflections from both sides of the mirrored sphere positioned in the middle of the rod, thus 'seeing' the surrounding environment – including the apparatus itself – in 360 degrees.

While in much of Woody's work his rebellion is aimed against the camera and its pinhole principle (and thus stresses the generating or constructing of the image without camera), Steina offers alternatives to the human eye (e.g., in her preference for cameras on machine-controlled moving tripods); together they attempt to deny the limiting cinematographic principle called 'camera-eye', and offer a different organization of perceptual experience. While their early video works supported observational modes of creation (for example, disclosing the frame during a deflection process), their entry into a digital medium directed the creators more towards a constructivist approach of creating an independent machine reality (constructing an artificial frame). Woody's robotic installations of the 1990s take 'out of frame' even further by letting the semi-autonomous machines navigate in an 'omnidirectional' digital space.

Dialogue with the tool

> Our work is a dialogue between the tool and the image, so we would not preconceive an image, separately make a conscious model of it, and then try to match it, as other people do. We would rather make a tool and dialogue with it; that's how we belong with the family of people who would find images like found objects. But it is more complex, because we sometimes design the tools, and so do conceptual work as well. (Gill 1976: 48)

To have a dialogue with the tool suggests that there is no preconceived idea of what is to be made. Observation of the machine behavior is an inherent part of the working process. Video processing tools were closely connected with audio synthesizers, which stimulated the development of video tools towards real-time aesthetics and production methods similar to playing (as with a musical instrument). The tradition of constructing audiovisual tools leads to baroque color organs and further; it is possible that Woody takes inspiration from the rich history of 'color music' and also feels a certain kinship with two Czechoslovakian solitaires: Zdeněk Pešánek, who since the 1920s developed various color pianos interlacing sound with the play of the light; and Milan Grygar, a Slovak-born and Prague-based author of acoustical drawings and scores using found mechanical toys from the end of the 1960s. Woody knew about Grygar's work and appreciated the accidental aspect of his creation, its playfulness and the real-time feedback features in his creative process.[1]

Dialogue with the tools also presupposes participation in the process of constructing the equipment itself, which means that the artist needs to learn how to use and construct tools and/or cooperate closely with engineers. In the case of the Vasulkas, they felt closely related to the subculture of tool makers in the United States in the seventies and eighties who retained their independence from the commercial system and worked outside the television industry, having 'the same purposeless urge to develop images or tools, which we all then maybe call art' (W. Vasulka 1978: 20). This independence from the system of commercial production was a key factor: an artist entering a dialogue with the tools begin to create his or her own creative (and living) environment. This creativity includes not only reshaping the tools, but also operating outside the established institutions, and forming an independent critical circle and alternative distribution systems. An 'ideology' of the tools (their production, distribution, accessibility, etc.) has become an important subject of study since the 1960s. What distinguished the 'art tools' from the commercial ones was usually a greater amount of flexibility, accessibility by those with limited financial means, and the possibility of free sharing and modifying of the tools. Tools invented since the beginning of the 1970s by various artists and engineers across the United States shared some common functions, and it was possible to combine them during use. In the construction of these tools, feedback played an important role: experience with one set of tools influenced construction of the ones that followed. In the case of the Vasulkas, the dialogue with the tools always contained certain personal consequences:

> But all the possibilities of dealing with the tool, or the technology, in fact evolving this self-learning process through the tools and in fact mastering that with our own environment and economical unit as two individuals, that is crucial to me. (W. and S. Vasulka n.d.: 16)

Organizing the matter

Like other artists, the Vasulkas saw video material as a sort of independent, plastic 'matter' from which certain structures could be detached, making them accessible to the visual and aural senses of the observers. We can talk about a double existence of electronic images: the primary (virtual) state as a latent existence of the image in a shape of signal (or code), existing independent from its visualization; and its secondary (actual) state as created by organizing forces, such as synchronization pulses. The content of the image is the visualization of its underlying code. Virtual signal or code can be actualized through the process of its 'formation', when it gets depicted on the monitor. Each image arises from a continuous spectrum, existing as one of the possibilities of its actualization. Such an understanding is evident, for example, from the following excerpt of an interview with Woody by Jon Burris:

> Woody: [The television frame] indicates that there is a relationship between a code and its physical manifestation in space. It's a system which provides us with actual interface.
>
> Jon: It also gives us a kind of stability within a range of possibilities that are immensely broad. It's a construct for our perceptions, it's a construct for our cognitions. (W. Vasulka 1997: 32)

One of the video art pioneers, Stephen Beck, described the synthesizer as 'a filtration device in which, due to the proper selection of numerous electronic conditions, a given image out of the infinity of possible images results as a picture' (Beck 1975: 162). The creator working with flexible electronic material generates an impulse: his or her task is to set up a situation and induce certain parameters, but the processing is necessarily shared with the machine, which further develops these parameters. Not without a certain irony, it is thus, '"the ability to turn the right knobs –" (Woody), "with the right piece of equipment." (Shridhar Bapat), which makes it "a new definition of the concept of the decisive moment." (Jud Yalkut)' (W. and S. Vasulka 1973). One of the most important characteristics of early video art was the cyclical character of electronic image, enabling immediate feedback, and many early installations played with the technology of the closed circuit. Here, the parallel with human consciousness and its functioning in perception is evident. Mathematician and physicist James P. Crutchfield from the Santa Fe Institute, a science research and education center, returned to the subject of feedback in the 1980s in his article 'Space-Time Dynamics in Video Feedback' in which he called the video feedback system a 'spatio-temporal simulator'. According to Crutchfield, feedback is an ideal testing space for developing and expanding the perception of spatial complexity and dynamical behavior (Crutchfield 1984: 191). For Woody, the discovery of feedback was one of his key early experiences with signal processing, and it underscored his awareness of the 'organic' character of the video medium:

> I had not seen anything like it before, and I was able to watch and observe this particular fire in a cave, as I called it, for days, which was always different and always fascinating. There is something that you know has other meaning in its ability to self-generate and self-organize. Of course, you can control it like you can control fire, but you cannot predict all its phases, you have no linguistic defense against this relentless process except by saying, 'It is like being in a dream.' And a dream it was. It took a few nights for my mind to deal with until, finally, a catharsis took place: 'You have been processed!' (Vasulka and Weibel 2008: 415)

Many tool creators and researchers of the time considered the new electronic equipment as new instruments of communication, or even tools for expanding consciousness. The strongly rooted belief that the structure of electronic tools reflects and shapes our thinking – that these are the tools which will challenge our mode of receiving the audiovisual information – was perhaps most decisively expressed in *Expanded Cinema* (1970), the influential book by Gene Youngblood devoted to the pioneers of experimental and computer film, holographic cinema, audiovisual media installations, and other forms of 'cinema-expanding consciousness'. In many places in the book Youngblood asserted that artists should invent or adjust the new tools to mediate their inner experience, their consciousness being formed at the same time by the new technology and by the experiments with new drugs (Youngblood 1970).[2] Above all, he claimed that it was the immediacy of the medium of television that gave rise to a belief in its potential of disclosing new relationships between the self and outer reality. However vague the definitions of the character of this expanded consciousness might have been, this philosophy nevertheless remains one of the strongest prevailing myths of the period.

The group of image creators who concentrated on the 'inner parameters' of the video medium were labeled with the term 'image processing', generally understood as a research of the basic parameters of the electronic signal. These artists formed a certain (only later defined) group or style of video making, experimenting with video synthesis and signal manipulation, and inventing new machines that could employ techniques like colorizing, keying, switching, or various combinations of 'invented' techniques.[3] The aim of these artists, including the Vasulkas, Nam June Paik, Dan Sandin, Phil Morton, Stephen Beck, Ralph Hocking, and others, wasn't to produce art 'objects' – for example, in the form of finished videotapes – but to examine the process of image formation and the relationship of the creator with her or his own tool. The Vasulkas began to examine electronic signal parameters by violating the rules of input and output, purposefully introducing errors into the system to disclose its structural qualities. The inner functioning of the technology appears through a 'broken cable' when the frames dissolve and disclose the concealing mechanism itself. Through the imperfections, which at first came up accidentally, the creators learned about the functioning of the television medium, gradually gaining a greater amount of control. The new machine reality becomes a kind of Utopia:

> Our reality should be the one that we can dream about, be utopian about. This is all a paradox, because I don't know why I serve these machines, and certainly don't want them to serve me. But I do willingly submit myself to this process of working with them, letting them speak, letting them live. (Vasulka and Weibel 2008: 396)

In his most abstract works, aspects of Woody's story about his relationship to his own tools gain a somewhat radical form, particularly in his concept of 'One Scan Journey', where a work is limited to the description of the evolution of an image frame:

> […] the story contained in just describing the construction of the electronic field/frame could become the story of the 'One Scan Journey' or the 'Spaces' or 'Parallelity' that brings quite different esthetic experiences, encoded into different kinetic scales, as separate layers of drifting images, different rates of Flicker. The extended narrative possibilities of those seem perhaps banal at first site, but could become a fantastic opportunity to elaborate on the subject of 'abstract narrative' in Sharits's terminology. (Vasulka and Weibel 2008: 416–17)

However, although the results of the Vasulkas' formalist research of electronic material are primarily abstract, they often carry references to a larger cultural and social context, and also contain important autobiographic aspects. Woody's endeavor to bridge the spheres of culture and technology presupposes a detailed understanding of the character of the electronic medium. It includes a desire to suppress inherited aesthetic concepts, which means not only leaving his career in documentary filmmaking and editing, but also entering a different sphere from the one he felt was more 'natural' in his own development. Leaving behind the secure sphere of more traditional approaches forces one to transform his or her own thinking, and the reflection of this process became, in Woody's case, the theme of his work.[4]

1. Early experiments

The New York City period (from 1965 to 1973, when they moved to Buffalo, NY) was for the Vasulkas a time of acquainting themselves with American independent art. Soon they were introduced to the medium of video, which eventually meant the abandonment of their work in film editing and music. The Vasulkas began to experiment with video 'full-time' in 1969, when they received their first portapak. For a short period (1969–71) they belonged among the devoted 'portapies',[5] documenting the 'off off off Broadway' scene of experimental theaters, jazz concerts, gay cabarets and street musicians, using the first portable video equipment introduced to the US market. These recordings became material for further use, being reworked or made parts of new works. The Kitchen, a free curatorial experiment providing one of the first venues for exhibition of the work of electronic media experimenters from various disciplines, was cofounded by the Vasulkas with Andy Mannick in 1971, and was the beginning of their curatorial and collecting activities.

1.1. Vision machines

After he arrived in New York in 1965, Woody worked as editor on the technical design of multiscreens for international world expositions. The important impulse for his break-up with cinematography was meeting Alfons Schilling, the Swiss-born artist who came to New York City in 1962 to try and find his way distinct from traditional art disciplines, and influencing Woody in this direction. In particular, Woody began to research the various manifestations of 3D imagery, such as holography, stereo-photography and 3D virtual spaces. Like other artists experimenting with new technologies, he also spent some time in the Bell Telephone Laboratories in Murray Hill, New Jersey, where he became acquainted with the work of Béla Julesz, a neurologist and experimental psychologist of Hungarian origin and the author of the book *Foundations of Cyclopean Perception*; Julesz influenced Woody's swing to autostereogram.[6] The stereo experiments constitute a part of the Vasulkas' work which has so far received little attention. Woody continued his 3D vision experiments later in his video work: a special tool for stereo experimenting was made for the Vasulkas by George Brown, and 3D imagery emerged with Woody's use of Rutt/Etra Video Synthesizer (also called the Rutt/Etra Scan Processor), where the frame itself can gain a shape of an

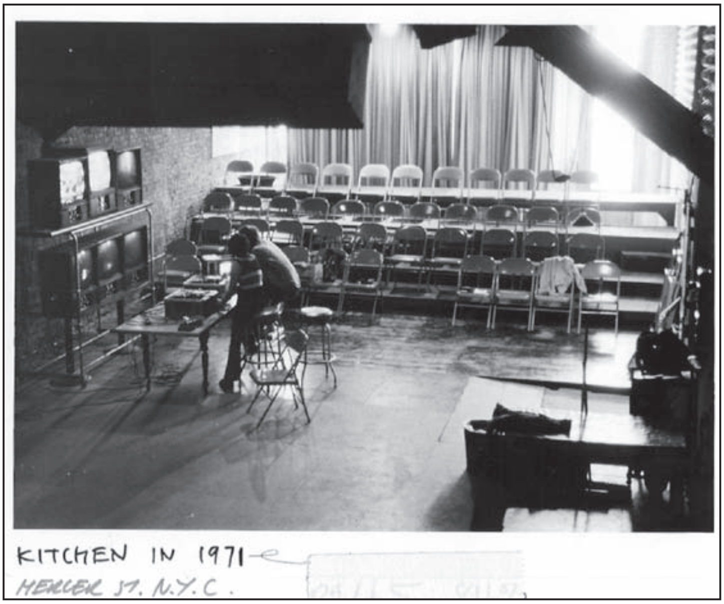

Figure 1. Tomiyo Sasaki and Ernie Gusella during an editing process in The Kitchen (1971). (courtesy. Steina and Woody Vasulka).

object floating in space. In Woody's installation cycle *The Brotherhood* (1990-98), there are 3D computer models, interrelated with the movements of a machine in physical space.

In the summer of 1967, Alfons Schilling and Woody moved to a loft at 128 Front Street in Lower Manhattan, and began to experiment with 'vision machines'. One of the instruments created by Woody was called Spider, a tool for recording the changes of parallax, enabling him to create a series of shots of the same object and producing a sort of 3D photo. They experimented also with stereo slide projectors, or two projections simultaneously on the same screen, whereby the rotating disc in front of the projector alternately interrupted the light flow, creating various 3D effects. Woody used adjusted 16mm Pathé cameras for experiments with a slit aperture; he removed the mechanism that moved the film inside the projector and closed off the whole lens except for a tiny hole in the middle, creating an early example of a slit-scan technique.[7] The experiments resulted in short (about four-minutes long) multiscreen films, *Aimless People*, *Peril in Orbit*, and the 360-degree *Three Documentaries*. An unrealized project *A Meeting/ Greeting* (1967), mentioned in a catalog of a later exhibition of the Vasulkas' work in Buffalo, was supposed to be an installation with two cameras located on a fountain. Each one of the cameras was automatically recording a 180-degree space of two people walking around the fountain.[8] Also, Woody experimented with sequential recordings with the use of stroboscopic light and with moveable turntables and projectors, which during the projection imitated and doubled the movement of film objects. The utopian aim of these experiments was to create a 'frameless cinema' and examine various ways of presenting the observer in the observed; this early 'endoscopic modus' (observing one's own observation) to a great extent influenced the later work of Steina and Woody.[9]

One of the main aims of practical work, as well as theoretical thinking of the time, became the difference between film and analog video and digital 'framing'. Artists were trying to discover how the enclosing of the field of visibility occurs in various media, and what conceptual and perceptual consequences it brings about. In his essay 'The Frame' Woody writes:

> The positioning of the frame is achieved differently in each medium. In film, physical 'sprocket holes' position the film horizontally while the gate positions the leading edge vertically. In video, the image/frame is constructed from timing pulses prescribing the position of the lines and the axis of the frame. The timing pulses are encoded into the video signal to emulate the 'sprocket holes' of film and to position each succeeding frame in the precise place of the preceding one. (W. Vasulka n.d.)

The nonexistence of a stable frame is what differentiates film from electronic image: here the frame (image or field) is a flexible and changeable entity, which becomes visible only when an unexpected event, an error, takes place. Unintentional errors, resulting from the instability of the television signal, become constituent parts of the creative process. The Vasulkas' entry into video was influenced by the legendary exhibition of 'television art' 'TV as a Creative Medium', which Howard Wise organized in his gallery in May 1969. Among the group of New York artists participating were Paul Ryan, Frank Gillette, Ira Schneider, Les Levine, Aldo Tambellini, Nam June Paik and Eric Siegel; Siegel was one of the tool designers the Vasulkas later cooperated with in tool development. For many, the exhibition was the impulse to realize that working with a television image can provide new perceptual experiences, and can allow a great variability of manipulations. Jud Yalkut summarized:

> TV art imagery engenders multitudinous means of presenting itself upon whatever chosen monitor the presentation of a complete closed circuit system loop as a gallery piece, the modulation and distortion of received transmissions, the inclusion of the spectator as a visual link in the cybernated chain, and the eventual broadcast, through the air via cable, of articulated and composed video imagery. (Yalkut 1969)

Beginning in 1970, the Vasulkas began to experiment more systematically with feedback, and discovered one of the key modalities of their work: the possibility of interrelating sound and image, at first using an audio input for generating or altering a video signal. Thanks to the grant gained through the nonprofit media arts group Electronic Arts Intermix (EAI), the Vasulkas were able to finance their first activities, which were connected with a newly founded 'electronic media theatre', The Kitchen. The money from EAI was spent on the programming and rent of The Kitchen, and on buying and constructing their first equipment.[10]

2. Image processing: wave, the signal is coming

> But the signal is a signal, that's what it is about. It's the signal. (W. and S. Vasulka 1985)

2.1. Video synthesizers: images versus sound

'Synthesizer video' (Gill 1976: 67) emerged at the end of the 1960s in close connection with the musical avant-garde. The development of the first video synthesizers was inspired by sound synthesizers, which many artists used; the Vasulkas owned the then common type of audio synthesizer, the VCS3, also called The Putney.[11] For the Vasulkas, crossing the boundary between audio and video synthesis was natural because of Steina's earlier musical education, and also Woody's musical praxis before he came to the States. Experiments with an oscilloscope (an instrument making visible

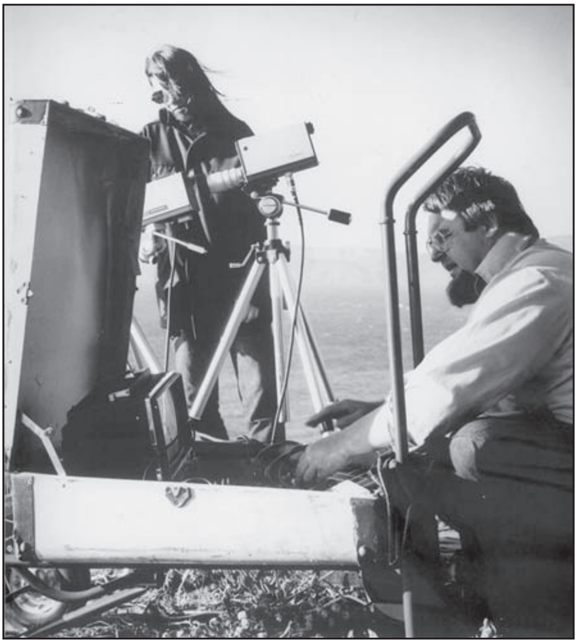

Figure 2. Steina and Woody Vasulka's 'open studio'; the photo is labeled 'From East Coast to West Coast' (1972). (photo. Warner Jepson; courtesy. Steina and Woody Vasulka).

the signal voltages) disclosed the fact that an electronic signal can be directly visualized in a form of waveshape, and influenced their structural approach to the video image. As John Minkowsky explains, the video synthesizer is 'a general term for a system of electronic modules that can generate and/or alter video imagery in real time' (Minkowsky 1978: 3). Several kinds of synthesizers can be distinguished; that the basic classification is into 'image processors' which use the camera input or prerecorded images and alter the parameters of the signal (e.g., the type created by Nam June Paik and Shuya Abe), and which typically also contain functions of colorizers, keyers, mixers and sequencers; and 'direct video synthesizers' (e.g., the Direct Video Synthesizer by Stephen Beck), which work without camera input creating (color) video signals only through electronic generation.

After discovering that the 'art materials' of their work were video and audio signals, frequencies and voltages, the Vasulkas found that working with video could be regarded as a continuation of sound experiments (Gill 1976: 83). Although the sound was never totally derived from image or image from sound, an image-generating signal often became a vehicle for generating or modulating sound, and vice versa. From the beginning, the Vasulkas insisted that their work was interactive, created in real time in the process of observing image behavior, and in the majority of their works from the early period, the image emerges, in a way, as a 'by-product' of sound. The artists tried to prove that electronic image and sound are of the same nature, only differently organized (the main difference is in frequency range, which in sound is more variable), and live audiovisual performance became the art form of the day. Apart from the Vasulkas, the foremost experimenters in real-time audiovisual performance were the key figures of the 'Chicago Circle', Dan Sandin and Phil Morton, and in California, Stephen Beck, the author of one of the first video synthesizers. Beck also considered his synthesizer (the Direct Video Synthesizer or DVS) not an instrument for making videotapes, but rather as the tool whereby he could 'play images as music' (Beck 1975). Dan Sandin was directly inspired by Robert Moog's ideas and the Sandin Image Processor (constructed in 1971–1973) was made as an analogy of Moog, version 2 (Sandin n.d.). The real-time aesthetics of the 1960s and 1970s is evoked in the contemporary audiovisual scene using algorithmic programming environments like Max/MSP/Jitter, Pure Data or Image/ine, or in 'livecoding' branches of current experiments when an 'artwork' emerges in real time in the process of writing and rewriting the software code (Yuill 2008).

2.2. Artists versus engineers ('New Americans')

Eric Siegel: Dual Colorizer; EVS

Eric Siegel, born in 1944 in Brooklyn, was a child prodigy; a techno-maniac who at the age of 15 made a closed-circuit TV system using outlet material, and a year later, the technical invention 'Color Through Black-and-White TV'; both these innovations received prizes at New York Science Fair (Siegel 1970). As an artist, he introduced a video synthesizer at the above-mentioned exhibition of TV art in the Howard Wise Gallery, where he also showed a work created on it, called *Psychedelevision in Color*.[12] What was originally called a 'video effects generator' or 'magic box' became known as the Electronic Video Synthesizer (EVS); Siegel had created a prototype of it in 1970 in San Francisco. The EVS processed at first only black-and-white images, but Howard Wise, who wished for a color version for the exhibition, gave him money to create a system which would add color. Siegel accented above all the color intensity ('the colors are the most intense ever seen on any television monitor before') and the live aspect of the tool, as it could be used for audiovisual performances. The idea to create a tool for live video processing in the tradition of music instruments had appeared already in an early phase of Siegel's development of what became the EVS. Siegel considered EVS not only an analogy of a music instrument in the visual sphere, but also a tool capable of inducing altered states of consciousness, for example, by using the tool to influence the flicker rate of a television image (Siegel 1992). He was also interested in biofeedback, and suggested using his synthesizer for observing the neurological reactions on 'self-activated' patterns.

Another tool which Eric Siegel created was the Dual Colorizer, a tool assigning 'artificial' color to black-and-white images according to differences in a gray scale. The user can, in real time, choose images with specific intensity and can determine into which image sections to place them. The Vasulkas were two of the artists who used Siegel's colorizer as part of their equipment for video image manipulation, and Siegel also helped Woody to set up his own colorizer (Furlong 1985). In works like *Black Sunrise* (1971), *Distant Activities* (1972) or *Home* (1973), the Vasulkas typically applied vivid and rich synthetic colors. Siegel further improved his colorizer later, adding additional circuits and improving its controls.[13] Siegel, one of the 'new Americans' (as Woody called the first tool makers and artists who naturally understood the sound and image synthesis), is also author of a notable video travelogue series made in India. When Woody asked him if he felt like he was an artist, he answered that he considers himself more of an inventor in the lineage of Nikola Tesla:

> Howard Wise wanted to label me as an artist and I was, you know, young and rebellious, and I didn't see the advantage of being labeled an artist. I was trying to tell at least Howard Wise that my work was more like a Nikola Tesla or some experimenter that's not just into art. (Siegel 1992)

'Tool person' George Brown

> George's instruments put us right into the middle of media experimentation. To us they felt very sophisticated and, just as with digital tools and the computer, we never reached the bottom of the trunk. To me a good tool generates its own secrets at a much greater rate than it discloses them. (Gill 1976: 130)

The tape called *Evolution* (1971) is a play with retiming of the image, in which the horizontal and vertical synchronization pulses get 'in conflict.' Woody mentions that the work was decisive for the early period. The first part of it is created using video feedback in which variable image signals control sound synthesizers; the second part – containing a 'film strip' with the evolution of a man drawn from biology textbooks – shows a horizontally and vertically deflected frame. In the third, light rays are generated with the use of a sound synthesizer (Vasulka and Weibel 2008: 411). The tool called a Horizontal Drift Variable Clock (1972), or so-called drift clock, is an oscillator circuit providing an external source of synchronization, which enabled control of the horizontal movement of image, thus 'drifting' the image from its frame. It was George Brown, another distinctive technical workmate of the Vasulkas, who constructed the drift clock. Horizontal drift is part of the original Vasulka repertoire. While in *Evolution* the drifting event was still a pure chance occurrence – the 'broken cable', which results here in the accidental horizontal frequency deflection with a variable clock – it was possible to control the drifting frame, change its velocity or direction, shift it up and down or to the sides or diagonally to illustrate the 'plasticity' of an unstable video image. Considering the images used in the second segment of the work, the story of human evolution is related with the story of going 'out of frame'. Woody described the work as such:

> A piece called later *Evolution* was our major aesthetic breakthrough. We found out, if you have two cameras, one locked into the ordinary sync, horizontal and vertical signal, and another which would be either superimposed or keyed, if you fed a different horizontal frequency into the camera keying over the other, the image would horizontally flow either left or right. (W. and S. Vasulka 1973: 10)

The Vasulkas approached video as a space phenomenon, and from the beginning tried to show their works on multiple monitors, using the same horizontally proliferating imagery. Their installation works from the beginning of the 1970s, such as *Calligrams* (1970), *Matrix I* and *II* (1970–72), or *Discs* (1970), where it was as though the image is stretched across a bunch of monitors, further disrupted the frame. In *Discs*, the visual motif of a semi-circle is used, into which smaller film roll circles enter in a continuously accelerating rhythm; the time delay of repeated signal inputs results in an almost abstract pattern.

George Brown, a Vietnam veteran of Hungarian origin, developed three decisive tools with the Vasulkas: in 1971, a switcher (sequencer); in 1973, a Multi-Level Keyer; and one year later, a Programmer. These new tools already suggested a less intuitive and more analytical approach to image making than with previous tools. Switchers and programmers are tools enabling an artist to program certain rhythms in connection with sound, and a keyer broadens the possibility of working with various image layers at one time. Returning to the early experiments with Alfons Schilling concerning binocular perception, the development of the Video Sequencer (George Brown's Video Sequencer

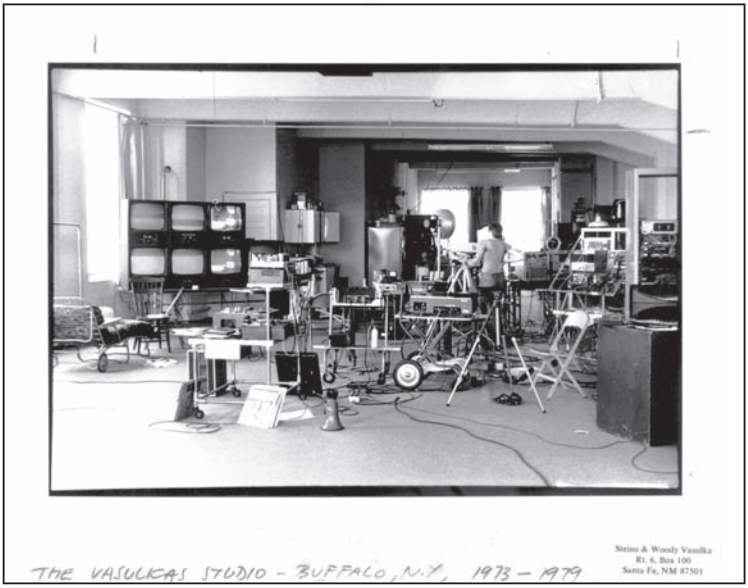

Figure 3. The Vasulkas' studio in Buffalo.
(courtesy. Steina and Woody Vasulka).

alias Field Flip/Flop Switcher) was inspired by the desire to further analyze the image-forming process as a subsequent depiction of individual frames. The tool enabled the two fields creating the image frame to be treated separately; the digitally controlled switching between two sources could be tied to various parameters such as rhythm or sound vibrations in various rates. The switching process could be triggered by vertical synchronization pulses of video or by outside audio or video signals generated by a different tool (Gill 1976: 130). For example, the Vasulkas used sequencers in the work *Home* (1973), where they switch between two camera inputs depicting home objects, completed with the interrelation of sound and video signals. In *Noisefields* (1974), the switching is between the background and the circle in the middle, which constitutues the only visual 'content' of the work. One of the fields always contains pure color, while the other contains only video noise.

The Multi-Level Keyer was made for manipulation of more image layers. While ordinary tools of the time provided a two-layer input, the analog Keyer made it possible to work with six inputs at the same time. The tool, consisting of a digital 'key priority encoder' combined with analog keyers/mixers, received and lined up single inputs and placed them in image layers with various space relationships. In real time, it was possible to 'cut out' parts of the images and replace them with new ones. The user chose the brightness level of the boundary between two sources, and parts of the image above or below this level were replaced by a different image input. The tool was used in *Vocabulary* (1973), where electronic textures permeate the depiction of a sphere and Woody's hand moving above it. *Vocabulary* is an important work, which in its simplicity clearly demonstrates the early approach made possible by the Keyer, the echoes of which will appear in later works. Dialogue with the tool is described here with the shot of the artist's hand catching up to itself as electronic rays, as if tempted to leak further into the electronic spheres. In the somewhat didactic works *Solo for 3* (1974) and *1-2-3-4* (1974), the 'layering' of objects (numbers) of various sizes takes place, which causes illogical space relations. The illogicality of the space in video was commented on by Dan Sandin in his video demonstration, *Triangle in Front of Square in Front of Circle* (1973), where he explains that it is wrong to use concepts from common language to describe what happens on the screen:

> You cannot refer to image planes as in front of or behind, etc., that is just an illusory human perception. The Cathode Ray Tube knows nothing of this, I can prove it to you. Shortly thereafter we got a tape in the mail illustrating that what appeared as a

Figure 4. Steina's face processed in the work *Time/Energy Structure of the Electronic Image*. (courtesy. Steina and Woody Vasulka).

> circle in front of a square with a triangle behind the square, simultaneously showed the triangle in front of the circle. (Gill 1976: 132)

Both above-mentioned tools already contained some digital programming elements.[14] Because the automatization of the process of working with the keyer was needed, the Vasulkas asked George Brown to construct a programmable instrument, able to pursue a sequence of operations. The first wholly digital tool, Programmer, could control the functioning of the switcher or keyer, store operating sequences and activate them in any given moment. Rapid switching appears, for example, in *1-2-3-4* or *Golden Voyage*. In later works from the 1970s, as with *Switch! Monitor! Drift!* (1976), *Orbital Obsessions* (1975-77) or *Machine Vision* (1978), Steina experiments with switching between various camera viewpoints in real time.

2.3. Buffalo: 1973–79

In 1973, the Vasulkas moved to Buffalo, as Woody was invited to teach at 'the first department of media art ever to be established at a university' (Vasulka and Weibel 2008: 13), the Center for Media Study at the State University of New York at Buffalo (SUNY Buffalo), founded by Gerald O'Grady in 1972. It was certainly a unique environment in its attempt to create a sort of dream faculty consisting of some of the most original moving-image makers of the time; the Vasulkas worked there (Woody became faculty member in 1973, Steina in 1977) together with experimental filmmakers Hollis Frampton and Paul Sharits, documentarian James Blue, and musician and videomaker Tony Conrad.[15] Although these artists were strong individualists and mostly concentrated on their own work, some mutual interaction and cooperation occurred.

2.4. Rutt/Etra and its use by the Vasulkas

The effect of a vertical 'stretch out' of video's image lines, producing an illusion of 3D shapes, emerges from the use of a scan processor called the Rutt/Etra Video Synthesizer, named after its inventors (Minkowsky 1978: 5). The Vasulkas belonged to a group of key users; Woody partly constructed his model himself because he couldn't afford to buy the complete set.[16] Woody emphasized that working with the R/E pointed him towards a didactic approach:

> Improvisational modes have become less important than an exact mental script and a strong notion of the frame structure of the electronic image. Emphasis has shifted towards a recognition of a time/energy object and its programmable building element – the waveform. (Vasulka and Nygren 1975: 8)

The Rutt/Etra, which Steve Rutt created with Bill and Louis Etra in 1973, is an analog system controlled by electronic voltages, which enables the manipulation of distorted signals in real time.[17] The camera image is replayed on a small, built-in, black-and-white monitor adjusted for processing the television raster through 'deflection modulation'. The Rutt/Etra alters the regular scanning pattern, and this altered image is then recorded using an external camera to gain the right timing information again.[18] While the visual part of recorded reminiscences gets deformed (among them Woody's Moravian cottage with scanned chicks in *Reminiscence* [1974], shots from the city in *Telč* [1974], or street-view with cars in *C-Trend* [1974]), the real sound remains untouched. There is a different relationship between image and sound than in previous works; the elements do not influence each other but are in contrast – sound remains the connection with reality. The camera imagery is deformed in such a way that the image lines follow the contours of the depicted objects. Not only do lines deform the process, but also the shape of the frame itself gets violated: in *C-Trend*, the street-becoming-object turns over its axis in an empty space, receives shape from a left-to-right rotating surface, and finally gets slanted. The empty space among the objects is filled with video 'noise', in this case created by blackout intervals which normally fill the 'gap' between the scanning of singular fields.[19]

The video frame is also suspended in an electromagnetic field in *Grazing* (1976), where the recording of sheep on an Icelandic pasture gains a cylindrical, moon-like shape. *No.25* (1976) is not the result of camera imagery, but of an empty television frame: the image information (noise) is curved into a cylindrical shape of circles shifting up and down; the compressed lines become visible, accompanied with the internally generated synchronized sound. The Vasulkas used the Rutt/Etra as part of a larger tool set in other videos; for example, in *Soundsize* (1974), the pattern of points is modulated by the synthesizer-generated sound, and at the same time influenced by scan processing, which makes the point area lift, creating 3D shapes. The effect is similar in *The Matter* (1974), where the abstract shape is variously curved in relation to generated waveforms in sine, triangle and square shapes. Later, Woody uses the invented video effects in the service of narration in *The Commission* (1983), a story about the relationship of two artists, composer Hector Berlioz and violinist Niccola Paganini: the stretched-up lines appear in the final scene in a mortuary, where Paganini's body becomes a moving clutter of colored lines as if deprived of its physicality. Moving 3D objects in *Art of Memory* (1987) refer to the spatial metaphors of antique memory techniques as described by British historian Frances Yates (Yates 1966). It seems as if here for the first (and perhaps last) time the technology was used as a connection with narrative content.

Beginning in 1974, influenced by working with the Rutt/Etra, Woody became interested in a theoretical reflection of his work with the electronic image. The raster imagery photo recordings called *Time/Energy Structure of the Electronic Image* (1975–76), provide a simplified encyclopedia of effects enabled by a scan processor. Part of the cycle was published in 1975 in *Afterimage*, with the article Woody wrote together with Scott Nygren called 'Didactic Video: Organizational Models of the Electronic Image'

Figure 5. Woody Vasulka shooting *Art of Memory* (1985). (courtesy. Steina and Woody Vasulka).

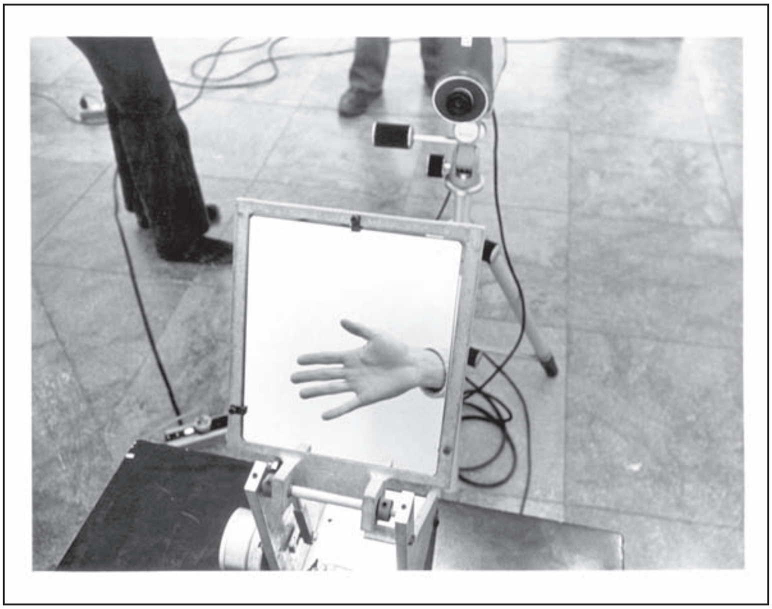

Figure 6. From the exhibition 'Vasulka. Steina – Machine Vision, Woody – Descriptions' organized by Linda L. Cathcart at Albright-Knox Art Gallery, Buffalo, NY (1978). (courtesy. Steina and Woody Vasulka).

(Vasulka and Nygren 1975: 9). To be able to fully grasp the process of image generation, Woody used a series of static images describing the electronic image step by step; he repeated the process later with digital imagery. His chosen basic elements, simple waveform shapes (sine, triangle, square) and camera inputs (Woody's hand and face), went through several stages of scanning deformation, creating a certain encyclopedia of effects at hand.

2.5. 'Color-Frames-Analysis Machine' (for Paul Sharits)

In Buffalo, Woody became more interested in a theoretical elaboration of the difference between film and electronic image. The effort to make a theoretical summary of experiences with electronic images to that point is documented in the transcript of lectures, which Woody presented in five May evenings of 1976 (Vasulka and Weibel 2008: 411–19), and in which he tried to suggest the necessity of inventing a new language to talk about electronic material. Woody also mentions the work of Paul Sharits, one of his faculty colleagues, and Sharits's desire to 'free the film frames' by way of rerecording a tilted filmstrip repeatedly put in the film gate. Woody shared Sharits' interest in defining the basic elements, the 'essence', of the medium. The main objects of Sharits's 'abstract narrativity' are elements usually hidden in cinematic presentation such as film perforations, the flatness of the screen or film frames. For Sharits, who is one of the key agents of 'flicker film', the fascination with the question of 'what happens between images' was as crucial as it has been for Woody.

Inspired by the dialogue with Sharits, Woody constructed a tool for manipulating colored frames. The grant application for 'Vasulka/Sharits Stroboscope Project'[20] describes the device for creating 'color-field motion picture films' by programmable color mixing. A time-setting machine was found at the dump in Horseheads, a city in upstate New York; the machine included a stroboscope, which was used for constructing the tool, which in turn enabled the creation of color sequences from an RGB filter (Dolanova 2008). A computer interface, using an algorithm created by another member of the Buffalo crew, Tony Conrad, was used to control lights and frame advances of the camera, and to reproduce the color scale onto 16mm film. However, Paul Sharits was not interested in the tool as much as Woody expected, preferring the handmade creation of the scores and their subsequent animation. Woody returned to the idea of the device later during the exhibition 'MindFrames' at the ZKM Center for Arts and Media in Karlsruhe, Germany, where, with the help of media artist and scientist David Link, he prepared a program for generating colors on the basis of Sharits's work. The visitors could repeat the creative process of making color flicker films using video analysis stations.[21] However, Woody's lasting sphere of interest in 'what happens between very fast frames' would require further research on the border of electronic arts and the science of perception.

3. From analog to digital

One of the subjects of the above-mentioned lectures is the transfer from analog to digital processes, which was dealt with on a practical level by both Steina and Woody in the process of constructing and testing their first digital tools. The transfer to digital systems brought the necessity of dealing with a new language of codes, and the 'syntax of binary images' changed the character of the dialogue with the tool. Woody mentioned that the necessity of translating the analog continuity into 'digital leather' was a 'little tragic moment', when the world of complete control and self-sufficiency was replaced by the world of computer programming which required a much larger amount of cooperation (Dolanova 2008). Woody dove into the world of optical fibers to find the worlds of new poetics, awaiting the exploration *and* explanation.

3.1. Digital Image Articulator

At the beginning of the tape *Cantaloup* (1980), Steina, Jeffrey Schier and Woody sit behind the table. We hear Steina's voice, explaining the development and (planned) use of the tool called Digital Image Articulator:

> In the summer of 1978 we decided to build a digital image tool. In the tradition of video, our work with the computer had to result in an instantly moving image, which would involve a large amount of numbers in real time. (S. Vasulka 1980)

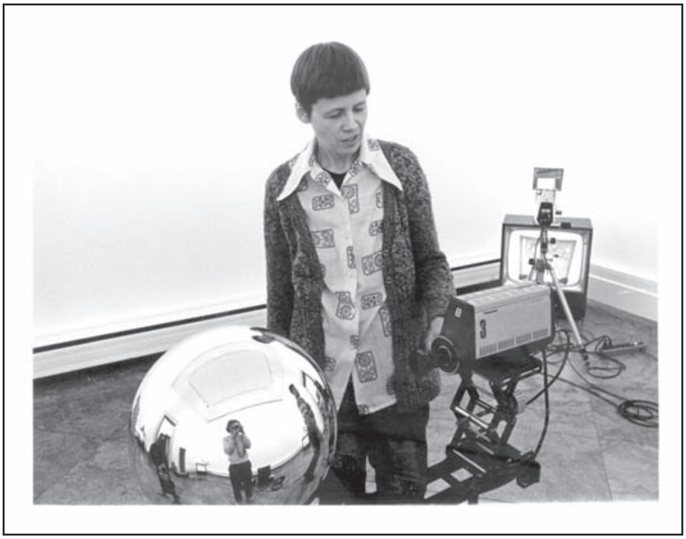

Figure 7. Steina with her *Machine Vision* installation at the Albright-Knox Art Gallery (1978). (courtesy. Steina and Woody Vasulka).

Following this is the shot of a working table, and Woody and Jeff discussing what is seen:

> Jeffy took the challenge to design such a tool which took 18 months from its inception to where it is now, which is by no means finished. Some 20,000 connections were wired by Woody and the device expanded from the planned four boards to eight. (S. Vasulka 1980)

A shot of Woody wiring and the description of the digitizing process follows the one described above; the image is 'sliced' into sixteen numerical values from the brightest to black. The proclaimed desire of the artists to 'look behind the image' was about to lead to the discovery of how the image is expressed by digital code. Woody's head appears in many colors, a hand is typing on the keyboard and the image gets transformed into a black-and-white version. Steina explains pixels and how you work with them: a shot of the street appears, at first not manipulated, later modified, 'briefly held in memory' and thus pixelated. 'Enter a character to grab the frame': Steina's face is being 'frozen' and pixelated by typing the commands on the keyboard. In the next sequence, the image of Woody is multiplied and his fourfold face is subjected to interruptions and pixilation in four time variants. Finally, everybody's image is subjected to multiplication: Woody engaged in 'absolutely senseless movement' of hand waving; Jeffrey playing with the sphere and blinking; and Steina prompting Woody to give her the close-up of her eyes. The work expresses a fascination with the fact that there is still real time, that you can 'see

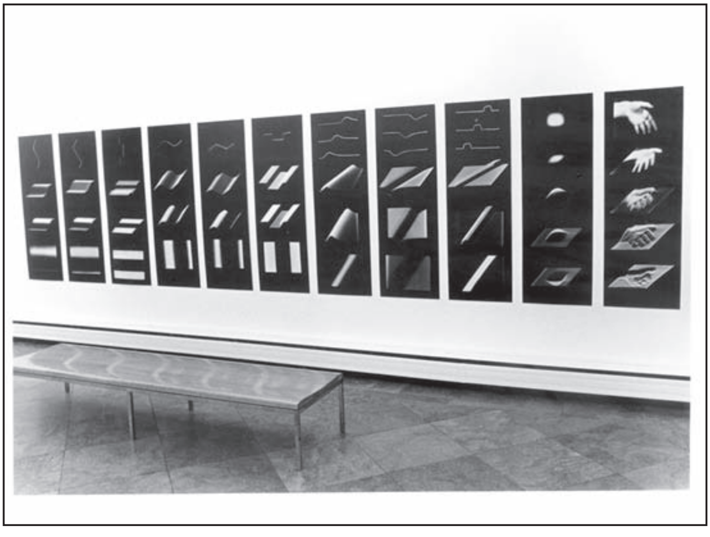

Figure 8. *Descriptions* by Woody Vasulka at the Albright-Knox Art Gallery (1978). (courtesy. Steina and Woody Vasulka).

the phenomenology of frame and field', and also do things that were not possible in video, like freeze the image in any moment or deal only with a specific part of the image.

Woody and Steina collaborated, beginning in 1975 with the physicist Don McArthur, computer scientist Jeffrey Schier and musician and programmer Walter Wright to build the tool, originally called Digital Image Processor, from which the Digital Image Articulator (DIA) later developed.[22] The main function of the Articulator was to process coded images in 'interactive real time' by transferring analog images into digital. The key was the requirement of real-time dynamic processing, even though at the beginning only low image resolution was possible, because the Vasulkas wanted to follow their modus of observing the system and working with images in real time (W. Vasulka 1978). The Vasulkas tested the DIA between 1979 and 1987, but it remained in a prototype stage. In a manual from 1979 written by Woody, Jeffrey Schier and Tom Moxton, they describes its functioning: it processed encoded images, transferred analog to digital, turning video signals to logical values of binary code. This numerical 'image' content was scanned and stored by a system of eight frame buffers in such a way that each light value was assigned a numerical value in a matrix of 128 x 128 pixels. Then various processes like image inversion, compression and frame expansion, outlining, changes of contrast, and pixelation were possible, including experimenting with feedback of programmed digital effects (Vasulka, Schier and Moxton c.1979).

As with processes of an analog world, Woody tried to explain the process of digital image development in a didactic way. In the text 'Syntax of Binary Images', published in *Afterimage* in 1978, Woody described his first encounter with digitally organized imagery, where the operations of binary code became a principle of image processing (Hagen 1978). Part of the article was an image tableau depicting the alterations emerging from the interaction of two structures in an arithmetic logical unit (ALU); the aim was again educational and by no means narrow in order to create a 'universal image score'. The ALU could carry out operations on two sets of 4-bit inputs at the same time, so the image groups A and B were used. The whole set consists of Tables 1–13, each including 16 images, resulting in 16 various arithmetic operations in different resolutions.

The work with the Articulator is documented in the tape *Artifacts* (1980). The transfer into the digital sphere is visualized in the shot of a sphere, which is subjected to pixilation, and we hear Woody's commentary, part of which is a famous declaration:

> By *Artifacts* I mean that I have to share the creative process with the machine. It is responsible for too many elements in this work. These images come to you as they come to me, in a spirit of exploration. (W. Vasulka 1980)

Then he encourages the viewers to blink their eyes, move their head, freeze and unfreeze the tape a few times while watching it, and thus metaphorically participate in the process of image forming. A black-and-white image of Woody's hand appears, the outlines of which spread over the surface, covering more and more of it until it is completely covered. While the first part of *Artifacts* reminds us of *Noisefields* in the relationship of the circular surface or hand to the 'background', the following colored section with the shot of Woody's hand in front of the sphere refers to *Vocabulary*. In another part, the shot is multiplied; a shot of Woody standing in the kitchen is zoomed in and out and shifted to the sides, then switched in synchronization with the sound. Finally the whole image is stretched vertically and horizontally until it reaches complete abstraction. In another multiplied image, a speeding zoom causes the images to look like a surface of vibrating spheres. In a following color shot, the sphere is filled with the black-and-white 'reflection' of the whole, and the movement of Woody's hand above the sphere is repeated inside it. This folding of the image into itself evidently refers to *Vocabulary*, where the hand was getting light beams out from the sphere; here Woody has the image as if in his hand and his movements influence the movement inside the sphere. *Artifacts* visualizes the possibilities of digital image manipulation and also the relationship to the analog sphere, especially by using the same initial imagery (sphere on background, hand, face), which makes this link evident. The elements descend into a detailed image analysis of the digital world as it discloses a larger amount of control. The working description for the DIA states:

> In computer imaging our attention to composition has almost all been consumed by a concentration on a single field formation. The density of events associated with this action, vocabulary, and a presence of a strong imaging myth, has fully satisfied our need for narrativities. We have directed all our attention toward that territory. (Schier 1978)

The minimal imagery put in the context of the digitizing process results in a typical, almost surreal magic in these first digital works. As in previous analog works, within the digital sphere a large part of the work consists of documenting the artists' relationship with the tool, and the process of 'testing' the tools remains the major concern of the artists. The bridges of analog and digital are visualized also in Steina's *Selected Treecuts* (1977) with its periodically stopped and pixelated shots of trees, or in *Bad* (1979) in which Steina works with the shot of a woman's face in correspondence with sound and image (audio signal decides when and how the images stored in computer memory appear on the screen). In the work *In Search of the Castle* (1981), created together with Woody, pixilation is used in 'narration' about the journey into the digital sphere, which becomes more and more overwhelming. Also in *The Commission* (1983) there are the sequences referring to the work with the Articulator: for example, the initial part with the image of multiplied hands and the dead body of Paganini; sequences of rapid switching between two video sources in which Berlioz, dressed in a white suit, mingles with pixelated landscape and clouds; or in the final scene of Berlioz alternately talking and playing harmonica.

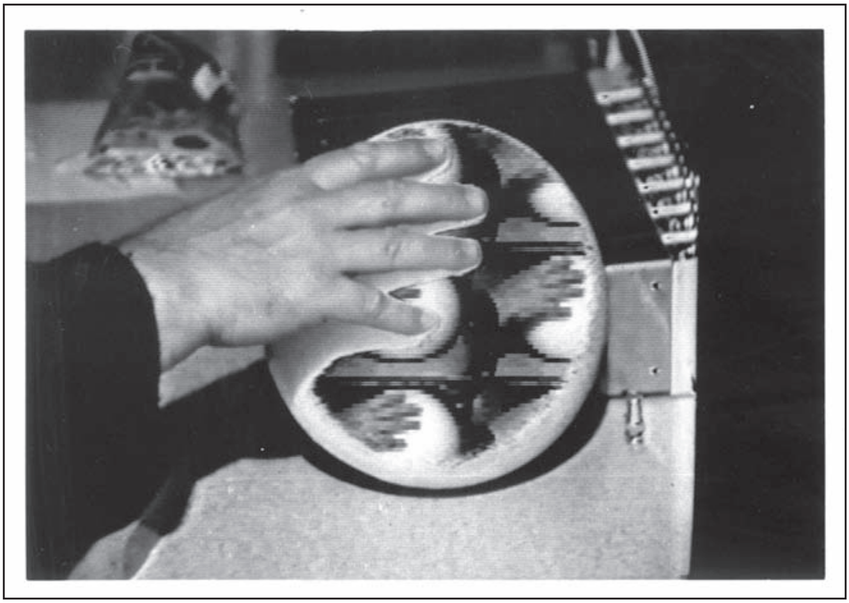

Figure 9. Screenshot from *Artifacts* by Woody Vasulka (1980).
(courtesy. Steina and Woody Vasulka).

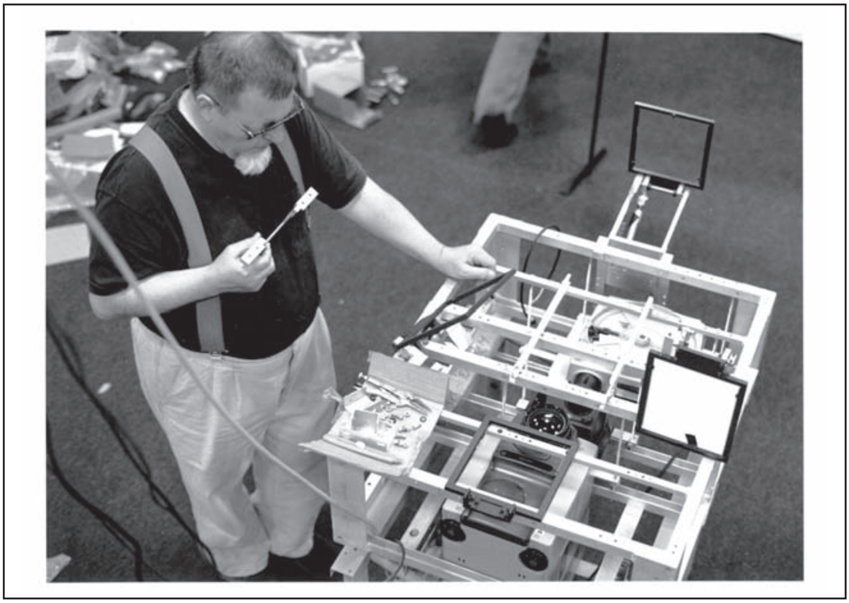

Figure 10. Woody Vasulka working on *The Brotherhood*.
(courtesy. Steina and Woody Vasulka).

4. Santa Fe

The Vasulkas have been living in Santa Fe, NM, since 1980. They discovered that the environment there is suitable for working and contemplation, with their custom-made adobe house-studio being constantly filled with cassettes, monitors, (parts of) installations, computers and found equipment that Woody had been collecting since the New York years. After the narrative opuses of the 1980s, such as *The Commission* (1983)

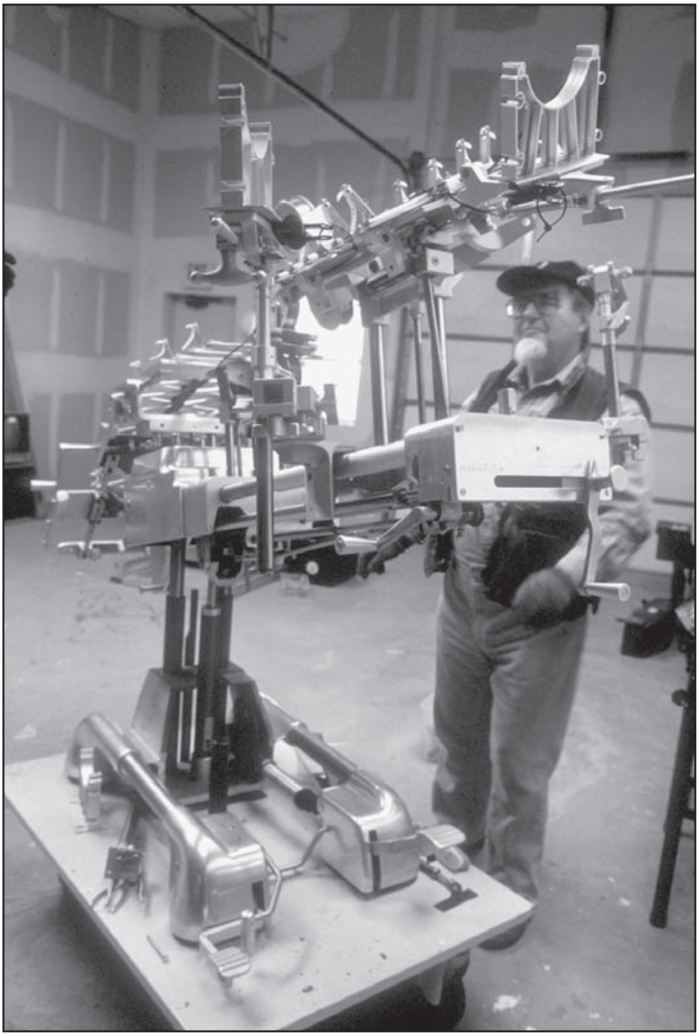

Figure 11. Woody Vasulka with *The Maiden* (Table 6 of *The Brotherhood* installation). (courtesy. Steina and Woody Vasulka).

Figure 12. Woody and Steina Vasulka and friend, Santa Fe, NM
(c. 1992). (courtesy. Steina and Woody Vasulka).

and *Art of Memory* (1987), which in a way summarized the invented analog and digital effects, Woody began to construct his series of robotic installations, *The Brotherhood*, at the end of the 1980s. Conceptually *The Brotherhood* followed the experiments of the 1960s and the cycles of *Machine Vision* created by Steina in the 1970s. In this work he is also reflecting his childhood collecting of airplane gadgets and his previous experiments with physical engineering (W. Vasulka 1996: 65–72).

4.1. Demons in the tool: *The Brotherhood*

Woody's essay on male inclinations towards war, ironically titled *The Brotherhood* consists of six 'Tables'; the first was the piece called *Theatre of Hybrid Automata*, and another followed in 1990–96. The work engages the machine's leftovers, 'idling in the junk fields of the Southwest, their electronic nervous systems, their hydraulic and pneumatic networks, ripped apart and bleeding' (W. Vasulka 1996: 65). He decided to cannibalize them and their structural intentions so that their 'spirit' is reoriented for the cultural purposes of navigating in image space. Parts of the equipment were brought from Buffalo by Woody, others were gained in auctions, and some came from Black Hole in Los Alamos. The whole cycle was exhibited at NTT InterCommunication Center in Tokyo in 1998.[23] The installations use hybrid optical, mechanical, robotic, and pneumatic systems in connection with digital technology, and work with the discrepancy between traditional cinematographic space and the new digital space. Woody cooperated with software designers Russ Gritzo and Tim Odell, system administrator Bruce Hamilton and robotics technician Roderick Peyketewa.

Woody's underlying aim to touch the possibility of autonomous machine behavior refers to the literary works by Czech sci-fi predecessor Karel Čapek, who became famous for using the word 'robot' for the first time in 1920 in his drama *R.U.R.*, which revived the subject of a machine-android revolting against its creators, then finally showing some naturally developed intelligence and feelings (Čapek 1990). Russ Gritzo wrote in his catalog essay about *The Brotherhood*'s 'soul in the machine' (Gritzo 1999: 113–15), that Woody decided to establish a means of communication among the various devices in space, 'ranging from sensors to musical instruments to robotics'. The software called Intercom translates output from system devices into commands that each of the other units understand. The next level was added in 1997, when the operating system UNIX added the level of 'authenticity' to the machine, and the 'Actor' architecture emerged:

> In essence, an Actor is a stand-alone, real-time software program that takes 'cues' from the real-world and delivers them as commands to real-world devices, according to its programming. The goal of Actor architecture is to provide a means in the software that, like a character in a drama, will perform a single, predictable role. Once activated by the stimulating device, the Actor communicates a specific response that results in a specific behavior. (Gritzo 1999: 113)

Actors can also communicate with other Actors, and while each Actor functions in a predictable manner, Actors show an 'organic' behavior. Russ Gritzo explains:

> I particularly enjoy the 'biological analog' invoked by Actor architecture. A network of loosely related, atomic processing units cooperating to bring about a high-level behavior, is very close to the structure of simple biological systems. The use of this 'connectionist' model as part of the art's implementation is one of many unique features of the Vasulka systems, which are, in fact, authentic down to the lowest software level. (Gritzo 1999: 115)

The fact that the operational procedures of these electromechanical devices are not 'psychologically dependent', as David Sears Mather stressed (Mather 1999: 105), is probably the key feature for Woody, who tries to 'disclose' a sort of intelligence in the machine, find 'demons' operating within it and dialogue with them. He mentioned the inspiration gained from Russian theater innovators from the beginning of the twentieth century (e.g. the biomechanics theory of V. E. Meyerhold), who advances the idea of a global theater system where actors should become closer to machines – their locomotive apparatus mechanized – while at the same time being able to observe and reflect their own position as actors (Dolanova 2008).

The military hardware of the first of *The Brotherhood* works, *Theater of Hybrid Automata*, orientates itself thanks to a rotating camera assembly (a robotic gyroscope used for missile navigation) in the middle, monitoring 360-degree space, and operating in the environment surrounded by four target screens. A synthetic voice states the position of the head, and a video camera sends the image of phased installation observation into the projector; the real projected images are alternated with 3D computer-generated models. The whole piece is network-connected so that it can be operated and controlled from a distant place. Woody builds his installations in this way because he wants to see how they function as a part of his continuous life laboratory. His concept of interactivity is different from the common use of the term; he intends that the activity of the public consists more of sensing the inner working of the machines than any real interaction with them.[24] The visitors can only aimlessly wander in the space given to them; they are confronted with the inaccessibility of these machines and lost in their space. Few hints of interactivity are provided, such as in Table 3, *Friendly Fire*, where the drum pads enable choice between the scenes and different speed and direction, so that the viewers can play with the recordings of a friendly-fire accident from the Gulf War when the American troops were mistakenly attacked by their own army.[25] Also *The Maiden*, the most anthropomorphic of all the Tables, dedicated to women nursing the wounded soldiers, can be controlled by sounds and Woody often cooperates with Steina, who has 'played' Woody's work *The Maiden* with her digital violin. No more concessions for the untrustworthy public:

> But this is maximum I could give to my audience. Am I happy about it? Of course not, because in some strange way they get into their own spasmodic modes and then they simply destroy the work. But it recovers and comes back to its own good old cycle. (Kirby 1997)[26]

5. Re:frame

The story wouldn't be complete without mentioning the archiving projects by the Vasulkas, for which they have also been developing some new techniques and methods, becoming among the most important archivists of the early historical period of video art and electronic culture. Their almost obsessive desire to collect and contextualize these phenomena stems from the belief that they have participated in the key chapter of twentieth-century media art history. Their motivation also includes the desire to create a history (or mythology, sometimes) themselves. Collecting has been present in their activities since the 1970s, when they began to collect information documenting the emerging avant-garde of electronic arts: texts, photographs, interviews (preserved as audio recordings or at least as transcripts), videotapes, and so on. From their first efforts in the 1990s, they continue with projects that evaluate the achievements of makers from the early period of video art. For example, invited by Peter Weibel, they prepared the exhibition 'Eigenwelt der Apparatewelt: Pioneers of Electronic Art' devoted to sound and image processing tools for the 'Ars Electronica' festival in Linz, Austria.[27] Their last large activity was the exhibition project 'MindFrames', in cooperation with Peter Weibel, prepared for ZKM in Karlsruhe and devoted to a group of creators centered around the media arts organization Media Study/Buffalo and the Center for Media Study. Through this project, they tested the possibilities of curatorship from a distance.[28]

The dialogue with the (demons in the) tools has been morphing; often the leftovers, the suppressed motives, leak in some form into the Vasulkas' artworks, but the main themes remain the same throughout their art-making histories. These themes were especially: real-time audiovisual synthesis; 'home-made' development of tools; and observing their own interaction (*Machine Vision*). Vasulkas' early period of experiments with portapak video cameras and the first synthesizers was one of intensified spontaneity that was typical for encounters with new media, when discoveries often occurred by accident. They got out of this phase quickly. The first of George Brown's programming equipment signified the step towards gaining more control; the Vasulkas were no longer just observing, but trying to force the tools to do something that could be to a certain extent predicted, but still only to a certain extent controlled. In the middle of the 1970s, Woody had a growing desire to look back, to step out of the process and analyze his own dialogue with the machine; this desire manifests itself in Woody's writing from the period. In the 1980s, the techniques and tools that Woody examined perviously were suddenly used in narrative videos – *Art of Memory* and *The Commission* – for creating works with real actors. In these works, the question is asked if, after so many years of Woody's preference for 'machine vision', narration is still possible.[29] With the entry into a digital medium comes the realization that he cannot control the creative process completely, and that cooperation is required in every phase of the tool creation. It is perhaps significant that the human body gains even more prominence in the Vasulkas' first digital tapes: the testing material consists almost solely of the recordings of Woody's hand, his or Steina's body, or studio interiors. Later tapes are increasingly accompanied with spoken commentary explaining what is happening on the screen, and the role of the artists as interpreters is thus being continuously confirmed. Also, the Vasulkas increasingly refer to their own previous analog works, making the circularity of their working process obvious.

Toward the end of 1980s, the first of the 'Tables' from the robotic brotherhood emerged. Here, the 'machine vision' and its observing gained another level. The effort to induce a sort of independent behavior coincides with the desire to have a theater to play with in which the actors are mechanized – controllable but at the same time unpredictable. Woody's idea of a total laboratory of life includes the observation of himself interacting with machines (interacting sometimes with the real 'actors'), while he situates himself in a special territory, that of an observer-commentator or interpreter of this new digital space. He admits that there might come a day when his control will be lost – a time for which he waits with curiosity. In the introduction for this essay I quoted Woody's probably slightly ironic statement about machines becoming more and more demonic. His statement recalls, among others, the idea of Pandemonium by a herald of artificial intelligence, Oliver Gordon Selfridge, who imagined consciousness as virtual machine, in which various homunculi – demons[30] – argue to reach a consensus. How much of our life we will deposit into technological structures and how poetical and human-like these will become can be perhaps enunciated by the next generation of scientists from fields like DNA computing. The dialogue with 'spiritual machines'[31] will have its attractions and will perhaps also result in some form of art. Woody once declared:

Early

At first we looked at video as a singular discipline. We, as well as the others, used wide register of genres, from work with abstract electronic imagery to documentary forms in a tribal aesthetic unity, escaping serious division plaging other media, namely film. The portapack itself was a dominant and unifying tool for all.

We were introduced to the alteration of Video images through the basic equipment available. We could manipulate the scan lines by changing the deflection controls of the monitor, use the recorder to freeze frames, advance or backtrack tapes manually and look into processes within a frame (Decays I, II). We learned forced editing and asyn-chronous overlays on the first generation 1/2 inch video equipment (CV) and practised all methods of camera/monitor rescan, the only way for us to capture and preserve the violated state of a standard television signal. Progressively, through new tools, we learned the principles of generating and processing of images, having access to internal structuring of the video signal itself.

A decisive tool in our early collection was a sound synthesizer (Putney) which pointed us in the direction in sound and image generation and in a mutual inter-hangeability of both.

Most significantly, we used a matrix of video screens to relate movements of video frames, a function of time, from which the horizontal relationships lead us to a more environmental understanding of video.

In the Fall of 1970, we laid down a cable from our loft on 111 E. 14th St. in New York City, over the roof of S. Klein department store, to 101 E. 14th St., the studio of Alphons Schilling, to experiment for a short time with one-way video and two-way audio transmission.

By 1971, it became obvious, that we could not accommodate the traffic of interested people, visiting our studio. We decided then to establish a permanent place for video and other electronic arts elsewhere. On June 15th of that year, we opened The Kitchen at the Mercer Arts Center in New York.

Steina and Woody

> Our technological environment is a web of rituals – it's inevitable – once you start connecting systems together, they become autonomous and we become their guests. To the machine we are the dispensable ones, we will die, but the system lives; technology becomes the house in which we are guests for a short time. In the long view, technology will become very complex and challenging. Will it need us? I don't know. (Vasulka and Weibel 2008: 387)

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Notes

1. For more on Pešánek, see Jiří Zemánek (1996–97), *Zdeněk Pešánek 1896 – 1965*, Praha: Gema Art Gallery. For more on Grygar, see Milan Grygar (1999), 'Milan Grygar: Image and sound – Collection of Modern and Contemporary Art', September 14 – November 11, The National Gallery in Prague, Praha: Gema Art Gallery.
2. In *Expanded Cinema*, Youngblood's rampant use of the term 'consciousness' (126 times in the book) suggests the belief in the necessity of a new form of communication as synthesis of various stimuli: this new consciousness can be 'oceanic', 'cosmic', 'collective', of course 'expanded' (or 'inevitably expanded'), also 'widened', 'more intellectually competent', even 'transnational teledynamic video consciousness'; it is contrasted with 'existing', 'yesterday's', 'old', 'ordinary', or 'narrowly-focused' ones.
3. For more about image processing see Furlong (1985: 233–37); and Lucinda Furlong (1983), 'Notes Toward a History of Image Processed Video', *Afterimage*, 11; and Sherry Miller Hocking (1983), 'Electronic Video Image Processing: Notes Towards a Definition', *exposure: New Technology*, 21: 1.
4. In Woody's words: 'In fact I'm looking for some possibility of acquiring a knowledge which would probably give me some security. So I would say that would be the main line since I've been watching with great interest what I'm doing as disrelated individual to what I am' (W. and S. Vasulka n.d.).
5. In these first years, when portapak cameras became accessible in the US, the workers in the emerging media arts field shared a certain affinity that was based on the media's specificity, which disappeared when the fact of sharing the tool ceased to be sufficient.
6. In the time Woody and Alfons met, Alfons was working on the documentary about '9 Evenings: Theatre and Engineering', a legendary performance series interconnecting avant-garde artists from theatre, dance and new media disciplines with research scientists and engineers from Bell Telephone Laboratories. The event took place in 1966 in New York. Here Woody also met Don White, a scientist who introduced him to the principles of holography in 1967.
7. This technique is used for creating images of time phenomena, e.g., in sport photography. An example of its use from the analog sphere is by tool maker Glen Southworth, who experimented with slit-scan by moving images forward and back against the slit. In digital, it is possible to extract single cuts from a sequence of video frames and chain them in a new image. Steina began to experiment with this technique using Image/ine software, developed in cooperation with Tom Demeyer in 1997 in the Amsterdam center, STEIM. In her performance *Bent Scans*, she uses real-time deformation of video recordings, inducing so called 'warped time'.
8. The work is described in the exhibition catalog for Anon (1978), 'Vasulka: Steina – Machine Vision, Woody – Descriptions', Buffalo: Albright-Knox Art Gallery.
9. Schilling develops this direction in the project of 'binocular stereoscopic videosystems', described in a grant application 'Electronic Spaces' in 1973.

10. The history of The Kitchen, which the Vasulkas managed from its founding in 1971 until 1973, is wonderfully documented at http://vasulka.org/Kitchen/index.html.
11. The VCS3 ('The Putney') was developed by Peter Zinovieff, Tristam Cary and Dave Cockerell from Electronic Music Studios of America (Amherst, MA) in 1968. This analog, duophonic synthesizer, also called a 'voltage-controlled studio', could influence audio signals and their interconnection.
12. Siegel exhibited only the part of the work called *Einstein*; while original work also included parts *Beatles*, *Tomorrow Never Knows* and *Symphony of Planets*. The work was shown again in 1973 in The Kitchen in better quality thanks to the new colorizer he used (Siegel 1984).
13. In 1975 he created 'Siegel Video Systems Processing Chrominance Synthesizer', distributed by Siegel-Ferraro Electronics company. Because the designing and manufacturing of tools was taking more and more of his time, in 1978 he stopped making video and concentrated on tool development.
14. In Vasulka (2008), Woody mentioned that he forgot to include another function that would not only separate the fields but would also cause intersections.
15. Later, in 1984, Peter Weibel also came to teach to Buffalo.
16. Woody reportedly acquired the Rutt/Etra for about $5,000 or $6,000 (a price common for friends of the inventors), while the commercial price was around $16,000.
17. In 1975, the Rutt Electrophysics company from New York began to produce them; two models were on market: RE 4-A (including a 525-line monitor) and RE 4-B (including a 1050-line monitor).
18. More information about Rutt/Etra can be found in Hocking, Sherry Miller (1986), 'Rutt/Etra: Notes on Development', http://www.experimentaltvcenter.org/ruttetra-notes-development. Accessed March 28, 2013.
19. From 'Tapelist', http://www.vasulka.org/archive/ExhFest7/VideoDataBank/tapelist.pdf. Accessed March 28, 2013.
20. Anon (n.d.), 'Vasulka/Sharits Stroboscopic Project', [unpublished manuscript], Collection of Woody and Steina Vasulka.
21. 'MindFrames: Media Study at Buffalo 1973–1990' ran from December 16, 2006 – March 25, 2007, at ZKM Center for Art and Media, Karlsruhe, Germany.
22. In Hagen (1978), Woody claimed that in 1975 Donald McArthur designed the basic architecture of a digital system and developed a binary specification of the screen, Walter Wright built the first programming schemes, and Jeff Schier revised and stabilized the current hardware and developed display modules for the ALU (Arithmetical Logic Unit). Alternative names for the tool were 'Emulsifier,' 'Vasulka Imaging System' or 'Imager'.
23. 'The Brotherhood: A Series of Six Interactive Media Constructions', NTT InterCommunication Center, Tokyo, Fall 1998. The catalog is available online at http://vasulka.org.
24. More of Woody's ideas about interactivity appear in the essay 'Digital Space: A Summary' written together with David Dunn, online at http://www.vasulka.org/Woody/Brotherhood/Text.html#03.
25. See http://vasulka.org for the explanation of the tables for *The Brotherhood*.
26. In *Binary Lives*, Woody also says here that he doesn't want to leave it to destructive instincts of other people, even if he feels that something like deprivation of the central position of the author is in the air.
27. In 'Eigenwelt der Apparatewelt: Pioneers of Electronic Arts' at 'Ars Electronica' in 1992, accompanying the exhibition was a unique catalog with barcodes inside, which triggered the image material from the disk (photographs, technical drawings, audio and video files), interconnecting the physical book with electronic space.
28. Online playlists combined materials from servers located at ZKM, and were managed from Cologne by Robert O'Kane: 'It was also, by the standards of media presentation in an art museum or gallery, a remarkably inventive one, that could permit other exhibition sites worldwide to reconfigure portions of the *MindFrames* to their own needs and have routed from a central source each desired visual work to its specific destination precisely on schedule' (Minkowsky 2008: 33).
29. Not surprisingly, these works have gained probably so far the largest recognition in the field of film studies from all of Woody's work. Raymond Bellour in his essay 'The Images of the World' writes about the paradox of electronic creation, which on one hand deals with unreal, abstracted time and tries to erase the connection with the 'real' world; and on the other, increasingly works with historical imagery (Renov and Suderburg 1997).
30. Selfridge's ideas were revived by Daniel C. Dennett in his book *Consciousness Explained* (1991).
31. Ray Kurzweil in his book *The Age of Spiritual Machines* (1999) predicts the emergence of machines with human-like intelligence in the near future. Concerning DNA computers, see, for example, Martyn Amos' book *Genesis Machines* (2006), in which he describes the experimental computers constructed with the use of DNA code.

A Demo Tape on How to Play Video on a Violin[1]

Jean Gagnon

In this article, I will focus on a trend at the root of video art that was important at the beginning of video production in the late 1960s and early 1970s: video synthesis, electronic image and sound manipulation aided by electronic and digital instruments. Although the trend almost vanished as a practice with the standardization of the video effects-generators that the industry (the Sonys of the world) started to develop and market in the mid-1970s, it reappeared in the 1990s with the use of digital tools and software.

At the same time, I will analyze the work of Steina Vasulka, a video pioneer who is still practicing today despite her intermittent presence in the annals of video art history (Rush 2003). By analyzing Steina's work, as well as that of her colleague and long-time partner Woody Vasulka, we can observe the contrast between the dominant iconographic and narrative modes of video in the contemporary arts today and the fleeting electronic image that is the material Steina and Woody Vasulka discovered and have worked with since the 1970s. Steina's body of work shows an interest in the phenomenology of vision through apparatuses and installations, as in *Allvision* (1975) and *Orbital Obsession* (1977). Many works are concerned with the sonic aspect of the electronic manipulation of signals, be they video or audio, such as *Violin Power* (1969–78), which will be at the core of my analysis here, and *Voice Windows* (1986).[2] (See Color Plate 6.) While examining these two last works, I will try to unearth elements that belong to the notion of instrumental playing – musical and electronic – that is marked by a dialogue and, at times, a confrontation with technological apparatuses that involve a performative aspect through embodiment.

The sonic intuition of video

> The video image is a standing wave pattern of electrical energy, a vibrating system composed of specific frequencies as one would expect to find in any resonating object. [...] All video has its roots in the live. The vibrational acoustic character of video as virtual image is the essence of its 'liveness.' Technologically, video has evolved out of sound [...] (Viola 1990: 43–44)

> Maybe one needs ten years to be able to perceive the delicate differences between thirteen different 'distortions' as was needed to perceive the delicate differences between many kinds of 'noises' in electronic music. (Paik in Rosebush 1974)

These quotes from Bill Viola and Nam June Paik, two artists considered masters of video art, demonstrate how video artists understand the medium of video differently from how we understand the visual arts or even cinema. It may seem like common sense to assert that video art is close to cinema, in that they both present moving images. Of course, no one would deny that video is both visual and cinematic as well as audiovisual, like film. Despite these accepted ideas, video is closer to electronic music and the realm of audio, and not only because, like film, it is time based, but because the video process of recording and decoding treats electronic visual information in the same way it does electronic sounds. This malleability of electronic signals is heightened nowadays by digital tools. By the time portable video appeared in the mid-1960s, electroacoustic music was already thriving; *musique concrète* had had its heyday in the late 1940s and 1950s. So artists, particularly those trained in music, were fast to pick up this dimension. Steina, who had trained as a concert violinist – albeit with a more traditional education than Nam June Paik who, after classical training in Korea and Japan, went on to study electronic music in Cologne with Karlheinz Stockhausen – was amazed to discover video upon her arrival in New York City from Iceland.

She recalls that she came across video through Woody Vasulka:

> Woody introduced me to his new discovery – video. What a rush! It was like falling in love, I never looked back. As soon as I had a video camera in my hand – as soon as I had that majestic flow of time under control, I knew I had my medium.[3]

And what did the newcomer to video do in order to master the flow of time and gain control over it? She played her violin. Music is about the mastery of time; beyond the reality principle of this control and mastery is the pleasure principle of playing the instrument, and in this mastery through instruments one also finds a detour to desire and embodiment. For Steina, this detour took the form of a videotape. *Violin Power* is one of the best examples in early video art of the articulation of an instrumental posture. It traces the artist's discovery of the electronic medium of video and its many instruments and tools while cataloguing her self-discovery through video feedback – oscillating between self-portrait, narcissism, the mastery of one's self-image, and the 'gaunt' images that are abstracted by sounds and noises.[4]

> *Violin Power* shows Steina's artistic evolution since the 1960s, as well as how she integrated her musical pursuits with her videomaking.[5] The final tape spans a decade of research, which she and Woody Vasulka call 'playing', and focuses on

> early experiments with analog synthesizers and other electronic devices and signal manipulators. (Wilson and Melega 1981: 8; Spielmann 2003)[6]

The video opens and closes with vignettes showcasing Steina as a virtuoso. At the end, looking around her at the monitors that show her in feedback, she says, '*C'est moi*.' This phrase definitely establishes *Violin Power* in the category of self-portraits. In a rather ironic moment, Steina seems to play up the differences between classical tradition and the pop culture that shaped New York in the mid-1960s. She first appears at the beginning of the video performing a satirical violin version of the Beatles' 'Let It Be', followed by a close-up of her lips mouthing the lyrics. Then the portrait enters an altered state, so to speak. The first sequence after the opening scenes investigates the impact of varying pitches on the speed of the image. Steina's body is invaded by a sort of double exposure that quivers like the vibrato she produces on her violin. In another sequence, Steina adds further components to an already complex interface. The sound modulations of the violin cause the viewpoints of two parallel cameras to alternate. She is first seen from behind, then the bow's movement seems to deflect the signal, and a keyed-in image of Steina from the front appears. This effect is generated by the combined use of a keyer and an audio synthesizer (Harald Bode's Phase Shifter) in a closed circuit with the two cameras. Other excerpts feature effects generated by the Rutt/Etra Video Synthesizer, a scan processor developed by Steve Rutt and Bill Etra. The sound waves seem to cause ripples in the image's surface, while the bow's friction on the strings results in textured visual effects that evoke the violin's timbre. Finally, the representation of the performing musician, the sounds produced and the modulations in the video signal converge into a single luminous entity, sometimes called by Woody a 'time-energy object' or an 'artifact'.

Violin Power shows many of the characteristics of the self-portrait as established by the French theorist Raymond Bellour. The self-portrait is distinct from autobiography in that it is not incarnated through a narrative; the arrangement of audiovisual material is governed by a logic of *bricolage* or *assemblage* ordered under rubrics. In *Violin Power*, there is no rubric as such, but rather a catalog of sound-image effects, each corresponding to an electronic instrument or a set of instruments. The self-portrait is more analogical, metaphoric and poetic than narrative. While autobiography is defined by a time closure, the self-portrait appears as an unlimited totality so that only the artist, as in the case of Steina's *Violin Power*, can arbitrarily decide that after ten years the work was complete. More importantly, one tool in the self-portraitist's arsenal is the possibility of playing with one's self-presentation, of showing subjectivity in search of its own nature, even if it also manifests 'the power of the impersonal, of literature as such (in the sense of Valery and Blanchot),' as Bellour observes (Bellour 1988: 341–43). In Steina's case, this impersonal exteriority is that of electronic technology. As a subjectivity, the instant video feedback allows the artist to work in real time, and adjust to her self-image in an interactive performance. Another work of Steina's, *Orbital Obsession*, illustrates the artist's interaction with a system that she has set in motion in front of the camera. The video self-portrait also invokes what Rosalind Krauss famously termed the 'aesthetics of narcissism', in which she argues that the human body is the central instrument of video and is caught in the parentheses constituted by two machines: 'The first of these is the camera; the second is the monitor, which re-projects the performer's image with the immediacy of a mirror' (Krauss 1976: 45). The problem with Krauss's argument lies in that she thinks of the technology involved as pure conduit, transparent and immediate. A close examination of Steina's work of the mid-1970s demonstrates otherwise; notably that Steina may rely on 'real time' but never in an immediated fashion.

The Vasulkas were deeply intrigued by the interface between audio technology and video technology. *Violin Power* adds an additional dimension to this dialectic research by simultaneously showing the gestation of images, their mediation by instruments (violins, synthesizers) and the moment when these images crystallize on the monitor. More important, as a self-portrait, *Violin Power* shows an identity becoming intermittent and fragile, caught in the act between mastery and control, self-affirmation through the virtuoso performance, and the dissolution of identity through sound waves. It is as if Dionysus, the ancient god who presided over tragedy competitions in classical Athens, intervened to dissolve the image of identity in its sonic mania. This work reveals the abandonment of mastery through the objectivity of electronic systems that are characterized by an autonomous inner architecture. Steina plays these images with all the playfulness that such a formula implies. At the end of the tape, strident sounds from the violin generate a deflected image, one reduced to shifting linear patterns in the intense light into which the sound energy has been transformed. In this process we find a posture similar to that of many artists of the time who, in the wake of John Cage's works and teachings, refused to project their egos in their work; in Steina's case, she let her self-mastery be challenged by the electronic system's objectivity. By contrast with Cage, for Steina, and to a certain degree for Woody, the issue was not one of indeterminacy and chance; rather, it was the articulation of control of the instruments and mastery of self-image alongside the pleasure of instrumental playing, always at risk of being subsumed by or diluted into sonic waves. This reading of Steina's *Violin Power* reveals an aesthetic of the electronic image, gaunt indeed, yet energetic and composed with innate musical pleasure, and with little use of figures or the full image of identity.

Several years in advance of the MIDI (Musical Instrument Digital Interface) instruments, Steina transformed her violin into an instrument generating patterns, shapes and various distortions via electronic (analog) interfaces. In later performances, in the 1980s and 1990s, Steina used applications of the MIDI protocol to manipulate, in real time, a bank of images stored on videodiscs. While in early parts of her career she literally played images through the use of her violin as input device to produce visual forms or visual alterations induced by sounds, in the later period she employed the MIDI violin to orchestrate banks of monitors or screens and control the unfolding of the sequences, reversing them, repeating them, and mixing video sources in real-time performances.[7] But more strikingly, Steina often used images she shot of other artists' performances.

One such instance is the violin performance she presented on December 18, 1998, at the aptly titled 'Touch Symposium' in Amsterdam. There she projected sequences of prerecorded performances by artists such as Michel Waisvisz, Laetitia Sonami, Cas de Marez, Trevor Vishart and Francis M. Uitti, and, in her typical way, she played the MIDI violin that controlled a set of videodiscs or files, reversing the flow of images, freezing them, and recomposing them into sound and visual rhythmic motifs. As the performer, she was in dialogue with this raw material (her image bank), but she was simultaneously in the remote place of the composer who creates rhythms, ordering or disordering time within the real time of the performance. The instrumental playing here gained further dimensions as the performance of composition in the act, so to speak.

The sound of music

Not surprisingly, the sense of autonomy of the category of phenomena called 'sound' increased at the end of the nineteenth century and the beginning of the twentieth with the advent of techniques to record and reproduce it. The recording of sounds, like the recording of images in photography and film, developed during the same period of modernism when machines started to replace the hand of the visual artist, thus creating the crisis of the 'aura' of the work of art often equated with a personal (handmade), unique quality of originality. Artists became fascinated by machines and the noises they made. With the advent of sound-recording machines, a struggle also began in the world of music in Europe, between noise and musical sound. In the book *Noise, Water, Meat: A History of Sound in the Arts* (1999), Douglas Kahn writes at length on the battles of composers, such as Edgard Varèse and others, who used noises or extramusical sounds in their music. In an interesting passage, Kahn addresses the fact that the visual arts (painting) did not hold the same position as music with regard to abstraction in modernist, avant-garde art. He argues that music, already 'valued as a model of modernist ambitions towards self-containment, self-reflexivity, and unmediated communication', remained in a certain tradition of western art music, and that the phonographic capabilities brought about by technology did not create an aspiration for phonographic realism (Kahn 1999). Unlike painting, which photography liberated from the constraint of verisimilitude, music was not liberated from its tradition.

In a certain sense, Steina and Woody Vasulka's experiments with electronic sound-image manipulation and synthesis show that only when video appeared could visual forms be created by methods closer to those employed in electronic music than in painting, sculpture, or even cinema. Musicians and composers, for their part, gained access to manipulating sound objects, or composing, in a real-time visual system, in a manner closer to a sculptor's process. From that point, the relationship of the artist or musician to the production of visual or sonic forms was characterized by instrumentation and the directness and interactiveness of instrumental creation, which allowed the pleasures of playing and of composing in Steina's performance.

Figure 1. Still from *Violin Power* by Steina (1970-1978). Image from Steina and Woody Vasulka Fonds, VAS B5-C2-14, Collection Fondation Daniel Langlois de la Cinémathèque québécoise. (courtesy. Cinémathèque québécoise).

With *Voice Windows* (1986), Steina renewed her efforts to generate a complex sound-image interface this time not with her own image, but with another of her themes – landscape – and not with her violin, but with Joan La Barbara's voice. In *Voice Windows*, Steina experiments with keying video tracks that visually convey the modulations of the human voice. La Barbara, an American singer, performer and composer, provided a repertoire of samples featuring all the registers of her voice. Her voice, an index of her body, is the instrument; with Steina there is always a performer, whether it is herself or not.

These samples are processed through software that synchronizes the frequency levels with a secondary video track, which is then keyed into a primary track whose contour matches the changes of timbre and tone of the voice. At the start of the video, blue lines waver on a black background, denoting sound modulations that resemble a musical scale. These lines open a gap in the first image, evoking the window of the video's title: a modulating window formed by sound waves of the voice, which opens to show a dolly shot of a street, the track modulated by the voice revealing a second landscape. The continual shifting between these two layers makes it impossible to gain a real sense of depth. The keyed track keeps the viewer's eyes on the surface of the screen, but the voice upsets our contemplation of the landscape and creates disorder in the process. Although this voice is a hindrance to a single, coherent vision, it generates access to further images.

La Barbara used a bank of images taken from *Voice Windows* in her performance *Vocal Window*, presented in 1987 at the Center for Contemporary Art in Santa Fe, New Mexico. In this piece, La Barbara manipulated the real-time video segments using Interactor, software developed by Mark Coniglio and Morton Subotnick. Segments of this performance also appeared in the multiscreen installation *Vocalization*, created by Steina in 1990.

Toward the end of the era of repetition

Although it is possible to see in this preoccupation with electronic manipulations of sound and image a purely materialistic or modernist attitude, one has to look at it differently to comprehend the exploration that Steina and Woody Vasulka embarked on and are still pursuing in this field. This involvement with the medium cannot be accounted for solely as learning the ropes of a new technology, or the modernist drive to point to the medium's specificities. It must resort to a pleasure principle that we can understand as instrumental playing and composition.

In his book about noise, Jacques Attali attempts a description of what he calls a 'political economy of music', at the center of which is the idea of music as the 'canalization of noises', or human-produced noises, in society (Attali 1977: 1985). Drawing from anthropological considerations of the rituals of early humanity, Attali suggests that music has evolved historically as a sort of regulator of noises in society under four historical periods – sacrificial ritual, representation, repetition, and composition – which explain the transformations in music's relationship to social and political integration. From this perspective, video art, like audio art, *musique concrète*, and electro-acoustic music before it, is appropriately discussed as the product of repetition. Even if another historical period is still present in our repetitive society, such as the representational form of the concert, the notion of repetition is operative in analyzing the peculiar relationship with instruments and tools that video artists like Steina and Woody Vasulka have used throughout their careers.

Let us look for a moment at this historical layer or 'network', to use Attali's term, that he calls 'repetition'. In a linear time sequence, repetition appears after the period of representation and is in part the fruit of both industrial capitalism and advances in technology. Representation marked the era of the concert and of harmony in music. From the end of the nineteenth century, with the passage from traditional modes of producing and consuming music to the decentralized and individual consumption of today's media contents, music has ceased to be a mirror, a *mise-en-scène* or a spectacle, and the concert the occasion for direct relation and social meetings. The memory of past sacrificial violence which served as a pacified social ground in the representation era has evolved into solitary listening and stored social relations in the forms of records, tapes, CDs, DVDs, MP3s, and other such video and audio devices, which implement the simulacrum of social exchanges through media. Power no longer represents its legitimacy; it records and reproduces the societies that it controls. To have the means of recording allows for the surveillance of noises, of disturbances; it allows for the control of the repetition order. Conceived to preserve a social order of representation, recording technologies have helped shape another one: that of repetition. The phonograph and the cinematograph were a means to assure the conservation of the representation of the ruling class, and by their very advent opened a new dynamic that replaced the representation of the spectacle of power with repetition and accessibility. With the mass production of music in the form of records, audiotape and radio, but also with cinema, television and the Internet, accessibility increasingly developed into the democratic ideal under which industrial capitalism thrived during the twentieth century, becoming the engine of the information networks of today's global economy. Attali's description of those transformations, brought about by the modes of the repetitive society, exposes, without saying so, the loss of the aura of the spectacle, of representation, and of the uniqueness of the work of art in an era of technical reproducibility that Walter Benjamin analyzed in the mid-twentieth century (Benjamin 1936).[8]

So the era that began with the emergence of the technological means to record and reproduce sounds and images not only is characterized by its storage and retrieval capacities, but will also eventually develop so that they become widely available to the individual – the consumer who can bypass the circuit of a centralized power that controls social discourse and can consume all sorts of cultural products. On this topic, Attali notes that '*l'accessibilité se substitut à la fête*' ('accessibility substitutes for celebration'), meaning that the occasion for a social meeting of a ritualistic nature is replaced by the virtuality of accessing anything, but only as a solitary pleasure through what we now call personal media (Attali 1977: 164). Although, in the case of early video art, accessibility meant inventing instruments and tools, as Woody Vasulka happily discovered when he arrived in New York, it also meant finding ways of getting hold of the available technology of repetition. Woody notes that he:

> […] understood, right from the beginning that the [electronic] systems I needed were not part of the available hardware [...] either commercially, or cheaply – in a way that I could afford it. For as long as I have been working with electronic tools, I've separated myself from industry. [...] I've been able to observe how they [electronic systems] became available, how they filtered down from this commercial or industrial world to the point where they were within my reach. I also understood that in the United States there's an alternative industrial subculture, which is based on individuals, in much the same way that art is based on individuals. (W. Vasulka 1978: 20)

The interview from which this quote is drawn dates to 1978 – a time that marks the Vasulkas' shift to digital tools and Woody's investigation of a 'syntax of binary images' – and is indicative of a more complex rapport between the artist and the available tools of repetition. In contrast to Attali's rather abstract description of the era of repetition, this quote reveals a mixture of willful opposition to industry with a desire for technological innovation based on available technologies.

During the past century, the mass availability of music and films, for instance, slowly became the motor of the integration of consumption, of inter-class leveling, and of cultural normalization. In this context, the new forms of music that appeared within this era – twelve-tone (or serial) music; *musique concrète*; and electro-acoustic music – were characterized, says Attali, by the scientism of Pierre Boulez and Iannis Xenakis; by Stockhausen's imperial universality; by Cage's depersonalization; and by Philip Glass's deconcentration and manipulation of power. But Attali's broad characterizations lack a real analysis of these and other artists' works and practices of the time. Fluxus performances in the 1960s, which Attali does not mention, were part of this same operation in which the distribution of power moved from a central master (the composer or conductor) to a diffuse set of executants, be they machines, performers or the public. We have seen that some of these characteristics – the depersonalization and deconcentration of power through playing with the objectivity of electronic systems – are found in Steina's *Violin Power*, as they are in other works such as *Orbital Obsessions* (1977) and *Ptolemy* (1990). In one of her violin performances, *Maiden* (InterCommunication Center, Tokyo, July 17th, 1998), she played the violin to one of Woody's robots, *Table 6: The Maiden* (1998), producing the music to which the automaton danced in a duet with the musician.[9]

Attali sees these new forms of music as corresponding to the demands of the repetition era, to what he sees as its absence of meaning, its failure to communicate. In his view, these forms of music are also similar to the technocratic language that generates 'a more efficient channeling of the production of the imaginary [...] forming the elements of a code of cybernetic repetition, a society without signification – a repetitive society' (Attali 1977: 137). According to Attali, who is filled with a sense of loss, this development is best illustrated in the relationship of the composer or the artist to his or her instruments: composers and artists are surpassed by their tools, and instruments no longer serve to produce forms (sonic or visual) at the will of the creator, but to control unexpected forms (Attali 1977: 187).

Attali certainly represents a quite common technophobia. His technological world, that of repetition and the concurrent cultural milieu thus created, is interpreted negatively as a loss of mastery, the artist being unable to master the machine. Although one has to admit that confrontation with instruments or machines in a creative capacity always entails a notion of mastery, he fails to recognize the value of immersing oneself in technology by setting your body within or in relation to an electronic system that 'you have set in motion', as Steina has often said. Steina's works, considered in their instrumental dimension – in the use of instruments or sets of instruments by the artist, with the violin as the master instrument allowing her to compose in live performance – rather show the beauty of surrendering to the machine, the intricate balance between mastery and abandonment, in interaction and dialogue. More importantly for my argument, Steina and Woody's relationship to electronic and digital instruments in the aesthetic domain parallels that found in recent epistemology of science. Don Ihde, in his book *Instrumental Realism: The*

Interface between Philosophy of Science and Philosophy of Technology (1991), affirms that even if technologies and instruments can be seen as extensions of the body or enhancements of human perception, they can also be considered as a group of 'relations [that] does not extend or mimic sensory-bodily capacities but, rather, linguistic and interpretive capacities' (Ihde 1991: 75). He calls this a second order of hermeneutic relations. He adds that 'in hermeneutic relations the technology is not so much experienced-through [as in the extended-body experience through technology] as experienced-with' (Ihde 1991: 75). Thus, in this last instance, technology becomes a 'quasi-other', just as a game is, and opens up to interaction and a dialogic posture in performance.

Composing with time

Steina and Woody's works within the nascent field of video art have been characterized by creativity in both art and technology. Since he started to work with electronic systems, time has always had a compositional meaning for Woody Vasulka; for him, audio and video are the same thing, 'energy in a particular arrangement in time' (Wilson and Megela 1981: 8). His 'time-energy objects' and 'artifacts', as he calls the audiovisual forms performed by different sets of instruments, result from a process involving time and energy arranged in a particular structure or form. While structures are static forms based on oppositions of differentiated elements, the element of time formation, the field of active intervention in the signals (the time the image needs to be electronically encoded and decoded in the electronic system, and the modulations and alterations thereof) introduces the notion of change over time, as well as a dynamic articulation of time (frequency), structure (circuitry) and energy (voltage control). This dynamism of the audio-video complex that Woody Vasulka has tried to define lends itself to the performative aspect of instrumental playing so dear to Steina.

For Steina time is 'real time'. However, she uses this notion in a peculiar way:

> We can say that editing as inherited from film may analyze, or rather, criticize the 'real time' of a scene, but in our context where video and computer are side by side, we must discuss a quite different aspect of 'real time'. The tools we use, videotape recorders, camera, etc., operate in 'real time' as a time in which signals propagate from input to output. [...] One result of real time system performance is that you can continuously modify the sequence, which in a process resembles [the] playing of a musical instrument. [...] So 'real time' in our context does not mean the 'infinite take,' but the observation of image forming processes, which look to us as perceptually continuous, yet interactive in all modes, including the image forming. (S. Vasulka 1980)

Here Steina points implicitly to the objectivity of electronic systems, in which the question of control is crucial. This control over the system does not negate the system's inner architecture or the autonomy of the system, but it is that ‘exciting control mode’ of ‘interactive real time’ of the instrumental relationship, the playing of instruments (Wilson and Melega 1981). In the real time of the performance, it is also the pleasurable self being played out. (Or as Attali suggests, ‘*C’est jouer pour jouir soi-meme*’ [Attali 1977: 217].)

The performance of the musician and video artist is always mediated by the trickery of technology; it is real time but not an immediated reality. In this paradox surrounding the notion of real time as it concerns Steina’s work lies the possibility for composition and play, for composition at play. If composition is the liberation of the artist’s body, as Attali would argue, in Steina’s case the body is not so much liberated from anything; it becomes the interface between the artist’s self-representation through instant video feedback, and the gestural orchestration of sources of images and sounds displayed on multiscreen configurations. In Steina’s work, unlike that of many other female video artists, the body’s presence and performance do not represent so much a concern with femininity or female identity and liberation, but rather a concern with playing with electronic signals, oscillating between controlling and losing one’s image through electronic systems, producing the pleasure of playing. These manipulations also reveal a dynamic dichotomy between the figurative image and its contamination and disturbance by electronic music and sound.

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Notes

1. The title is from Steina Vasulka, quoted in Hanley and Wooster (1993: 86). In art contexts, the artist now uses the single name Steina.
2. The videotape lists 1969 as the beginning date of the creation of *Violin Power*, but many catalogs mention 1970.
3. Gene Youngblood and others review and comment on Steina Vasulka's works in Gene Youngblood et al. (n.d.), [archival document], Steina and Woody Vasulka Fonds, VAS BI-C7-2, file 'Tape descriptions'; Montreal: The Daniel Langlois Foundation. Underlining in the original.
4. The art historian and critic Rene Payant used the French adjective *famelique,* which I translate as 'gaunt' (Payant 1987).
5. It is possible to see many of these videotapes, in their entirety or as excerpts, on The Daniel Langlois Foundation website, www.fondation-langlois.org/flash/e/index.php?NumPage=460. (A high-speed Internet connection is recommended.)
6. Yvonne Spielmann describes at length the instruments used for the production of Steina and Woody Vasulka's works. Also available online are archival documents that explain the conception, building, and functioning of these instruments.
7. Part of this description and others in this article are taken from the website of the Center for Research and Documentation of The Daniel Langlois Foundation: www.fondation-langlois.org/f/collection/vasulka/archives/intro.html. Accessed April 6, 2013.
8. The question of the loss of the aura cannot be further developed here. It is worth noting that the notion of 'spectacle' used by Attali is quite different from that of Guy Debord in his book *The Society of the Spectacle* (1994). But again, I must leave this question aside in the present article.
9. Table 6 was one of Woody Vasulka's six 'hybrid automata' that he constructed from the early to mid 1990s.
10. I translate from the chapter on repetition in the French original, pp. 143–214.

This essay in its original form was published by the College Art Association as Jean Gagnon (2006) 'A demo tape on how to play video on the violin', *Art Journal*, 65: 3, pp. 70–81. Reprinted with permission.

Application to the Guggenheim Foundation, 1980

Ralph Hocking

Since 1968 I have been employing a variety of electronic image processing devices in my work with video as a visual art. In the past four years of research, I have been using an analog/digital processing system. I have chosen this system because it provides a wide range of imaging and control techniques. The following is a general discussion of the issues central to the videotapes I propose to develop.

The system, through camera inputs, permits the simultaneous presentation of a number of spatial perspectives and their reorientation in whole or in part through techniques of superimposition and keying. The realignment and layering of these various perspectives is achieved partially through the use of keyers in combination with sine, square and triangle wave oscillators producing the basic wave shapes which can then be used singly or in combination as images and to divide the picture plane. I am particularly concerned with the juxtaposition of optical and oscillator-generated forms. A number of perspectives of the same activity can be presented either in a simultaneous or sequential manner. The reassignment of parts of whole images within the picture plane serves to further disrupt the pictorial space, allowing the emergence of new relationships of scale and perspective. The sequential structuring of a series of images can be controlled in increments of one frame or less; this rapidity of change challenges the ability of the eye-brain perceptual system to resolve the sequence into discrete images, developing superimpositions and phenomena such as image retention which occur within the perceptual system rather than on the display screen.

The development of temporally asynchronous relationships is an important part of the work; real time and recorded time can be simultaneously or sequentially presented. Manipulations of the duration of real-time activity are attained with slow-scan and slow-motion systems, reinforcing this fundamental temporal dichotomy.

Control over the changes within the parameters of these image-making variables is achieved through manual manipulations of potentiometers, or knobs, and the construction of input control voltages. The control voltages are generated by a voltage control bank, an audio synthesizer and a computer. These signals can be used to control the timing of changes within an image and among a sequence of images. These signals may also be used as sound structures. The use of stereo sound on the tapes allows the definition of an auditory space. I am interested in revealing relationships between image and sound which are fundamental and preserve the integrity of both components; frequently the voltage-control signals simultaneously affect both the recorded audio track and the image.

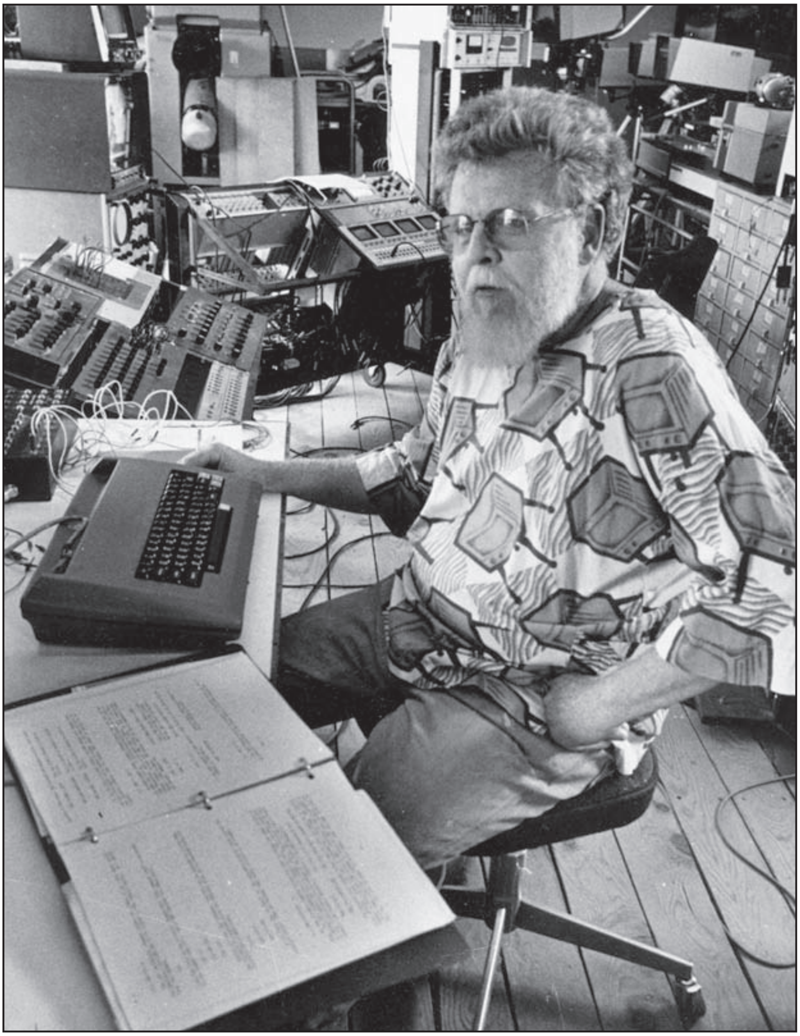


Figure 1. Ralph Hocking in his studio with an early computer (c. 1980).

The introduction of a computer to the system has presented several critical issues which require a concentrated investigation. The video image is actually defined by an electronic signal which changes with respect to time, the nature of the change determining the appearance of the image. A single second of digital video is actually composed of over 1.5 million discrete picture elements. The computer allows both a precise and replicable specification of and access to each of these elements and also a grouping, by the artist, of like processes, wherein the artist defines the nature of the control or change rather than the specific value of each pixel.

The computer is, in part, a control system for imagemaking which includes seven channels of digital-to-analog and analog-to-digital conversion. It also contains a frame buffer that converts images into discrete blocks of sixteen shades of gray; the gray levels in the original image can then be reorganized or grouped together to form more generalized gray-level definition. This computer system in conjunction with the other analog components can control predefined image changes, for example, color, and can also translate camera or other input images into a digital code, buffering the image and operating the signal code to define the images in terms of gray level.

Programming is a process of adapting the machine to the artist by codifying the defined image sequences and changes and involves both the modification of existing programs and the creation of new ones. In collaboration with Paul Davis, Instructor at the School for Advanced Technology at the State University of New York at Binghamton, and video systems designer David Jones, I am interested in addressing this problem. We are working on programs and ultimately a language which are derived from the visual arts; analysis and definition of the primary classes of image elements is the initial stage of this research. The objective is to define and codify a descriptive language of the electronic image; the software retains features of accuracy and repeatability but is responsive to the artist, specific to the language of the visual arts and tailored in a way that does not require extensive prior experiences with computers. I believe that this approach is important because it provides a human quality and scale and allows the maker to gesture, to re-form images in a direct and sensual way.

Electronic image processing is a new and developing field and has necessitated a major commitment by artists toward the design and development of the image-making tools. It is only recently that the field has matured to a degree that invites this type of proposed study.

Summary

My involvements in video include administration, teaching, curriculum development, systems design and my own art. While this divergent style is stimulating, it is very difficult to regain the thread of a previous thought and feeling toward a tape when work on it must proceed in this interrupted fashion. I propose to devote one year to making tapes which evolve from my interactions with the system and aesthetic considerations which derive from a relatively conventional background in the visual arts and a decade of involvement with video as a visual, contemporary art. This project will allow me to work in an intense and focused manner; it will also provide an opportunity for a more objective perspective both on my own work and on the field of image processing. The intention of this project is not a didactic cataloguing of possibilities but the realization of visual ideas refined to a degree that would provide insights into the expressive use of imaging tools.

Thoughts on Collaboration: Art and Technology

Sherry Miller Hocking

Technē – the integrated practice of art and science

Can the conceptual frameworks of the once-new media of 'video' and that of the now-aging 'new media' collaborate?

Dichotomies

Individualism was a hallmark of mid-twentieth-century fine arts practice, and an essential aspect of any definition of the identity of the American citizen. But contemporary artists of the 1960s – e.g., Oldenberg, Judd, Serra, Christo – began to contract out for services and use commercially available materials. Is purchasing services which the artist is unable or unwilling to provide collaboration? Is personal mark-making necessary?

Collaboration flourished in music and performative arts, and was adopted by media artists in the late 1960s and early 1970s as they struggled to create new working models for the then-new medium of video. Artists created collaborative working relationships to achieve projects which pushed the boundaries of conceptual and activist art works – e.g., Ant Farm, TVTV, Raindance, Videofreex.

Formal and informal collaborations were also created among artists and technologists, as individuals worked together to create new instruments with which to make works. Commercially available tools were too expensive, too restrictive, and unimaginative.

Art was something that a group of people could engage in simultaneously not as parallel practice but as interactive human activity. Collaboration was a successful economic strategy: some video instruments were beyond the reach of individual ownership. To keep pace with the rapid advances in technology, group ownership was an important strategy. 'Production units' – co-ops, collectives and media arts groups – reflected the social and political zeitgeist of the times.

Collaborations in the media world of the 1960s and 1970s occurred among artists, among artist and technologist, and among media and other arts disciplines. The artwork was experimental, the process was experimental, the discourse and practice were experimental.

In order to achieve this collaborative practice, artists moved outside the existing organizational structures – art world or corporate media – and created a more utopian system. The art world and the economic engine it serviced were critiqued. The distinction between artist and amateur was rejected; citizens became arts activists. Artworks became immaterial.

Eventually this experimental and collaborative art was co-opted and appropriated into the dominant cultural practice, and experimental and unconventional works became the norm. Artists willingly elected to participate in the very worlds they critiqued. Media artists sought broadcast outlets for programming and became art museum stars.

The dominant paradigms of TV and the art world

TV was video's 'Frightful Parent':
- hierarchically organized and professionally produced
- reinforced the status quo
- work funded by capital from advertising
- one-way audience delivery system
- 'objective' information from authoritative source; talking head
- images were formulaic and representational
- formal narrative conventions derived from theater and radio
- goal was to reach mass audiences

Video/art was the antithesis of TV:
- organizing principles were individual and collective
- institutions were artist-run and democratic
- work was created by amateurs and artist
- funded by gift economy
- two-way, participatory information structures
- subjects were subjective and personal
- presentation was creative, often abstract, nonnarrative
- aesthetics central to medium
- goal was to reach specialized, smaller audiences

Art World
- industrial and corporate models
- elitist - access restricted
- artist as star
- restricted acceptable media
- concern with reproducibility of work—easily reproduced media devalued the art product
- precious and unique object - as means of maintaining value, limiting supply

Video held conflicted relationship with art
- anti-high art
- group and collective process; inclusive
- equality of participant-producers
- tapes shared, copied freely
- no precious art objects - erasable
- infinitely reproducible, impermanent

What is the evolutionary matrix for new media?

The late 1960s' media universe of abstract/experimental/art video:

- immaterial – the phenomenology of video
- processual – lacking 'objecthood'
- conceptual, ideational or systemic – not a commodity
- formally inventive – a medium creating itself
- immediate
- interactive – feedback system
- time-based
- sculptural – aspects of apparatus
- antiauthoritarian, radical/democratic critique of capitalist economic system
- collective or cooperative ownership as social organizing principle
- open-sourced sharing of work, information, toolsets

These concepts were realized in video through the media collectives formed to produce work; through shared information and videotape exchanges by bartering and gifting; through media organizations created to provide free access to media tools to all people, to circumvent the means of production tightly controlled by major corporations; through the creation of works critical of existing social, educational, political and arts institutions.

Figure 1. Hank Rudolph with the 2005 International Summer Residency participants (photo. Fei Jun and Pamela Susan Hawkins).

Contact

Collaboration and sharing of information were a part of the early philosophical, and therefore physical, structures of the field. We gave away videotapes rather than selling or distributing them; we shared schematics and modifications to tools so that all could benefit. Most people were involved for love, not money; we were amateurs, in the literal sense of that word. The gift economy ensured that video groups could survive without emphasis on earned income. We didn't have to compete with each other to survive.

The field was small; we knew each other. The New York State Council on the Arts established for itself a leadership role in ensuring that organizations and individuals convened on a regular basis. There were town meetings, small conferences, informal symposia. We created our own circles of communication – largely by phone or personal travel. There were organized tours, bicycling of tapes and artists around the state, to provide public exposure for the art and makers.

Those of us working in the area of 'experimental' video or 'video art' had, of necessity, to engage in tool design and development. Early commercially available tools were very limited and limiting. The collaboration between artist and engineer had precedents and origins in the art of the early twentieth century. Because we had nothing to gain by being secretive or proprietary about our inventions, the information could be passed around. We felt it was morally the correct thing to do. Some of these inventions were partially supported by public funds on a state or national level, so there was also a requirement to make the information public, if at all possible.

The issue of genres was and remains complex. At first I don't think any of us saw any genres or definitive boundaries. As the 'camps' emerged, boundaries were reinforced by funding agencies, art institutions and scholars; critics all struggling to make 'sense' of the form. Interdisciplinary or collaborative work didn't easily fit into genre or category.

The Web now seems like a natural place to re-share this information and to engage in twenty-first-century collaborations. This is why the Experimental TV Center began the 'Video History Project' in 1994.

From the contributions we receive, we wonder about the parallels between the development of early video and the emergence of new media art and practices:

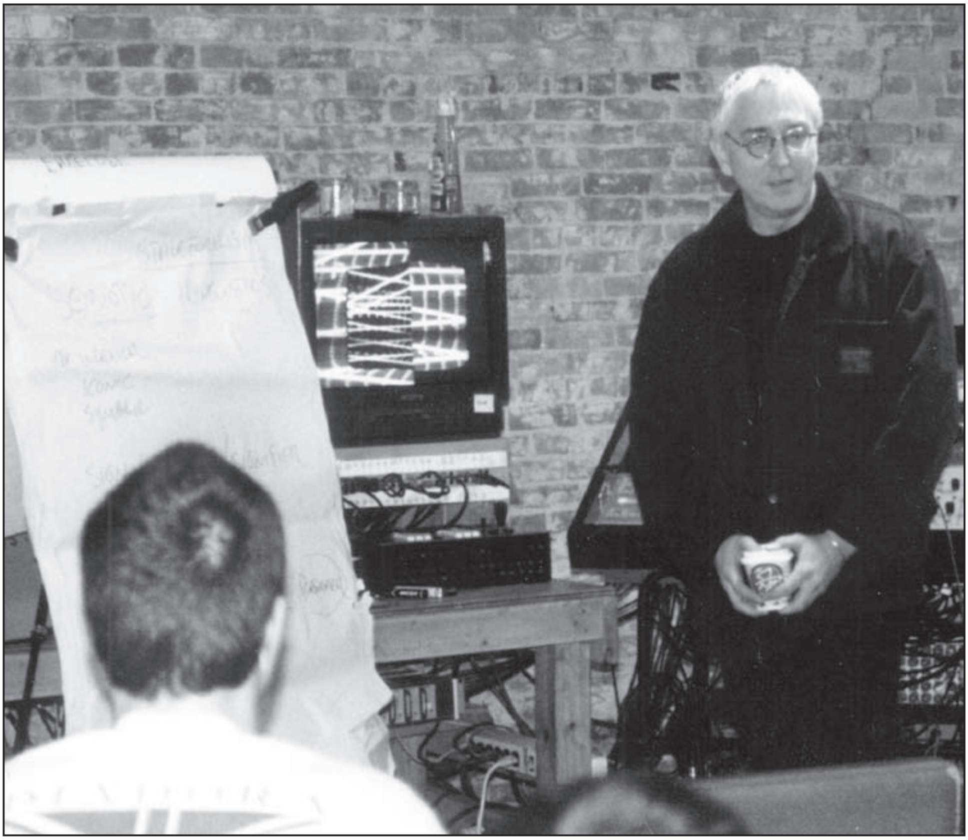
- Does a decentralized, open-source-based network support a collaborative process or circumvent one?
- Does collaboration engender responsibility to the network? Beyond the network?
- Does it engender discourse across disciplines?
- Is collaboration a distinct practice? Or is that oxymoronic?
- Are two heads really better than one?

- Is interdisciplinary collaboration an overarching discipline?
- Is art-as-commodity dominant, and destructive of collaboration?
- Does collaboration support distributed knowledge?

Notes

1. Erica Eaton, Pamela Sue Hawkins and Kelly Jacobson (eds), (2005), Stereo Visions – Looking Back/Moving Forward: Art, Writing and Sound from the Evolutionary Girls Club, Rochester, NY: Evolutionary Girls Club.

Interstitial Images: People and Networks



Guest Instructor Peer Bode speaks to participants at the 2000 International Student Workshop at ETC. (photo. Pamela Susan Hawkins).

Thurs., Dec. 2

RECEIVED
1 call from Paik, Nam June. Message: hurry ralph. Duration 3-min.

RECEIVED
1 col. call. From same. Message Many things. Duration: many. To Ralph.

NEEDED
Copy of Resnik revision. Send special delivery. To Lady. From NJP.

REVIEWS
See all new reviews. In Evergreen, Harpers, art mags. Once in lifetime opportunity.

ARRIVALS
Of NJP, Abe on Dec. 23. Watch for them at a house near YOU.

RENTED
1 room. Nice view. Utilities included. No pets.7239509.

WANTED
1 directors chair. In NYC. After 11 Dec.

NEEDED
To rent. 1 truck. Capacity: several TVs. Call Ken or Van. By Dec 11.

RETURN REQUESTED
1 call to Aswad, Esq. 7223495

Fri., Dec 3

LEGALS
The aforesaid is legal notification that the CCTVP is now formally and legally a Corporation, under the title Experimental Television Center, Ltd., unto perpetuity. Aswad, Esq.

LEGAL
This is to state that Kenneth Harold Dominick is fully fledged by CCTVP. Evangelos Dousmanis, Lord and Esq.

NOTICE
Meeting to be held 2-3 pm. In Gordon's office. To discuss da future.

Mon., Dec.6

AUDITS
Done. No waiting. Full includes our guarantee of responsibility. Our many service plan allows you to take full responsibility but we will help. Call Updike. 7225386 for your free estimate. Recommended by WSKG TV.

SERVICE
For Seeburg service see Vince Williams. 7487100.

URGENT
Needed by 3 pm Monday. Brand-new Panasonic. Old one broken. Call Jack and arrange. I love you. NJP

TEACHING OPPORTUNITY
At SUNY Binghamton. Summer. 4 weeks. Sal: 1000-1500, depending on experience. Include justification of existence with your application.

CAN'T SPELL?
Investigate our new service. You need never again fumble around in the dark looking for the word you can't quite put your hands on. So put your hands on Dial-a-Dict. 7239509. Anytime.

Tues., Dec 7

TEACHER NEEDED
To lecture and demonstrate TV equip., & let kids use. Jan. Chenango Forks area.

TO BUY
Windshield wipers for GMC truck. Urgent before Fri. am. 7239509.

TVs
29 used. 4 used small. Ideal for Christmas presents or otherwise. Also good for Sam. Call Colonial first.

LOST
Claire. In vacinity of vacationland. Need to know when 50 thou. must be spent, if file for tax exempt., & type of audit needed. 7239509.

PERSONAL
Ralph. You sound like a sweatheart. Call me sometime. Bill 7982631.

CORRECTION
For sweatheart, read sweetheart. Or something. See Dial-a-Dict.

KEYS
Keys made while you wait. Even those hard-to-duplicate ones. Ralph's Key Shoppe

Thurs., Dec 9

TO RENT
1 recording unit to rent for Tues. 8:15 pm. Will return Wed. Will call back to confirm. Ann Yeoman

NEEDED
1 interested party to call Ginny Tell her to get me up. I'm upstair and have meeting 11 am. Far out. Up Down. R.

NOTICE
It takes all the running i can do just to keep in one place. Sherry in Wonderland

Mon., Dec. 13

LEGALS
Ralph. call Dick Aswad, Esq. 723-3495.

NOTICE
I will not be responsible for the debts incurred by my self. Ashton.

LOST
1 RF unit. In vacinity of Ashtons. Who is not and never has been a SONY franchise dealer.

PERSONALS
Bob. Call Pat.
Ralph Call Michelle. 7237387.

SALE
Inventory.Sale of cameras, monitors. To ETC from CCTVP. Going out of business. Everything must go.

NOTICE
3 more days to Friday.

REFUND REQUESTED
$5.00 to Scalese. re: travel voucher.

Tues., Dec 14

NEEDED
Phone # of Doug. Urgent. Call Angel.

NOTICE
Tom Keene. 34 Home Avenue. Middletown Conn 06457. 2033470093.

NEEDED
Phone # of Doug. I flushed the other one down the toilet. Urgent. Call Angel.

INFO.
Who you spoke to? Still no have phone. Thank you Lady byebyebyebye

ARRIVAL
Abe. From West coast. Dec.18. For return engagement. If you send ticket.

COMING SOON
Channel 13. At a studio near you

PERSONAL
Stuart Gitlitz 2126773750

Telephone messages logged at ETC in 1972.

Nam June Paik

Feb 25 78

I have worked frequently at ETC, Binghamton since it started.
I cannot describe, how much I owe to this center in the series of most important works of mine.

1) Paik-Abe Video Synthesizer was officially premiered at WGBH, but still it was well below the broadcast standard. It was finally welded tinto this broadcast standard at Binghamton. Without Ralh Hocking, this mchine would not have been completed.

important

2) I made at Center two most video sculptures.

Video Bed

TV CELLO.

TV cello played the KEY role in the making of the Global Groove at WNET TV LAB, that without Hocking's help I would have never been able to complete , or even conceive the Global Groove.

Video Bed played important role as recent as in the DOCUMENTA telecast from Kassel Germany in the summer of 77.

3) My Selling of New York was almost completely made at ETC Binghamton with all TV LAB people being brought there. Loxton and Godfrey stayed 2 days at Binghamton to videotape and R Connor acted for two days.
4) This video tape session was so succesful, that it was used also in the "TRIBUTE TO JOHN CAGE (WGBH-WNET production), and this part is pne of the key section in my Cage Tribute.

5)Selling of New York was revived as the opening segment of

Nam June Paik describes his work at ETC (1978).
(courtesy. Nam June Paik Studios).

my MEDIA SHUTTLE -New York-Moscow, in collaboration with Dmitri Devyatkin, and will aired through EEN over the wide area of PBS system... Also it will be aired in the Belgian TV. (1978. Spring)

6) Even in my 1977 "Merce and Marcel" due to be aired through WNET TV 1978 autumn, there is important segment "a baby", which is the baby of th Binghamton (Bob Diamond), which inspired me to construct whole show in the theme of resurrection through Video disc.

7) I must add that Shigeko Kubota also produced at ETC Binghamton her Duchamp-Chess piece in collaboration with Ken Dominick, which was shown at WHITNEY's Projected Video and

' Rene Block gallery (NYC) and Kitchen at Mercer Art Center.
and Japan House gallery 1978

Both Shigeko and I am eternally indebted to ETC and Hocking for all this adventures and fruits.

Nam June Paik

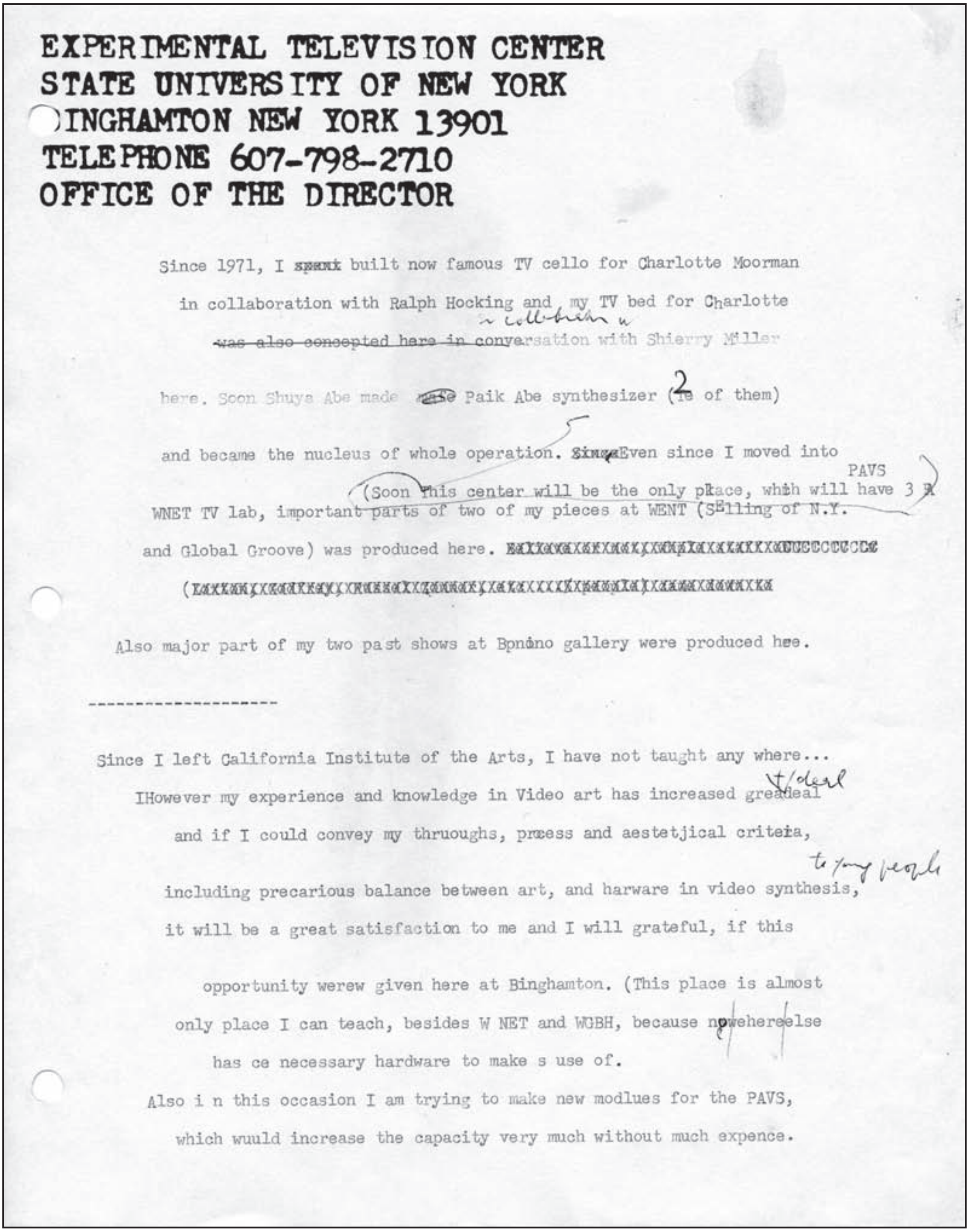
Nam June Paik describes his work at ETC (1978).
(courtesy. Nam June Paik Studios).

EXPERIMENTAL TELEVISION CENTER
STATE UNIVERSITY OF NEW YORK
BINGHAMTON NEW YORK 13901
TELEPHONE 607-798-2710
OFFICE OF THE DIRECTOR

After the absence of one ~~and half~~ year, I came back to TV center at Binghamton., to be pleasantly surprised by the enormous growth of ETV cent here ~~to my pleadent surprise, TV center grew mich more than I expected and I hear that t~~ studio facikity ~~is booked already upto~~ december. This center is attracting artists from New York City , vario wide arear in upstate New York and Pennsylvanis and Canada, local artists. It is a ~~good~~ rather curious scene to watch that artists makes long trips from Manhattan to work in the sleepy little town in h near Appalachia. Another case to note is that although this centre started with portapak operation, slowly and natu = rally more sophisctcated video synthesis won over and has become the major part of operation... even for the local artist from Bingham ton. (It may be true ?)

My invovement with Binghamton dates back to May of 1968, when Ralph hocking walked into my second show at Boninp Gallery in New York. (first ~~when I met you~~ Steina and Woody) In 1969 Ralph invited me to the Harpur College, SUNY, and ~~waasaa~~ he started a modest beginning at the cellar of tehe Harpur College. In 1970, when I was leaving ~~Bostonzforzlaf xtaxtaaak~~ WGBH, Boston for Los Angeles C to teach at California Institute of the Arts, I trusted all my electronic gears to keep art work on to Ralhph Hocking . ~~To~~ (1971 I ~~prepared~~

Letter from Nam June Paik concerning his work
with Ralph Hocking and ETC (n.d.).
(courtesy. Nam June Paik Studios).



EXPERIMENTAL TELEVISION CENTER
STATE UNIVERSITY OF NEW YORK
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OFFICE OF THE DIRECTOR

Since 1971, I ~~spent~~ built now famous TV cello for Charlotte Moorman in collaboration with Ralph Hocking and my TV bed for Charlotte ~~was also concepted here in~~ in collaboration conversation with Shierry Miller here. Soon Shuya Abe made ~~same~~ Paik Abe synthesizer (2 ~~ie~~ of them) and became the nucleus of whole operation. ~~Since~~ Even since I moved into WNET TV lab, important parts of two of my pieces at WENT (SElling of N.Y. and Global Groove) was produced here. (Soon this center will be the only place, whih will have 3 PAVS)

Also major part of my two past shows at Bonino gallery were produced hee.

Since I left California Institute of the Arts, I have not taught any where... IHowever my experience and knowledge in Video art has increased great deal and if I could convey my thruoughs, proess and aestetjical criteia, to young people including precarious balance between art, and harware in video synthesis, it will be a great satisfaction to me and I will grateful, if this opportunity werew given here at Binghamton. (This place is almost only place I can teach, besides W NET and WGBH, because nowhere else has ce necessary hardware to make s use of.

Also i n this occasion I am trying to make new modlues for the PAVS, which wuuld increase the capacity very much without much expence.

Letter from Nam June Paik concerning his work with Ralph Hocking and ETC (n.d.). (courtesy. Nam June Paik Studios).

EXPERIMENTAL TELEVISION CENTER
STATE UNIVERSITY OF NEW YORK
INGHAMTON NEW YORK 13901
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Last but not least. I have never been paid for my wok
here at Bunghamton... I paid even all the bus fme myseld easily 2
20- 30 trips) Therefore I am quite happy th
that ~~myxlmx~~ fairly past x investments in money and time wo
would yield some monetary return to me .

Letter from Nam June Paik concerning his work
with Ralph Hocking and ETC (n.d.).
(courtesy. Nam June Paik Studios).

NICHOLAS RAY

April 1st, 1972

Mr. Ralph Hocking
T.V. Educational Center
164 Court Street
Binghamton, New York

Dear Ralph,

I've been working my usual long and unconventional hours, and ask your understanding in taking so long to answer your note of February 17th.

It seems ridiculous to me that you (or I) must petition for grants through public support when it could and should be administered through the recognition of accomplishment and need, [redacted] by people who, I suppose, are learned in our fields.

Your accomplishments with the Center at 164 Court Street during the brief time I have known you and observed the growth of the Center itself need only a before-and-now photo to remind those who do administer money how far you've advanced your program since last August. Any student of mine who does not avail himself of the facilities and a brush with your philosophy is, in my opinion, a dolt.

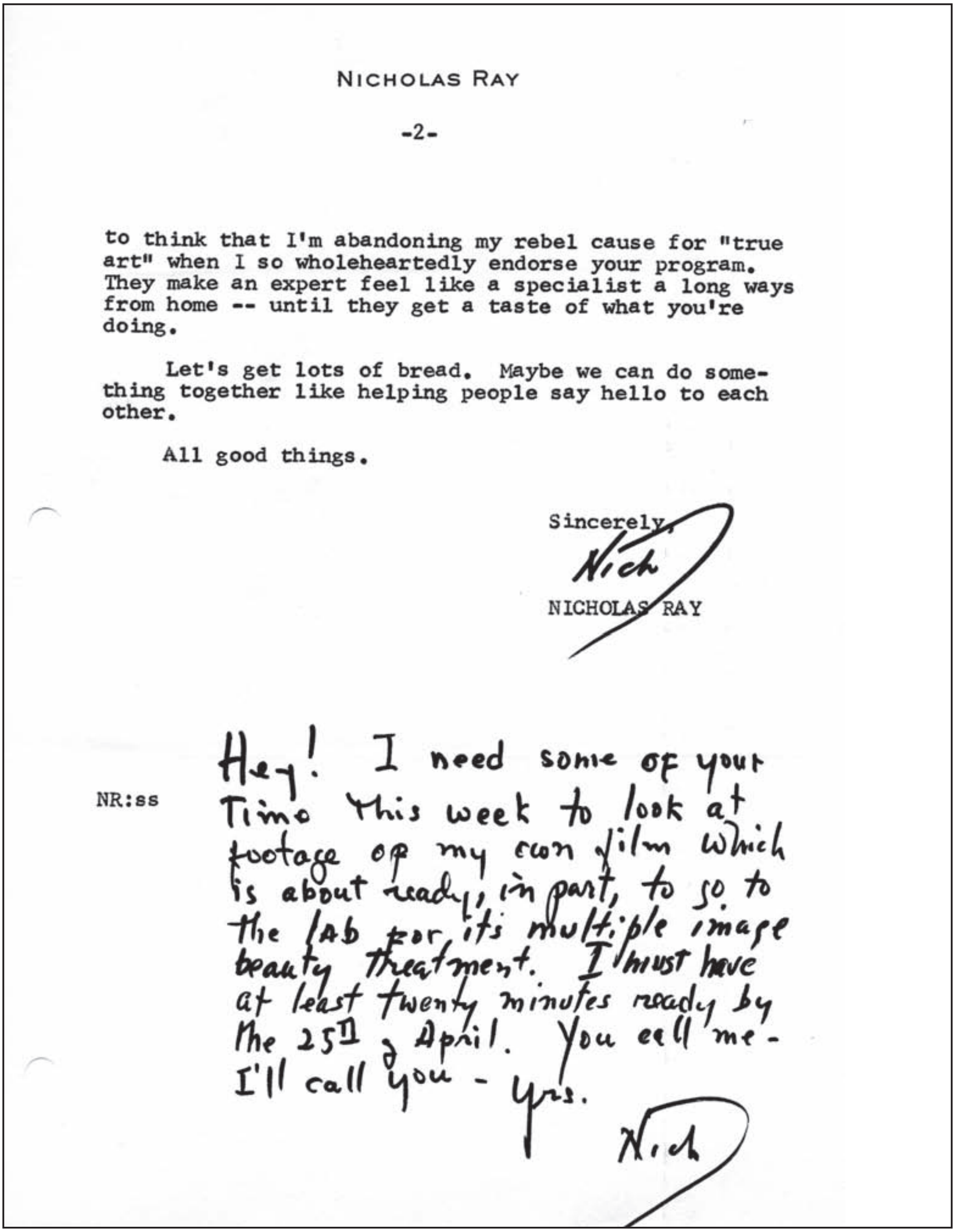
As you've probably noticed, in recent weeks I've been attempting to labor you less by sending you only the best; yet I know I must eventually send each one of them to you or else I would not be fulfilling my function as a teacher as I conceive it.

But prepare for a new invasion. Each 11th or 12th grade high school class I've spoken to in recent weeks has been given your address.

Some afficcianados on the University level choose

(cont'd)

A letter from Hollywood film director Nicholas Ray describing his work with students at ETC. (© 2011 The Nicholas Ray Foundation).



NICHOLAS RAY

-2-

to think that I'm abandoning my rebel cause for "true art" when I so wholeheartedly endorse your program. They make an expert feel like a specialist a long ways from home -- until they get a taste of what you're doing.

Let's get lots of bread. Maybe we can do something together like helping people say hello to each other.

All good things.

Sincerely,

Nick

NICHOLAS RAY

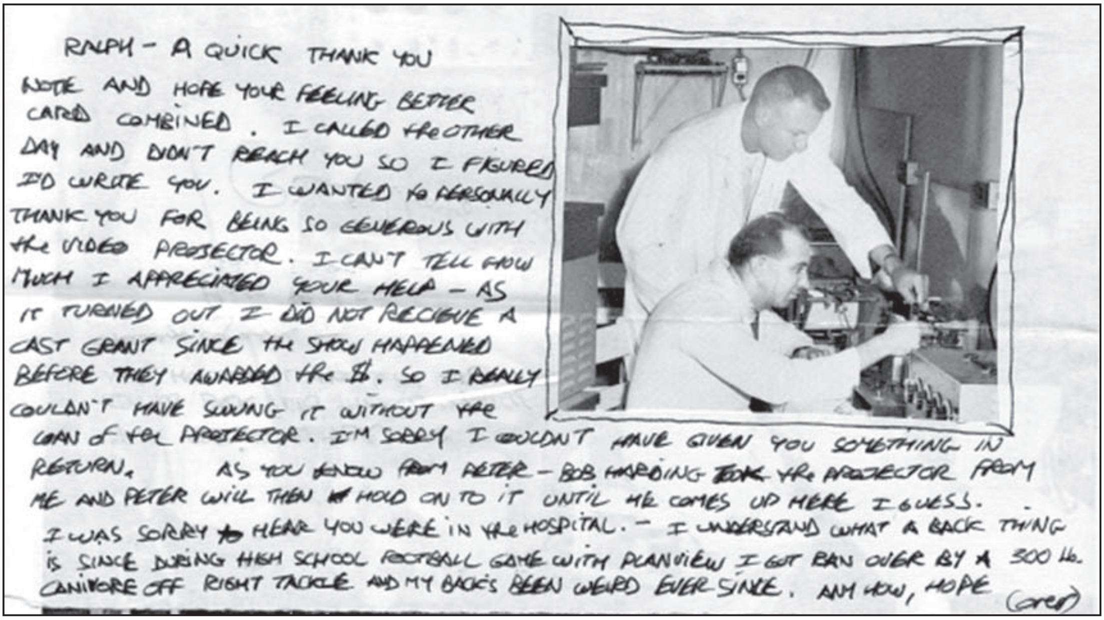
NR:ss

Hey! I need some of your Time this week to look at footage of my own film which is about ready, in part, to go to the lab for its multiple image beauty treatment. I must have at least twenty minutes ready by the 25th of April. You call me - I'll call you - Yrs.

Nick

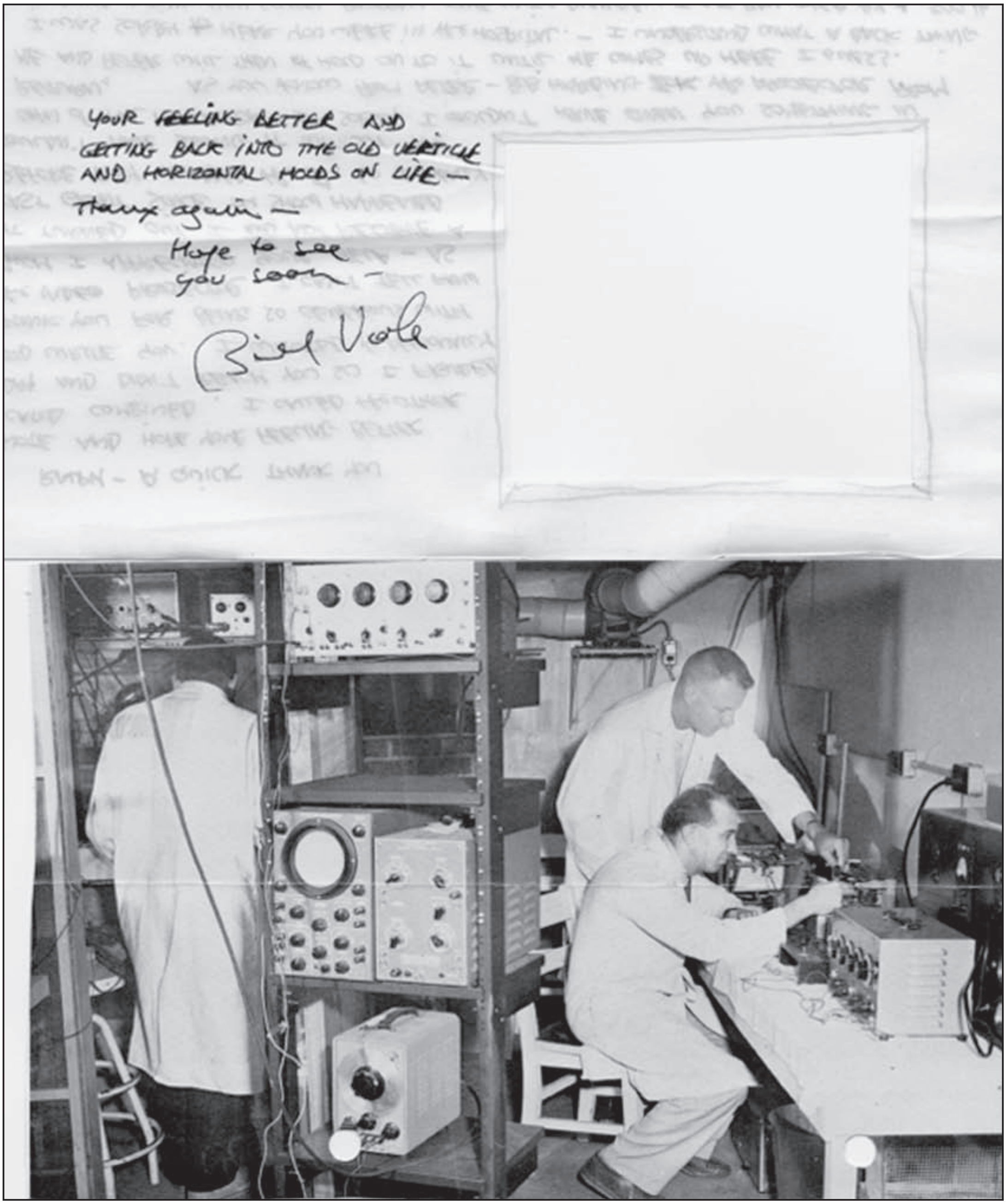
A letter from Hollywood film director
Nicholas Ray describing his work with students at ETC.
(© 2011 The Nicholas Ray Foundation).

The narrator on Nam June Paik's *The Selling of New York* (1972), Russell Connor is processed through the ETC system.

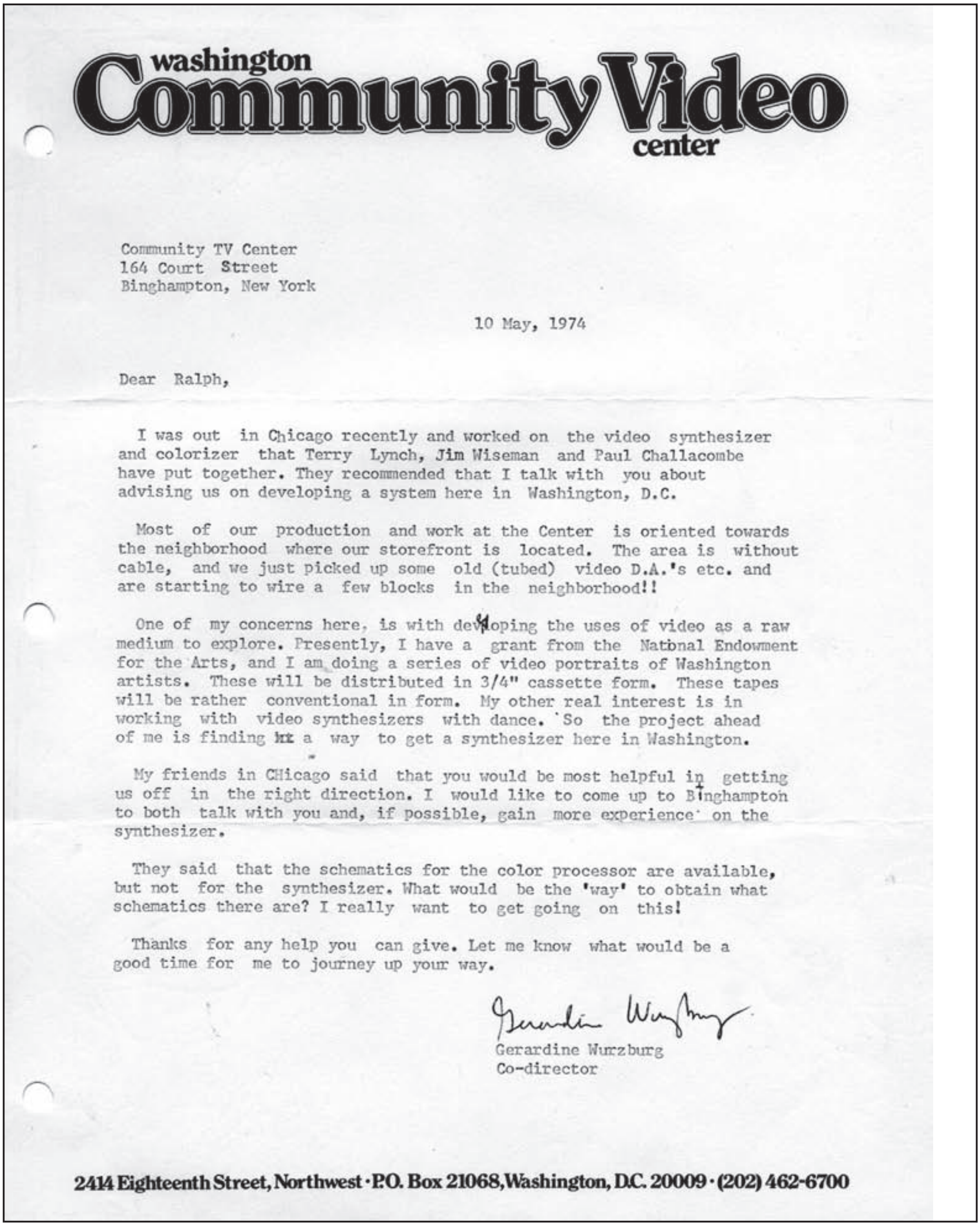


RALPH – A QUICK THANK YOU
NOTE AND HOPE YOUR FEELING BETTER
CARD COMBINED. I CALLED THE OTHER
DAY AND DIDN'T REACH YOU SO I FIGURED
I'D WRITE YOU. I WANTED TO PERSONALLY
THANK YOU FOR BEING SO GENEROUS WITH
THE VIDEO PROJECTOR. I CAN'T TELL HOW
MUCH I APPRECIATED YOUR HELP – AS
IT TURNED OUT I DID NOT RECIEVE A
CAST GRANT SINCE THE SHOW HAPPENED
BEFORE THEY AWARDED THE $. SO I REALLY
COULDN'T HAVE SHOWN IT WITHOUT THE
LOAN OF THE PROJECTOR. I'M SORRY I COULDNT HAVE GIVEN YOU SOMETHING IN
RETURN. AS YOU KNOW FROM PETER – BOB HARDING ~~TOOK~~ THE PROJECTOR FROM
ME AND PETER WILL THEN HOLD ON TO IT UNTIL HE COMES UP HERE I GUESS.
I WAS SORRY TO HEAR YOU WERE IN THE HOSPITAL. – I UNDERSTAND WHAT A BACK THING
IS SINCE DURING HIGH SCHOOL FOOTBALL GAME WITH PLANVIEW I GOT RAN OVER BY A 300 lb.
CANIVORE OFF RIGHT TACKLE AND MY BACK'S BEEN WEIRD EVER SINCE. ANY HOW, HOPE (over)

Bill Viola thanks Ralph Hocking and ETC for the loan of a video projector (1974). (Courtesy. Bill Viola Studio).



Bill Viola thanks Ralph Hocking and ETC for the loan of a video projector (1974). (Courtesy. Bill Viola Studio).



washington Community Video center

Community TV Center
164 Court Street
Binghampton, New York

10 May, 1974

Dear Ralph,

I was out in Chicago recently and worked on the video synthesizer and colorizer that Terry Lynch, Jim Wiseman and Paul Challacombe have put together. They recommended that I talk with you about advising us on developing a system here in Washington, D.C.

Most of our production and work at the Center is oriented towards the neighborhood where our storefront is located. The area is without cable, and we just picked up some old (tubed) video D.A.'s etc. and are starting to wire a few blocks in the neighborhood!!

One of my concerns here, is with developing the uses of video as a raw medium to explore. Presently, I have a grant from the National Endowment for the Arts, and I am doing a series of video portraits of Washington artists. These will be distributed in 3/4" cassette form. These tapes will be rather conventional in form. My other real interest is in working with video synthesizers with dance. So the project ahead of me is finding ~~kt~~ a way to get a synthesizer here in Washington.

My friends in CHicago said that you would be most helpful in getting us off in the right direction. I would like to come up to Binghampton to both talk with you and, if possible, gain more experience on the synthesizer.

They said that the schematics for the color processor are available, but not for the synthesizer. What would be the 'way' to obtain what schematics there are? I really want to get going on this!

Thanks for any help you can give. Let me know what would be a good time for me to journey up your way.

Gerardine Wurzburg

Gerardine Wurzburg
Co-director

2414 Eighteenth Street, Northwest · P.O. Box 21068, Washington, D.C. 20009 · (202) 462-6700

Letter from Gerardine Wurzburg of Washington Community Video Center to ETC (1974).
(courtesy. Gerardine Wurzburg www.stateart.com).

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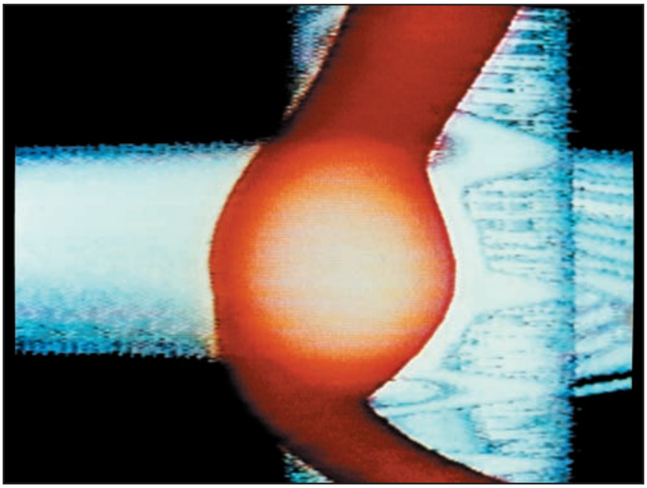

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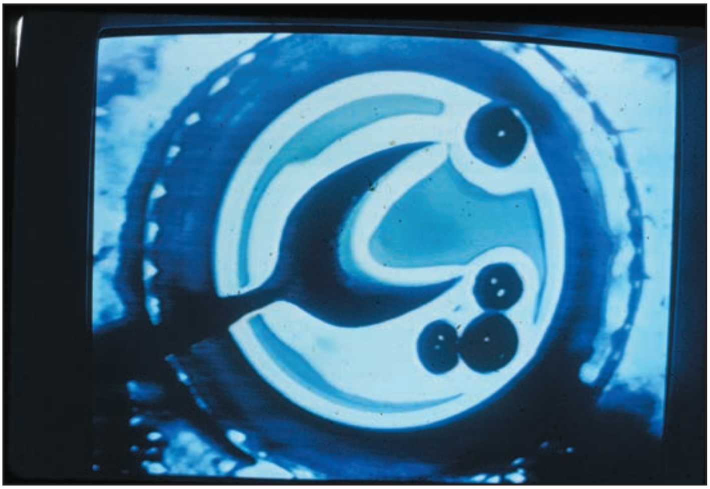

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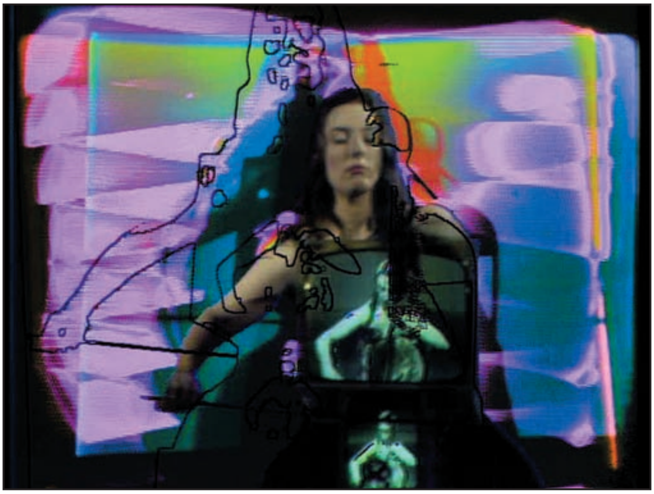

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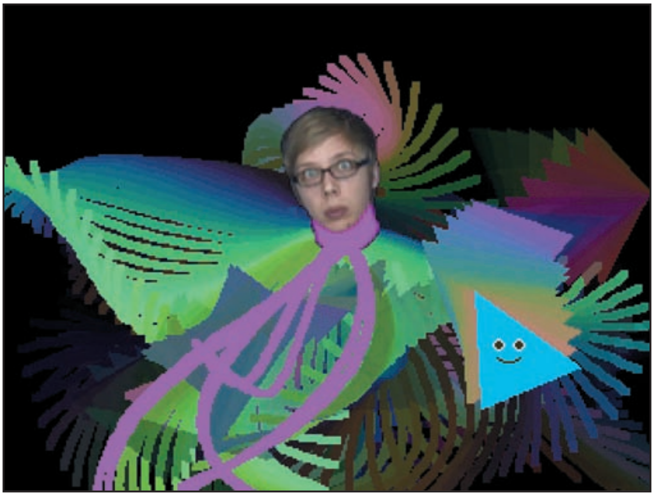

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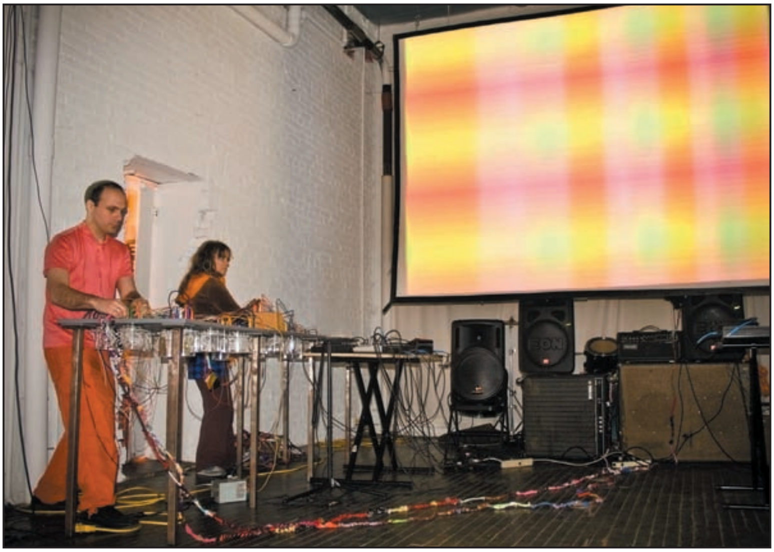

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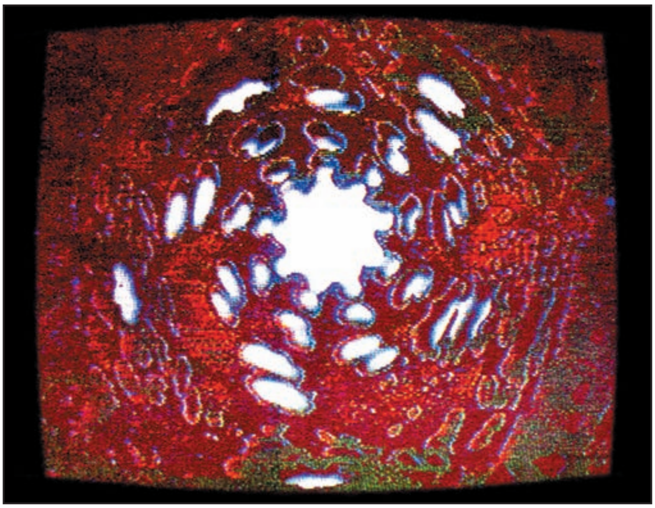

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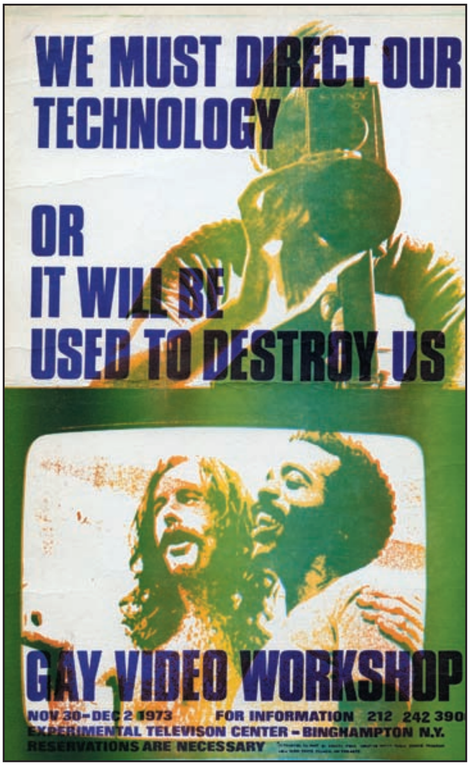

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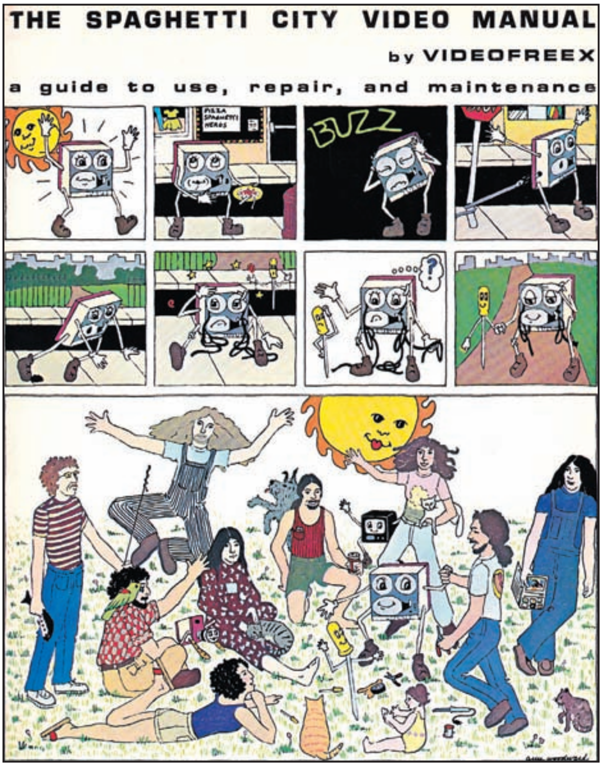

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The Emergence of Video Processing Tools

Television Becoming Unglued

Volume 2

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edited by Kathy High, Sherry Miller Hocking and Mona Jimenez

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Dedication

For those who have passed on – Barb Abramo, Connie Coleman, Evangelos Dousmanis, Dara Greenwald, Bill Hearn, David Loxton, Don McArthur, Phil Morton, Nam June Paik, Mary Ross, Steve Rutt, George Stoney and Jud Yalkut. Your work helped shape this project and still inspires.

And for the artists and technologists who have contributed to the creation of instruments and those who continue to do so

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SECTION 3

TOOLS

Introduction

Mona Jimenez

In its broadest definition, a tool is defined as 'something used in the performance of an operation; an instrument' (Morris 2000). In the 'Tools' section, the texts speak to the devices and operations used by artists to produce and alter video and audio: the nature and functions of the machines and processes, how they were designed and shared, and how the tools might remain 'alive' and functional. The reader may wish to reference the Experimental Television Center's web site 'Video History Project – Tools' for additional information, such as tool descriptions, diagrams, manuals, and photographs about the specific tools mentioned in the essays in this section.[1]

The section opens with Kathy High's 'Mods, Pods and Designs: Designing Tools and Systems', which lays out the impulses and motivations to hack, modify and invent custom video tools and describes the various relationships among artists, tool designers, engineers and enthusiasts that resulted in such tools as the Paik/Abe Video Synthesizer, the Rutt/Etra Video Synthesizer, the Jones Buffer, and software packages Image/ine and Jitter.

In the 1970s and 1980s, the Experimental Television Center (ETC) sponsored many grant proposals for software and hardware development; one of the most developed concepts (although never fully realized) was the Computer-Based Video Synthesizer System, carried out by Richard Brewster, Donald McArthur and Walter Wright; the final report is included here. The Computer-Based Video Synthesizer System was one of a host of projects, proposals and philosophies shared at a remarkable cross-disciplinary conference 'Design/Electronic Arts', held in 1977 in Buffalo, NY, and described here in an essay of the same name by its organizer, John Minkowsky. Organized under the auspices of Media Study/Buffalo, a nonprofit media arts center in Buffalo, NY, the conference brought together theoreticians, tool and system designers, and artists/users from the media arts, computer graphics, animation and modeling, media communications, neuroscience, electronic music and information science. Attendees included Gene Youngblood, Ken Knowlton, Laurie Spiegel, Joel Chadabe, Charles Csuri, Sonia Sheridan, Tom DeFanti, Tom DeWitt, Robert Ashley, John Whitney and Stan Vanderbeek.

In his essay 'Instruments, Apparel, Apparatus: An Essay in Definitions', Jean Gagnon places artist use of technological devices for sound- and image-making firmly within the realm of performance. Gagnon analyzes historical terminology used in material culture, music, and science to examine the way artists use electronic instruments to instantaneously enact visual and aural changes in real time. Also on the theme of definitions, Jeremy Culler's 'Expanding "Image-processed Video" as Art: Subverting and Building Control Systems' traces sources for the phrase 'image-processed video' that was formulated in the context of a critique of conventional commercial and educational television and quickly evolving categorizations of video art.

Sherry Miller Hocking's 'The Grammar of Electronic Image Processing' interweaves the vocabulary of video processing (as it appeared in various ETC technical publications), the words of artists and inventors, and descriptions of custom video tools and their development. Explanations of concepts such as signal, sync, switching, sequencing and keying found in ETC's manuals not only enabled artists to increase their technical understanding and thus navigate the open-ended ETC studio, but also documented the basic theories and language of image processing.

The theme of performativity is returned to in 'ETC's System' by Hank Rudolph, an artist and educator who worked for many years as the studio manager for ETC. Rudolph introduces the capability of ETC's studio, setting forth what he believes are its six fundamental characteristics that exemplify the system: the ability to affect image and sound in real time, an open-ended architecture, indeterminacy, interactivity, sound-image synchronization, and the ability to electronically generate images – a camera-less method of working. In the interview 'On Voltage Control' with Kathy High and Mona Jimenez, Rudolph further explores one of the core principles of video image processing – voltage control – that, like many design principles for video tools, was adopted from audio synthesis. Carolyn Tennant's 'Insofar as the rose can remember…' captures the feel of a bittersweet artist residency occurring just before the ETC studio closed, where she and her partner, J. T. Rinker, conjured and combined images of some of the key presences in ETC's history.

Dictionary definitions of tools still distinguish analog manifestations ('a device […] used to perform or facilitate manual or mechanical work') from digital (a software application that 'creates, manipulates, modifies, or analyzes') (Morris 2000). While one may expect a general trend in tool development where analog tools were eventually replaced by digital, contributors describe the parallel development and integration of digital and analog tools in the 1970s and 1980s. This integration was the norm at places such as ETC and the Electronic Visualization Lab at the University of Illinois at Chicago Circle Campus, where the Sandin Image Processor was used in combination with Z-GRASS, a computer graphics program developed by Tom DeFanti.

Yvonne Spielmann, in 'Analog to Digital: Artists Using Technology', reiterates a relationship between analog and digital processes in custom video tools, citing programmability, modularity, logic circuits and clock functions as examples of shared attributes. Spielmann associates specific functions of video tools with artists' works, particularly works by Steina and Woody Vasulka, Gary Hill and Peter Donebauer, and discusses parallels with earlier collaborations among artists and engineers through the group Experiments in Art and Technology (EAT). In the interview with designer Dave Jones in 'Analog Meets Digital In and Around the Experimental Television Center', and in articles on HARPO (software for voltage control) and Pantomation (an early motion-tracking device), the melding of the manual with the algorithmic is revealed with early custom video tools: the use of hand-turned knobs and patch programming was often combined with automated controls that created, manipulated and modified images through externally applied digital and analog signals.

Jimenez returns to the notion of tools as instruments in 'Preserving Machines', considering theories and practices of conservation as they apply to machines. Instrument conservation, the conservation of media-art installations and industrial conservation all deal with how the full function, design and purpose of a tool can remain visible and evident. The essay documents the efforts of advocates and experimenters who are working to keep tools functioning and available, such as through the 'Rutt/Etra Restoration Party', a fixers' event. 'A Catalog Record for the Raster Manipulation Unit' is next, an example of a cataloguing template that Jimenez designed as one way to document custom tools.

In 'Copying-It-Right: Archiving the Media Art of Phil Morton', Jon Cates gives voice to Morton's philosophies on the circulation of culture and ideas, reminding us to be free and generous with what we make and have learned. He discusses various forms of resistance to laws and policies that would limit the free exchange of ideas and creative work. His essay is paired with Ralph Hocking's manifesto on videotape preservation using a 'Resurrection Bus' with its emphasis on grassroots action.

References

Morris, William (ed.) (2000), *American Heritage Dictionary of the English Language*, 4th edition, Boston: American Heritage and Houghton Mifflin.

Notes

1. See Video History Project at http://www.experimentaltvcenter.org/history.

Mods, Pods and Designs: Designing Tools and Systems

Kathy High

> Creativity chooses to show up differently according to professional occupation: entrepreneur, artist, researcher or engineer. (Paik 2011a: 21)

How did artist-tool production get started in the United States? What is the relationship between artists, technologists and designers, and how can we describe the slippery ways these definitions of artist and technologist switch back and forth in the creation and development of new tools? Tool development and design is an ongoing and always-evolving process, with the technical needs being constantly redefined and the limitations or possibilities of the technology being explored. Successful collaborations between technologists and artists inspire each participant to have an investment in the contribution of the other. Composer and musician Philippe Manoury, who collaborated with software designer Miller Puckette, described an ideal working relationship: 'I think it's very important for a composer to have in front of him somebody [who] has also his own aesthetic idea. It sounds good or not good, and how we can ameliorate that, and to make suggestions' (Manoury et al. 2008). Thus each party from the artistic side and the engineering side contributes to the process of building something entirely new. This chapter looks at examples from artists and engineers/designers to think about the assorted methodologies used to build custom tools. To capture a feeling for how these processes evolve, I felt it was important to leave extensive quotations from artists and designers, allowing them to speak for themselves. Thus artists and designers speak in their own voices.

We have to ask: In what ways do artists and programmers think differently about creating software? How are their approaches similar? Tom Demeyer, creator of video processing software Image/ine explores this idea:

> Really fundamentally? No difference other than that between different artists. […] Obviously programmers tend to think from the perspective of technical possibilities, artists from artistic potential. This ends up, often, in the artists having to restrain the programmer – at least, the good ones; others want more and more, thinking it will give them freedom of expression where in truth it becomes harder and harder to make good use of the tools. (Demeyer 2010)

Let us consider the history of this medium of video. Video, in the form of television, has been around for a while. Electronic television was released by RCA in 1939 at the World's

Fair in New York City, leaving its older cousin, the less resolved mechanical television, behind in the dust.[1] This was good for big corporations such as RCA, who took over the business of developing the technologies; bad for the tinkerers, hackers and developers who had been experimenting with mechanical TV transmitters and receivers. Since the late 1930s, electronic television dominated the communication waves, was maintained and developed only by a few companies, and thus was more difficult to build and alter.

In the United States by the late 1960s, television production equipment became smaller, portable and affordable, and thus began to get into a broader public's hands. Resourcefully, hackers and artists used scrapped materials or jerry-rigged found equipment to create new machines. By 1970 and on, there was pioneering video work being made – creating machines for art making. There were handfuls of teams across the country building, modifying and designing tools:

> In the long-ranged future, such a versatile color synthesizer will become a standard equipment like today's Hammond organ, or Moog's synthesizer in the musical field, but even in the immediate future it will find wide application. […] [I]t might end up by producing a new fertile genre, called 'electronic opera'. (Paik 2011b: 9–10)

The 1960s and 1970s were particularly fruitful in contemporary art for art and technology explorations. It was also a period of extreme social unrest in the United States, with growing 'anti-establishment' sentiments. People were drawn to new models of labor, working in collectives, sharing resources and establishing a shared 'commons'. Artists and tool designers were interested in repurposing and scavenging, using scrap waste from industry to rebuild their own machines, and to experiment with those new machines to create original images. Working artists and technologists were crafting a vision of a creative culture, a do-it-yourself radical culture that opened up new ways of seeing the video medium. Artist Peer Bode describes watching the image output from a Jones Buffer at the Experimental Television Center:

> What a weird fucking image that is. I mean, that thing was video […]. It had cinema, video, and then a keyer. It had aspects of all of those. That's what it was, right in the circuitry. But it made an image that none of us had seen before. […] And so it created this wonderful problem for years, because it was a solution to a problem nobody had, you know? Sort of like, what are we going to do with this? (Bode 2012)

Peer Bode imagined the machine hacking of that period also as a form of tweaking culture and rethinking people's relationship to big business and to mass production. Notions of disturbance played into this art and technology development: much like the historical art movements of the Dadaists, Surrealists and Fluxus, artists became interested in the question of how to disrupt and provoke the status quo to encourage people to think

Figure 1. Dave Jones at workbench, Experimental Television Center (c. 1974).

critically. Similarly, gestures such as modifying and adapting industry tools became ways to interrupt the mainstream media message and create a new kind of signal.

Bode, who served as Artists' Coordinator at the Experimental Television Center (ETC) from 1978–87, was intrigued by the idea of 'hacking into things that already exist', and credited Ralph Hocking and Dave Jones with these 'adjustments' to machines, such as:

> [D]oing modifications of cameras, they were […] adjusting how the Videcon tube responded, contrast, brightness, just delay, lag. So stuff that was on the board, that you would use a screwdriver for, Ralph had David made those things external, so that you could control them. (Bode 2012)

Bode points out the advantage to this kind of externalization of controls: 'It had extra controls that were brought on the outside, so again, you could get at some of the stuff that was in the circuitry. So this was this kind of hacking idea.'

Bode aptly describes the significance of this kind of modification of machines. It was a way to insert various cultural meanings and rereadings of the corporate 'norm' or 'mass media':

> I think, conceptually, it was also about the fact that there was some sense that television was technology, but it was also like a cultural form. And in a way, it meant the culture. You know, sort of like Nam June destroying violins wasn't just that he had a thing about violins, but it was about Western culture [chuckles] and Western history that he was making a gesture about. And I think that some of the kind of modifications of stuff were like that, in terms of the technologies. (Bode 2012)

One of the most important aspects of building machines was building the 'commons' and thus an information exchange that grew out of each network of artists and builders. People began trading tips and amateur tweaks that could be made to industrial machines. Out of these exchanges came documentation of systems, designs and even scores for creating new instruments.

At this time, New York State was a 'haven' for artist support with extensive state-based public and foundation funding, as well as institutional support, such as through university centers. And upstate New York (the area outside the New York City region) became a hot spot for innovation. In the 1970s, designer Dave Jones worked for a number of years with the Experimental Television Center, developing its tool set while aiding others to build tools as well. Jones spoke about the fluid ways that people began to find each other to gather technical advice:

> Back in those days, the people that were doing video, for the most part, had to at least learn a certain amount of tech to be able to do it, because there weren't readily available technicians to help out. It was new to pretty much everybody. And so just to be able to hook everything up, you had to do your own tech work. And when your equipment broke down, you either had to take it to someplace like Sony and get it fixed, or you had to talk to whomever you could talk to about getting materials and trying to fix it yourself. […] Mostly, it was about networking. (Jones 2007)

Sources for sharing information in New York included the Raindance Foundation's *Radical Software* magazine (started in 1970) with technical tips and information on low-cost portable video equipment. Another source was a monthly newsletter called *Electronotes: Newsletter of the Musical Engineering Group*, published out of Ithaca by Bernie Hutchins. There were also electronics companies, such as Pia Electronics, offering DIY audio synthesizer kits that were used by many musicians, and PD Surplus, an electronics surplus store, among others. What appears to be an organic and innate process of DIY teaching and information exchange became what Jones calls '[a] fairly even flow of information […] technicians would talk to other technicians about what they'd done and different ideas they had and, you know, it was a fairly even flow of information' (Jones 2007). These 'tech talk' exchanges reflected moments of community support.

The best collaborations often grew out of specific projects. Software designer Miller Puckette and musician/composer Philippe Manoury seemed to find a very comfortable middle ground between them where they both articulated their theoretical and the practical needs to each other. Manoury describes a keen balance that is necessary for artists and technologists to collaborate:

> [T]o make good research, it's necessary to have a musical project. […] The program had a lot of scientists, scientific people who were working on computer music but were too proud of their systems or ideas. And it's necessary to have a theoretical point of view, it's absolutely important, but you also need a practical approach. We must have them both. (Manoury 2008)[2]

People were experimenting and creating tools that had not been built before. What was remarkable about this interdisciplinary approach from the 1970s onwards was that both artists and designers were pushing the video medium forward and discovering innovative ways to work with it. Technician/artist collaborations often involved volleying processes with much back and forth, give and take. Steve Rutt, engineer, technologist behind the Rutt/Etra Video Synthesizer, describes his relationship with his artist-designer collaborator Bill Etra:

> Bill would come in and he would go, 'I want to build this thing!' And I'd go, 'what does it do?' And he'd explain something – I might or might not get it. I mean, I would usually get what it was supposed to do, but I wasn't sure that the world needed it. And then I'd go back to trying to clean up the signal or make a better something on it to make it a little easier to build, or maintain, or to move, and Bill would like, stay on my case – 'come on, we need this something or other!' And eventually he'd badger me into, well, go ahead and prototype something. Back then we used to do everything in-house – we etched our own boards, we laid them out ourselves… pieces of tape – you didn't have a computer to do it back then. We would eventually have a new module that did something, and then we would run off with it and come back after a while with some product that was done and go, 'Look! See? See, it's cool!' (Rutt and Etra 2007)

The cool factor went far. People were into new territory and did not know what to expect from these machines. Peer Bode describes his reactions to the Paik/Abe Video Synthesizer at the Experimental Television Center, and how everyone had to grapple with this new kind of image making. He bemoaned the fact that he had not made more recordings with the device:

> The Paik/Abe [Synthesizer] was, like […] nobody could figure it out. That was such an uncontrollable device. But it made great images. And so if you could handle just having a little bit of control, and also having – […] Well, I definitely came out of a cinema kind of background, and with a certain sort of taste values around some of that stuff. And I know some of the first things I saw were with the Paik/Abe, and I couldn't believe how horrible I thought they were. [chuckles] They were just totally like, 'Oh, my God, what is this shit?' Which I think was the reaction of a lot of people. You know, because it was a kind of totally non-culture – no one had seen it. Again, now I feel embarrassed about my own kind of conservatism in my response. (Bode 2012)

Korean-born artist Nam June Paik was one of the pioneer tool builders in the United States and the Paik/Abe Video Synthesizer was his first video-processing machine. Paik had very concrete ideas of how he wanted his video synthesizer to work:

> Here are a few aspects of my conception: effective variations of scanning, in circles, in zigzag, complex feedback, mixing of audio signal, rescanning with ten black and white Sony video cameras, applying optic factor. And above all, I had conceived things in a way to create an open system with multi-input and multi-output, that is, an unclosed electronic environment that allows for public participation. It was an open system something like an archetype of an interactive video game. (Paik 2011a: 18)

Nam June Paik described the Paik/Abe Video Synthesizer as a 'sloppy machine, like me' (Park and Lee 2011: 38); 'sloppy' because it was unusual and unruly for the time, and it manipulated the video image in almost abstract ways. But far beyond its ability to produce unusual imagery, it was also an 'unclosed electronic environment that allow[ed] for public participation'. This philosophy of public participation was the basis of Nam June's artwork. He was creating a 'commons', and with this synthesizer device, a means for a broad public to interact with television, at that time of a closed one-way delivery system. He wanted to enable people to build a 'versatile color synthesizer' that would become 'standard equipment' (Paik 2011b: 9–10) in peoples' homes, so that they could control their own means of production – furthering participating on communication and creating a dynamic communication platform.

Paik collaborated with Japanese engineer Shuya Abe to build the Paik/Abe Video Synthesizer (PAVS). Paik met Abe in 1964 and they become long-standing collaborators after that. Paik found a rare collaborator in Abe. Abe spoke of his commitment to their work:

> I had a vague idea when Paik roughly described [the Paik/Abe Video Synthesizer], but it was a complete blank to me what a synthesizer was until September 1969. […] Paik showed me a sheet of blueprint at home. When I saw it, I told myself 'Oh, I guess will have to quit my job in order to make this happen.' (Park and Lee 2011: 23)

In 1970, the Paik/Abe Video Synthesizer, which was built with funds from the WGBH New Television Workshop, was used in the WGBH studio for a four-hour live television broadcast entitled *Beatles from Beginning to End*. Abe helped build the synthesizer with specifications allowing it to stay within FCC norms and television broadcast regulation standards. In fact, Abe himself 'performed' the Paik/Abe Video Synthesizer for the entirety of the hugely successful live TV production. Nam June summed up the contradictory aspects of the experience by saying, 'Ironically a huge Machine [WGBH, Boston] helped me to create my anti-machine' (Paik 2011c: 11).

Paik and Abe's 'anti-machine' was among those at the forefront of artistic machine development at this time. Working closely with the development of the machines allowed artists to create works exploring how to disrupt the electronic signal itself. Messing with the signal was very much a similar process to modifying and adapting machines, building circuit boards and such. It was also a way to break down the system of authority, a corporate/capitalist system that dominated mass communication networks. Artists were literally 'breaking' the video signal, messing with the electronics in ways to distance their work as far from the monolith of television as possible.

In the evolution of analog video image–processing tools, one machine led to the development of the next version. There seemed to be steps taken by artists and engineers that promoted understanding and growth in building machines, as well as many failures between the design and building of a tool, and the ways to imagine it working. Steve Rutt talked about this one-step-forward-two-steps-backwards process: 'When we looked at what we were building […] we kind of took a big step back before we even got to repeatability, and we said, "What are we trying to do here? We're trying to move an image"' (Rutt and Etra 2007). There are whole lineages of machines, a constant stream of updates and tweaks and new systems of ideas implemented. As artist-designer Matt Schlanger said: '[T]hen a lot of the gear were signposts, they were stepping stones along a process […] manifestations of a process, manifestations along a process that were interesting at the time, but have no place in the studio now' (Schlanger 2012).

Certain machines were early versions of other machines; ones developed later better articulated the designer's ideas. How did designers think about versioning? Were some modifications and some finished designs? And in the future what machines will be preserved and revisited historically? Are they the final iteration of the final tool? Is that part of the process and design of interest? Did all of the design elements become expressed in the next version of the custom-built tool? The process and the documentation of the process becomes integral to understanding the evolution of these systems – and their preservation.

Bill Hearn, who built the voltage-controlled video synthesizer the Videolab in 1975–76, describes how he felt once he realized that a certain machine could have been made better: 'Right after the machines I made for you [Woody Vasulka] and Jack Brice, I was a little ashamed of the way they were put together' (Hearn 1977–78). Hearn envisioned a new device, and to do so, broke down the process of what it was to be used for:

> But a funny thing happened. Bill Etra and Steve Rutt called me on the telephone […]. Bill had started out saying he wanted a voltage-controlled colorizer. […] And something snapped in my head and I said, 'What you guys really want is a synthesizer that has all these things and is capable of doing all the standard special effects.' So I sat down and […] it was really a terrific thing to think of, to reduce everything in video to a few little modules that could be interconnected and produce all the standard effects. I had to ask myself, 'What do you do when you make a wipe? What do you do when you make a key? What do you do when you make a split screen? What do you do when you do all these things?' (Hearn 1977–78)

Thus older machines are often incorporated into newer machines – another form of adaptation. Engineers' processes are not that different from those of the artist when it comes to conceiving tools. The goal is to build in possibilities and options to be creative. Bill Hearn, in discussion with video artist Woody Vasulka, discussed artists' use of the Videolab and ideas of aesthetics:

> Vasulka: Have you ever written about aesthetics? Even if it was a total failure or a total success? […] Something that you described how the tools could be used?
>
> Hearn: I have recommendations in here (the user's manual) […] esthetically I say really simple things like, 'If you're going to colorize, don't run the saturation up too high, mix in the original image and overlay the color on top of it'. That's the kind of advice I give in general. […] I think about the person who made organs for Bach, the person who designed and built them. And what I want to do, what I really lust after is to make machines that are so clear to a creative person and give them so many possibilities that they can use them. That it gives them freedom as an artist. […] It's like putting the keys on an organ or how many pedals, or how many stops, how close they are to the keyboard. What's the most elegant way of giving tool control to the person who's using it. (Hearn 1977–78)

Ideas for new machines started from other preexisting machines. Machines could be added to or converted to something else – expanded on, upgraded, evolved. Modification to machines was common, especially since these artists wanted to push the images to new parameters. Carl Geiger, one of the founders of the experimental video center Synapse at Syracuse University in the 1970s, speaks of 'retooling' machines and describes ways to hack their production equipment to make it produce 'the psychedelic, the alternative, the non-traditional video images':

> We had a portable studio – it was actually black-and-white cameras but the switcher was color – and it had a colorizer in it. We were always hacking that. We learned that you could push two buttons at once on the different busses. It wasn't supposed to happen and there was a little thing that locked it out, so you couldn't do that. But you could

> actually push on this one little mechanical thing that prevented you from pushing two buttons – so that you could push two buttons. And then we learned that if you took the preview output and put [the signal] back into the inputs and then mixed it with itself, you would get a delayed stutter effect that was cool. Me especially and others were very interested in, you know, in effect, the psychedelic, the alternative, the nontraditional video images. The images that were, you know, more vivid and intriguing. So we were off and trying to hack different things in different ways. (Geiger 2011)

And there was a basic knowledge that this hacking process Geiger describes above was not legitimate nor totally accepted:

> You know there were engineers that would maintain our studio sometimes, and we had to hide that kind of stuff. We were hacking the equipment, and we would have to hide it so they didn't know what we had done. And then if it broke we'd have to, like, get all that stuff off of there and so that they would fix it and then we could do it back. (Geiger 2011)

Many early practitioners modified black-and-white cameras and decks to allow more control over the image or to create certain types of effects. And some of the distributors of video equipment in New York City, like CT Lui and Technisphere, also offered modifications to equipment. Technisphere offered six modifications to the Sony Rover open-reel ½" portable video system. These modifications included the following: installing camera target level control; installing a mike/line switch; installing manual audio gain control; converting a battery meter to a battery/audio meter; installing coaxial video output; installing coaxial video input with internal-external switch.[3]

Dave Jones, engineer-designer, describes the changes and modifications he made to cameras and decks in the 1970s:

> Probably one of the most common [modifications] that I did was a sensitivity adjustment on the cameras [like portapack or Sony 3400 cameras]. The cameras were not very low-light cameras. […] The lens was the only adjustment you had. So a lot of times, you tried to go into a low-light situation and they would amplify to a point of just being noise. Or you went into a bright light area, and the automatic gain controls just shut everything down. So in some of those cameras, I put in a switch and a knob that'll allow you to override the automatic gain control and just manually control the setting for the two. You have to remember, this was the days of tubes in the cameras for the pickup, rather than solid-state devices like CCDs. So you basically had this glass tube with a voltage applied to the back. And as the voltage changed, it changed the sensitivity of the pickup. So I was able to tap into where that voltage was, and put it on a knob to allow somebody to basically adjust the sensitivity of the camera. (Jones 2007)

And modifications were also done to cameras to switch the raster up and down. Jones describes a simple adjustment to modify the camera to 'flip' or 'reverse' the video image:

> The pickup tube inside the cameras worked just like a monitor worked. It had a set of coils around it. And one set of coils was the horizontal, one was vertical. So it was very simple to reverse the wires for that and flip the image up and down or flip it side to side. […] often, it would be a situation where somebody might hang the camera from a ceiling, and instead of the image being upside down, they could then switch the flip and it would be right-side-up again. You know, where it was typically compensating for the way that the camera was mounted, to get back to a normal image, rather than just flipping it, keeping the camera upright and flipping the image.[…] Some people would do it as a way of flipping an image, and might have multiple cameras in a shoot, where one image was normal, one was reversed. The Videofreex did a fairly well-known video back then where they used two images; one was normal and one was reversed. They were doing a kind of a mirroring effect. David Cort did it a number of times in some videos. (Jones 2007)

The Experimental Television Center's combined tool set created a meta-tool for users to experiment with. ETC's studio of multiple custom-made tools was in tandem called the 'System', which was integrated in such a way as to allow artists to combine machines to create their own version of this system. There was a matrix that allowed one to feed any machine into another, and so the entire studio was developed as a modular system that was completely patchable and allowed you to treat it like a database. Peer Bode speaks of this structural conception of ETC's studio System:

> I give Ralph [Hocking] a lot of credit for his vision about experimental structures and making it so that you could ask questions and try things out easily. So that these things of modularity and the matrix – I don't know, they went through so many different matrix panels, so that you could get things in and out of devices without rewiring each moment. And that actually made a lot of things happen. (Bode 2012)

Of course, these image-processing systems, such as the one at ETC, were complicated to use, and it took a certain amount of time to master and produce anything original using them. Bob Snyder, founder of the Sound Department at The School of the Art Institute of Chicago, worked with the Sandin Image Processor (IP). In fact he hired people to build one for his own studio, since he felt he was not part of the movement to 'heat up the soldering iron and go for it, even though that was very much part of the ethos of the times' (Snyder 2003). But he did recognize the importance of having unlimited access to the Sandin IP to create work, a concept of open-ended artist access that Ralph Hocking of Experimental Television Center endorsed as well. While the ETC had a vibrant artist residency program, Hocking always encouraged people to create their own

Figure 2. Tele-Techno Conference participants at Lanesville TV, 1975. Seated from left. Ken Jesser (Intermedia Art Center), Kevin Kenney (MERC), Dave Jones (ETC), Paul Lamarre ((Textronix). Standing. Don McArthur (ETC), Richard Monkhouse (EMS), Bill Claghorn (Adwar Video), Carl Geiger (Synapse), Chuck Heuer (Portable Channel), Chuck Kennedy (Media Bus). (photo & courtesy. Chuck Kennedy and the Videofreex Archive).

home studios as well, where they could use the machines daily and learn to play them like real instruments. In response to a question from interviewer Mona Jimenez about access, and likening the process of working with these machines to 'learning how to play an instrument', Snyder states that:

> I think that you've got to remember very, very few people ever had the kind of access you just described. Only us, you know, only us macho guys – who could commandeer the studio all summer or, you know, could build one and have it in our house – ever had the opportunity to even try to do that. Students got a little time and there were some brilliant students who did some remarkable things within the really limited amounts of time they had, but that's a really good point. I think you're absolutely right. You'd have to be very interested in using the instrument and have the time and the resources to really be able to tweak it and work on it for a long time. (Snyder 2003)

It must also be noted that while many women became videomakers, the custom tool design arena remained heavily male dominated. There were some exceptions, such as Sharon Grace (San Francisco), who built Paik/Abe Video Synthesizers under the tutelage of Shuya Abe, soldering boards and putting machines together; Barbara Sykes (Chicago), who built her own Sandin IP for her own use; and Louise Etra (Los Angeles), collaborator with Bill Etra and Steve Rutt, who had input into the functionality and actual design of the Rutt/Etra Video Synthesizer, among others. Mostly though, building machines remained a 'macho' activity with a limited number of women participating in it. Bob Snyder's comments resonate in terms of representing the gender politics of the period.

Snyder commented that it was hard to recreate anything with the Sandin IP, saying he hadn't the 'faintest idea' how he got certain effects: 'I just kept turning knobs until it looked right and then I stopped'. He worked with both music and video, not separating the two. Instead he developed a systematic way to approach working: 'The design of [the Sandin IP] was based on a kind of metaphorical transformation of modular analog sound synthesizers. […] So rather than having the sound and the image be the same signal, they were different signals with the same control structure'. As a result of these kinds of experiences, Snyder considered the Sandin IP an instrument:

> I viewed it as an instrument and I viewed the monitor as an instrument. You know, I mean, one way to define an instrument is that it's a device. […] An instrument is a – I mean not a scientific instrument, but a musical instrument – is a device that produces patterns of energy. And I very much viewed an image as a pattern of energy. I think that was the idea. Its color, its shape – all of those things to me were, you know, were like music. […] There wasn't a strong distinction. (Snyder 2003)

Beyond questions of access, many artists in the 1970s were committed to the idea of needing to understand the creation of the tools they were using to be able to work with them most successfully. As well as understanding circuits, artists wanted to build their own machines for their own studios, and be a part of the 'heat up the soldering iron and go for it' ethos that Snyder spoke of. (See Color Plate 38.)

The wealth of tech in upstate New York

An example of this kind of commitment was the different ad hoc groups in upstate New York sharing technical information about building tools. Telephone exchanges in 1975 called the 'Tele-Techno Conferences' were inaugurated by Lanesville TV to encourage participants to share technological discoveries between various video working groups in New York State (supported by the New York State Council on the Arts – NYSCA).[4] The participants included Synapse, ETC, Portable Channel, Media Equipment Resource Center (MERC) and Lanesville TV.[5] Designer Dave Jones started something called the

'Tuesday Afternoon Club' in Barton, New York, near Owego, in 1982–83. Jones taught a group of artists to build circuit designs for their own machines, and to help develop prototypes created for the Experimental Television Center. The artists who participated included Peer Bode, Matt Schlanger, Barbara Buckner, Mimi Martin and Neil Zusman. Some of the artists went on to develop their own machines, and their understanding of systems and design influenced their artistic practices and determined their future directions. This idea of building your own circuits expanded from the 'Tuesday Afternoon Club' to the creation of a kind of open-source circuit board project through ETC called the 'Four Board Project', making boards available to artists to build their own systems. Dave Jones commented on the practice of sharing and building tools:

> Actually, within that same vein, there was a community of people who were building tools in the '70s. […] That was a community of designers not so much copying each other's exact circuitry, but sharing design ideas with each other. It was concepts of 'if you take a keyer and do this to it, or run that into that, and wiggle this around.' […] It was more general, conceptual conversations. 'Have you heard about this integrated circuit? Have you heard of this part?' – things like that. It was an entire side community in the video art world.
>
> […] Also, in the early '80s, there were a number of people who were either a part of the TV Center, or were in the area and used the TV Center. I had moved to a house with a lot of empty space in it, so every Tuesday those people would come over [The Tuesday Afternoon Club]. Each person had a different thing they wanted to do; since they knew about the equipment at the Center, they wanted a keyer or a colorizer – they'd have a piece of equipment in mind, or an effect they wanted. Or I'd have a new idea and say, 'Well, I've been thinking about this or that,' and someone would say, 'Yeah! I want to try that'. So I would write up the schematics. A couple of them needed to be taught how to solder, so that was part of it, while others had done soldering so it was more advanced: 'Put this here and connect that there. Once that's working I'll hook it up to the oscilloscope'. So three or four people would sit around building circuits for themselves, slowly trying to build their own image-processing systems; meanwhile I was getting to try new things out. […] It was a mixture of things: them learning and getting a circuit in the end, and me getting them to try out new ideas and building them for me while making another 30 or 40 dollars for the day. I think we met every Tuesday for a few months. (Jones 2005)

Matt Schlanger, artist and designer, successfully created his own studio much like the one at ETC. He describes the 'The Tuesday Afternoon Club' sessions:

> One of the original philosophies was that people would build their own. This System [ETC's system] is a prototype for individualized systems like this System, right?

> I'm Ralph [Hocking]'s poster boy here, ok? I did it. […] A lot of the conversations on Tuesday Afternoons and not Tuesday afternoons with Peer in the room and others was about real time. Was about our process. Was about image processing as a movement which maybe never really had its voice the way it should have, but there were tributaries of philosophies around image processing, and part of it was process-oriented videomaking. Part of it of course which you know about was the signal processing and building your own machines […] and embracing circuits and circuit design, and embracing the notion of the artist taking control of the means of production and doing things with it that are different than broadcast goals would dictate. (Schlanger 2012)

The ETC System was based on real-time processes, and the production of the machines in that System was based on 1960s audio synthesis processes. The development of these analog custom tools can be likened to building instruments, each machine having its own sensitivity and individual quirks. The analog devices were used in real time, which created a performative approach to working in the analog studio that was much like performing with musical instruments. The System was the instrument that needed tuning and the results were recorded on videotape.

Building tools also required structural thinking and designing, a kind of choreography of the machine, if you will. Peer Bode speaks of these benefits and of thinking about a system's infrastructure:

> Ralph [Hocking], here and there, got equipment that he bought really cheap, like racks – racks to put boards into that were a standard. And those racks probably were, like, $500 apiece new, and I think he got them for a dollar or two. And they were all in the back; they all had all the wire pins and they were all wrapped, connected, and you could disconnect – the first thing we had to do was disconnect them and just make them basic shells again, basic empty racks, so that we then would put stuff in. So all the stuff we were doing, pretty much […] was also going into these kind of rack structures that Ralph had provided, that seemed like a reasonable kind of infrastructure idea for how to connect these things up. (Bode 2012)

There was a culture of scavenging used materials. This kind of ingenuity led to adaptive thinking and the creation of new ways to use these parts. This was a pre-eBay period of time, but tool designers were then very much tuned into ideas of repurposing surplus. IBM was in Binghamton, where the Experimental TV Center was, so there was lots of surplus.

Much like Dan Sandin's 'Distribution Religion', the 'Four Board Project' at ETC was produced as a means to disseminate information, to build and make available some basic image-processing circuits, and to enable artists to begin to build their own systems. The 'Four Board Project' was sponsored by a grant from NYSCA. The project also helped update the ways these circuit boards were produced.[6] Dave Jones was the lead designer on the project:

> The TV Center thought it would be great to have these types of image-processing devices printed as boards. Then we could make multiple copies – the Center could have one, I could have one, and different artists who worked at the Center could build their own copies. That was what became known as the Four Board Project: a multi-channel colorizer, a keyer, an oscillator and a sequencer. […] And again, everything was voltage control. […] I kept that going with the Four Board Project and everything was voltage controllable. We built a bank of oscillators for the TV Center, which are also still there. In fact all of the things we built with the Four Board Project are in the studio and used every day. (Jones 2005)

Another information-sharing session occurred around computer programming activities and was instigated by Ralph Hocking. Computers evolved into the Center's System over a number of years. The first ones had limited capabilities, and were slow, hard to program and generally difficult to use: 'Computers were not really capable of generating images in real time, or manipulating images beyond putting out some control voltages to turn knobs or throw switches' (Jones 2005). (See Color Plate 42)

In what video archive researcher and curator Carolyn Tennant describes as an 'exchange of ideas within the laboratory where experimentation happens' (Jones 2005), the artists and designers who were hanging around the Center started to develop a more versatile computer. Paul Davis and artist Walter Wright put together an NEA proposal and got a grant to buy and build up the computer. Davis and Wright, along with Dave Jones, all became part of another information exchange called 'Computer Sundays':

> Then probably in the early '80s, Ralph [Hocking] went to Paul and said 'OK. Things have changed with computers. Now there are personal computers'. There were a number of different things that Paul had been playing with at the school, setting up labs, so Ralph charged him with the task of finding a computer that we could do things with. So Paul put together a computer and we started playing with it.
>
> Because it took a while to write software for it, Ralph would invite us out on Sunday afternoon to write a program, make a modification, or add some new boards to the computer. It became a regular thing [Computer Sundays]. Paul and I would get together and spend the afternoon trying to add some program to do new features. They'd found a graphics card from a company in California that was capable of putting out video, initially a very low-res graphics card; we did some interesting little things with it, but they were just big blocks of color. Then they found this Frame Buffer card from this company that could actually capture full frames of video, make different scales of images, or manipulate an image and do something to it with software. A lot of the Sundays were spent trying to get that to work, and then writing programs to grab and manipulate images. […] So we'd have an idea of things or interfaces to add that we'd throw out, and Ralph would respond. It was back and forth between me,

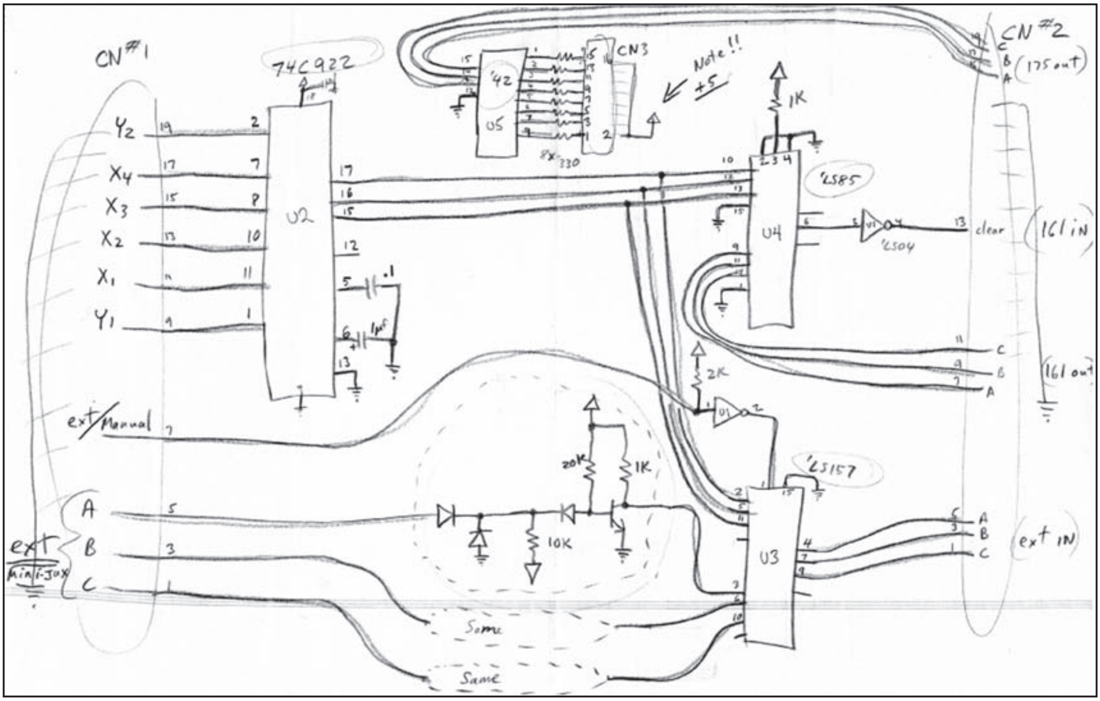

Figure 3. Schematic drawing for the control section of the Jones Sequencer designed by Dave Jones at the Experimental Television Center (1984).

> Paul and Ralph, playing around and trying to give the computer some features and character.
>
> […] Whatever we worked on would either be based on Ralph's comments about something he wanted to do, or something we'd already done that he tried to use but wasn't happy with, and other times […] we would have some other idea that none of us had tried before and so the next week maybe Ralph would be reacting to that. 'Oh can you do this?' 'Well, not quite. But we can do this instead.' Ideas came out of this back and forth, between what he wanted, what we saw possible, and then the results of when we tried to do it. And it didn't always come out the same way, anyways. (Jones 2005)

Because the time to program software for increasingly larger projects took longer than an afternoon, the Computer Sundays eventually stopped meeting. ETC had always been interested in developing computer interfaces with video image–processing systems across the upstate region, and worked closely with other media centers such as Media Study in Buffalo, Portable Channel in Rochester, Lanesville TV and Woodstock Community Video. As early as 1975 there was a concern on ETC's part to create a laboratory for tool development. Here is an excerpt from an NEA grant submitted in 1975 by ETC:

> There is at the present time a need for a center which serves as a focal point for technological developments in the fields of systems design, research and construction. The artist is probably best able to indicate his needs in terms of systems functions and a relationship between artist and scientist is essential for the development of systems. (ETC 1975)

ETC stands out as one of the experimental laboratories that focused on 'systems design and computer interface with video synthesizers' that was able to conduct ongoing research into this radical rethinking of media at the time.

Software – it is a good term

In this excerpt of a 1978 conversation between artist Woody Vasulka and designer Bill Hearn, questions were raised about storage, performance, and concerns with working between digital and analog:

> Vasulka: In digital there is a hope to get a score [similar to a musical score]. It would also be some sort of security. For analog, it requires high skill. It's not easy to work with analog systems. Some people get very good at it by practicing. You cannot just approach this tool and do a masterpiece. It in fact takes years of experience to use analog devices. So that digital has some hope of having a library. It suits this easy access to a library because it's possible. That is one advantage which digital [tools] will have […]. These express very much the personality of the person who created them. […]. There's only tradition's experience, and skill will die with people that die. The operators or artists that master it. It wouldn't get passed on as a score.
>
> Hearn: But a patch, all you have to do is take a picture of it or you can describe it digitally. It would be easy to encode a patch. I think that might take, maybe, only 200 bits of information to code each of these patches. Suppose more, suppose a thousand bits. You know, that's nothing.
>
> Vasulka: That's an interesting thought. You had better add a score module and then we can talk about something that can pass on this kind of experience. But it's very hard to expect that knowledge be accumulated. That's something for you to think about. How to pass it on. How to assemble a library that is craft oriented. A library that is of the craft of this tool.

Hearn: Software.

Vasulka: It doesn't have to be called software. But it's something like software.

Hearn: It's a good term. (Hearn 1977–78)

And as digital capabilities continued to emerge with the evolution of computers, software creation and digital tools were developed between collaborating artists and programmers. As artists crossed from analog into digital it was evident that the computers were not fast enough to process the huge amount of information that real-time video demanded. And artists were anxious for real-time video processing. As of the mid-1990s, programs were starting to be developed that could keep up with the processing time needed to produce real time. Artist Steina Vasulka worked closely with software designer Tom Demeyer to create Imag/ine in 1996–97. Image/ine was the first open-source software program for processing real-time video prior to others like Isadora and Jitter, which looked to this software for their development.

Steina stubbornly stayed 'an analog person' avoiding the frustrations and slowness of early digital work: 'Until I got to STEIM in Amsterdam. I was there as an artistic co-director and as I stepped into STEIM they said that they were making video software in honor of me. Which was very nice of them' (Vasulka 2011):

> In November of 1996, I arrived at STEIM[7] as the artistic co-director (with Michel Weisvisz) in Amsterdam. I had met Tom [Demeyer] previously, and of course knew about Big Eye, which I believe is the first motion tracking software written.[8] I was told that Tom was writing video software in honor of my arrival. I welcomed the endeavor, there could definitely be some use for primitive video software, though I knew that video had way more information than could be moved real time by software. […] How was Tom going to write a real-time video in software, when we had in Buffalo in the late seventies built a huge hardware system for the same purpose? (Vasulka 2010)

Tom Demeyer, author of the Image/ine software, crafted the software for Steina. He felt their collaboration was productive:

> The development process became very creative and fruitful when Steina took up residency as artistic director of STEIM. She was of course very experienced with the analog machines, was able to guide and coax me in various ways, had a personal interest and an artistic input that really made it a 1+1=3 collaboration. (Demeyer 2010)

Steina and Tom's relationship matured over time:

> SV: I was very condescending. Because I knew it couldn't be done. There was no way you could write real-time video, a real-time performing machine in the world because real time was not […] there was no computer that was fast enough and there was no way it could be done. And he started showing me this and that and it was kind of OK. It was keying and some kind of colorizing. And then he showed me displacement.[9] […] And I just wired up. We went through it and I think it was the first software – digital real-time video software. (Vasulka 2011)

> TD: No, our ideas were not fundamentally different. Details of implementation, relative importance of features and functionality, sure. As a matter of fact, I remember us discussing how incredibly similar the steps in development of the different techniques and effects seemed to be. Hers a long time before in analog hardware, mine digitally, but seemingly following the same track. (Demeyer 2010)

> SV: And it behaved like an analog machine but it was really MIDI controlled. And MIDI controls replace the famous knobs of analog devices – knobs and sliders. So I was in my element and it's still a wonderful machine, I use it a lot. So that's about digital. […] You could use the property of the signal, of the electronic content to express your aesthetic desires. (Vasulka 2011)[10]

Starting with 160 x 120 @ 15 fps the resolution for Image/ine soon advanced to 320 x 240. Currently it is capable of running HD at 25 fps using limited effects. But as Demeyer said: 'Good people use what's available and aren't phased by technical limitations' (Demeyer 2010).[11]

By the late 1990s computers became faster and because of 'the third generation PowerPC computers were fast enough to do quarter resolution video in real time' (DuBois 2012). This speed issue had been frustrating designers since the 1980s. The software program Max enabled different programs to be developed: softVNS, NATO.0+55+3d, and Jitter. The flexibility of Max allowed various approaches. This was because of its 'data neutral paradigm' where anything was permitted and every object used in Max became equal. This concept of data neutrality can also be thought of as signal flow and voltage control, no matter what is generating the signal. And as new media artist and programmer R. Luke DuBois said: 'And so that voltage control thing was implicit in the semantics of the system from the beginning. Because everything can be something you experience or something that controls something you experience' (DuBois 2012).

> So the video thing, we were waiting for […] we started working on Jitter – when was it – probably 2000. And it took about two-and–a-half years to get working. And our alpha tester, our baseline tester was an artist in NY named Toni Dove. Toni Dove was working on a piece called *Spectropia* (2007) and we used it as a benchmark. And

> basically the theory was if we could do her wacky piece then it would be good enough for everyone else.
>
> […] Toni Dove is a filmmaker – but there is a trick: she performs the editing of her films onstage. So she'll shoot like a full budget science fiction film – and shoot every shot six times, from two different persons' perspectives, close, medium and wide. And then onstage she has a motion-sensing instrument. She waves her hands and based on how she waves her hands, she can cut between the male perspective and the female perspective, go forward or go back, get inside people's heads or whatever. And she has done them as installations and she has done them as performances. […] But we sort of wrote Jitter for her. The assumption being that if it could do what she needed then it would be fine for all the VJs that share on a Sunday night. […] Because she needed to basically do four channel standard definition cutting in real time, controlled by a computer vision input, so she needed a camera and four movies all going at once plus sound, right? All scrubbed at 30 frames a second. So we developed it and it was her benchmark. (DuBois 2012)

The creation of the video software packages Image/ine and Jitter were built around the work of artists Steina and Toni Dove. While these women did not participate as much in the actual hands-on design of these tools, their performance methodologies and their ways of producing their video work shaped the conceptual development of each software. In fact, they served as the 'benchmarks' for the outer limits of the software.

These examples provide just a small discussion of the ways that tool design and collaborations can happen. Today, the boundaries of artist/engineer are perhaps blurring more and there are many more artist/technologists programming and building tools. And we will see how these changing skill sets will reshape tool production and collaborative processes for the future.

Make the generation happy

The impulses of artists and engineers to build machines – be they analog or digital – have remained the same: to inspire a broader public to engage in a creative act. From the early 1970s, video artists were teaching and helping students how to think critically, and creatively and to build their own systems. Among others, Ralph Hocking was at SUNY (the State University of New York) Binghamton, the Vasulkas were at SUNY Buffalo, Dan Sandin at the University of Illinois at Chicago Circle Campus and Nam June Paik with Shuya Abe at the California Institute of the Arts (Cal Arts).

Between 1971 and 1972 Paik and Abe took on seven students at Cal Arts, challenging them to build their very own Paik/Abe Video Synthesizers. Sharon Grace, a young artist at the time, partook in this extended workshop. Grace then also became a close collaborator with Paik and Abe, traveling around the country with them, soldering and helping build the machines they left seeded all over the country: at WNET, WGBH, the Experimental TV Center, Cal Arts and MIT. She was a quick study and Abe-san helped coach her with her soldering skills. The three became a production team. Eventually they felt their work was done and Abe-san returned to his family in Japan, while Paik and Grace went onto other projects. In an interview Sharon Grace commented on the sentiments behind Paik and Abe's early 1970s workshops, where they trained students to build the Paik/Abe Synthesizer:

> Whenever people asked them why they had done this, they would say that they were worried that the American youth were going to self-destruct on psychedelic drugs and this was their alternative to it. And the kind of sorrow and horror and grief that was internalized by everybody [from the Vietnam War]. […] They would always say because the American youth was so depressed that they wanted to make them happy. […] They would say that over and over and over again. […] And they really did want to make the generation happy. (Grace 2012)

The youth of the United States were certainly mourning involvement in the Vietnam War in the early 1970s. Perhaps these early video tools had a more profound effect in changing today's communication dynamic than we can ever give them credit for. We were lucky to have had great teachers. Thank you.

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Notes

1. Mechanical television, while popular in the US in the 1920s and 1930s, can be dated back to late 1880s.
2. Carolyn Tennant: 'While working as a researcher at Institut de Recherche et Coordination Acoustique/Musique (IRCAM) at the Centre Pompidou in the late '80s, computer programmer Miller Puckette developed a graphical programming environment that facilitated the work of composers using computers in their experiments with audio processing. Since its invention, the audio program known originally as Max has evolved into both a sonic and visual software program, Max/MSP Jitter, which today is available commercially for personal computing (Puckette went on to develop an open-source application in the '90s called Pure Data or PD). The program is widely used not only by artists working with real time audio and video signal processing but also as the engine behind countless interactive environments such as multimedia installations' (Jones 2005).
3. Undated product literature from Technisphere, ETC archive. Thanks to Sherry Miller Hocking.
4. Further discussion of the 'Tele-Techno Conferences' is detailed in Jeremy Culler's article, 'The Experimental Television Center: Advancing Alternative Production Resources, Artist Collectives and Electronic Video-Imaging Systems' in this book.
5. See http://www.experimentaltvcenter.org/tele-techno-notes. Accessed July 12, 2012.
6. Sherry Miller Hocking: 'In 1984–85 ETC, in conjunction with Matthew Schlanger, Connie Coleman and Alan Powell, documented the "Four Board Project". The intent was to make the documentation available at no cost for artists to use to build their own systems. We also discussed the idea of developing kits, but this proved too complex. Much of the documentation is now available online at the Video History Project.'
7. 'STEIM – the studio for electro-instrumental music – is the only independent live electronic music center in the world that is exclusively dedicated to the performing arts. Amsterdam, Netherlands.' From their website: http://steim.org/about/. Accessed July 12, 2012.
8. The Big Eye software was developed at the request of Fred Kolman, who had developed the tracking motion system with a hardware engineer, Andries Lohmeier, while a student at the AKI school in Enschede.
9. 'The concept [of displacement] is you build it up on the property of video. Which you have right from the get-go. Analog video, you have 0 intensity is black and 1 volt is white. And any gray scale in between is a fraction of 0 and 1. But not like zero and one like in digital, this is an analog curve. And this property makes it possible to key, because you key out first the darkest and then slowly up. Or you key from the brightest – you take out that particular part of the gray scale. And in displacement […] you have one picture, you could say that's the top picture. And then under it you have another picture and it is the other picture's properties that get lifted up into the surface picture. So if the bottom picture […] whatever is black there is no distortion and if it is white there is distortion. […] But it's a displacement that made the brightest part of the picture lift up' (Vasulka 2011).

10. 'I was at STEIM for about a year and after I left Tom designed the graphic panels, which nailed all the loose ends into a system, and Sher Doruff wrote a very extensive instruction manual. STEIM offered the program for sale, there were many takers, and soon there was a user blog named LEV. Unfortunately, the site got infested with a brutal takeover by "Netochka Nezvanova" a software writer who build video modules (NATO.0+55+3d) as an add-on to the Max software. She would not tolerate any im/i discourse, and eventually killed the site (I think). Mark Coniglio was an artist-in-residence during my stay at STEIM. He became inspired to write his own video software, titled Isadora. Not long thereafter rumors of another Max video software turned to be Max/Jitter. With every new generation of MacIntosh, the software improved and expanded. Tom used the opportunity of OSX operating change to totally revamp the graphic part. At that point, it was renamed imX and became a freeware, which often is a death sentence for software. There is no denying that imX was crashing a lot and the new graphic interface was still undergoing changes. Apple's move to Intel has done very well for imX, and whereas Isadora, Jitter and Pure Data are well suited for musicians, imX seems to speak better to visual artists' (Vasulka 2010).
11. '[T]here had been two other attempts at making a video packet for Max. One was called VNS [softVNS] made by David Rockeby, an artist up in Toronto – the Very Nervous System. And the other one was called NATO [NATO.0+55+3d] and was developed by a very interesting consortium of Dutch men pretending to be a woman from New Zealand as a sort of performance art act. So it was a sort of hacker collective where they had a very serious activist bent. So the software package cost more if you were from a NATO country in protest of the bombing of Kosovo. You know all this kind of stuff. And the public persona was a woman named Netochka Nezvanova– which was the Dostoyevsky character. And they hired this woman whose name was Rebekah Wilson who was a performance artist from New Zealand to pretend to be this programmer. But actually it's a bunch of guys from audio – it was a bunch of men from the Netherlands. But they had this front woman who was doing this kind of stuff. And that turned out to be – well the company, and it wasn't even really a functional company, but they went under at about that time' (DuBois 2012).

Computer-Based Video Synthesizer System, ETC

Donald McArthur, Walter Wright and Richard Brewster

EXPERIMENTAL TELEVISION CENTER LTD.
164 COURT ST.
BINGHAMTON NEW YORK 13901
607-723-9509

Computer-Based Video Synthesizer System

This report summarizes the results of the research and development of a computer controlled video image processing and synthesizing device, a project supported in part by the National Endowment for the Arts and the New York State Council on the Arts.

Dr. Donald McArthur, Systems Design
Mr. Walter Wright, Software Development
Mr. Richard Brewster, Systems Construction

October 1977

The Experimental Television Center Ltd. is a not-for-profit educational corporation supported in part by the New York State Council on the Arts and the National Endowment for the Arts.

EXPERIMENTAL TELEVISION CENTER LTD.
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607-723-9509

As video image generating, processing and synthesizing systems become increasingly sophisticated, the problem of achieving maximum control over these systems must be addressed. This is particularly relevant to situations in which videomakers work independently and frequently as individuals in the creation of their works. Many video systems provide such a large number of image making variables that manual adjustments within the parameters of each control necessary to obtain desired structures and sequences is not always possible. The artist must then compromise the image to the system. Video synthesizer systems offer an enormous potential for intricate image constructions, but without appropriate control systems the individual artist may not be able to take full advantage of the system to achieve with accuracy the structures desired. Microprocessor systems, it was believed, could provide the necessary control for precision of image structuring if these computer systems could be completely dedicated to the processes of visual art making and be made usable by artists in direct ways.

The primary aim of the Computer-Based Video Synthesizer project was the research and development of such systems with capacity for direct use by artists in the production of independent works. A major design consideration in both hardware and software development concerned the establishment of a holistic system directly related to the requirements of individuals working in the electronic arts and usable by them in their personal work. It was considered important to reduce, as much as possible, the reliance by artists on outside technical support in the production processes because of the difficulties of communication and interpretation and the intimacy of the creative situation. The initial planning for this project began in 1975 with conferences at the Experimental Television Center involving Mr. Ralph Hocking, Mr. Walter Wright, Dr. Donald McArthur and Mr. Richard Brewster of Binghamton, New York and Steina and Woody Vasulka of Buffalo, New York. With support from the National Endowment for the Arts and the New York State Council on the Arts, the project was completed in the Fall of 1977; the resulting system is now operational at the Experimental Television Center and is available for use by artists through the production program at the Center.

An important philosophical consideration throughout the project concerned a humanistic approach to the design and utilization of computer and video systems technologies; one of the initial stages of this project involved the development of methodologies which would guide the construction of complex tools and systems dedicated to the needs of visual artists. To achieve this end, it was essential that artists, programmers and engineers work together in all aspects of the project, each group communicating from its own unique perspective. Artists helped to articulate and define the types of controls which they felt were important in image making. Engineers and programmers frequently introduced image making devices and control methods which had not previously been available; the structural and compositional potentials of these components were completely unexplored. In the design and construction of the hardware there were a number of specific objectives. A flexible and versatile system was important in order to provide artists with as many options as possible for image generation, processing and control. The present system is modular in design and permits the inclusion or exclusion of discrete components in the assembly of a system specifically tailored to meet the individual requirements of a particular artist or project. Modular and standardized design also allows for the future research and development of new components and the modification of existing hardware and software all of which can be incorporated into the present system with a minimum of effort. The system is capable of interfacing with many video and computer components an increasing number of which are owned by or accessible to individual artists and small arts organizations. For example, the system at the Center is compatible with the system of Steina and Woody Vasulka, and exchanges of software and hardware are possible between Buffalo and Binghamton. Video production requires a fairly powerful microprocessor system which is capable of efficiently handling the large amount of information necessary in the generation and control of image structures. The needs for a powerful system, also low in cost, had to be weighed against the factor of complexity since the system was to be used by individual artists the majority of whom had little or no prior experience with computer hardware or software. The 16 bit system as it was designed and constructed met the criteria of low cost, high power and ease of operation. The hardware made use of commercially available components as much as possible in the interests of efficiency of operation and construction and ease of duplication of the system by artists and arts groups. Many specific components and interfaces, however, had to be designed and constructed specifically for this project since they were either not available commercially or were too costly; many of the commercial components which were available did not meet the specific requirements determined by the nature of the application of the system.

The software development for this project also emphasized a humanistic approach to the use of microprocessor and video systems by artists. The goal of the software research was the development of an interactive language usable by artists. This language had to be understandable to artists so that they could address the computer directly, using language and concepts derived from the visual arts, without the necessity of translation into high level computer languages. The language had to be responsive to the needs of artists, enabling them to manipulate discrete elements of design and compositional structures. Further, it had to allow the artist to intervene at any point in the construction of the composition so details of compositional configurations as well as whole sequences could be easily altered. Precision was felt to be critical; the artist had to be able to develop and score the composition, store, run and edit it in a manner which insured its accuracy and repeatability. It was felt that the language should also provide for the option of programmed randomness and operate in either structured or random modes or a predetermined combination of both modes.

The computer-based video synthesizer system which is now operational at the Center consists of two sub-systems, the microprocessor and the video system and their interface. The computer section consists of a 16 bit DEC LSI-11 microprocessor, teletype and printer, dual floppy disk and 20K of memory. Components designed and constructed specifically for this project include the parallel interface, buffer memory, module to element bus, element bus, digital to analog converters, analog to digital converters and real time input. The video system includes a four channel analog colorizer with keyers, a 50 point switching matrix, spatial and intensity digitizer and a voltage control bank. The video system is modular in design; each of these components was researched, designed and constructed over a period of four years under the research and development program at the Center. Each of the video components may be combined with any other to form a system tailored to individual requirements; the video system may be operated manually or placed under computer control. This design consideration allows a maximum flexibility with a limited amount of equipment, permitting the same components to serve a variety of artists with different systems needs and experiences. Hardware design also permits manual interruption of computer processes at any point through the use of analog to digital converters and real time input. This feature allows the artist more complete control over all elements of the image and its temporal structures. Changes in composition may occur by software reprogramming or direct manual interactions by the artist or a combination of these techniques.

A more detailed description of the hardware aspect of this project is presented in the papers by Dr. Donald McArthur. Section I A provides an orientation to the system architecture. Section I B is a paper written from a transcript of a presentation by McArthur in Buffalo, New York in March 1977 for the 'Design/Electronic Arts' conference supported by the National Endowment for the Arts and the New York State Council on the Arts and sponsored by Media Study/Buffalo and the Center for Media Study, State University of New York at Buffalo. This presentation by McArthur was based directly on the research McArthur had done for the Computer-Based Video Synthesizer project.

The aim of the software aspect of the project was the development of an interactive language which uses concepts and vocabulary derived from the visual arts. It was anticipated that this approach would make the computer based video system accessible to a much larger number of artists than would a system which depends on the presence of a programmer to interpret the ideas and images of an artist into a computer language. Before any except the most rudimentary of programming could be developed, analysis of the fundamental elements in the composition of single images as well as their temporal structures had to be conducted. Identification and definition of these elements and the parameters of change within each variable were the initial steps. Within single images, discounting the time function, elements which were chosen included color field variables such as hue, saturation, chroma and intensity, form and shape variables including type of shape, position and frequency, texture and density. Each element has parameters of change which involve the temporal aspects of video. The methods of change involve problems of duration and sequencing with references to rhythmic structures.

As is noted in the papers by Wright, the software research is still in its initial stages and further explorations are necessary before the interactive language is fully functional. Several programs have been developed, one of which is analyzed in Wright's paper, section II A, which represents an incomplete stage of the language. Section II B is a transcript of a presentation by Wright at the 'Design/ Electronic Arts' conference in Buffalo in 1977; these materials are based directly on the research Wright had done for this project.

The computer based video synthesizer system is now operational at the Experimental Television Center in Binghamton, New York and is available to artists under the production program. As a greater number of artists utilize this system, each artist will be encouraged to articulate ways in which the system can be made more responsive. The results of this project have already indicated several important avenues for continued research, among them further and continued software development and the publication and dissemination of the results of the research to date. The computer based video system can serve as a model system; publication of research results will allow the duplication and modification of the system by other individual artists and arts organizations. Although the research to date has been specific to video, microprocessor systems are useful tools in many of the visual and performing arts, and a publication of this nature would assist many individuals from a variety of fields. A complete set of documentation has already been prepared; the next phase of this project, for which the Center is seeking support, includes the publication of these materials, including detailed schematic documentation. This publication will also include more theoretical papers, approaching the system and its applications from the points of view of aesthetics, physics, electronics and video and microprocessor technology. The aim of this publication is to provide specific and detailed information to permit duplication of the system and also introduce conceptual frameworks from which to view the electronic arts.

Design/Electronic Arts: The Buffalo Conference
March 10–13, 1977

John Minkowsky

In March 1977, not many months into my tenure as 'Video/Electronic Arts' Curator at Media Study/Buffalo (MS/B), a regional center in Western New York, I was given the opportunity to organize a four-day conference, 'Design/Electronic Arts', to explore the collaboration of video and audio artists and theorists/engineers/technicians/scientists in devising new tools for creative imaging and sound. Two dozen prominent innovators in this field were invited to exchange ideas regarding the principles of design and practical information about it. While suggestions concerning the roster of participants came from many sources, the two most generous advisors were Woody Vasulka and Gerald O'Grady. Nearly all the sessions were conducted in a large auditorium at the Marine Midland Bank in downtown Buffalo. Funding came from the New York State Council on the Arts, the National Endowment for the Arts and the Center for Media Study (CMS) at the State University of New York at Buffalo (as a cosponsor).

I was founding Curator at MS/B from the fall of 1976 through the end of 1984, and organized 300 presentations and performances by videomakers and musicians, as well as touring exhibitions and residencies by artists to create new works and to design audio tools. I came to the position with a substantial awareness of the current trends in both video and electronic music, having arrived as a freshman at the State University of New York in 1971, just as CMS and MS/B were coming into existence. Every week, a different artist working in video was invited to make a screening/presentation at the University, and I attended them all, taking in the full range of video experimentation. I was also fortunate to have Stan Vanderbeek, Ed Emshwiller, Peter Campus and Nam June Paik as some of my earliest instructors in videomaking. Paik, in a short seminar, introduced everyone to the raster distortion of broadcast signals by placing powerful electromagnets atop TV monitors.

Buffalo was, therefore, teeming with electronic media activity by virtue of both the Center for Media Study at the university and the independent Media Study/Buffalo – both founded by Gerald O'Grady – with a particular interest in the development of new tools for electronic art, of which there were perhaps only two other locations in the country (the Experimental Television Center in Binghamton, New York, and the Electronic Visualization Center in Chicago [both well represented at the conference]). Buffalo was also the home of audio-tool designers Robert Moog and Harald Bode, and the computer music pioneer Lejaren Hiller, with whom I had various degrees of interaction. The arrival of Steina and Woody Vasulka to teach at CMS in 1974 proved to be the final key ingredient, for they had been the preeminent innovators in exploring

Figures 1 and 2. Poster for 'Design/Electronic Arts: The Buffalo Conference', March 10–13, 1977.

Design/ Electronic Arts

Thursday **March 10, 1977**

6:00 PM
Fargo Dining Hall
Ellicott Complex — North Campus
State University of New York at Buffalo
Buffalo, New York 14261

RECEPTION
By Invitation Only

8:00 PM
Room 170
Millard Fillmore Academic Core
Ellicott Complex — North Campus
State University of New York at Buffalo
Buffalo, New York 14261

Self-Observing Systems: The Video Revolution in America
Gene Youngblood
Film & Television Study Center
6233 Hollywood Blvd. at Vine
Hollywood, California 90028

Open to the Public

Friday **March 11, 1977** **By Invitation Only**

Auditorium
Marine Midland Bank — Western
One Marine Midland Center
Buffalo, New York 14240

9:30 AM
Introduction
Gerald O'Grady
Director, Center for Media Study
310 Wende Hall
State University of New York at Buffalo
Buffalo, New York 14214
and
Media Study/Buffalo
207 Delaware Avenue
Buffalo, New York 14202

10:00 AM
Technological Art: Some Problems
Ken Knowlton
Bell Telephone Laboratories
Room 2C 525
Murray Hill, New Jersey 07974

11:00 AM
The Geometry of Consciousness
George Chaikin
Brain Research Laboratory
New York Medical College
Flower Fifth Avenue Hospital
at 106th Street
New York, New York 10029

12 Noon
Visible Languages: Towards Diagrammatic Environmental Communications
Aaron Marcus
School of Architecture
and Urban Planning
Princeton University
Princeton, New Jersey 08640

1:00-3:00 PM
Lunch

3:00 PM
Designing in Time: Common Principles in Visuals and Sound
Laurie Spiegel
175 Duane Street
New York, New York 10013

4:00 PM
A Description of the Landscape Within Which Computer Music Systems Are Designed
Joel Chadabe
Department of Music
State University of New York at Albany
Albany, New York 12222

5:00 PM
Applications of Speech Synthesis to Music
Joseph Olive
Bell Telephone Laboratories
Murray Hill, New Jersey 07974

6:00-8:00 PM
Dinner

8:00 PM
Generative Systems—The Missing Media
Sonia Sheridan
School of the Art Institute of Chicago
Michigan Avenue and Adams Street
Chicago, Illinois 60603

9:00 PM
Music with Roots in the Aether: Video Portraits of Composers and Their Music
Selected Short Subjects: (1) Cast and Crew, (2) Manners, (3) Are There Any Questions, (4) There's Always a Scandal, (5) Coming Attractions, (6) Intermission
The Feature: What She Thinks
Robert Ashley
Director
Center for Contemporary Music
Mills College
Oakland, California 94613

Saturday **March 12, 1977** **By Invitation Only**

Auditorium
Marine Midland Bank — Western
One Marine Midland Center
Buffalo, New York 14240

10:00 AM
3-D Digitizing and Motion Description
James H. Clark
Information Sciences
University of California at Santa Cruz
Santa Cruz, California 95064

11:00 AM
A Description of the Anima-II 3-D Color Computer Animation System
Charles Csuri
Ohio State University
Research Center
1314 Kinnear Road
Columbus, Ohio 43212

12 Noon
Synthavision: An Overview
Larry Elin
Synthavision
3 Westchester Plaza
Elmsford, New York 10523

1:00-3:00 PM
Lunch

3:00 PM
How to Apply What You Know About Analog Electronic Art to Your First Computer
Tom DeFanti
Department of Chemistry
University of Illinois at Chicago Circle
Box 4348
Chicago, Illinois 60680

4:00 PM
The Image Processor: Design, Operation, Use
Dan Sandin
Department of Art
University of Illinois at Chicago Circle
Box 4348
Chicago, Illinois 60680

5:00 PM
Crosseye, General Motors — 1976, Re-Scanning of Eve-1 and Eve-88 and Glimpses of Other Entities in Process
Phil Morton
1839 S. Halstead Street
Chicago, Illinois 60608

6:00-8:00 PM
Dinner

8:00 PM
From Slit-Scan to Raster-Scan
John Whitney
Motion Graphics
600 Erskine Drive
Pacific Palisades, California 90272

9:00 PM
Art and Technology
Stan Vanderbeek
Department of Art
University of Maryland
Baltimore County
Baltimore, Maryland 21201

Sunday **March 13, 1977** **By Invitation Only**

Auditorium
Marine Midland Bank — Western
One Marine Midland Center
Buffalo, New York 14240

10:00 AM
Pantomation
Tom Dewitt
111 North Pine Avenue
Albany, New York 12203
Phillip Edelstein
Technical Supervisor
Electronic Music Studies
State University of New York at Albany
Albany, New York 12222

11:00 AM
Digital Meets Video: The Best of Both Possible Worlds
Lou Katz
College of Physicians and Surgeons
Columbia University
630 West 168th Street
New York, New York 10032

12 Noon
Computer Control of Real Time Television Devices and Devices for Micro-Processing
William Etra
42 E. 23rd Street
New York, New York 10010

1:00-3:00 PM
Lunch

3:00 PM
A Computer-Based Video Synthesizer: Part I Hardware
Don McArthur
Experimental Television Center
164 Court Street
Binghamton, New York 13901

4:00 PM
A Computer-Based Video Synthesizer: Part II Software
Walter Wright
Experimental Television Center
164 Court Street
Binghamton, New York 13901

5:00 PM
The Territory, The Subject and The Transmission of Knowledge
Woody Vasulka
Center for Media Study
State University of New York at Buffalo
310 Wende Hall
Buffalo, New York 14214

6:00-8:00 PM
Dinner

Sunday **Open to the Public**
Ellicott Square Building
Grand Court Lobby
295 Main Street
Buffalo, New York 14203

8:00 PM
PERFORMANCES BY THE SONIC ARTS UNION

Robert Ashley
The Great Northern Automobile Presence

David Behrman
Music for Cornet, Micro-Computer and Homemade Electronics
David Behrman - Electronics
Jim Horton - Computer Programmer
Gordon Mumma - Cornet
Kim One - Harmonic Changes

Alvin Lucier
Bird and Person Dyning (1975)
For Performer with Microphones, Amplifiers, Loudspeakers and Sound-Producing Object

Gordon Mumma
Passenger Pidgeon (1676-1976)

Co-Sponsored by Center of the Creative and Performing Arts, SUNY/Buffalo, The University-Wide Committee on the Arts, and Meet the Composer, a Project of the American Music Center, Funded by The New York State Council on the Arts the materiality of the electronic media using new instruments designed for personal analytical and expressive purposes.

The particular artist/designers who were invited to the conference were selected from a much longer registry because they brought with them a range of approaches, which were nonetheless interrelated, to each of the categories of work described below. But there were reasons why some were not present as well. For example, Ivan Sutherland told me that he was no longer interested in making such presentations, having done so many in the past. For still others, like Shuya Abe in Tokyo, it would have been prohibitively costly to fly to Buffalo given budget constraints. And still others, however enthusiastic, simply were faced with scheduling conflicts that prevented their attendance. All of the initial negotiations were conducted by telephone, and so no written documentation of these communications is extant, although handwritten lists indicate the gradual winnowing away of prospective speakers and presenters. Still, overall, I was satisfied that we had covered the bases with a convocation of brilliant practitioners that would generate a lively exchange.

My intention at the conference was to bring together representatives of three types: conceptual designers, or philosopher/theorists of art, technology and communications; tool and system designers and builders, or those actively engaged in constructing hardware and software systems to be employed by artists; and designers of images and sounds themselves who made use of these new tools. As might be expected, these were soft distinctions that began to dissolve from the outset. Throughout the conference, there were attempts to identify where tool designers and artists could be distinguished in the collaborative cross-fertilization between these traditionally distinct realms.

The nature of the collaborations between artists and designers could take a number of forms, among them the hardware or software designer creating machines and programs to specifically meet the needs of a particular artist's vision; the artist learning the potentials and limitations of a system from the designer in order to create works based on these criteria, and an open exchange of ideas that could result in image and sound forms unforeseen by those involved, and in the creation of new instruments toward these ends. An artist's desire to affect certain manifestations of her own ideas might prompt the scientist to envision fresh approaches to his own art of post-industrial invention and application.

Here, in Sections 1 – 4, I present the situation vis-à-vis electronic art circa the late 1970s and how it had come to be (1), followed by a list of principles of electronic tool design as enumerated by Dan Sandin for his analog Image Processor (2). There follow summaries of the talks, demonstrations and performances by each of the 24 presenters, and a final address by Woody Vasulka (3). Finally, I offer my brief perspective on the techno-cultural developments in the more than thirty years since the conference (4).

Most quotations are directly from the audiotape records of these proceedings. Those from other sources have been footnoted.

1. The state of the art: 1977

It had only been a decade since Sony mass-marketed the portapak, the affordable hardware that initiated the independent video movement in America. That was phase one. The second phase, within a few years, was the move by a handful of artists to invent specialized analog tools – video synthesizers and processors, colorizers, and multi-keyers, among others – that permitted a wide variety of modulation of video signal waveforms in real time to allow vast arrays of 'special effects' beyond those available in the standard television studio.[1] By 1977, video was in its third stage – the transition from analog to digital generation and control of the television signal to further extend the creative use of the medium. It was then that the first home computers appeared for purchase by the general public, based on the microprocessor technology that came as a result of integrated circuits acting as central processing units. The first attempts at interfacing digital and analog – converting digital information back to the analog mode of the television system and vice versa – were, at this stage, often dependent upon the mainframe computer systems available only at large industrial, research and educational facilities that could afford them, although this was rapidly becoming less the case.

This had been the trajectory of video art in its first decade – from a primitive portable straight-on recording instrument, to analog signal-processing tools that were often unpredictable in their behavior, to the beginnings of precision control with digital computers.

While this is a huge simplification of developments during the first decade of video tool exploration, it does point to the fact that 'Design/Electronic Arts' took place at a pivotal moment – the cusp of video taking its next step into uncharted territory. And it is essential to reiterate that the transition from analog to digital was very much a new direction in tool making that would have enormous impact on all that came after in the electronic arts.

2. Some principles of tool design

Throughout the conference, as designers outlined some of the principles upon which they already worked in the hardware and software they were developing, the two most operative words were 'real time' and 'interactive'. No one articulated his own criteria with such specificity as Dan Sandin in describing his design of the analog Image Processor (IP). I present Sandin's list as an expedient template in considering the many ideas that were later recapitulated by others in different ways. Although Sandin focused on his analog IP at the time of the conference, most of the design ideals he expressed would extend to its digital counterpart already under way.

Real time: 'Analog systems are so dumb they can't store any information,' said Sandin, 'so the stuff's got to come out as fast as it goes in. It is an inherently real-time system in most cases, especially with video' (Sandin and Morton 1977).

This was not the case with digital tools, where storage capacity of signal data was to a large degree fundamental to the ways they were to be employed. The particularities of the hardware itself and complexities of the software programming could create delays between one end and the other, or determine the durational parameters of the act of creation based upon the time required to compute a single image frame. There was, at the beginning at least, a trade-off between analog spontaneity and digital control. But it was not an either/or situation: some systems permitted both modes of real-time decision making and more contemplative modes of composition, the scores of which could be retrieved immediately upon completion of a work for evaluation and revision.

Interactive: Interactivity is part and parcel with real-time systems, and it became more a question of degree and type; for example, how easily the user could make the cognitive connection between her actions and the images or sounds produced, and to what extent repeatability of a particular visual/aural event was possible.

Rich feedback: The immediate gratification of witnessing the results of one's actions is closely linked with real-time interactivity. Optimally, thought Sandin, feedback should be as rich in character and detail as possible.

General purpose: Systems should be general purpose, ones in which the logical organization or architecture would not present 'walls' (limits of flexibility) to the user. These were opposed to special-purpose turnkey tools – one-trick black boxes which performed with the flip of a switch – that limited what Sandin termed 'modes of thought' encouraged by more generalized flexibility.

Modularity: A key factor here was constructing the machine out of discrete units capable of particular input-to-output processing that a user could easily interconnect to generate images of enormously diverse natures. Modular systems could reproduce functions of the special effects console as well as many more radical visual manipulations. And the interchangeability of voltage controls and image allowed one image to affect another. Furthermore, the neophyte could first master the small domain of this array of modules to simulate a special purpose piece of hardware, and then begin to combine it with others to discover new complexities as his sense of competence increased.

Easy to learn: Admittedly, Sandin noted, general-purpose systems often contravene ease of learning. Digital computers, which are always general purpose, require that the user could proceed only with a substantial body of knowledge, such as complex assembly languages, rules of programming, and the generation of subroutines. But here, Sandin thought, the tension between too many and too few options could be mitigated by finding 'a slice through these two worlds that gives you a tremendous amount of generality and still maintains a conceptual clarity or kind of hierarchy that allows one to start knowing very little, with the machine teaching the rest' (Sandin and Morton 1977).

High tactility: This was one means of easing new users into the system, a manner of developing a direct relationship between what the hand does and what the eye sees. The IP used patch programming – something like a superannuated telephone switchboard – to plug together modules in as simple or labyrinthine manner as desired, but other peripherals like joysticks were also employed. Working at 'touchie-feelie' inputs of this sort obviously constituted a different process than typing elaborate instructions at a computer keyboard to obtain results.

Portability: Portability is a relative term. Although cumbersome, the IP could be packed and transported to other sites for performances, and this was a common *modus operandi* of Sandin's compatriot Phil Morton to create his two-way interactive installations. Mobility of other large systems was clearly impossible, and even Don McArthur, who aspired to portability with his Computer-Based Video Synthesizer, had up to that point only created hardware roughly comparable in size to two refrigerators.

Low cost: Putting a tool in the hands of as many individuals as possible to explore at their own pace was one of Sandin's primary objectives, and he provided the schematics gratis to anyone who wished to construct her own IP at an estimated cost of $3000. Compare this figure with the $10 million machine available at Columbia University and the discrepancy is breathtaking. But, as many noted, the home computer would bring digital tools out of the institution and directly into the hands of artists.

Issues of safety: An assurance that, in their interaction, neither was the user hurt nor the tool damaged was a design consideration for Sandin, and it is not an irrelevant one when speaking of intimate and extended hands-on employment of a complex electronic instrument. Stephen Beck, the designer of the Direct Video Synthesizer at the National Center for Experiments in Television in San Francisco, never let anyone else use his machine for fear that they might cause damage that would require countless hours to diagnose and repair.

These, then, were some of Dan Sandin's criteria for an ideal electronic imaging tool.[2] In what follows, the manner in which other designer/artists shared them and envisioned additional ones will become clear.

3. Presentations at the 'Design/Electronic Arts' conference

Placing Sandin's criteria in a proper context requires a description of the conference proceedings and participants. They are here categorized under 'Theory', 'Music', '3D motion graphics', 'Graphic arts' and 'Design by collaborative teams for computer-based video systems', as well as 'Evening events: presentations, a mini-retrospective and a concert', and Woody Vasulka's summary comments.

Theory

By theory I mean that which offers conceptual models that are projective, prescriptive, or analytic, or otherwise describe unusual and original systemic paradigms, and three presentations – those by Gene Youngblood, Ken Knowlton and George Chaikin – fell within this category.

Gene Youngblood's keynote lecture, 'Self-Observing Systems: The Video Revolution in America', took place at the Ellicott Complex at the North Campus of SUNY/Buffalo. Author of the influential 1970 book, *Expanded Cinema*, he eschewed his earlier focus on specific tools to speak more generally about the need for a large-scale restructuring of the mass communications system from centralized one-way distribution to consumers to a specialized two-way, point-to-point, user-controlled feedback system.

This was to be a revolution through the total inversion of the structural and functional organization of the mass media, replacing 'the processing of centralized output with processing of decentralized input as the chief characteristic of the medium' (Youngblood 1977), giving the public access to information specified by the user through channels controlled individually. There was at present no mass communication, only mass distribution. Its reorganization would constitute the first true communications revolution in history – the invention of movable type excepted – rather than a mere series of technological innovations.

Youngblood tied the effect of the mass media to human evolution. Influenced by the writings of the Chilean biologist and cognitive scientist Humberto Maturana, his underlying premise was that there appeared to be no grounds for human unity in social modes of thinking and organization other than the desire for it, and that the mass media, by offering only one monolithic version of reality, served to attenuate the passive receiver's ability to imagine others. The interactions of two or more people engaged in communication are requisite to formulating models of what can and should be new structures for talking, thinking, and actualizing their own internal representations of reality. The goal of Youngblood's proposed model was to be achieved with newly (or soon to be) available technologies.[3]

Ken Knowlton offered something like a second keynote address the following morning in 'Technological Art: Some Problems'. Knowlton worked for many years at Bell Laboratories in Murray Hill, New Jersey, designing and implementing software for computer graphics and films, most notably the programming language BEFLIX (Bell Flicks), the first bitmap movie-making system. With his collaboration, these were made available to artists like Stan Vanderbeek, Lillian Schwartz and Laurie Spiegel. Knowlton is also a recognized artist in his own right.[4]

Knowlton used the occasion of 'Design/Electronic Arts' to raise three questions about art as it was coming to pass in the always-morphing environment of new technologies, and the manner in which these technologies should be employed and presented to novices. The first issue was the degree to which the artist should explain the ways in which a work was created, that is, the equipment and processes themselves and how they were used, rather than the particular aesthetic decisions made from a landscape of possibilities. The second was whether collaboration was desirable or more a matter of necessity, given the types of technical knowledge required that might otherwise keep artists at bay. And finally, there was the question, as he put it, of whether one should take 'big steps or little steps in defining new media' (Knowlton 1977), the first ostensibly creating a baffling and alienating hurdle for those who encountered challenging works, and the last representing a set of incremental transformations that would connect new forms with those that came before.

Knowlton's ruminations can be summed up as follows: how to use technology without letting it interfere with the perception of the role of the artist who employs it; and how to initiate a new generation of viewers/auditors into these radical forms in some measured manner.

George Chaikin of the Brain Research Laboratory at the New York Medical College, in a presentation entitled 'The Geometry of Consciousness', proposed a model of visual encoding based on logarithmic spirals – such as one might find in the nautilus shell and the architectural design of the Parthenon – rather than linear logarithms. He speculated that this new model would more closely resemble the way the eye functions, a fact, he said, recently verified by scientific studies. A machine retina could be made not only to be more fully representative of human optical systems, but also to allow for more rapid computation of electronic images, and he had simulated an elementary version of a hypothetical camera that would scan in this manner. This intriguing concept had resonance beyond the manufacture of concrete instrumentation for art to that of the nature of human perception itself.

Music

The development of electronic audio tools long predates that of visual systems. The first is generally considered to be Dr Thaddeus Cahill's Telharmonium (1897), but it was Lee DeForest's invention of the first vacuum tube in 1906 – which would also lead to radio broadcasting and early computers – that spurred a great deal of instrument making for audio signal processing in the 1920s. The most famous of these is the Theremin (1919) by the Russian inventor Leo Theremin. Many prominent composers like Edgar Varèse and Darius Milhaud employed this and other early analog instruments. In the early 1960s, Don Buchla introduced the Buchla Box, and Robert Moog created his commercial audio synthesizer, the Moog. Both were modular in design and used the transformation of tone-generated signals in an additive and subtractive manner to alter pitch, tone and other aspects, and could be played live. These early analog synthesizers were models to a large extent for those who later embarked on building video synthesizers.

In the meantime, digital computer music was also making headway, with systems being developed by Max Mathews at Bell Labs and others in the 1950s, and explored at the Electronic Music Studio at the University of Illinois at Urbana-Champaign founded by Lejaren Hiller, and the Columbia-Princeton Electronic Music Center by Otto Luening, Vladimir Ussachevsky, Milton Babbitt and Roger Sessions. Like many digital video explorations two decades later, these were reliant on large mainframe systems, and most primarily focused on the use of the computer as a compositional rather than performance tool.

One afternoon of the conference was devoted to the most recent developments in computer music by Laurie Spiegel, Joel Chadabe and Joseph Olive.

Laurie Spiegel, a highly respected composer/performer as well as designer of tools for computer music,[5] also worked in the mid-1970s at Bell Laboratories. There, she began to experiment with computer video graphics, using a Rand Tablet and FORTRAN IV software program she'd written for drawing directly onto a display screen, and VAMPIRE (Video and Music Program for Interactive Realtime Explorations). Her talk, 'Designing in Time: Common Principles in Visuals and Sounds', covered the ways in which she interfaced visual composing with the time-structuring software she was already using for music compositions, and the similarities and differences of working in both of these forms.

Joel Chadabe, a Professor of Music and founder of the electronic music studio at the State University of New York at Albany, presented 'A Description of the Landscape Within Which Computer Music Systems Are Designed', which was later published in the *Computer Music Journal*. Chadabe had been a pioneer in the development of real-time interactive systems, attempting to bring the level of feedback of the visual arts to music, and here he spoke broadly about the organizational design of systems that incorporated the digital computer as an important element, either as performer or composer-performer. He used the term 'memory automation' to signify the computer's capacity for storing a score and playing it back for the composer who could then interactively 'conduct' the work. He distinguished this from 'process automation', whereby computer-generated data was based on rules specified by the composer, who was then free to make selections from the outputted sequences. But it was toward the simultaneous composition and perception that Chadabe had concentrated his greatest focus, a procedure that allowed for constant evaluation and flexible redefinition of rhythm, speed, articulation and other details of the music as they were being generated.

Joseph Olive, also a researcher at Bell Laboratories, spoke on 'Applications of Speech Synthesis to Music'. After a brief overview of centuries-old endeavors to simulate human speech by artificial means, he explained the use of spectrographic analysis in attempts to emulate resonances and the like by means of computer software that dominated his text-to-speech synthesis research. His interactive programming was able to alter the time axis, the pitch contour and the sound spectrum. Examples of all of these experiments were interspersed throughout, but the talk culminated with an excerpt from his own opera, *MA-RI-IA-A*, its humorous libretto an enactment of a scientist teaching his machine to talk.

3D motion graphics

In 1977, 3D motion graphics systems, now so commonplace, were in their infancy, with the largest developmental support coming from investors outside the art world. The ability to create only 2D imagery for the video screen was now being extended to manifest representations of synthetic worlds along three axes, a capacity that would have a profound effect not only in industrial, scientific and entertainment endeavors, but those of artists as well.

Therefore, one morning session was dedicated to three-dimensional computer animation systems, or what Charles Csuri referred to as 'visible surface calculation', for motion graphics. The focus was simulation of naturalistic objects and environments for a variety of applications in science, industry and art, and the presenters were James H. Clark, Charles Csuri and Larry Elin.

James H. Clark of the Information Sciences Department at the University of California at Santa Cruz ('3D Digitizing and Motion Description') had been involved in tri-dimensional interactive systems, computer-aided design and geometric modeling since he was a graduate student at the University of Utah. There, he had worked with the legendary Ivan Sutherland, who, among his many other accomplishments, created the first Virtual Reality (VR) system that simulated a 3D environment through which the user could navigate. In 1977, Clark described a system he was developing for NASA that would generate a mathematical model of a wind tunnel to analyze potential flaws in the design of aircraft in real time, and had undertaken the creation of a more sophisticated VR head-mounted display.

Charles Csuri was a Professor of Art and the founder of the Computer Graphics Research Group at Ohio State University. He came from a traditional painting and drawing background, but discovered that programming line plotters could offer a vast array of variations on a theme – again many more than he could have envisioned – through both calculated parameters and random-generated sequences, and created the 1967 film *Hummingbird* based upon them.

At Ohio State University, he was developing the ANIMA II system with artists in mind. Essential design aspects were the use of a script language, or what he called 'scene directives', the use of joysticks for fine-tuning the positioning of an object, and a system of orientation notations that appeared on-screen to assist the user in how to proceed. Defining figures was achieved by combining simple geometric objects that Csuri likened to sculpting, which were then subjected to transformation routines to enact scaling, movement and rotation. Numerous other routines refined this shaping of entities, including the warping and bending of specific planes to enhance naturalistic representation. For the most part, real-time interaction was again considered the key to the successful results of ANIMA II.[6]

Larry Elin came from neither the academic nor the art world, but was, rather, a filmmaker/producer for the Mathematical Applications Group, Inc. (MAGI) in Elmsford, New York – one of the breakout companies for the simulation of three-dimensional solid objects in motion for film and television, using its digital animation process, Synthavision. Much of Elin's work in 1977, as exemplified by his sample reels, was created to assist in the design and application of industrial, military and scientific systems, but there was also a smattering of entertainment-related excerpts that would prove to be precursors for what several years later would be MAGI's most visible project – the production of sequences for the 1981 feature film, *TRON* (dir. Steven Lisberger).

His talk defined the three elements an animator using Synthavision had to address: creating the 3D object shape through a process like Csuri's, here called 'Combinatorial Geometry'; defining an imaginary camera with a location, lens and direction from which to view this synthetic object; and determining a light source by which the scene was to be illuminated. The last of many subsequent stages involved recording each frame of the calculated animation onto film stock. Clearly, this was not a real-time system in any sense, and the results had a 'cartoony' feel that would serve it well when a fellow MAGI employee, Jon Lasseter, cofounded Pixar Studios.

Graphic arts

Aaron Marcus and Sonia Sheridan gave talks on the use of new technologies for the graphic arts – from computer-assisted design to the aesthetic applications of xerographic systems.

Aaron Marcus was a designer and computer and conceptual artist from the School of Architecture and Urban Planning at Princeton University. His work was in 'Visible Languages', a term he used to describe calligraphic and typographical signs, drawings and markings as a 'useful tool for examining systematic aspects of diagrammatic compositions of iconic and symbolic forms' (Marcus 1977). During a period in residence at Bell Labs, he developed a 'prototypical, interactive, computer-assisted page design system' (Marcus 1977), which permitted the flexible electronic arrangement and manipulation of signs and symbols on the surface of a cathode ray tube. Many of the elegant works Marcus projected bore resemblance to concrete poetry, where the relationships of figure to field, geometrical components and other formal properties became aspects of expressive alphabetically-based art.

Most pertinent to the general conceit of the conference were slides from his dynamic series *Cybernetic Landscapes*, virtual realities of a sort that he described as 'poem-drawing environments'. These were highly interactive systems whereby the viewer, by means of joysticks, was able to travel through a dark landscape upon which had been designated signs, symbols, letter forms, objects and other graphic elements rendered as pure-white line drawings.

Sonia Sheridan was the creator of the Generative Systems Program at the University of Illinois at Chicago Circle Campus, a remarkable facility that functioned as a research center for student artists of what she referred to as 'The Missing Media' between video and computers; as a place that wedded earlier methods of art making, such as drawing, photography and textile design, to new electronic technologies; as an interactive force between industry, education and the public; and, perhaps, most importantly, as an attitude and process that extended beyond the use of any specific machine: 'It attempts to reverse the order of motion, from machines remain, to humans remain while machines move' (Sheridan 1975: 6–10).

Sheridan's work focused on Electronic Systems Printout (ESP) using a variety of industrial copying equipment tools such as 3M's Color-in-Color machines, Xerox copiers, and other means of thermographic and electrostatic reproduction. Rather than the more conventional relationship between artist and industrial scientist/technician – where the latter might serve largely as instructor of the machines of the former – Generative Systems often gave back new methods in which these complex pieces of technology could be differently employed: '[I]ndustry has a backlog of 50 years of inventions for which they are looking for new uses, applications and markets. The artist who has access to these inventions is well equipped to dream of alternative inventions and applications' (Sheridan 1975: 6–10). Concomitant with that approach was the recognition that scientists were as creative in their activities as artists, albeit with different aims in mind.

That the systems were interactive and largely in real time was extremely important to this approach as innovative ways to engage them. In this, the thrust of Generative Systems was not unlike the attempts of video and computer artists to provide rich feedback to the creative user.[7]

Design by collaborative teams for computer-based video systems

The portion of the conference most plentifully represented was that of close collaborations by small cadres of artists/engineers to realize hybrid analog/digital video synthesis tools in Chicago, Albany, New York City and Binghamton. This model was, without question, the most productive of any, and that which demonstrated an ideal for design in the electronic arts.

3.1. The Chicago Group – Dan Sandin, Tom DeFanti and Phil Morton

Dan Sandin, Tom DeFanti and Phil Morton created the Electronic Visualization Center, and referred to it as a 'habitat' – a felicitous term signifying an environment in which one could work for indefinite periods of time, continuously learning new ways to yoke the system to her or his own creative ends.

Dan Sandin of the Art Institute of Chicago, then just undertaking the digital version of his analog Image Processor, reviewed the design principles that had gone into it, and these have been described above. One further quote makes yet another salient point:

> I designed the IMAGE PROCESSOR from the point of view of, what does the student have to do to use it? [N]ot from, what can the machine do? [W]ith electronic visualization done properly, the feedback is no longer the *limit*; the limit then becomes how fast your mind can process information; and that is a *much higher limit*, in some cases, especially when processing visual information. (Sandin and Morton 1977)

In Tom DeFanti of the Department of Chemistry at the University of Illinois at Chicago Circle Campus, a formidable computer software designer, Sandin found a kindred spirit with whom to collaborate. DeFanti's GRASS (GRAphics Symbiosis System) became the basis of interfacing with Sandin's analog processor, and DeFanti said that he almost thought of GRASS as an analog system, in that it allowed him and Dan to appropriate real power to accomplish a great deal in short order. He also was a firm believer in high levels of interactivity – to make the system so unsophisticated that it could operate in real time – and in tactility, with large knobs and other paraphernalia. Digital-to-analog conversion made Sandin's analog IP and DeFanti's GRASS software entirely compatible.

Phil Morton, also of the Art Institute of Chicago, was one of the primary users of Sandin's and DeFanti's system, and took it in directions that were distinctly his own. A keen advocate of Citizens' Band radio in particular as a model adaptable to video, he was deeply engaged in the whole topic of telecommunications in general.

Morton forayed into the realm of interactive communications by way of high performance two-way video and audio 'transmission' installations. These were modest (but doable) in scope compared with Youngblood's convulsive model. The typical staging of a Two-Way Communication System consisted of three basic components: (1) an observation area for contemplating the ongoing process and resultant product; (2) two public user terminals, each consisting of a video camera and microphone trained on the other to send information with a monitor and headphones to receive signals from the other site, and tactile devices allowing modification of the focus, angle, intensity and scale of the camera coming from the opposite terminal; and (3) a processing area, where one person (termed the CO-OPERATOR) mixed the camera outputs into a single recordable channel, a second performed on an Arp music synthesizer (the ARPIST), and a third processed the images through Sandin's tool (the IPIST).

3.2. Tom DeWitt and Philip Edelstein: Pantomation

Film and videomaker Tom DeWitt and electronics designer Philip Edelstein from the Electronic Music Studio at SUNY Albany made a joint presentation about a new multipurpose tool they had devised, The Electronic Pantograph, which had applications in music, dance and other temporal arts. Edelstein, with others, was responsible for the basic hardware, The Key Positioner, and the specific application by which the process was designated – pantomime – the particular interest of DeWitt. The Pantograph, DeWitt noted, 'uses the eye of a television camera and the brain of a computer to keep track of moving points in space and writes a record of this movement in the abstract language of a computer-choreographer' (DeWitt 1977). It was a graphic notational system of body movements, in particular, achieved by attaching a yellow spot to the performer that was followed by a camera employing chroma key techniques. The computer component provided additional flexibility through its control language, such as, according to Edelstein, 'keeping an object in a fixed position in a video frame although it was originally moving in the real world'

(Edelstein 1977), as well as retracing the described movement by storage of horizontal and vertical components in computer memory. Excerpts of the first use of the Electronic Pantograph, DeWitt's comic sci-fi pantomime, *Outta Space*, demonstrated this process.

3.3. Lou Katz and William Etra

Lou Katz was working at the College of Physicians and Surgeons at Columbia University making 3D models of scientific objects when he developed an interest in using its large computer to create aesthetic entities as well. As this work developed, he began to consider rules by which to create images of greater symmetry and complexity that could be changed for the purpose of experimentation and further be preplanned and controlled for repeatability.

At this point, he became acquainted with the artist William Etra who, with the designer Steve Rutt, had created one of the earliest video processors, one which operated on very different principles than did other analog synthesizers of the time. Katz took notice of the possibilities of working with video, and he and Etra began to collaborate on developing a computer-controlled video system. This included finding the means to convert terminal displays and feed them into synthesizers and other effects tools. Like Sandin, Katz also began to make voltage and image signals interchangeable, so that one picture element could be used to control another.

Etra was introduced to lightweight portable video equipment as a film student at New York University and, after having been exposed by Walter Wright to Scanimate, a commercial analog synthesizer, he teamed with engineer Steven Rutt to construct the above-mentioned Scan Processor. While working in an electronic music lab, Etra became convinced that computers constituted the next step, and several years later acquired his own microprocessor. One of the attractive uses of the computer, he noted, was as a notational tool for greater control and repeatability, and the viability of new types of peripheral devices.

3.4. Donald McArthur and Walter Wright: A Computer-Based Video Synthesizer

The penultimate session consisted of a two-part presentation by Donald McArthur and Walter Wright about the construction of 'A Computer-Based Video Synthesizer' at the Experimental Television Center (ETC) in Binghamton, New York. McArthur designed the hardware – aka the Spatial and Intensity Digitizer (SAID) – and Walter Wright was responsible for the software for system operation.

McArthur's background was in theoretical physics, and while teaching at the State University of New York at Cortland he became acquainted with the work of the ETC. In 1975, he and Wright initiated the computer-controlled video system, based on the use of a microcomputer interfaced with McArthur's own self-designed digital-to-analog conversion circuitry to provide a NTSC video signal that could be controlled in real time, used for live performance, and recorded on standard videotape recorders.

Rather than paraphrase McArthur's comments at the conference, it is better to quote him at some length describing the functions of the SAID architecture from a paper written in June 1977, functions that bear resemblance to Joel Chadabe's own design concepts:

> There are basically two modes of operation of the system: interactive-compositional mode and automatic-production mode. In the compositional mode, the artist can enter programs and parameters through the keyboard, observe the resulting sequence of images, and then modify parameters through either keyboard or a real-time input and thus build up a data set for a complete piece. The data set, representing all the aesthetic decisions made by the artist, is stored in the computer at each stage of the composition. When the composition is finished the system will operate in the automatic-production mode generating the final video signal in real time with no intervention by the artist. The artist may also choose to use a combination of these two modes in an interactive performance or to allow an audience to interact with the system operating automatically. The system is structured so that all of these variations can be accommodated by appropriate programming. (McArthur 1977)

McArthur spoke further of some of the design principles that went into the construction of this complex system consonant with those expressed by others, including that it be based on a general-purpose machine operating in real time – modular, hybrid and portable.

Walter Wright's talk served as complement to McArthur's presentation, approaching software programming to establish his working relationship with the microcomputer and video synthesizer. Being an artist foremost, he began with the end product – the image – and basic rules of composition that needed to be considered. Wright also extended feedback beyond the interaction between the artist and image to include that between synthesizer and computer, achieved by factors like predictable unpredictability, conditional (if/then) branching, and setting the computer to reprogram itself under certain conditions. This creative programming made the Computer-Based Video Synthesizer a very versatile tool with the potential for all manner of production, presentation and storage.

Evening events: presentations, a mini-retrospective and a concert

After long days of fervent interchange, evenings were given over to more palliative presentations. Composer Robert Ashley showed excerpts from his recently completed series of unconventional video portraits of his peers entitled *Music With Roots in the Aether* (1976). John Whitney, the dean of new technologies as inventor and artist employing systems for abstract animation, was scheduled to give a talk entitled 'From Raster Scan to Slit-Scan'. In its stead, he concentrated on his most recent work, the stunning *Arabesque* (1975), which was the first film that he made using digital rather than self-designed analog equipment, and is a complex seven-section fluid weave of intricate curvilinear patterns composed of a 360-point array in constant movement. Whitney offered a close reading on an analyzer film projector of the harmonic principles, akin to those found in music, that underlie its structure. This represented his most current concern with the periodic organization of perceptual experience, and a fully illustrated essay in the same vein, along with a broader look at his career development, can be found in his indispensable book, *Digital Harmony* (1980).

Immediately following Whitney, Stan Vanderbeek presented a mini-retrospective of his work over the previous two decades, beginning with camera-less and cut-out animation films that began his career, through his computer work with Ken Knowlton creating a series of *Poemfields* at Bell Laboratories, and beyond. He also discussed a number of other innovative projects he had undertaken, including projection of film images onto steam, and eight-hour night-long *Cine-Dreams* staged in a planetarium, where viewers were encouraged to drift in and out of sleep to a barrage of images projected on the dome, and later report their oneiric experiences by telephone. Vanderbeek specifically referred to the planetarium as a 'tool', and made use of its unique imaging systems in addition to his own work.[8]

On the final evening, the members of the Sonic Arts Union – Ashley, David Behrman, Alvin Lucier and Gordon Mumma – each performed one of their musical compositions in the Grand Court Lobby of the nearby Ellicott Square Building. Their relevance to the concerns of the conference is best indicated by the title of Behrman's piece, *Music for Cornet, Micro-Computer and Homemade Electronics*, which credits as performers Jim Horton on computer programming and Kim One, his microcomputer, on harmonic changes.

Woody Vasulka: a summary talk

It fell to artist Woody Vasulka, a professor at the Center for Media Study, SUNY Buffalo, to provide final observations and an open exchange with the audience on the ideas expounded throughout the conference. He prefaced this discussion with his own conception of what he called 'The Territory, The Subject, and the Transmission of Knowledge'.

His notion of 'The Territory' was that of placing development of new artists' tools in the context of a particular era and certain contemporaneous technological innovations. In looking at 'The Subject', he proposed that new concepts arose in electronic imaging that differed substantially from those of photography and cinema. This subject was that which comprised the electronic image as a time-energy construct, such as waveforms and control signals. Vasulka's own personal proclivity was apparent here, as an investigation of the primary elements of the video image (or, as Walter Wright had put it, finding out 'what makes TV tick') had dominated his work from the outset, and he had often referred to his own activities as dialogues with tools, an attempt to understand them and what they revealed about the medium.

Regarding 'The Transmission of Knowledge', he strongly promoted greater dialogue between individuals in transferring of information on hardware and software. Not only was there secrecy in the military-industrial complex, as one example, but also, in what seemed a misplaced implication, between members of the 'tribe' – his term for the very sorts of participants involved in this four-day conference – who seemed to have been engaged in nothing so much as information interchange.

After his quasi-polemic, Vasulka opened the floor for an extended period of discussion in which a plenum of subjects were touched upon, among them: that an artist reflects who he or she is irrespective of the system employed; whether too much emphasis has been placed on innovation and that the idea of being first diminished the importance of being best; and whether the system and program, as well as the resultant image/sound, were, in fact, a work of art.

4. The subsequent years, 1977–2010: some thoughts

As noted above, there were some pragmatic reasons to distinguish between artist and engineer in the electronic arts in the late 1960s and 1970s – the complex technical knowledge necessary to write software for institutionally based computers, and access to artists from those working within these facilities being the two most prominent. But a number of these engineers saw themselves as artists as well, and established makers were already conversant with software design and how it could be applied to their desired ends – this too was part of their creative process. The question raised by some conference attendees as to whether the design of hardware and software systems could themselves be considered an art form clearly depended on how broadly or narrowly one wished to define 'art'. Perhaps this convergence of both roles is best summed up in the following quote by Andy Hertzfield of MIT's Media Lab:

> It's the only job I can think of where I get to be both an engineer and an artist. There's an incredible, rigorous technical element to it, which I like because you have to do very precise thinking. On the other hand, it has a wildly creative side where the boundaries of imagination are the only real limitation. […] It takes incredible concentration and mind space. (Brand 1987: 58)

In the more than three decades since, an entirely new information techno-culture has evolved that has made the kinds of capabilities envisioned in 1977 so pervasive as to be commonplace to a new generation weaned on digital technology – including emerging artists.

It would be an exaggeration to say that analog technology has become obsolete – but only by a fraction. Although there are still pockets of artists making use of analog tools here and there, in the larger context conventional television has been broadcast solely digitally throughout the United States since the middle of 2009. That DTV may in fact cause some degradation in image quality and color distortion is largely overlooked – much as had been the case with the transfer of analog to digital audio, except among true aficionados.

Personal computing devices of many degrees of portability and versatility have, of course, become ubiquitous – perhaps even more so than TV sets themselves. Software packages for computer graphics are often part and parcel with these devices and otherwise stock shelves. Some of the techniques artists were struggling to obtain in 1977 can be readily learned in coursework at art schools and other institutions. And, needless to say, 3D computer animation of all sorts is inescapable.

And then there is the rise of the Internet – Sir Tim Berners-Lee's World Wide Web – the apotheosis of a true communications revolution as defined by Gene Youngblood. No one in 1977 could have envisioned this phenomenon, but in the words of the great performance artist Yogi Berra: 'It's tough making predictions, especially about the future'.[9]

The new form of Internet art (or net art)[10] developed in the mid-1990s, but the extent to which this phenomenon has been of great moment except to the relatively few cognoscenti is difficult to gauge, and what sorts of work it will produce in the future remain to be seen. A notable contribution has been made, surprisingly, by the website YouTube, which has created a new outlet for the distribution of video art. Virtually every artist who appeared at the conference has works deposited there for viewing in an easy-to-access format.

This is not the place, nor is it my intention to make any sweeping comments about the current state of electronic art. Certainly a great deal of video appears in galleries and museums, and has become wholly integrated into mixed-media installations and performances of all sorts, as a result, in part, of high-quality digital cameras and projection systems. The art world has accommodated and even embraced video as it had earlier ghettoized it.

At first consideration, it seems that less of the kinds of expression we once identified as electronic art – e.g., video synthesis and image processing – has made the transition into the present. But I would qualify this by the reflection that work of this nature was always a subgenre of video in general; many, if not the preponderance, of early tapes and installations evolved around the conceptual and minimalist art movements that often employed apparatus little more sophisticated than ½" monochrome recording equipment. The apparent dearth of electronic video may also have much to do with a general trend away from abstraction and the fact that the novelty of video synthesis has waned over time.

Finally, has anything been lost in the retirement of analog image-processing tools? From my own perspective, gone is some degree of idiosyncratic charm or personality that we associate with handicraft and folk art, by way of machines that reflected in their design and use the human touch that may be missing from many of today's far more sophisticated systems. But the trade-off so substantially favors current technology in other respects as to make this sentiment largely irrelevant. Unearthed artifacts of the Stone Age tell us much about the nature of the progress of civilization, but hardly inspire nostalgia for a lost innocence and quality of life prior to the development of new industrial and post-industrial tools. To the extent that this essay has been an archaeological enterprise of a sort, the conference participants it documents were continuously striving for the new tools that would constitute the next step in transforming aesthetic culture.

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Notes

1. There had been a longer tradition of the development of electronic music synthesizers. Those most recent and influential had been Don Buchla's Buchla Box (1963) and the first Moog Synthesizer (1964), both of which provided models for the design of the early video synthesizers. An excellent source for information about early visual and sound tools is *Eigenwelt der Apparate-Welt: Pioneers of Electronic Art* from 'Ars Electronica', 1992, an exhibition curated by Woody and Steina Vasulka.
2. It is interesting to compare Sandin's list of desired design principles with those articulated for the industrial computer put forward in 1962 by Claude F. Shannon in his lecture, 'Computers and Automation – Progress and Promise in the Twentieth Century': 'The next generation of computers will be faster, smaller, with greater flexibility and memory capacity, and more reliable. We expect the programming to progress so that it becomes easier to communicate with computers using our own language or something close to it' (Shannon 1962).
3. Another, albeit unusual, reflection of technological innovation and its suppression, as well as biological evolution in this context, can be found in William S. Burroughs's hallucinatory novel, *The Place of Dead Roads* (1983: 215–17). See also *Electronic Revolution* (Burroughs 1971/76: 21–31).
4. See http://www.kenknowlton.com/.
5. See Laurie Spiegel's website, http://retiary.org//ls for extensive information about her software design for digital arts, as well as her music and other activities.
6. In 1977, Csuri's system had been in development for only a few years and was still developing new features. A more comprehensive expression of the artist's ideas, circa 1975, is available at http://www.atariarchives.org/artist/sec25.php.
7. The specific applications that Sheridan and her students employed are too numerous to list here, but an archive of her work has been preserved at The Daniel Langlois Foundation for Art, Science and Technology (La fondation Langlois) in Quebec, Montreal.
8. A somewhat fuller description of Vanderbeek's first *Cine-Dreams* event at the Strasenburgh Planetarium in Rochester, NY in 1972, which I attended, was published in *WNET News*, 1: 3, and it quotes Stan as saying that dreams are 'a rehearsal for the future. Cronkite, instead of reporting the weather, may one day report that 3,000 people dreamed of earthquakes last night'.
9. Claude Shannon, again, spoke in more concrete terms about the pitfalls of predicting future developments, also in the Rice lecture: 'With the explosive growth of the last two decades in computer technology, one may ask well what lies ahead. The role of the prophet is not an easy one. In the first place, we are inclined to extrapolate into the future in a straight line, whereas science and technology tend to grow at an exponential rate. Thus our prophecies, more often than not, are far too conservative. In the second place, we prophesy from past trends. We cannot see the great and sudden mutations in scientific evolution. Thus we find ourselves predicting faster railroad cars and overlook the possibility of airplanes as being too fanciful' (Shannon 1962).
10. 'Net art' comes in a variety of forms with a broad range of intentions, encompassing everything from e-mail projects and websites to innovative Internet software and participatory networked art enterprises among users. It is an international movement that had its origins in Eastern Europe and is largely interactive. For an excellent history of the phenomenon, see: R. Greene (2004), *Internet Art*, London: Thames & Hudson.

Instruments, Apparel, Apparatus: An Essay of Definitions

Jean Gagnon

One of the many developments of media arts in the last decade is a heightened awareness of the role that machines, apparatuses and devices play in our lives and in the arts. The result is an emerging, complex and risky field of research slowly taking shape to chart this new focus on tools and instruments, or the apparel and apparatuses related to the production and reception of art. Tools and instruments have had long histories associated with material cultures, musical and scientific instruments. Despite the fact that technologies have had a tremendous impact on the arts since the nineteenth century, the question of tools and instruments, the means by which artists shape materials (*l'outillage de l'artiste*), has remained little studied outside of the field of music.

This essay is an attempt to describe what lies at the heart of the instrumentation of art practices as an 'instrumental relation'. To date, terms used to refer to the artist's instrument or about works of art resulting from the use of instruments have been limited to terms, such as 'machine', 'device' or 'apparatus', that remain mostly undefined and are often used interchangeably. Here, borrowing from music where types of works are commonly categorized as 'instrumental music', I want to refer specifically to 'instrumental art' which I use to describe artworks produced by the use of electronic instruments that permit the generation of images, sounds or audiovisual forms in real-time live performance. Before exploring aspects of 'instrumental art', I will attempt first to clarify the terms and definitions of the discussion.

In the following, it is useful to note that I deploy musical instruments as the model to establish a phenomenology of the instrumental relation and playing in the production of audiovisual art forms. However, to arrive at a more accurate description of this relation, I also take into consideration the role and nature of instruments in the field of techno-science, where they have long played a dominant role. Today's electronic and digital instruments share similarities whether they are used by scientists or by artists: they facilitate visualization, and pick up and emit signals, sounds or lights. But whether they belong to music or science, what are the common traits of instruments in general? Once these commonalities are established, the discussion attempts to distinguish specific characteristics of the 'instrument' in contrast to those of the 'apparatus'. The analysis then continues by making further distinctions between these terms and the notion of 'apparel'. Apparel, derived from *appareil* in French, and to which it corresponds, may strike some as archaic English; however, this essay proposes that a reconsideration of the notion may greatly contribute to a more accurate description of some of the more subtle uses of technological devices in the arts.

What is an instrument?

Where does the word instrument come from? Etymologically, the noun is borrowed from the Latin word *instrumentum*, meaning 'furniture' and 'implement'. As a verb, it is also related to *instruere*, 'to arrange' or 'to instruct'. In English, the network of relations between the meanings of the words 'instrument' and 'implement' as nouns and verbs is vast compared to their original derivations. In Latin, the noun *implementum* refers to the action of filling up, while *instrumentum* refers to the means whereby something is achieved, performed or furthered. The implement is therefore the device used in the performance of a task. As verbs, 'to instrument' means to address a legal instrument, or to score a musical performance, to orchestrate; while 'to implement' is to carry out or accomplish something, to provide instruments or the means of expression for something.

Encompassing all these meanings, the word 'instrument' in English thus refers at the same time to both the executive and operational technical dimensions, and its cognitive and cultural aspects, in order to instruct us about something. Put another way, the instrument is understood not only as that which allows us to play and produce sounds but also as a legal function of mediation.

Tools and instruments

Given that tools and instruments are generally conflated terms, refining an understanding of their similarities and specificities will help to better grasp both terms. Broadly speaking, tools and instruments are considered as body extensions, that is, the exteriorization of human capacities operating through the amplification of perceptual functions. The microscope or the telescope are such examples.

Both tools and instruments embody the power of humans to anticipate and imagine. To imagine is to create a future; to anticipate is to preview what has not yet happened. Thus to be human is to be in time. These two human faculties of imagination and anticipation do not float in the immaterial sphere of the 'spirit'. Rather, they manifest through their incarnation and exteriorization and by the actualization of these capabilities.[1] It is therefore important to keep in mind that tools and instruments allow for modes of embodying the power to anticipate and create the future. My insistence on this temporal dimension is to underscore the fact that media arts and new media are fundamentally time-based.

In his philosophy of 'technology' (which he referred to as 'technique'), Gilbert Simondon defines the tool as a technical object extending or gearing up the body to accomplish a gesture, and the instrument as a technical object that enables the body to extend and adapt to obtain a better perception (Simondon 1989: 114).[2] In short, Simondon's distinction is to insist that individual humans seek to enhance their knowledge by using instruments. But Simondon also advocated for a technical culture independent from labor: 'This relation of the human individual to the technical individual is the most delicate to form. It implies a technical culture which introduces the capacity of attitudes different from labor or action' (Simondon 1989: 119). According to him, because tools, instruments and machines are used by humans to achieve practical aims in often unnoticeable ways, as long as they fulfill their duty, developing a technical culture would enable a consideration of technical objects for their own sake and as technical beings. Here I suggest that play might also be an attitude towards technical objects that is different from labor and action.[3]

He continues by affirming that what work and action have in common is the predominance of the finality over causality, while in auto-regulated systems, any causality has a sense of finality, and any finality a sense of causality. Cybernetic systems are auto-regulated. But they are also closed circuits, as dynamic as they might be; they are systems relying on redundancy and, as such, are counter to the openness of imagination. Simondon's solution to escape imprisonment in cybernetic feedback loops resides in the notion of invention. Invention, like creation in art, despite several differences, finds its fuel in the anticipatory nature of human thinking, which delocalizes the present into the future, and in an 'indeterminacy margin' (*marge d'indétermination*) that Simondon posits at the heart of technological evolution. He discusses it in relation to the question of the evolution of technology, and it is relating to notions of forms and information. The form of a signal permits us to distinguish information from noise. An instrument – a machine in Simondon's text – is made out of forms, and through these forms information can occur as an event outside of the predictable. Thus information is not a form; it is the 'variability of forms'.

The indeterminacy margin is therefore constituted in instruments as critical phases in their functioning. The instrument that can receive information is the one that can localize temporally its indeterminacy at critical moments full of possibilities. This structure, according to Simondon, is that of the 'decision' and 'relay' (Simondon 1989: 141). For instance, digital instruments, such as those used in music or those working from body signals and movement sensors, show this indeterminacy at play. This temporal structure of decision and relay is what allows the player to intervene despite the fact that, at times, the system can also take some of it in charge, and it is at the heart of the functioning of electronic instruments at the moment when information comes into play. (See Color Plate 40.)

Musical instruments

Where do musical instruments come from? What has been the moving force behind their invention? Are they a necessary service and pleasure for humans? Among the ethnologists, musicologists and historians who have long sought answers to these questions, André Schaeffner's position offers a promising point of departure: the origin of musical instruments in human societies, according to Schaeffner, is in what unites 'language and singing, dance and instruments' – that of the human body (Schaeffner 1994). The human body's first impetus is to make noise and to shape instruments to respond and correspond to itself and its postural and gestural capacities. While language, singing and dance are in the singular, 'instruments' for Schaeffner is in the plural, as if they could only be conceived in their multiplicity and variability of materials and morphologies. The very multiplicity of instruments testifies to their 'incarnated nature'. They are embodiment linked to human gestures and postures. One could even say that instrumentalists and dancers share this gestural and postural performative relation with music.

A gesture can be seen as dynamic, whereas a posture is often considered static; dance would certainly deny that, showing postures that are always in equilibrium, on the brink of losing mastery. Mastery, here, plays a role as great as in playing musical instruments: both involve the body of the performer although in different ways and manners; both are concerned with 'pleasure through mastery'. But an instrumental gesture has some more features: 'it is applied to a concrete and material object with which there is physical interaction' (Miranda and Wanderley 2006: 10), and the forms and dynamics of that interaction can be mastered by the subject.

According to Schaeffner, one of the most significant aspects of music is its perpetual power to limit tonal sources through the use of a few privileged materials, fixing their resonance to specific degrees of intensity. Concerning instruments, it is only habits and local conventions that establish these limits. It is through this effect, which is also a selective process, that certain sounds emerge and manifest, while others are suppressed or relegated to the margins or simply disappear. The sonic world is organized according to certain materials and timbres that reduce other sounds to silence. This explains the variability of musical systems and tonal canons of instrumental music in different cultures. Shaeffner's point is similar to that made by Jacques Attali in his renowned essay 'Noises' on the political economy of music, in which he argues that music is a regulator of noise in society in order to preserve a certain social order. The powers that govern any society impose codes to analyze, mark, restrain, suppress, train and channel the noises of bodies, language, tools and objects. Schaeffner also reminds us of music's relationships with the rhythms of work, with toys and games (Schaeffner 1994: 108), and with magic (Schaeffner 1994: 117): 'It is not the aim of these pages to grab the part play has in music, but rather the part of sonic material (sound) in play' (Schaeffner 1994: 108). In the same spirit, I would like to suggest that my intention here is not to impose the 'playful' (*ludique*, in French) as a category of new media – this has been done by others – but rather to consider instruments (such as toys and games) as a determinant of 'instrumental playing'. Instrumental playing as it participates in the structure of the playful relation is a central notion, as it qualifies the relation by pointing to its performative aspect, with a particular embodiment for the instrumentalist for whom the play's immediacy is apprehended through the mediation of his or her knowledge and mastery of the instrument. It is worth mentioning with another author, Hugues Dufourt, that one of the founding moments of Western music and culture took place a long time ago when the Pythagorean used an instrument called a *canon*, which produced both the sound (a vibrating string) and its measurement (Dufourt

1991: 247). Thanks to this instrument, Pythagoras and his disciples could imagine the isomorphism of sound and number; with them, Greek thought founded musical science on mathematical concepts. The Pythagorean harmony would not have been possible without geometry, which made the visual transposition so determinant (Dufourt 1991: 246). The Greeks did not go further in this vein and were satisfied with this conception of proportional isomorphism between spatial relations and numbered relations, which allowed them to study relations of consonance (Dufourt 1991: 250). It is through the use of an instrument that they were able to establish iconic visualization of sounds in the form of geometric and numbered representations.

This has opened a long dialectic in Western history, articulating the relative values and powers of a visual and an aural paradigm[4] that, I suggest, underwent a shift more recently when electronic audio-video instruments, and later digital instruments, appeared to allow the visual artist to gain the immediacy of instrumental playing while giving musicians and composers a live visual system with which to create music and sounds.

In his 1991 article on scientific instrumentation, philosopher Don Ihde noted the similarity of electronic and digital instruments in music and art and those of science: 'The emergence of the sound studio which bears a direct parallelism with a science laboratory, provides the possibility for further manipulation and transformation of sounds' (Ihde 1991: 22). Returning to ideas developed previously about scientific instruments, he noticed in musical instruments what he called their 'multi-stability' in reference to how their use is transformed by the context. For instance, the bow that is used to hunt can become a stringed instrument by adding a resonator, a function that can sometimes be accomplished by the mouth (Ihde 2007). Therefore, human action is embodied in multi-stable instrumentation which serves both survival and artistic musical playing.

Scientific instruments

Informed by phenomenology and Merleau-Ponty's views on intentionality, Ihde sees scientific instruments as embodiments of knowledge, suggesting that they are 'in use and in relation to users', that they cannot be conceived 'apart from their context of involvements and referentialities' (Ihde 1991: 73). The technical object cannot be conceived outside of the environment and the human subjects within it with which it interacts. This aspect of how humans and instruments relate in and to the world is essential to understanding technical objects. To use Simondon's terms, the technical object is a mixed milieu that is both technical and geographical, and in which individuals intervene. For Simondon, humans are the true mediators or mediating operators between the technical and geographic worlds, and between technical elements, technical individuals and technical ensembles.

While instruments can be seen as 'extensions' of the body, or as enhancements of human perception, according to Ihde, there exists a second order of relations for instruments, 'a second group of relations [that] does not extend or mimic sensory-bodily capacities but, rather, linguistic and interpretive capacities' (Ihde 1991: 75). In addition to the more transparent first order (experienced-through), there is a second order composed of degrees of opacity (experienced-with) as if instruments were accompaniments that enhance and refine our perceptions of the world rather than a means that disappears when used. The more complex the instrument, the more they require a second order of relation with the user, which Idhe describes as a 'hermeneutic relation', where 'the technology is not experienced-through as experienced-with' (Ihde 1991: 75).

Ihde sheds light on the amplification-reduction structure of instruments that shapes their evolution, and creates a friction between the two structural terms, a friction he calls the 'opacity' of instruments. According to the degree of opacity of a given instrument, it requires a more or less sophisticated hermeneutic knowledge as to how to read and interpret its results. This friction occurs along a graduating line that goes from the ideal and desired state of total transparency, when the instrument mediates and enhances human senses (microscope, telescope), to the other extreme of maximum opacity that requires hermeneutic procedures, learning and knowledge (spectrographic imagery). Certainly, notes the author, this dream of the purely transparent device points to a developmental *telos* for technological advances. The amplification-reduction structure in data-gathering instruments is uncovered as intertwined within the context and the situation in which it occurs with the intentionality of human subjects.

Scientific and musical instruments

Now let us ask ourselves what is the difference whether one strives for increasing one's knowledge and power through the use of instruments or, instead, one's pleasure and imagination through instrumental playing, as in music and art? While the scientific instrument is ideally meant to be as transparent as possible, the musical instrument does not wish for transparency. Timbres of musical instruments, among other things, favor their opacity. It will be through a long and often painstaking practice that instrumentalists will eventually reach mastery of their instruments, therefore attaining transparency by mastering the opacity of an instrument. Don Ihde arrives at the same conclusion when he writes: 'But as skill is acquired, the flute is "mastered" in that it withdraws or becomes more and more transparent [...]' (Ihde 2007: 11).

To schematize this distinction between the scientific and the musical instruments, I may propose the following equation (Figure 1):

> Now, this equation applied to the musical instrument presents a somewhat reversed situation: instruments, in diverse degrees, are opaque and only a few of them can be played without real training. One of the most difficult, the violin, can be very annoying played by an untrained person. So, to learn an instrument requires knowledge acquisition and active practice in order to master it and play some music. This mastery

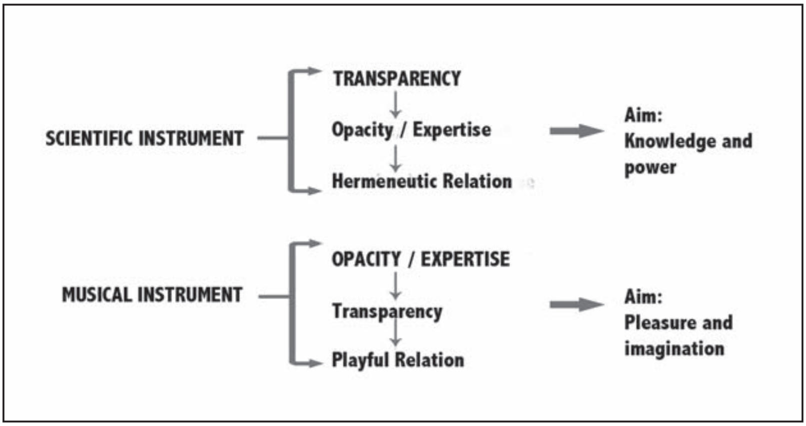

Figure 1. Difference between scientific and musical instruments.

of the instrument necessitates that of the body at play through a particular dexterity and posture. From this embodiment with instruments springs the playful.

Don Ihde proposes an 'instrumental realism'. We affirm here an instrumental playfulness (*ludique*). Two types of instrument are here contrasted: those that strive for transparency and end up in this hermeneutic relation where the instrument's rendering of reality is to be interpreted; and those that we encounter first as opaque because of timbre, in the case of musical instruments, or of other marks of their materiality, which through a playful relation, a mix of mastering the instrument and having it lead the way, attain transparency in performance. Playing musical instruments and the music played on them can have aesthetic or semiotic values and symbolic resonances.

Both the hermeneutic and the playful relations suppose mastery and knowledge but for different aims: acquisition of data and knowledge in one case and aesthetic pleasure in the other. The two types of instruments share the performative, effective, implemental effect of modifying the state and scale of our perception threshold and of our level and quality of presence in the world.

A musical instrument is most often a technical object. It has something of an individuality, even if it belongs to one class of instruments or another. It possesses a particular morphology and timbre constitutive of its opacity. While most traditional musical instruments are passive, waiting for the player's intervention, when we consider electronic instruments in music we see that some are semi-autonomous – they will perform certain operations that will be fed back to the instrumentalist. The instrument can therefore be conceived as a 'quasi-other', a quality that instruments share with games. In art, though, the instrument is in a live dialogic loop with the performer, who is looking for mastery of the instrument in the pursuit of the pleasure of playing and making the music happen. Instruments, by nature, are not immersive. There must be a triangulation between the player, the instrument and a visible or an audible result.

What is an Apparel?

A recent anthology published in French, *L'art au temps des appareils* (Huyghe 2005),[5] provides the occasion to introduce the notion of 'apparel' to further distinguish instruments from apparatus (*dispositif*) and apparel (*appareil*). In what follows, I will distinguish two versions of the apparel, one with a capital 'A' designating a system, and one with a small 'a' as a specific device. As pointed out earlier, the term *apparel* is not used much in current English, at least not in discourses on art. However, I would like to introduce it here as a potentially useful categorization of certain types of electronic and digital systems. In 1993, the Metropolitan Museum of Art had an exhibition entitled 'Infra-Apparel', an exhibition devoted to under-garments, which inspired me to use this term.

Interestingly, the English verb 'to apparel' is derived from the Middle English *appareillen*, from the Middle French *apareillier*, to prepare; it also derived from vernacular Latin *appariculare*, and from Latin *apparare***:** to put clothes on. In this sense it is close to the noun 'implement', that I have discussed earlier, in that it designates an article serving to equip, 'the *implements* of religious worship'. The noun *apparel* means the equipment (as sails and rigging) of a ship; personal attire, something that clothes or adorns. In French, we find a rich network of terms derived from or part of the same family as the noun *appareil* and the verb *appareiller*: *apparat* (ceremony); *apparaux* (boat); *appareillage* (masonry, marine, boat, to go); *apparier* (two, to link). The semantic networks of these terms relate them to notions of *apparaître* (to appear), of *apparence* (appearance), which, as we know, can be both deceiving and revealing; they include ideas of joining of parts and of garment, of externalization and of departure.

According to Véronique Fabbri, the distinction between apparel and instrument lies in the study of the relations of apparel with materials (*matériaux*) structures and rhythms (Fabbri 2005: 96). In a passage where she conflates indistinctly many terms, she further tries to make distinctions:

> [T]he relation of the apparel to materials, thus distinguishing it from the instrument and the machine: the instrument, the tool, the machine have the common function of transforming a material, of submitting it to a form. The apparel, on the contrary, arranges the material and renders it available for transformation or for being set in motion (*mis en oeuvre*). (Fabbri 2005: 95)

Fabbri continues and points to Adorno's important affirmation of the concept of material in art, which has put in crisis the relation of the form and the content. Artistic works are less concerned with creating forms than with exploring those already in motion in the material.

The distinction we find here, badly expressed and confused, using the terms ‘instrument’, ‘tool’ and ‘machine’ without sufficiently defining them, seemingly grouped together in opposition to the apparel, must stop us for a moment. We could multiply examples of this kind of confusion. But let us retain here that the apparel seems to be what makes materials useable, conforms to a ‘project’, says Fabbri. The apparel sets up material potentialities and makes them available for human use, while the instrument transforms and informs the material. In electronic music, writes Fabbri, electronic audio systems and devices, which constitute the apparel of the studio, make possible for the sound to be a material at the composer’s disposal, allowing him or her to distend, expand or contract sounds, to modify sound textures and orchestrate time in rhythms. Here, the Apparel of the studio and instruments in the studio share the material of sound (or electronic signals sent through audio channels); while the Apparel of the studio makes sounds available as material for composition, performance with electronic musical instruments forms and informs the material, here the sonic material. As long as the Apparel of the studio sustains the material of sound in its unformed and raw status, available and virtual, it is not involved with human intentionality.

The point here is not so much that instruments form and inform materials, rather that human intentionality is in the playful mode of instrumental playing. The use of instruments is guided by intentionality of the instrumental composition and the choice of instrumentation. Instruments also require instrumental gestures to be activated. Among instruments at the disposal of artists and composers, we can imagine a gradation from the pure apparel that turns on electrons to the very active gesture-triggered musical instrument, passing by the more intricate case of the instrument that has a certain number of automatic settings and combinations that requires minimal human intervention while performing or once set in motion.

I have used Apparel, with a capital ‘A’, to designate a system, like the sound studio, an addition or an interconnection of devices that may or may not include instruments. While instruments are not immersive, always maintaining or requiring the triangulation of the player, the instrument and the audible or visible results, the Apparel can be immersive, environmental, somehow abolishing the distinction of the user/player through participative/immersive modes. In this vein, one can use, as does Fabbri, the notion borrowed from Benjamin of the reception in distraction, the form of reception Benjamin sees as our relation to architecture, rather through habits and in a tactile and kinetic fashion than through distant contemplation and visual apprehension. Thus a distinctive mark of the instrument is its active and singular implementation of imagination and anticipation in performance within the Apparel.

The body appareled

The Apparel is immersive: it is an environment, it makes the signals lurk around us. It can even generate anxiety or anguish as ‘big TV studios’ did to Nam June Paik: ‘Big TV studio always scares me. Many layers of "Machine Time" running parallel, engulf my identity' (Paik 1973). Another version of the apparel is also possible, this time with a small 'a', to distinguish it from the Apparel as system or ensemble. In this instance, the apparel is what adorns the body of the player/dancer/spectator: data suit, harness, head-mounted display, and the like; they become 'cyborgs' (Hables 1995). The body is here appareled; it is immersed in data feedback loops and, as the Apparel, this apparel is abolishing the distinction between the body and the 'world', and it favors tactile apprehension over distant visual or aural perception.

Such distinctions between the instrument and the apparel help us to have a more nuanced comprehension of how artists and composers invent and use technological devices. These distinctions are also necessary to respond to the numerous art projects with virtual reality, augmented reality or responsive environment. With these new, often immersive environments, the notion of a body-appareled has to be distinct from the body-playing-instruments, from instrumental playing, even though they all use similar technologies. A body-appareled does not necessarily (perhaps with the exception of that of a dancer) control the apparel, does not necessarily search for mastering it, and might as well be more inclined toward surrendering to the machine; instrumental playing relates the body to an object, an instrument responding to gestures that produce a certain set of sonic or visual output. The effect of one is immersion and is experiential, tactile; the effect of the other is pleasure at mastering the production of sonic and visual forms as aesthetic objects and as playing in performance.

What is an Apparatus?

Italian philosopher Giorgio Agamben recently published in French a book entitled: *Qu'est-ce qu'un dispositive?* (2007) ('What is an Apparatus?') in which he establishes the etymological source of the term *apparatus*. Agamben questions this concept used by Foucault, who never really defined it. The philosopher retraces briefly the origin of the term, as employed by Foucault, from his philosophy professor Jean Hypolite under the concept of 'positivity'. Hyppolite interprets the Hegelian concept of positivity as the historical anchorage of religion and as constraints to human liberty, as imposition of institutional norms onto the individual beliefs and subjectivity. Indeed, all apparatuses have to do with the construction of the subject and his/her position relating to a concrete and particular situation: '*Ils doivent produire leur sujet*' ('They must produce their subject') (Agamben 2007: 27).

In French, the term *dispositif* is often encountered in contemporary art discourse. In English, *apparatus* is probably less in use outside cinema criticism; one would see 'device' as the more common term which shares with the French *dispositif* a vagueness as to what it is precisely. Devices are often part of and confused with installations, as the device generally designates any assortment of electronic or digital equipments, intervening in

Figure 2. *Le manteaux de l'admiral (the admiral's jacket)*, Peter Blasser, wearable instrument (2003). Image from Peter Blasser documentary file, Daniel Langlois Foundation de Cinémathéque québécoise. (courtesy Cinémathéque québécoise)

the space or in the relation of the spectator with the image and with his or her self-image, to transform the experiencing subject and the space of the work.

The cinematographic apparatus

Not known for much else in film studies but for two articles published during the first half of the 1970s – a decade that saw the bringing together or the merging of Lacanian psychoanalysis, literary semiology and Marxist philosophical inquiry into ideological analysis, first in France, and then in the Anglo-American universities – Jean-Louis Baudry was at the inception, with Christian Metz and others, of a particular way of analyzing cinema. The aim of Baudry when he wrote 'Ideological Effects of the Basic Cinematographic Apparatus' (1970) and 'The Apparatus: Metapsychological Approaches to the Impression of reality in Cinema' (1975)[6] was to decode the technical film apparatus in terms of an ideological configuration meant for replacing the comprehension of reality (human, material, cultural and economic) by the virtue of misrecognition, suspension of disbelief and the impression of reality. It is also one limit of Baudry's texts in that they don't look outside the mainstream situation of the fiction feature film; the author in fact does not talk about any particular film in order to focus on the canonic commercial cinema experience. His object is the reception, the spectatorship positioning in relation to the basic technology

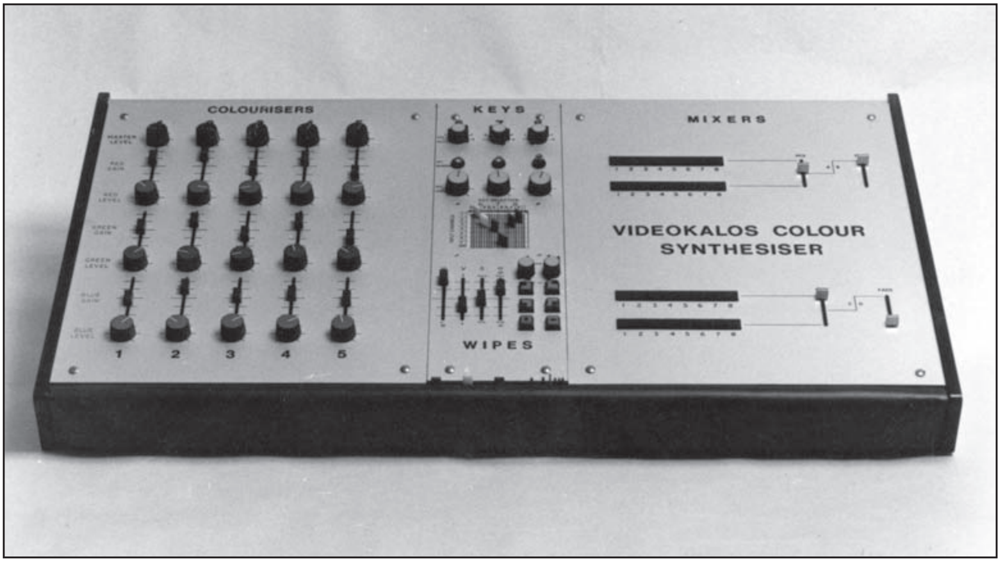

Figure 3. Videokalos color synthesizer; engineer. Peter Donnebauer (c. 1978). Image from Steina and Woody Vasulka Fonds, VAS B38-C11-3, Collection Fondation Daniel Langlois de la Cinémathèque québécoise, (courtesy. Cinémathèque québécoise).

of cinema: the projector at one end of a darkened room with the shadows on the screen at the other end, with the spectators in the middle 'harnessed' to their seats, *sujets tout percevant*, all-perceiving subjects, as Christian Metz would have said.

The impact that the notion of apparatus had on Anglo-American film studies has been mainly through the translation of Althusser's text. The term apparatus had been introduced in Marxist philosophy by Louis Althusser as in the 'Ideological State Apparatus'. It had a good English *fortune critique* through two books: the first, *Apparatus, cinematographic apparatus: Selected Writings* (Cha 1980) and the second, *Narrative, apparatus, ideology: A Film Theory Reader* (Rosen 1986). This is not exactly a novelty, and anyone familiar with 1970s French cinema studies is familiar with this kind of ideological analysis. But Baudry's concept of the apparatus was expanded later in the 1980s by Anne-Marie Duguet. Baudry concentrates on the question of ideological analysis with an Althusserian undertone; in his second text, he looks into the psychoanalytical basis of the impression of reality, this time in Lacanian terms. Of course, in the end, the two texts are somewhat linked, since ideological delusion functions in similar ways as the impression of reality: both function through psychic projections and identifications, through misrecognitions and misconceptions. Baudry's notion of ideology here is not concerned with discourses but with their vehicle. His idea of ideology is not a matter of promoting a political discourse or denouncing one; it is rather to analyze how the spectator's positioning installs him or her[7] in a receptive posture or mode allowing these discourses to be effective, to have an effect in return on the spectators' lives and structures as subjects. Baudry defines the apparatus of cinema as 'support and instrument of ideology [which constitutes] the "subject" by the illusory delimitation of a central position' (Rosen 1986: 295), in view of providing for the maintenance of a certain social order and of idealism.

The notion of apparatus became more largely used outside of film studies to consider artworks that used some sort of technological devices (video, audio) for presenting moving images and sounds. Anne-Marie Duguet was one important proponent of the *dispositif*, of the concept of apparatus in a larger sense. But this was done to the detriment of ideological analysis, which disappears behind the curtain of 'critical' artistic practices and forms within the art discourse. In her article entitled 'Dispositifs' (Duguet 2002: 42), Duguet notes that video installations, using an electronic apparatus (*dispositif électronique*), activate a radical displacement of the experience of the work, and that the work is a relational system which returns the spectator to his own perceptive activity (Duguet 2002: 17). Recognizing her debt to Baudry's work as well as those of Christian Metz and Thierry Kuntzel, she points out the definite fact that video and electronic (nowadays, digital) systems allow artists greater liberty in the arrangement of elements in the work, playing on the malleability in capturing, producing, reproducing, disseminating and perceiving images and sounds, by imagining such apparatuses for reflecting on spectatorship within the work. This opens up to interactivity, but the apparatus is still a device or set of devices aiming at decentering or displacing the spectator, and dislodging him or her from the position of stillness that cinema seemed to impose.

By pointing to differences between the Apparel and the Apparatus, this later concept, as I just too briefly exposed, appears to have historical contours by which its terms of reference, Althusserian ideological analysis and Lacanian psychoanalysis, are concerned with a visual field rather than a tactile or an aural one and, consequently, it conceives spectatorship in terms of the centralized/decentralized perceiving subject. I have shown that the notion of instrument and of instrumental playing brings about an active and gestural embodiment that demands a degree of knowledge and mastery as opposed to a passive relation to an apparel or being surrounded by the Apparel. Both instruments and apparels might be part of the Apparatus of a work: both are part of the positioning of the subject within a work, but they certainly differ in the way they establish this position. The construction of the subject differs greatly whether you play an instrument with a distancing triangulation at the heart of the instrumental relation or you are immersed in or surrounded by the Apparel where boundaries of subject and object tend to blur.

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Notes

1. The famous studies of André Leroi-Gourhan on the relationship of humans to tools and to their surrounding material milieu are eloquent on this point. See Leroi-Gourhan (1971; 1973).
2. Even though Simondon's book was first published in French more than 50 years ago, there is still no full English translation of it. You can find online part one of the book in English translation: http://accursedshare.blogspot.com/2007/11/gilbert-simondon-on-mode-of-existence.html. There is also useful information about him on Wikipedia : http://en.wikipedia.org/wiki/Gilbert_Simondon. All quotes from this book are my translation.
3. Playing and games, like the arts, are activities and things without finality other than their own performance or representation, generating symbolic pleasures and satisfactions for those who are participating in or witnessing them. At least that would be Hans Georg Gadamer's argument concerning the auto-representation of games.
4. See Curtis (1978).
5. The title could read in English: *Art in the Time of Apparels*. All quotes from this book are my translation.
6. A third text, which is not discussed here is entitled 'Author and Analysable Subject', and appears in Theresa Hak Kyung Cha (1980).
7. Feminist film analysis has uncovered this spectator's positioning as not being the same whether a man or a woman is seated in the theater. See my text, 'Media phantasmagoria' (Gagnon 2005).

Expanding 'Image-processed Video' as Art: Subverting and Building Control Systems

Jeremy Culler

> Alternative television also meant creating images that looked different from the standard T.V. Thus, 'image processing' as we know it grew out of an intensive period of experimentation that for some, in a vague way, was seen visually to subvert the system that brought the Vietnam War home every night. (Furlong 1983a: 35)

In 'Electronic Video Image Processing: Notes Towards a Definition', Sherry Miller Hocking, Assistant Director of the Experimental Television Center, describes the process of electronic image processing as using 'properties inherent in the medium of video' as 'art-making material' (Miller 1983: 22). Hocking explains:

> Artists work at a fundamental level with various parameters of the electronic signal, for example, frequency, amplitude, or phase, which actually define the resulting image and sound. Electronic tools are the instruments with which the signal is created and then altered. These signals carry the image in an electronic coded form. These coded structures are what the artist actually works with when creating an image-processed work. When these signals are decoded by a television monitor, the images and sound are displayed. (Miller 1983: 22)

Hocking's statement about the mechanics of electronic image processing not only explains a technical process that uses inherent properties of the video medium as 'art-making material', but also describes what artists do to time-based and time-dependent signals in order to create artworks for television (Miller 1983: 22–23). As a technique, image processing involves manipulating the various parameters of the electronic signal, including frequency, phase and amplitude, which, as Hocking notes, 'actually define the resulting image and sound' (Miller 1983: 22). Artists working with these parameters are able to change the electronic configuration of the standard television signal by feeding it through raster manipulation devices, colorizers, mixers and/or audio and video synthesizers. They also advance what Hocking and others see as a distinct genre, known as 'image-processed video', within video-based art.[1]

In principle, then, 'image-processed video' seems like an appropriate term for describing this type of work. However, many artists and scholars argue that the term is misleading. This is because, as Lucinda Furlong notes, it may be used to reference all works on television containing synthesized imagery, including music videos created for commercial television networks, such as MTV, and time-based correction procedures employed by broadcast television engineers (Furlong 1983a: 35). For this reason, Furlong considers 'image-processed video' a pejorative and misleading term (Furlong 1985: 233). She explains that in addition to its use as 'a genre and a catch-all phrase for every technical process in the book' the term 'conjures up a number of very specific – often pejorative – stereotypes: densely layered "psychedelic" images composed of soft, undulating forms in which highly saturated colors give a painterly effect, or geometric abstractions that undergo a series of visual permutations' (Furlong 1985: 233). For many artists using image-processing tools and techniques, these characterizations, which emphasize non-aesthetic results that television engineers learn to avoid in commercial broadcasting, are 'superficial and belie the range of concerns that fall within the image-processing umbrella' (Furlong 1985: 233). Despite such stereotypes, however, artists continued to develop new electronic devices and image-processing techniques and, as a consequence, advanced the idea of 'image-processed video' as art.

The idea of 'video image-processed art', according to Furlong, germinated out of 'an intensive period of experimentation that for some, in a vague way, was seen *visually* to subvert the system that brought the Vietnam War home every night' (Furlong 1985: 234). Artists – including Stephen Beck, Bill and Louise Etra, Ralph Hocking, Nam June Paik, Steve Rutt, Dan Sandin, Eric Siegel, and Steina and Woody Vasulka – used image processing not only to subvert commercial television programming, but also to explore 'the electronic signal as a plastic medium, a material with inherent properties that can be isolated' (Furlong 1985: 234).[2] For instance, Steina and Woody Vasulka utilized custom-built equipment to isolate and then construct video frames as plastic, compositional material in works such as *Matrix I* (1970–72) (Figure 1). This formalist approach was one example, among countless others, that turned out to be 'central to the development of what became the image-processing aesthetic' for artists (Furlong 1985: 234).

It is clear then why many artists see 'video image processing' as an inadequate term. That the term could compromise the integrity of artworks and, thus, problematize the validation and legitimization of electronic video image processing as an innovative art genre is why so many reject it. The term's problematic signification, however, did not hinder the advancement of the idea of 'image-processed video' art at alternative resource centers, public (access) television stations, galleries and museums during the 1970s and 1980s – nor did it stop scholars and artists from using the term in academic texts or alternative production manuals (Furlong 1983a: 35–38; 1983b: 12–17; 1985: 233–37; and Tamblyn 1991: 303–10). A determination to expand television and video as art forms led artists and engineers, who wanted to challenge commercial television programming, to develop an 'image-processing aesthetic' and establish a visual language unique to video-based art.

One of the primary ways that artists advanced this new visual language was by using pioneering 'control systems' and image-processing devices developed at the Experimental Television Center (ETC). These 'control systems', which directors Ralph and Sherry Miller Hocking define in an ETC funding report (1980–81), are 'either manual or pre-programmable in operation' (Hocking and Hocking 1981). They explain:

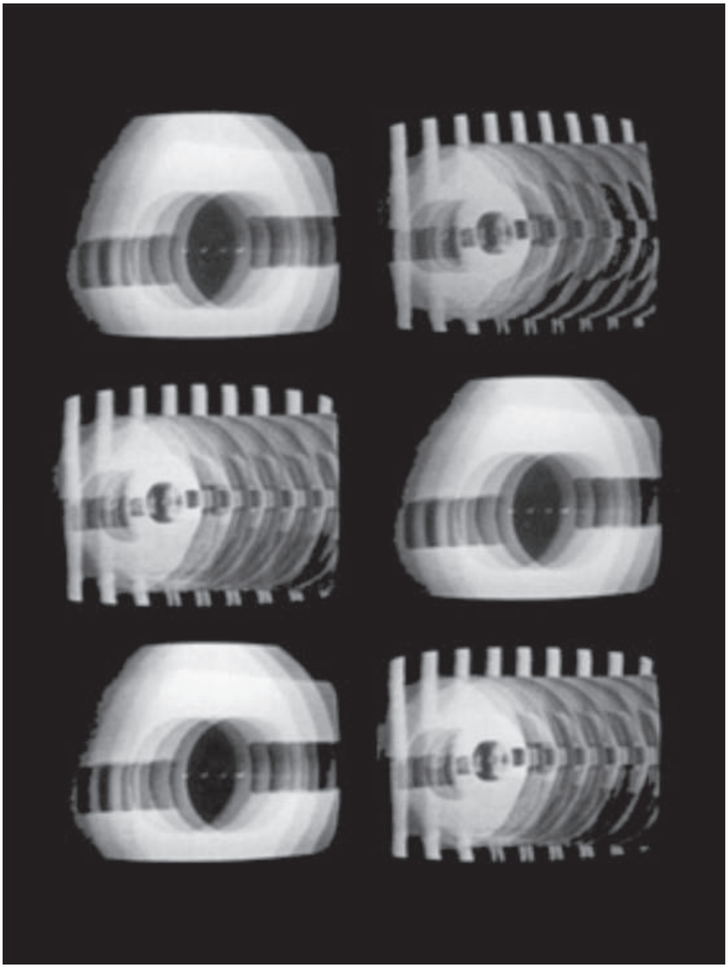

Figure 1. Steina and Woody Vasulka, detail of
Matrix I (1970–72).

The adjustment of a knob setting by hand to change hue, for example, is the simplest example of *manual control*. This is primarily a gestural and reactive process and although the apparent result is an alteration of the compositional element color, the artist is actually manipulating specific parameters of the electronic video signal which defines the change in the image. The analog control device generates waveforms which can be used as image and sound and as control signals. With this method of control, the manual adjustment is replaced by a preconceived and structured signal voltage which causes the change in the compositional element. The computer control system [on the other hand] provides to the artist methods of *pre-programming* the image changes; the

> result is the codification and, therefore, the precise repeatability of the process. (Hocking and Hocking 1981; my emphasis)

Whereas manual control systems involve a process that is gestural and reactive – requiring a time-dependent, manual adjustment of a knob for example – a computer control system offers preprogrammed options that process a signal internally. For example, in using the image grabber or frame buffer function in a Z-2 8-bit microprocessor, one can capture a video image and convert it into discrete blocks of 16 shades of gray (Hocking and Hocking 1981). Hocking explains that in addition to being able to reorganize or group the gray levels in the original image, 'this computer system can control pre-defined image changes, for example color, and can also translate camera or other input images into digital code, buffering the image and operating on the signal code to define the image in terms of gray levels' (Hocking and Hocking 1981).

Integrating analog and digital video image-processing devices into the Experimental Television Center's studio and building manual and preprogrammable control systems to operate them was only part of what was needed to enable artists, educators and members of the community to produce artworks and advance 'image-processed video' as art. The other component involved pedagogy. In a report discussing workshops available at the Experimental Television Center between 1972 and 1981, its directors emphasized their commitment to educating the public by offering courses, such as 'Basic Video', 'Video Post-Production', and 'Image Processing and Video Art', for free (Hocking n.d.). These courses provided instruction on topics that were unavailable to the public at other institutions, such as public television studios (Hocking n.d.). They also expanded Ralph Hocking's idea for developing a space that offered television and video production resources to artists. This idea began in 1969, when Hocking founded Student Experiment in Television (SET) at the State University of New York, Binghamton and continued in 1970 and 1971, when he established the Community Center for Television Production (CCTVP) and the Experimental Television Center, respectively.

After 1971, the Experimental Television Center expanded its mission and, in turn, cultivated social networks, established community research and screening programs, and developed an analog/digital hybrid studio. Many in the field also shared the Center's additional interest in subverting and building control systems, not for profit or notoriety, but instead for the chance to facilitate the advancement and expansion of image-processed video as a viable mode of cinematic and artistic expression. On the one hand, the advancement of electronic video-imaging systems was crucial if image-processed video was to be considered more than just a technical craft. On the other hand, cultivating networks, building control systems and facilitating technical processes that use the inherent properties of the video medium as art-making material were essential if the development of a visual language unique to the video-based art genre was to occur. That the discursively loaded term 'image-processing' can be used as 'a catch-all phrase for every technical process in the book' (Furlong 1985: 233) does not mean that it nullifies the real value of approximately four decades of media arts using image-processed video. Rather, it suggests that from the very start, image-processed video was a heterogeneous phenomenon that, for pioneering artists, provided innovative solutions for subverting the restrictive nature of commercial television. In other words, image-processed video was a means with which artists could exceed the limits of commercial television programming and expand the boundaries of television and video production for artistic and aesthetic purposes.

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Notes

1. For example, see Furlong (1985).
2. It should be noted that the 'material' that Furlong refers to is actually de-material or immaterial in nature.

The Grammar of Electronic Image Processing

Sherry Miller Hocking

Video is an art of space/time. As artists first adopted video technology to create art in the late 1960s, they struggled to understand how the technology generated and altered images, and the implications of those processes for their work. It was clear that video was fundamentally different from film. The motion of film was created by rapidly viewing a series of photographed stills; holding the film up to the light revealed each of those frames as discrete images. The video image did not exist as an entity at all. Inspecting recorded videotape reveals nothing. The tape holds signals which have encoded images as electrical impulses playing out point by point through time. Film is projected and we experience the motion as reflected light. Video is displayed in such a manner that we look directly into the light source. While both media present motion, it was clear from the beginning that video was unique in its construction. What were the implications of the processes of video to the aesthetics of video art practice?

For many early makers, an understanding of the basic language of the technology of image creation – the grammar of the electronic image – was necessary:

> Film was boring while it imitated the conventions of the proscenium arch stage; and television remains trivial while it imitates film. Artists and innovators signal their break with such trivial use of television by calling *their* use 'video'. Video rejects the conventions of both film and broadcast television and attempts to discover the unique formal necessities of its electronic processes. Video is finding the conventions suitable to such necessities; and we now have an electronic visual art form to complement electronic music. (Arn 1973: 15; original emphasis)

As artists took up the tools of video making, many began to construct a language which could not only explain the technical processes, but offered tools for creating a new aesthetic understanding of this new medium.

Woody Vasulka referred to the 'organizational models' of the electronic image in 1975:

> The aesthetic here is specifically didactic: to visually display, as clearly as possible, the step-by-step development of very primitive, basic modes of information available with this [the Rutt/Etra] synthesizer. Accordingly, sine, triangle, or square waves are used as the bases for most images. The didactic purpose involved is to enable the principles of time-energy construction to become common knowledge, as a primary

> conceptual and technological tool of our evolving electronic society. (Vasulka and Nygren 1975: 9)

Vasulka goes on to describe his study of smaller and smaller time-sequences of the video signal, necessary to an understanding of the formation and programmability of waveforms. In Barbara Buckner's *Light and Darkness in the Electronic Landscape: Some Aspects of the Video Image* presented at the Collective for Living Cinema in 1978, she also remarked about this grammar of video.

In the early 1970s, people at ETC began to write a series of manuals which attempted to define the basic vocabulary of video – the formal characteristics of the medium. We tried to articulate the building blocks of the image, and to categorize each of the characteristics and processes in terms of functionality within a larger system. Peer Bode, Richard Brewster, Hank Rudolph, Matthew Schlanger and Walter Wright among others contributed to the writings of the ETC texts, and have engaged in their own studies, both text- and image-based, about the foundational principles of the video image.

The image-processing system was used in a wide variety of applications, from real-time documentary recordings, to imagistic narratives, to formal abstractions. They were presented as live performances, prerecorded tapes, interactive sculptures and installations. Regardless of the form the art took or the specifics of the system employed, the image-processing systems could be seen as grounded in a similar grammar: the grammar of light in motion.

The definitions which follow are taken primarily from manuals written between 1974 and 1985 at ETC.[1] Portions were reprinted in *Eigenwelt der Apparatewelt: Pioneers of Electronic Art*. The text focuses primarily on analog signals. A discussion of digital and computer tools is included elsewhere in this section.

Signal

The generation and display of the video image are time dependent. The composition of the signal defines the visual nature of the image as it exists in time; it dictates both the appearance of the single 'still' image, which really exists within a specific duration of time, and its behavior through time.

On a basic level, the signal can be viewed as the art-making 'material'; the creation of an electronic image is an architectural process and constructed in time. Video images are codes of information conveyed by signals. The specific video picture information conveyed by a signal is in the form of changes in voltage; changes in voltage dictate changes in the information being carried, and thus the image and sound. In this way the hardware of the system can be viewed, in part, as 'a carrier of aesthetic definitions' (Hagen and Kite 1978: 22).

Signals within a processing system can be categorized as video, audio, control, and synchronizing or timing signals. Signals may function in single or multiple categories. For example, a signal can influence aspects of an image – a process called voltage control – and also produce a sound.

Two devices are used to check the output signal coming from a processing system: a waveform monitor and a vectorscope. A waveform monitor does no processing of the video signal, but it allows us to examine the video signal by displaying a graphic representation of the changes in the voltage of the video signal over time. The waveform monitor is really a special-purpose oscilloscope. Vertical distance on the waveform display represents voltage, while horizontal represents time. One field or one line of the video signal can be observed. Each aspect of a video signal must fall within a predetermined set of limits so that the recorded tape is compatible with other playback machines and can be displayed. The waveform monitor ensures that the system is operating within these prescribed parameters.

A vectorscope shows the color portion of the video signal and ensures that the recorded colors are consistent. It uses the convention of a color wheel to represent the signal. Chroma, or saturation, is indicated by how far the signal extends from the center. The hues are marked at specific points initialed M (magenta), R (red), G (green), Y (yellow), B (blue) and C (cyan). At a specific setting, when color bars are patched to the vectorscope input, the signal's six points will correspond to the correct marks.

Signals can be further specified as analog or digital structures; the terms refer to how changes occur, either discretely or continuously. An analog signal is a voltage which continuously varies within its allowable range. A digital signal consists of discrete levels or parts. Digital signals are concerned with stepped information; the change from one value to another in a waveform is not continuous but, with some qualification, is instantaneous and the signal is either on or off.

A signal then conveys certain information about an event. It contains a number of variables, such as frequency, amplitude or placement, which can be changed and controlled.

The inputs to an image-processing system are signals generated by video cameras, sonic modules, the output of another processor – for example, a keyer – or in certain cases prerecorded video.

Scanning

In film the impression of movement is derived from a succession of frozen moments. In contrast, the video image, even if each frame is examined, is all motion – a single rapidly moving and constantly changing dot, one dot only, does all the work. The basic illusion of film is motion. The basic illusion of video is stillness. A detail of the video image may be located by pointing out where it is (as in film), but also by specifying its distance in time from any other point of the image. Any point on the image is both 'where' and 'when' or 'wherewhen' from any other point. Video is quite literally a space/time machine. (Arn 1973: 17)

If the motion we attribute to the film image is as illusion, nevertheless the serial still frames of cinema are discretely apprehensible entities that may be held in the hand and examined at our leisure. When these frames are projected, they are uniformly interwoven with equal intervals of total darkness, which affords us intermittent moments to think about what we have just seen. Conversely, the video field is continuous, incessantly growing and decaying before our eyes. Strictly speaking, there is no instant of time during which the video image may properly be said to 'exist'. Rather, a little like Bishop Berkeley's imaginary tree – falling forever in a real forest – each video frame represents a brief summation within the eye of the beholder. (Frampton 1977: 34)

The raster is the visible rectangle of light coming from the cathode ray tube (CRT) of a monitor or camera when no picture information is displayed. Scanning describes the process by which the raster is constructed in the CRT of both camera and monitor. The function of the scanning process in a camera is to 'read' the object before it as a mosaic of varying light and dark values, converting them to variations in the electrical signal so they may be reproduced on a monitor in real time, further processed by an electronic processing system or recorded by a videotape recorder for storage and later display. The function of the scanning process in a monitor is to display the image of the object presented to the camera or derived from the output of a processing system. The camera thus translates the scene before it into a signal which reproduces these fluctuations in light and dark; light energy is thus changed to electrical energy. The function of the monitor is to translate the electrical signal containing the image information into a perceivable image; in the monitor, electricity is converted to light energy.

In both the camera and monitor, the raster is constructed by a beam of electrons which is focused to a point; this point is moved in a continuous and repeatable manner so that the rectangular field of the raster is inscribed. The scanning process is linear and sequential; the electron beam excites a single unit at a time across each line, called a 'picture element' or 'pixel', which emits light when hit. The beam then progresses to the next pixel. In this way a horizontal line is written; as they stack up the raster is formed. The raster is a matrix of dots. Each field is made up of 262 1/2 lines, or exactly half the number of lines comprising one frame. The first field is composed of all the odd numbered lines, the second field the even. Each frame is composed of two separate fields or 525 lines. If the lines of the even field fall precisely between those of the odd field, this is known as 'interlace scanning'. One field is scanned every 1/60 second; since the frame is constructed of two separate fields, each scanned 60 times per second, one frame is displayed in 1/30 second or 30 frames per second. Because of the phenomenon of persistence of vision and the retentive characteristics of the phosphor surface of the cathode ray tube, we perceive complete images rather than the travels of a single dot. The serial nature of image formation is characteristic of video and very unlike film. In video, the entire picture exists only as a function of time and is never present as a single entity. The term 'frame' is somewhat misleading because of the association of a complete image which exists at any one instant of time. The video frame is a process of constructing and deconstructing the image.

Sync

The video signal has two basic parts: the section containing picture information; and the section containing sync information. The sync information is composed of a number of individual types of signals. Synchronization is derived from the Greek *syn* and *chronos* (to be together in time); the term implies that several processes are made to occur together in time at the same rate so that they are concurrent. For a coherent picture to be formed which is readable to the eye and brain, the scanning motions of both the image (signal) generating device – for example a camera – and the image (signal) display device – the monitor – must proceed in an orderly and repeatable manner. The scanning processes in both camera and monitor must begin and end at precisely the same time. The camera and monitor must be in sync.

As the camera begins scanning the objects in front of it, the monitor begins to scan the line which the camera is scanning. As the camera ends the scan line, the monitor must also end that line. When the camera reaches the bottom of the field, the monitor must be exactly in step. Without this synchronization, the camera image and the monitor image will have no relationship to each other. 'Horizontal sync' maintains the horizontal lines in step; without horizontal sync the picture will break up into diagonal lines. Horizontal sync dictates when

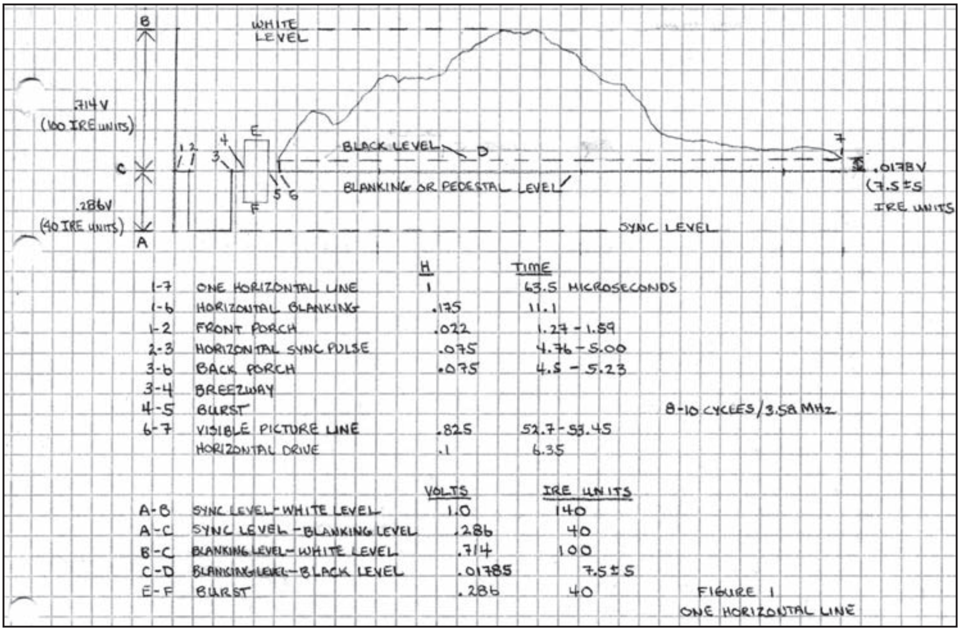


Figure 1. The video signal for one horizontal line, with sync by Sherry Miller Hocking (1986).

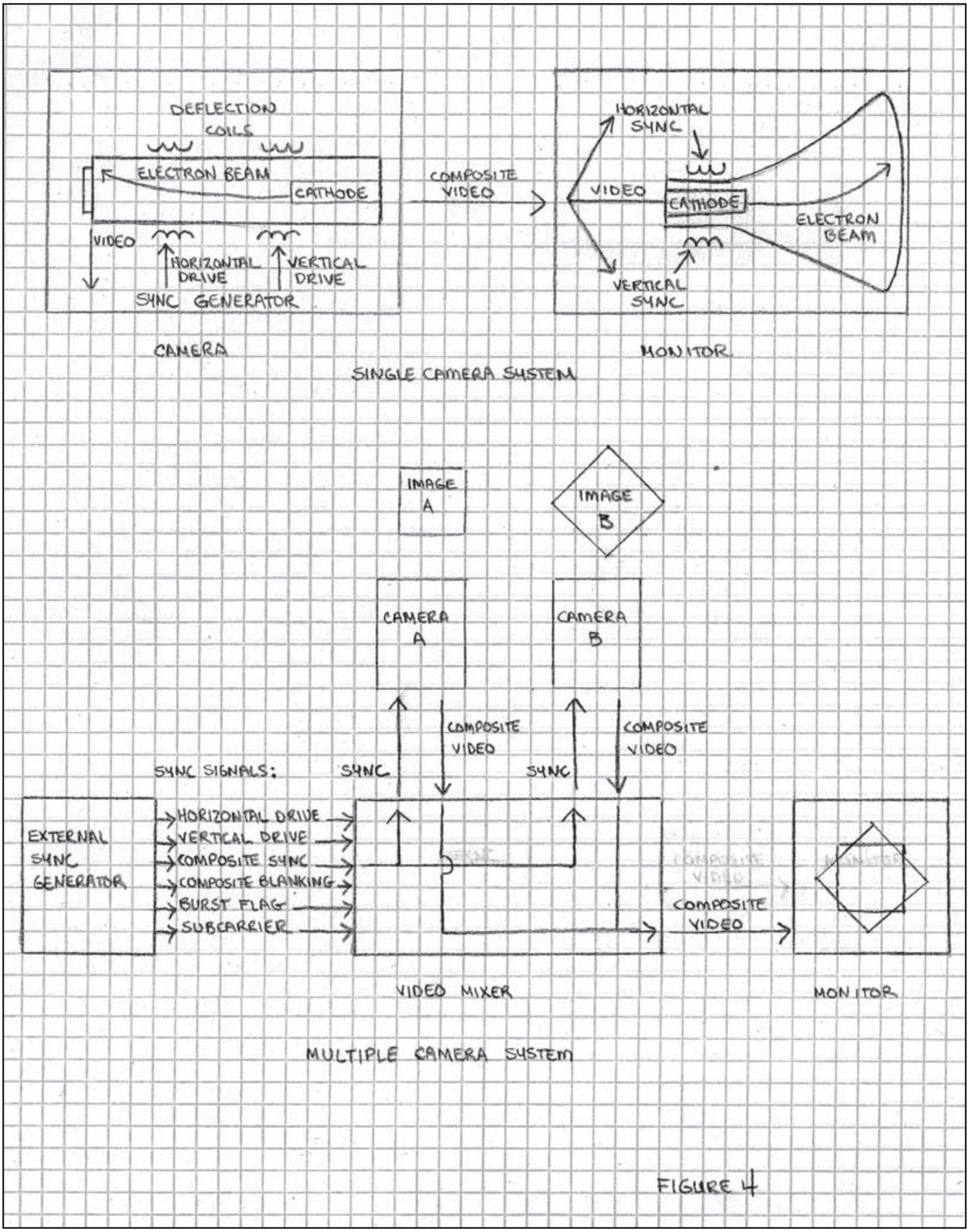


Figure 2. Sync and signal flow in single and multiple camera systems by Sherry Miller Hocking (1986).

each horizontal line begins and ends. 'Vertical sync' also keeps the picture stable; without this, the image will roll. Vertical sync tells the camera and monitor when each field begins and ends. Both together are essential to a stable rectangular shape. Sync then can be conceived of as an electronic grid which provides horizontal and vertical orientation to the image.

Each visible line forming the raster is drawn from left to right across the CRT. Before beginning to scan the next line, the beam must return to the left. During this horizontal retrace period, the beam is invisible; this process and the time interval necessary to perform this function are called 'horizontal blanking'. Horizontal blanking is a part of synchronization.

At the end of each field the beam must return from the bottom to the top of the CRT before beginning to scan the next field. Again, this vertical retrace is not seen. This process and the interval are referred to as 'vertical blanking'. Vertical blanking is also a part of synchronization.

Sync and drive pulses are the timing pulses which keep one or several cameras in step with each other and with the videotape recorder or monitor. In a single-camera system, sync can be obtained from the internal sync generator built into the camera. In a multiple-camera system, all cameras must receive the same sync signals from a common source at the same time, from a sync generator external to all of the cameras. Video or picture signals from all the cameras are then mixed in the processing system and combined with sync information. This single composite signal, containing both picture and sync information, is sent to the deck to be recorded. The sync generator serves as a master clock which establishes the time frames for the signals which, when decoded, produce images.

A color sync generator supplies horizontal and vertical drive, composite sync and composite blanking, and two additional signals variously called 'burst' or 'burst flag', and 'subcarrier' or 3.58 MHz. Color signals must carry all color information, including the hue, brightness and saturation of the colors, by the use of three primary colors: red, green and blue. In addition, their structure must be such that they are compatible with black-and-white systems. Color signals must therefore contain both luminance and chrominance information. Luminance conveys the variations of light intensity and is the part of the signal used by the black-and-white monitor. Chrominance conveys variations of hue, saturation and brightness. The subcarrier signal, a frequency of 3.58 MHz, carries information about color value. This frequency is produced by an oscillator in the sync generator, and is modulated or changed by the color information coming from the color camera to the colorizer in the image-processing system.

Sync also plays a role in a system which uses a prerecorded videotape as an input. In this instance, it is necessary to lock the system sync to the sync from the source videotape recorder. A genlock is required for this operation. Genlock is also used for cameras which are not externally syncable. This includes most consumer cameras. The output of the camera goes to the genlock input of the SEG and the system will lock to the internal sync of that camera. A VTR cannot be used as a direct source if the genlock is occupied by the camera.

Sources, processors and controllers

Video synthesizer and *image processor* are general terms referring to an assemblage of individual video signal sources and processors, all of which are integrated into a single system or meta-tool. The ETC system is designed to let the artist actually create an individualized system by patching various modules together to route the signals.

There are three general categories of devices: (1) signal sources – devices which output a signal used in the system to generate an image, a control signal or a sync signal; (2) processors – devices which perform some operation upon the signals, such as gain or phase changes, and are often used to mix inputs and put out processed signals; and (3) controllers – devices which generate signals which are themselves inputs to processing devices to control an aspect of the image. These devices and the signals can be analog or digital in nature.

Image generators produce optically based signals from cameras or non-optically based signals from oscillators. Image processors are devices which alter a signal from these sources in different ways; each processing module provides a means by which a single parameter or set of parameters of an image can be changed. Processing modules within a system are often arranged so that the output of one – a keyer, for example – can serve as an input for a second – for example, a colorizer. Signal processors act on the signal after its initial generation and before its recording or display. The image or signal controllers often act on the processors; for example, a control voltage in the shape of a square wave may switch colors in a colorizer from red to green. Further, some processing devices, such as certain colorizers and computer-based systems, are more accurately signal/image generators since they operate without external inputs.

Controllers

Control over the signals which define image variables is central to electronic image processing. Whether manual or automated, it is exerted on a signal which defines an image and not on the image itself. A potentiometer offers manual control over voltage through the adjustment of a knob.

Control over signal parameters can also be automated rather than manual. The technique of voltage control allows the pots to be adjusted by another voltage rather than by hand.

Voltage control is the control of one voltage, often called the 'signal voltage', by another voltage, the 'control voltage'. If the control voltage frequency is within the range of human hearing, the signal can function both as a control voltage and as an audible sound; this dual role for signals and the resulting relationship between image and sound is a technique used frequently in electronic imaging. By use of control voltages, the problem of continuously varying changes is overcome; one can move between discrete values without having to proceed through intervening values. Control over digital and computer tools can be through knobs and switches or through computer programming.

The introduction of a computer to an imaging system like the one at ETC posed additional questions related to control and interfaces. At the ETC studio in 1977, where artists generally had week-long residencies, the software which ran the LSI-11 computer had to run invisibly, so artists did not need to learn programming languages. The computer in the ETC system functioned as an image generator and as an image controller:

> Sherry Miller Hocking: A lot of the stuff that we did when we got involved in the computer which really started around 1976 had to do with Ralph's interest in trying to figure out interfaces, so that artists didn't have to become mathematicians and programmers and software experts – and artists could come to ETC and use the tools. We went through all kinds of variations from interfaces where you could turn the knobs to control the computer, to drawing tablets and digitizing tablets. Walter [Wright] and David [Jones] wrote software that would be transparent in the process, so that the artist didn't have to deal with the software but it was operating in the background. There was a very user-friendly interface to that software sitting on the screen that someone could easily use or work with. And that is the tactic now that we are using with the new stuff – Jitter and Max/MSP, trying to come up with these little modules that people can use.
>
> Ralph Hocking: Yeah, but that's different. I think that when the Amiga was born I really got into the whole idea of what digital might be. So I spent many years playing with the Amiga. I firmly based my teaching on that machine and you had to learn how to connect to the language of that machine at a level that you knew what you were doing. I used Basic because machine language was too difficult for everybody else and too difficult for me. But we worked at a level of a language called the Director. They found all the possibilities that they could think of within that construct of the board and the CPU and all the little doodads that they had running beside it. They said 'OK. Here is what you can do visually, this is what will affect the graphic presentation on your screen'. And it was wonderful because you could write all kinds of really strange programs. You could write the programs yourself. You were right in there with the machine, you weren't dealing with Photoshop, or analogs, but working with machinery without having to be fed by technologists. (High 2006: 8)
>
> At Synapse – the 1970s Syracuse video collective that spawned Bill Viola and where I taught early courses in video art – Carl Geiger purchased one of the first Altair computers. He generated non-objective stills by entering programs using nine flip switches: eight to define a byte, and one to enter it into RAM. There was no storage, so he had to enter your program each time you wanted to run it. Carl would run the computer output through the Synapse video switcher to play hell with the video synch pulses and keying voltages, and capture the output with a still camera. Occasionally we'd drag the school Moog Synthesizer from Franklin Morris's electronic music

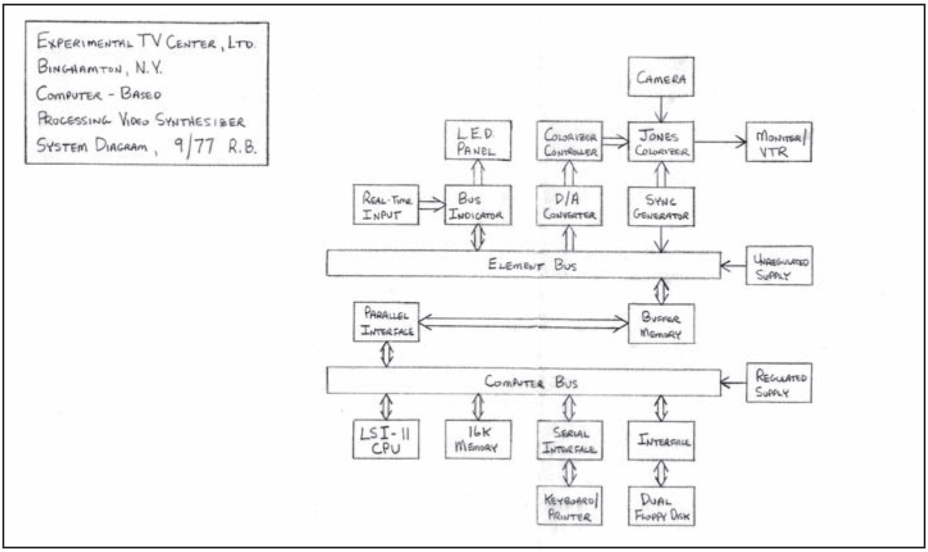


Figure 3. Signal flow documentation by Rich Brewster of LSI-11 computer project at ETC (1977).

> classroom, where we'd try modulating the switcher and colorizers with the Moog output. (Edgar 2011: 3)

Processors

Signal processing – switching

Switching is a basic kind of signal processing from which other imaging techniques such as mixing, fading, superimposition, keying and wiping are derived. It turns signals on or off. Switching is the serial presentation of image or sound derived from two or more sources, and is achieved by the sequential change from one input signal to another. The term 'serial' can be misleading because as the rate of switching is increased beyond a certain frequency, we no longer see one image following another. Instead the image might appear to contain two or more source images simultaneously.

In general there are two kinds of switchers. In a 'broadcast' type, certain of the inputs are permanently connected to specific outputs. The result is efficient switching, but this type limits choices. In the 'distribution' type switcher, any input can be sent to any output. Because of the large number of cross-points, manual switching of this large number of points is time-consuming and potentially confusing. Most image-processing systems with distribution switching use a second system to electronically control these switching points.

Superimposition will appear if the rate of switching is faster than about 1/10 second, even though discrete images are presented. In this case, superimposition appears because the speed of the switching is such that the eye perceives not separate images in sequence, but images being mixed together.

Wipes can be thought of as switching within the frame. They appear as stationary or traveling horizontal or vertical divisions of the screen into two or more areas, each containing the corresponding portion of the input image.

This allows a spatial fracturing of the picture plane which is created by a rapid switching between or among images as they are constructed through time. It is this temporal aspect of switching which allows the spatial reorganization of imagery. Disparate images can be combined and possess technically logical relationships as a whole, yet call into play ideas of scale and our sense of 'real' time and space. These techniques as they have been employed in video have frequently been compared to Cubism, in their simultaneity of presentation of points of view, to the Suprematists with their use of purely geometric and often rectilinear formal properties, and to Surrealism, in their careful combination of logically dissimilar and impossible though seemingly realistic imagery. When live imagery is combined with prerecorded events simultaneously, our understanding of 'real' time and its apparent serial and progressive nature is challenged.

Figure 4. *The Hat* (Ralph Hocking, 1976). A combined use of oscillators and keying.

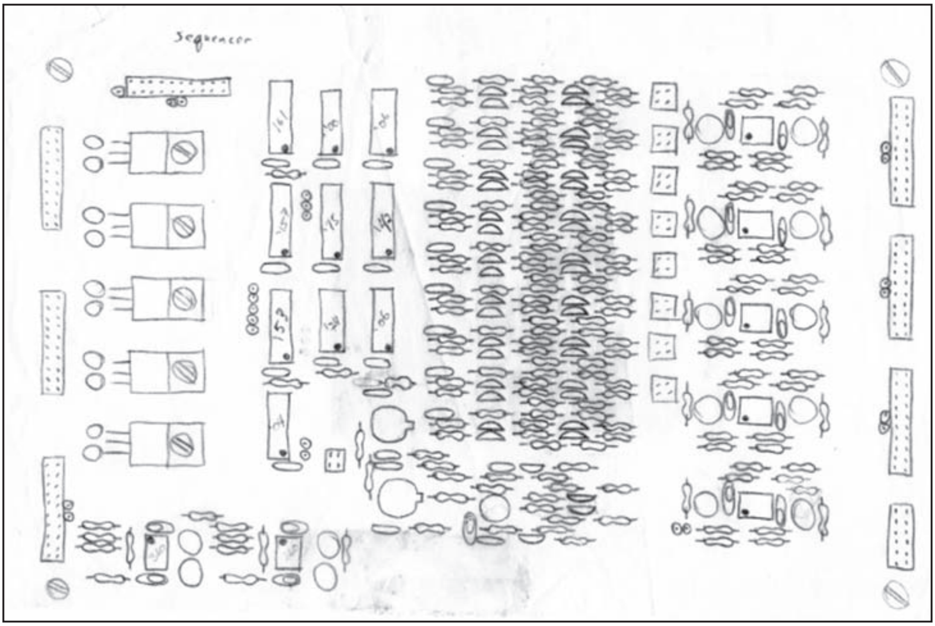


Figure 5. Schematic by Dave Jones for his sequencer.

Signal processing – sequencing

A sequencer may be thought of as a specialized kind of switcher. The switching series can be programmable so that the series can be easily repeated. The order is changeable so that the switching is not necessarily consecutive from input 1 through input 5, but may be preprogrammed so that you can jump from one to another in any order and repeat that order. Sequencers may contain a clock which controls the speed of the sequence. Switching began as a technique for cutting among a number of video images and thus allowed a number of points of view to be presented sequentially. Switching and sequencing are integral to video because they function within the timing limits of video imaging. As techniques of image processing, they are frequently used with 'real-time' images. In contrast, editing presumes that the images are recorded. If the switcher is able to accept videotape recorders as inputs, this sense of a 'real-time' sequence may be false, since 'recorded time' events are intercut with live events.

Signal processing – mixing

Mixers were developed in the 1950s as special cases of switchers. As with switchers, mixers used two inputs, but the images were combined in an additive way rather than an either/or way. In a mixer, the input image signals are added together and then, in effect, divided or scaled down so that the resulting signal output is within the prescribed limitations of signal amplitude of one volt, peak-to-peak. Mixing happens in real time

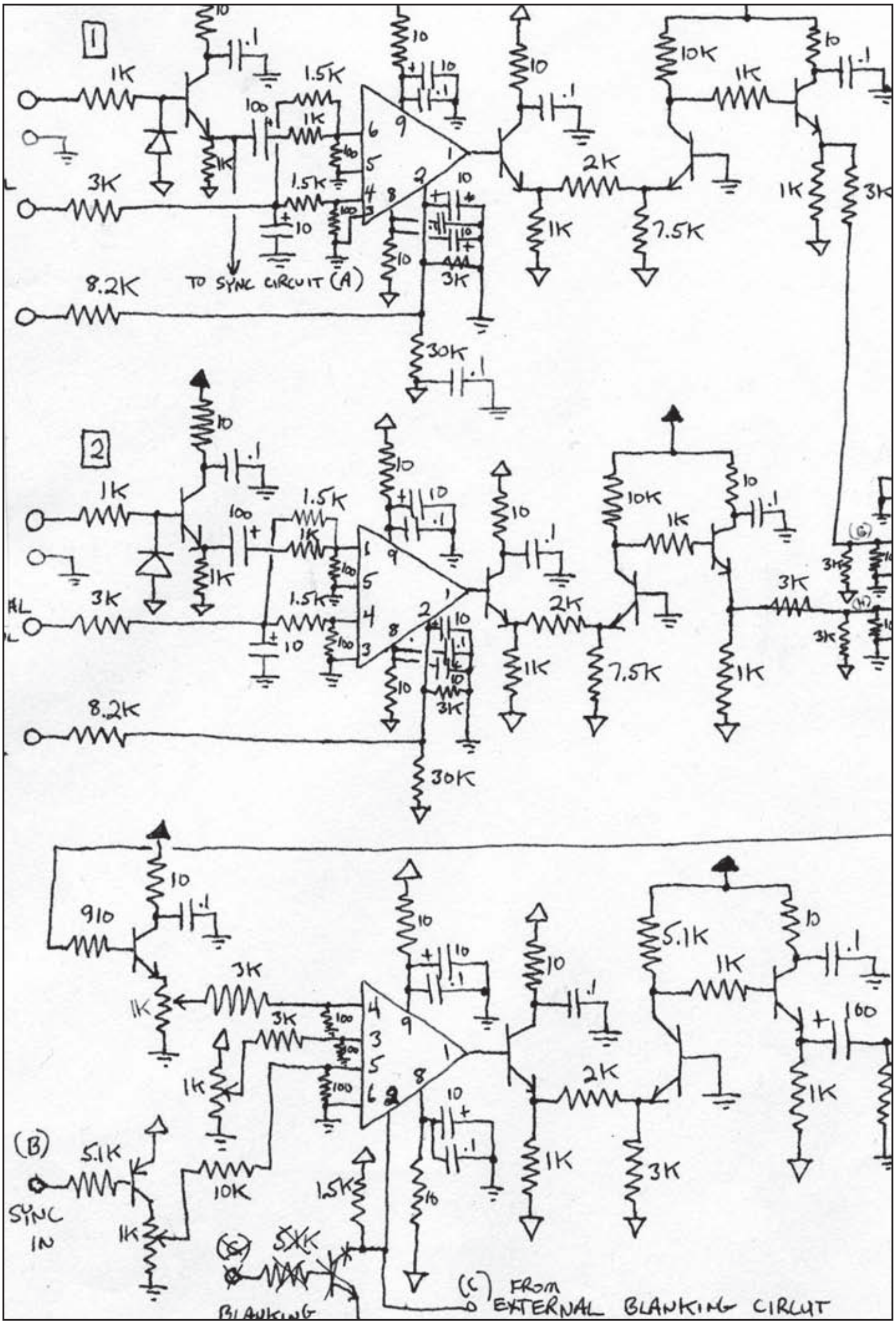


Figure 6. Rich Brewster's documentation of a Jones Keyer.

so that the output is the instantaneous sum of all the instantaneous amplitudes for each point along each horizontal line of the inputs. As the lines are built up into fields and frames, the resulting image is a mix of both source images. Mixers thus provide the means for the development of superimposition.

Signal processing – comparing/keying

Keying is another important imaging technique which is based on switching. It involves creating a window in an image so that corresponding portions of a second image appear in the hole. In monochromatic keying, the hole is defined by a gray value, therefore it will have different shapes depending on the spatial locations in the image which contains the specified gray value. The hole is created by a threshold voltage level which falls somewhere between 0 and 1 volt, the acceptable range for black-and-white video signals. As it comes in, the camera signal voltage is compared with this threshold voltage and at every point where the camera signal exceeds this threshold, the video is eliminated. As the video is eliminated, the keyer switches to a second input signal. In keying, the switching process occurs within the image rather than between 'whole' images. It occurs within each horizontal line rather than between fields or frames. It is then high-speed switching which occurs in real time, point by point, for each horizontal line. The clip sets a voltage level or gray value which determines when the keyer switches from A input to B input, thus inserting image B into the hole we created in image A. The clip can be a steady-state voltage which can be varied between 0 and 1 volt by adjusting a knob. The clip can be a signal from an oscillator, a sine, square or triangle waveform, or a complex waveform signal already constructed from other basic waveshapes. Or the clip can be a signal from one of the two video inputs or a third camera. A number of keyers can be banked or cascaded together; they can be operated independently of each other or the output of one can become an input for another. In this way, extremely complex, layered imagery can be constructed. Keyers frequently are voltage controllable; rather than increasing or decreasing the clip level by manually changing a knob setting, the clip level is changed by a signal voltage from another source.

Independent video technologists began to experiment with all these techniques in the early 1970s. Working with the Vasulkas, George Brown developed a Video Sequencer (also known as a Field Flip/Flop Switcher) with digital control in 1972. In 1973, Brown developed a Multi-keyer, an analog device with digital control (Spielmann 2004a).

In 1973, ETC technician Dave Jones modified an off-the-shelf Sony Special Effects Generator to accept direct sync interface with the Paik/Abe Video Synthesizer, with a provision for external wipe signal input. In 1974, Jones developed the Jones Colorizer, a four-channel voltage controllable colorizer with gray level keyers.

In 1975, at the ETC studio, a sequential switcher, along with the Jones Colorizer, were incorporated into the processing system. A 64-point push-button switching matrix was built and used in dance performances by the American Dance Asylum with Bill T. Jones and Arnie Zane (Hocking 2004: 9–10).

Processors – Scan Processors & Raster Manipulation (or Rescan) Units

> The concept in the Rutt/Etra is that the Rutt/Etra changes the time in which you see parts of the picture. It's a machine that manipulates images in time. I see it as a time processor. [...] I would allocate that feature as Steve's and my contribution. (Bill Etra in Vasulka 1978: 9)

Scan processors reorganize images by acting on the systems which control the scanning motion of the electron beam; these devices do not directly change the output signal but rather reorganize the way in which the signal is displayed. In a conventional CRT, the deflection systems maintain the horizontal and vertical orientation of the raster, producing a full and stable raster of light. Because the scan processor acts on the deflection system – the means of displaying the image – rather than the signal itself, the appearance of the image is changed; the signal which defines the image remains unchanged. In general, a scan processor consists of a CRT, the normal deflection system of which is modified; a set of controls over the deflection system which alter the raster in specific ways; and, finally, a rescan camera. Because the signal defining the image is not changed but only the appearance of the displayed image, the images must be reproduced optically; scan processors do not output a video signal which can be directly recorded. The reproduction of a scan-processed image is done by the technique of rescan: a video camera is pointed at the signal processor's CRT display and the image changes are rephotographed. The rescan camera output can then be recorded or used as an input source for further processing. Scan processors can operate on a variety of image or signal sources. Live camera or prerecorded information from tape or film, non-optically generated imagery derived from oscillators, and the output video signal from an image-processing system are all possible sources. Audio signals generated by microphones, radios or audio synthesizers may also be used. Scan processing can be performed on the raster itself, with no image displayed.

The types of image transformations possible with a scan processor include shape, position or placement, size, intensity and movement. The raster can be reversed along the X and Y axes by causing a reversal of the normal scanning operation. Reversal around the vertical dimension transposes right and left, creating mirror images, while reversal around the horizontal dimension transposes top to bottom, creating an inversion of the image. Collapse of the raster around the vertical axis produces a single horizontal line, while collapse around the horizontal axis produces one vertical line. Simultaneous collapse of both horizontal and vertical create a single, centered dot. The image can also be moved around the screen or repositioned and rotated in two-dimensional and apparent three-dimensional space. The deflection systems can also be controlled by external signals such as audio signals created by oscillators.

A brief history of scan processors

Ture Sjolander and Bror Wikstrom developed a modification to the raster in 1965–66, which was used in the artwork *Time* (Saask 2004). Other examples of raster-based tools are the Scanimate, the Rutt/Etra Scan Processor (also known as the Rutt/Etra Video Synthesizer) and Nam June Paik's Raster Manipulation Unit or Wobbulator.

The Scanimate was a programmable, computer-controlled animation system for primarily commercial applications. A high-resolution camera, usually looking at a high-contrast black-and-white film transparency, is input to the analog computer animation controller; this permits manual control over elements such as size, intensity, placement or rotation by generating varying voltages which are then applied to the horizontal and vertical deflection systems of a high-resolution monitor or scan converter. The changing voltages create different scanning patterns on the raster, and therefore different treatments of the image, displaying images which correspond to the voltage changes. The computer creates and stores these sets of voltages and then plays them back in real time on the rescan system; a second camera views the rescan monitor and its output is then

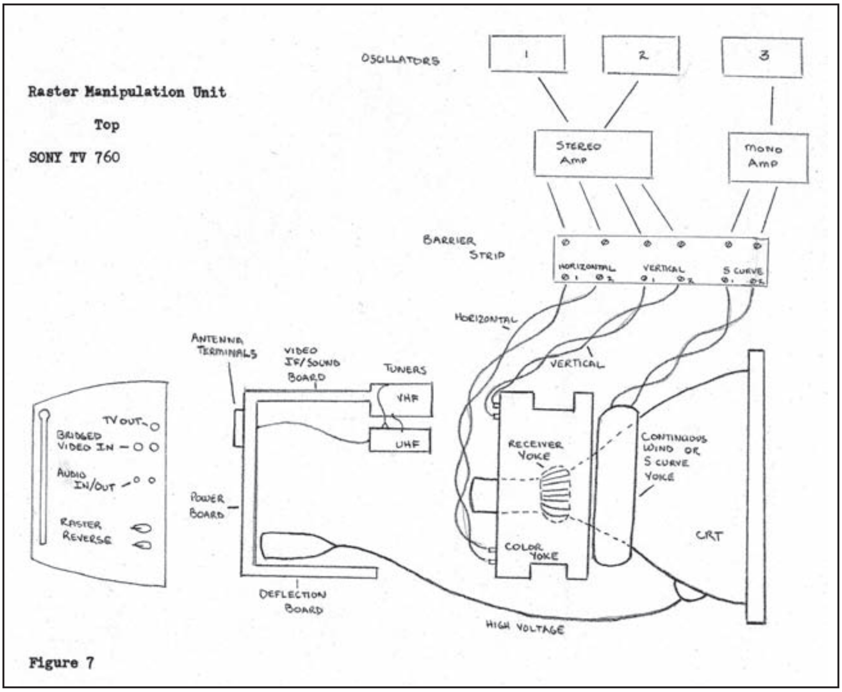


Figure 7. Block diagram of the ETC Raster Manipulation Unit
by Sherry Miller Hocking (1980).
See Color Plates 35 and 36.

fed to a colorizer. The colorizer operates on a set of five gray-scale values; each gray level has separate controls over red, green and blue. The output of the colorizer can then be recorded. The introduction of the computer to this system allows the changing voltages to be 'memorized' and stored and then played back in sequence to create movement in real time. The display was rescanned by high-end video camera or on film, and the output recorded. Walter Wright offers a cogent explanation of the working of the Scanimate in *Multimedia Performance: Beginnings* (2006).

Sid Washer also contributed to scan processing, making use of the deflection circuitry to generate patterns rather than the usual raster. These early prototypes often did not have video inputs because video cameras and oscillators at that time were prohibitively expensive. Initial experiments resulted in 1963 in a color television which displayed Lissajous patterns by connecting the deflection circuitry to amplifiers to modulate the red, green and blue beams separately (Burris 1978: 2). By 1965, he had developed a 3D color music device called the *Albatross*, which was designed as a performance instrument. The device used the modified color television, which was reflected in a vibrating mirror surface driven by a loudspeaker at a specific frequency; the patterns on the color set were controllable in terms of size and position, and provision was made for an external audio source, usually a phonograph, as an input. The vibrating reflecting surface created apparent three-dimensional effects. The system was essentially a pattern generator; images from this system were rescanned onto film. This device was exhibited, and a number were sold. Around 1972, Sid Washer developed a proposal in which he specified the parameters of the system, which was modular in design with the necessary signal patching. The system consisted of a display-processing unit, as well as control units, and generated a full-color display. The patterns generated could be controlled in real time in terms of width, height, brightness, color balance and spatial orientation; they were described by Washer as similar to 'computer-type graphics' generated without a computer. The system had provision for video inputs which he specified as character special effects and waveform generators, as well as audio sources and systems. In 1974 Washer began work with Steve Rutt and Bill Etra.

In California, Bill Hearn had worked since the mid-1960s on the development of a system for the production of color Lissajous patterns using phase-locked oscillators. Just prior to 1970, Hearn designed and built the Vidium, an XY display system which used a color CRT. The XY display was controlled through stereo microphones and the color was related to the speed of the electron beams. The red, green and blue guns were modulated by the velocity of the beam; each spectral color was assigned to a velocity and therefore changes in velocity produced color changes. Its primary use was in the direct generation of images from audio by electronic musicians, and it was never developed commercially. Although Hearn himself didn't consider the Vidium to be a video tool, since it relied on the functions of a conventional color television set, Hearn made significant contributions in the development of imaging systems (Vasulka 1978).

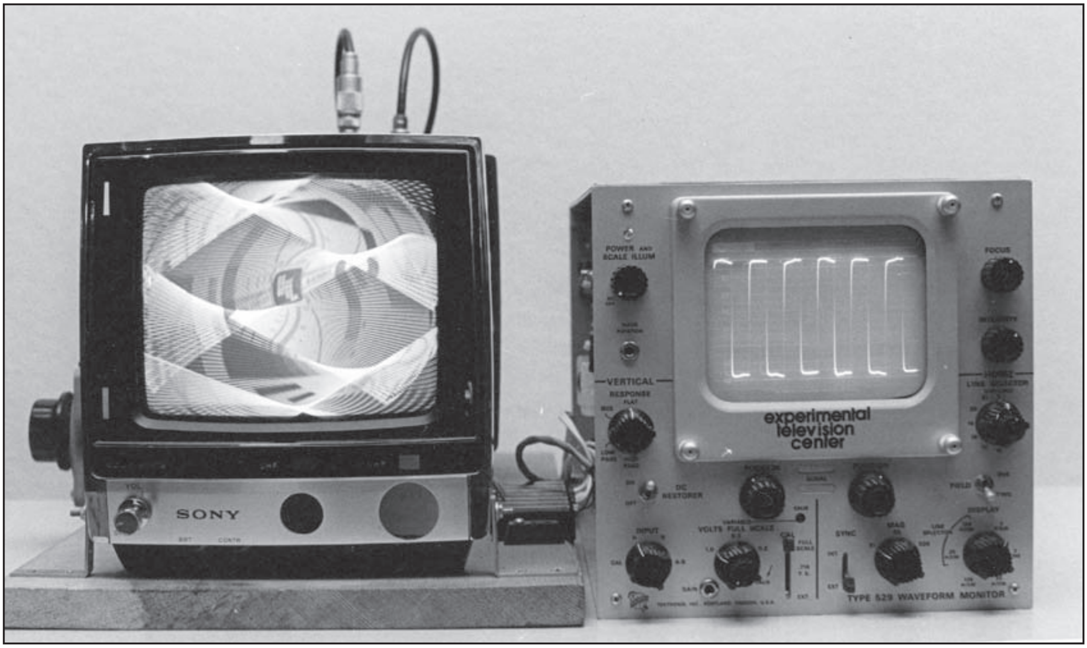
In 1969 Joe Weintraub exhibited *Audio-Controlled Television* at the 'TV as a Creative Medium' exhibition at the Howard Wise Gallery in New York. The work transformed 'music into a complex kinetic image on the screen of any color TV' (Howard Wise Gallery 1969). The volume of the audio controlled the brightness, while the pitch controlled color. The red, green and blue electron guns of the color receiver were governed by the frequencies of the audio divided into low, middle and high ranges. The patterns generated were dependent on the interaction of volume and pitch.

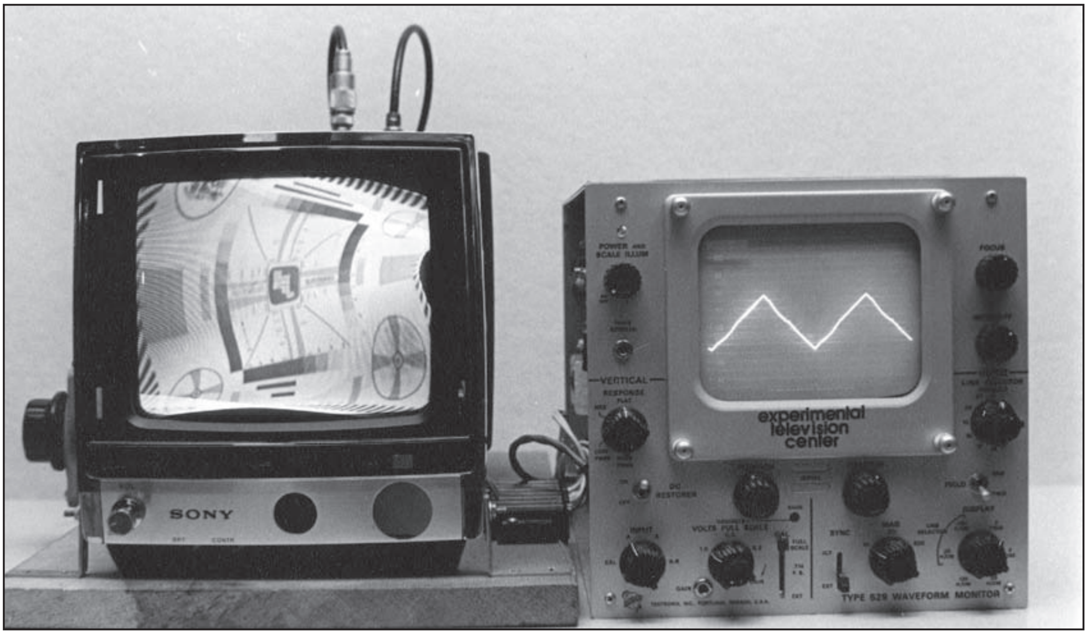
Nam June Paik is credited with the development of a Raster Manipulation Unit or 'Wobbulator', a prepared television which permits a wide variety of treatments to be performed on video images; this is accomplished by the addition of extra yokes to a conventional black-and-white receiver, and by the application of signals derived from audio or function generators on the yokes. The unit is a receiver modified for monitor capability; all of the distortions can thus be performed either on broadcast signals or, when the unit is used as a monitor, on images from a live or prerecorded source.

The distortions performed on the image result from the actions of audio signals on the yokes. Periodic and regular audio signals, such as sine or square waves, are often used when treating a video image; these signals are derived from an audio or function generator. However, any audio signal source may be employed; these devices include audio synthesizers as well as more conventional components, such as audio tape recorders, tuners, microphones or phonographs. These types of signals are most evident visually when used in conjunction with the horizontal or vertical collapse functions which reduce the raster to a horizontal or vertical line. These audio signals cause the line to distort in direct correspondence with changes in the audio signal.

In 1972, a raster scan manipulation device was constructed for the ETC studio and the construction as well as operation of the unit were documented in 1980. This how-to manual was distributed freely by ETC (Hocking, Brewster and Wright 1980) and is available online.[2]

In 1971, Bill Etra saw a Paik Raster Manipulation Unit at the Television Lab at WNET-TV in New York; he felt that because Paik's unit was AC-coupled it could only allow waveform distortion. Etra was interested in a modification to this unit that allowed for zooming and panning, the permanent placement of the image at any position within the raster. The Paik unit allowed for the placement of an image within the raster but it was not permanent. During 1972–73, with support from the New York State Council on the Arts through the TV Lab at WNET and with an investment of personal funds, the Rutt/Etra was prototyped. The Rutt/Etra was collaboratively designed by Bill Etra and Steve Rutt in association with Sid Washer, who assisted in the design and construction, and Greg Leopold, who was primarily responsible for the packaging of the system. In its initial stages of development, the Rutt/Etra scan processor was an oscilloscope using pots to change deflection voltages on the yokes. In the production model of the Rutt/Etra, the display CRT, which was rescanned, was available in 525- or 1050-line scan systems. Control was either manual or preprogrammable through the use of control voltages. The dual-trace production models of the system offered control over height, width, depth, shape, brightness, position and movement, as well as rotation in two- and apparent three-dimensional spaces. The height control on the display control unit





Figures 8 and 9. The Wobbulator showing the two different images resulting from two different waveforms modulating the scans of the same source image.

permitted reduction of the raster image to a line, expansion of the inverted image beneath and horizontal rotation. The width control allowed reduction, inversion and vertical rotation. Positioning control allowed vertical and horizontal placement, and horizontal and vertical axis adjustment was accomplished by a centering control. Variations of brightness were produced by an intensity control.

> Bill Etra: The concept in the Rutt/Etra is that the Rutt/Etra changes the time in which you see parts of the picture. It's a machine that manipulates images in time. In fact, I see them all as time processors. That's the way I see the whole scale of events. They are either parallel or sequentially time-processed images. (Vasulka, 1978)

Processor – colorizer

At the beginning of this discussion of video synthesizers, I called such devices the artist's paint and palette, and no module better fits this description than the colorizer. There are many designs for colorization devices both commercial and unique. In systems which use a camera encoder to generate the final output, the colors are determined by mixing red, green and blue components. While pleasantly reminiscent of mixing colored paint, this system is less efficient to use than the colorization made possible by video color parameters: luminance, chrominance and hue. With the latter system it is possible to pass a previously encoded color signal through the synthesizer and recover it unchanged at the other end (through the luminance channel). Now colors can be added by entering signals into the hue and chrominance channels. Where gray-scale encoding is used, such as in quantization, the single-hue parameter can produce rainbow-like effects. The Siegel colorizer, invented by Eric Siegel in 1969, uses gray-scale encoding to modulate all three parameters simultaneously. Dividing the inputs into three channels gives an increased degree of control over the final output. The commercially manufactured Grass Valley colorizer uses the luminance, chrominance, and hue parameters but is not voltage controlled and hence is not dynamic. (DeWitt 1976: 4)

The simplest type of colorizer is one that adds the color burst signals to the picture and modulates the phase of the subcarrier with the luminance of the black-and-white signal. These kinds of machines commonly have controls for chrominance (amounts of color), modulation (the amount of color change caused by the black-and-white signal), luminance (the amount of black-and-white signal mixed into the output), and tint or hue (the phase of the signal when phase shift initiated). This technique was used in the Riker industrial colorizer, George Brown's colorizer built for sale by C.T.L. Electronics in New York, and in the first colorizers designed by Bill Hearn for Electronic Associates of Berkeley, California. Similar effects can be achieved by using video signals as inputs to a standard RGB encoder (the machine that turns the signals from the guns of a color camera into color). If the same signal is used to drive all channels, and attenuators are present at the inputs, similar effects can be achieved. Video pioneers Nam June Paik and Shuya Abe used this technique in the colorizer section of their Paik/Abe Synthesizer.

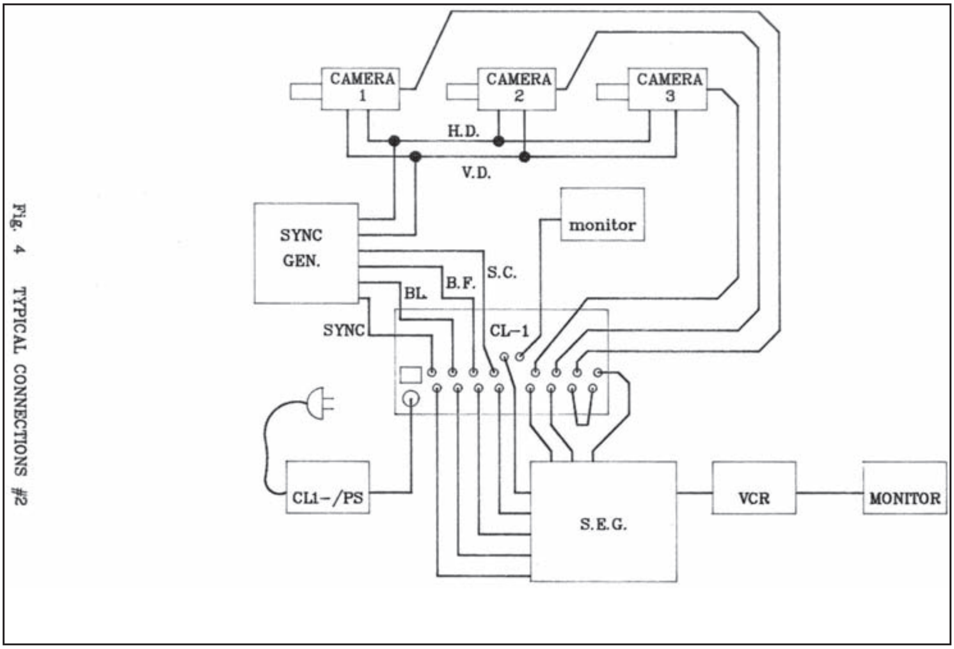


Figure 10. Jones Colorizer CL-1 Manual. Block diagram of multicamera operation. Documentation by Dave Jones and DesignLab (1986).

They added three more inputs (cyan, magenta and yellow), and allowed for different video signals into each input. They also added a phase shift on the whole system, which essentially changed the color value of each input.

The Image Processor of Chicago video artist Dan Sandin handles all signals as independent channels (Videography, December 1976) and, as a last step, puts them into an RGB encoder. Dan's machine goes several steps further, however, since it can process the signal to generate outlines and other complex effects before colorizing. One of the most interesting features of the IP is its ability to do amplitude classification, or quantization. Quantization is the division of the signal into a number of levels. Colors can then be added to each independent level. Most large video switchers use their keyers to quantize the picture, and by keying in color background generators, can colorize the image.

> This class of machines, direct video synthesizers, generates shapes by using analog or digital methods to switch color information from on or off, according to vertical and horizontal timings. In addition to the Sandin Image Processor, the EAB [Hearn] Videolab, the Colorado Video Colorizer, the Paik/Abe Synthesizer, and the Siegel Video Colorizers, other notable devices in this category include the Beck Video Weaver, the Chromaton […]. (Etra 1979: 30)

> My second experience with knob twiddling was on the Paik/Abe Video Synthesizer (PAVS) – a much different 'beast' from the corporate Scanimate. It was an artists' machine – built by an artist for artists – more emotional and less intellectual. The PAVS was about color – not about counting, positioning and bending raster lines. Rather than the hard-edged, cartoon color of the Scanimate, it produced gorgeous, electronic watercolor. The PAVS had gain controls for the 7 video input channels. In addition each channel had a positive-negative toggle switch. There were controls for overall pedestal and gain and a large knob to affect the overall hue of the colorizer. (Wright 2006: 28–29)

In 1972, ETC began construction of the Paik/Abe Video Synthesizer, designed by Shuya Abe and Nam June Paik and built at the Center with David Jones and Robert Diamond, for eventual placement at the TV Lab at WNET TV.

> This system was used at the Center by Paik and the staff of WNET, including David Loxton and engineer John Godfrey, to produce a portion of Paik's *The Selling of New York*, a part of *Suite 212* broadcast in 1972 by WNET. Another PAVS was used early in the Center's Residency Program by artists such as Ernie Gehr, Hollis Frampton, Jackson MacLow and Nick Ray, and featured in the exhibition 'Work from the Experimental Television Center' at Everson Museum of Art, September 19 – October 1, 1972. In 1974 a set of oscillators were designed by Dave Jones for use as signal inputs to the synthesizer and as sonic modules (Hocking 2004: 9).

Other types of processing – modifications to camera and decks

As is discussed by Kathy High in 'Mods, Pods and Designs' elsewhere in this section, many early practitioners modified black-and-white cameras and decks to allow more control over the image or to create certain types of effects. Some of the modifications brought controls which were located inside the tool to the outside to allow manual adjustment by the operator.

The method of editing with the earliest of video decks involved physically splicing the tape.

The ½" open-reel video recording decks which appeared later were expensive, and the cheaper models did not allow you to make edits without interrupting the video signal, which caused glitches or short video erasure. Dave Jones speaks about modifications he made to reel-to-reel decks to assist with cleaner edits:

> There weren't any really hardcore editing decks that were in the low price range. There were decks that were considered editing decks, like the Panasonic 3130, which had the ability to do assembly edits, but did not have the ability to do insert edits. It

VSK-1 VIDEO SPLICING KIT

You can now make perfect videotape splices with no picture break-up or distortion using the SONY Videotape Splicing Kit. This kit, which can be used with any ½" SONY videotape, consists of a precision splicing block, a bottle of tape developer, video splicing tape, and a tape cutter. A pair of sanitary gloves is also included to prevent fingerprints and grease from contacting the oxide surface of the tape. (The tape developer has no adverse effects on the skin.) Read this instruction booklet carefully and save it for future reference.

1. Splicing block
2. Tape developer
3. Splicing Tape
4. Cutter
5. Sanitary gloves

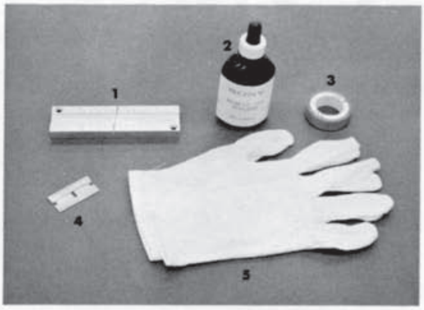


Fig. 1. VSK-1 Splicing Kit.

BEFORE SPLICING

It should be borne in mind that, due to the proximity of the audio and video heads, the audio and video signals are not recorded at the same point on the tape. (This is typical of all video tape recorders.) The audio signal is, in fact, recorded approximately 2½ inches ahead of the video signal. For all practical purposes, however, this difference in physical location may be ignored since, at a tape speed of 7½ ips, the difference in time between the two signals is only about 0.3 seconds.

What this means is that when a video portion is precisely cut from a tape, it may be missing the first 0.3 seconds of the corresponding audio.

The primary requirement of a good splice is continuity of control track pulses. Instructions are provided for developing the tape to observe these pulses. Portions of the tape that have been developed should be discarded. Do not develop any part of the tape that is to be played on the Videocorder.

It is most important that the tape and splicing block be kept free of developer, grease, or any other foreign matter to ensure a clean, noise-free splice. Use the sanitary gloves supplied when handling the tape.

Try a few practice splices on a section of unimportant tape to familiarize yourself with the procedure.

Figure 11. Sony VSK-1 Splicing Kit.

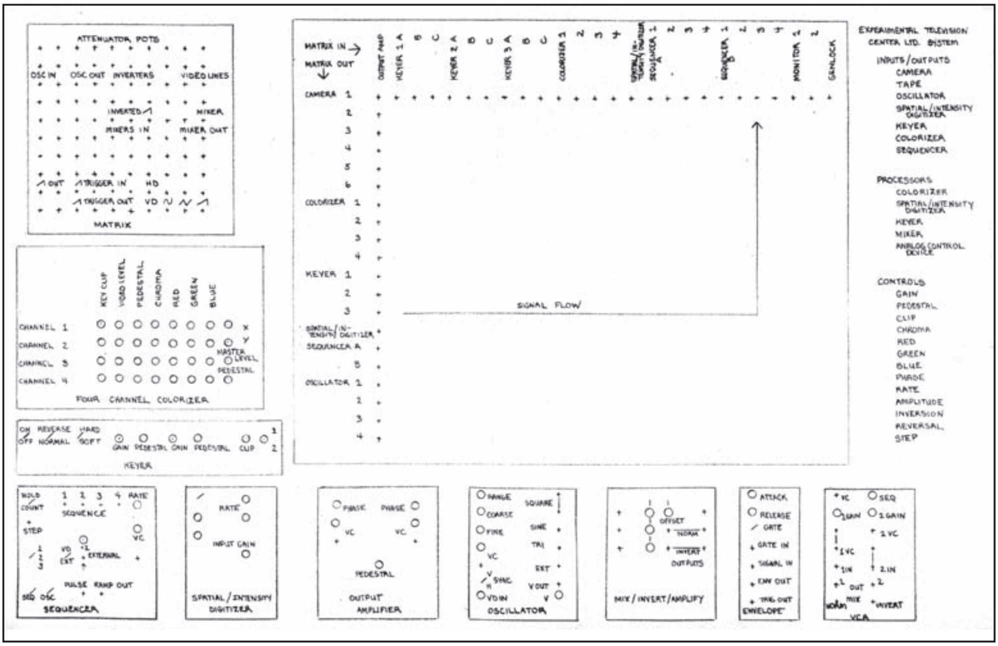


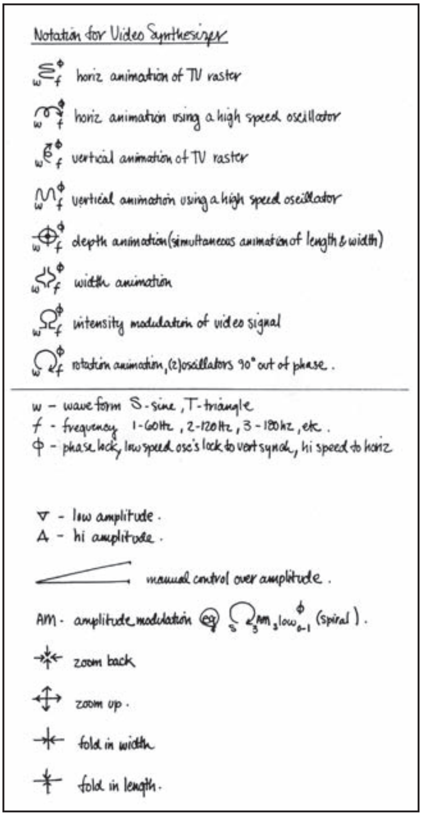
Figure 12. ETC Imaging System diagram showing the front panels of all the modules by Sherry Miller Hocking (c. 1980).

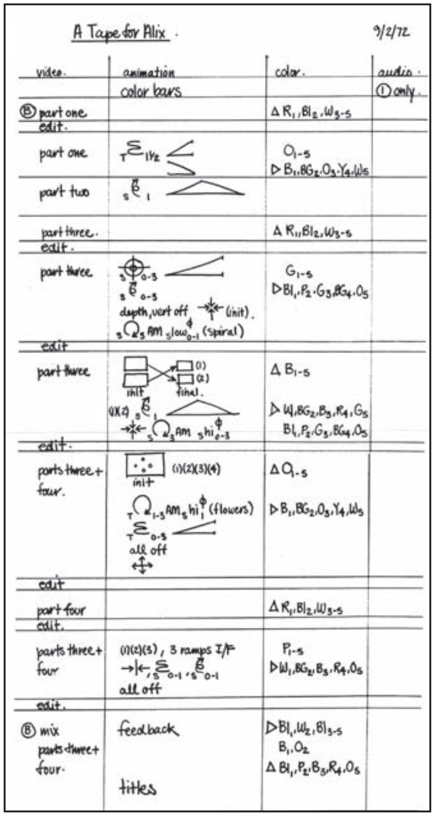
> didn't really have a flying erase head that was needed to really do proper insert edits. And so I did a modification for that, where I put in a switch on a coil that would allow the main erase head for the tape to not erase the tape. And it was basically up to the video heads to kind of be strong enough to override the signal already on the tape, and you would be able to get an insert edit. Without that, when you went into the edit in that deck, you would end up cutting in fairly quickly; but when you cut out, you would have maybe eight seconds of noise before your original image came back, because the erase head was just a bulk erase head and it erased everything on the tape, as long as the button was down to go into record. (Jones 2007)

Other types of processing – recording and playback

Time-delay playback

This involved placing two ½" open-reel playback decks a short distance from each other. The tape was threaded onto the first, which would be the recorder. The tape continued on to the second deck, which would play back the images recorded by the first deck. The space in between the decks resulted in a noticeable time delay, since the recorded information didn't reach the playback head for the duration of the separation.





Figures 13 & 14. Walter Wright notation system and a tape score.
From program notes, The Kitchen, New York City (1972).

Image degradation

This could be achieved by making a recording and then playing it back while a camera was recording the image from the monitor. As this was repeated, the image took on textural qualities.

Sync – drift and roll

With this technique, artists could explore the space of the video image, setting the image drifting across the monitor screen or from one monitor to the next by controlling the horizontal sync. If the vertical sync was off, the result would be an image that rolls from bottom to top. Joan Jonas's *Vertical Roll* (1972) is a well-known example. Peer Bode also explored this technique:

> *Video Locomotion (man performing forward hand leap)* (1978). Homage to Eadweard Muybridge. Muybridge photo grid put into a video system space. Movement is created by detuning the horizontal and vertical video synchronization (time base) signal.

> Drift and horizontal doubling takes place. When the horizontal frequency doubles the man doubles on top of himself. A para-cinema shutter discovered by combining video luminance keying of the sync signal together with time base drifting. A basic video structure; sync and a basic video process; keying together create a video based film like shutter, simulating a crude persistence of vision system. Primitive physical structures of the video signal, combined, bring Muybridge's photo grid into an electronic animation of false movements. The overall time composition is a simple structure of increased time display of the photogrid and decreased time duration of the photogrid drifting. Two b&w cameras, time base detuning and keying. (Bode 2001)

> The Vasulkas have used drift in many of their early works including *Home* (1973) and *Golden Voyage* (1973). George Brown constructed a process for them in 1972, which the Vasulkas called the Horizontal Drift Variable Clock which output the sync which controlled the speed of the horizontal drift (Spielmann 2004b).

> Using the colorizer, multi-keyer, and switcher, as well as horizontal drift, *Home* consists of three sequences in which still lifes are set in motion – e.g., an apple drifting past a teapot on a kitchen stove. *Golden Voyage* refers directly to Magritte. It is a sort of animation of his painting *The Golden Legend*. 'We were looking at this picture and we were joking about how many cameras we'd need to reproduce it,' Steina explained. 'Of course, three. One camera would be on.' These images were combined using the multi-keyer and set in motion via horizontal drift. Loaves of French bread embark on a journey. They travel across various backgrounds - a mesa, a beach, a building as well as a reclining nude woman. Initially mere loaves, the breads take on phallic connotations as they encircle the woman - an attempt at absurdist humor. (Vasulka and Vasulka nd: 2)[3]

Feedback

Feedback results when the camera is pointed at a monitor which is displaying the image from the camera. There are many variables, including lens and monitor adjustments, ambient lighting, and angular orientation of the camera relative to the monitor, each affecting the resulting feedback. By pointing a camera at a monitor, you are electronically 'rephotographing' or rescanning the images on the monitor screen. This image can be a live image from another camera or the output of a processing system, a prerecorded image from videotape, or, if the monitor is displaying the camera which is pointing at it, feedback. The output of the feedback loop can then be further enhanced using other processes such as keying or colorization:

> Video technology moves visual information from here to there, from camera to TV monitor. What happens, though, if a video camera looks at *its* monitor? The information

> no longer goes from here to there, but rather round and round the camera-monitor loop. That is video feedback. From this dynamical flow of information some truly startling and beautiful images emerge. (Crutchfield 1984: 191)

> 'Feedback' in this usage is a technical term, designating the procedure of connecting camera and display-monitor in a loop, the camera photographing the display and feeding the result back into the same display. […] A feedback image is not a picture of anything, finally; it is a balance of purely electronic forces below the threshold of perception. It is our entrance into that very specialized branch of video called image synthesis, in which images are not records but creations achieved by manipulating the basic electronic forces at work in video cameras and displays. (Arn 1973: 20–21)

As Bill Gwin explained:

> Feedback is the image configuration most video experimenters discover first. It is produced by the most simple complement of electronic tools, a camera and a display monitor. By manipulating these two objects the artist can conjure limitless variations of stunningly complex imagery. In the early days of discovery, feedback is magic: spirals, flowers, mandalas burst forth with the touch of a fingertip and regenerate themselves indefinitely on the screen. Later, for some, feedback's simplicity becomes deceptive and its ease occasions serious questions of composition. […] Video feedback is produced by aiming a camera at a monitor; the camera actually takes a picture of itself. The patterns thus engendered can be altered in several ways, by exerting various controls over the electronics, and by affecting the optical path of the picture/monitor loop. (Gwin n.d.)

The term *feedback* was also widely used by artists and designers in discussions of systems theory. Phil Morton and Dan Sandin used it as a descriptor for their Image Processor, along with the concept of interaction. They stressed the importance of the machine providing real-time visual and auditory information to the artist so that he or she could interact with the system. If the machine cannot provide complex real-time output, then the system must include predictive tools to allow the artist to 'guess' what is going to happen:

> SO I WENT ABOUT DESIGNING A VIDEO IMAGE PROCESSOR […]. The primary idea was to do instant modification of instant feedback […] simply the experience of getting INSTANT feedback is an extraordinary thing […] it is a NEW thing with the realization of electronics […]. (Sandin and Morton 1973)

Modularity, patching and notation

A video synthesizer or 'image processor' is a general term referring to an assemblage of individual modules which produce video or control signals, or process signals, all of which are then integrated into a single system. Arn and others have noted the distinction between direct synthesizers – those which allowed for no inputs – and indirect systems which alter the signals from a variety of external input devices. In reality, systems like the Vasulkas, the Hearn, the Sandin IP and the ETC system permit a variety of camera-based and electronically generated inputs that can be interconnected in different ways. Often, patch cables were used to physically determine the paths of the signals as they moved through modules. Later, as systems became more complex, designers used a matrix which was essentially an XY configuration of inputs and outputs. By positioning a slider, for example, the connection was made between an input and an output. The specific architecture of the system changed as modules were added to or removed from the patch or the system.

> Modular design is essential in video, because it permits parallel and simultaneous processing of high-frequency signals […]. As in the development of the audio synthesizer, artists have provided engineers with functional module building blocks which efficiently accomplish commonly needed functions. Modular design also permits a wide range of interconnections depending on the 'patch' made between them. For example, a system of only 8 modules, each with a single input and a single output can be patched in over 40,000 different ways […]. While modular systems provide both variety and efficiency, they also can present the artist with a confusing welter of two-ended wires which makes live performance difficult and leaves him with no permanent record of his patch. The first step in improving this situation came with the introduction of the matrix switching systems of the Arp and EMS synthesizers, adapted for video by Woody and Steina Vasulka. These systems have manually set crosspoints and permit patchfields to be recorded by graphic notation. Going a step further Don Buchla and Bell Labs have developed computer controlled patchfields which are notated with a verbal language. (DeWitt 1976: 2)

Many artists developed methods for documenting the pathway of the signal through various modules as they were interconnected, in part so that a particular effect could be recreated. In 1972, Walter Wright created a notation system, which he described as recording 'the state of the machine'. He used the system to create visual scores for his video compositions. He first developed this for the Scanimate, but later applied it to tools at the Experimental TV Center. Because the system was constantly changing, he modified the notation system to one which documented patches (Wright 2006).

Image-processing system

The System at the ETC studio was designed to be modular. Each artist could select subsets of sources, processors and controllers, and 'build' an individualized system. Artists applied these electronic processing tools within a variety of formal structures, ranging from narrative and documentary to abstract, formalist and didactic. The works were displayed in diverse ways – single channel, multichannel, live, interactive, sculptural or performative. Artists such as Woody Vasulka and Peer Bode described their works as documents of specific processes. The process could be scored, as for example by Walter Wright, and a tape specifically created from that score. Processed imagery could also be employed to convey or evoke emotional or spiritual states as in the works of Barbara Buckner, or to unfold a complex narrative as in works by Irit Batsry, Alexander Hahn or David Blair. They were intimately tied to music in the works of Reynold Weidenaar, or electronic sounds as in the early works of Gary Hill or Kjell Bjorgeengen.

The work could be performative, such as the works of Peer Bode with Meryl Blackman and the American Dance Asylum, with Arnie Zane, Bill T. Jones and Lois Welk. *Couple 513* (Everson Museum of Art, 1976) and *Movements for Video Dance and Music* (Herbert F. Johnson Museum, Ithaca, 1976) were both early explorations of video/dance. *Synergism* was a travelling performance collaboration between Woodstock Community Video and the Experimental Television Center (1975 and 1976). Participants varied but included Tobe Carey, Gary Hill, dancer Sara Cook, Ken Marsh and Walter Wright. *Ballet Di-Gi-Tal*, a live video and dance performance by Connie Coleman and Alan Powell with the Dada Processors, was presented in 1989 at International House in Philadelphia, and also at CEPA Gallery, in 1992–93.

The video system could also be set up by selecting signal sources and processes and then run as a sculptural installation, or set to respond to aspects of the outside environment using triggers. *Cloud Music* was a mixed-media installation created by David Behrman, Bob Diamond and Robert Watts and exhibited between 1974 and 1979. The installation consisted of a black-and-white camera which was pointed at the sky. A video analyzer allowed the user to position the placement of six targets on the monitor of the sky image. The device generated six control voltages which were each proportional to the light value of the associated target. As the light values of the passing clouds changed when moving across the crosshairs, the voltages changed. These varying voltages were sent to an electronic music system, which converted the signal changes to varying tones. *Cloud Music* was exhibited first at the Electric Gallery in Toronto (1974), and at the Experimental Television Center in Binghamton (1976), as well as other venues.

The ETC system continually evolved. As new tools were prototyped, different control methods were designed, and as consumer equipment finally began to catch up with independent video's early years, the building blocks would change and artists continually created new systems.

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Notes

1. See Hocking and Brewster (1974–86). These manuals were used by the artists in the studio and in workshops. They were also used by other media centers, for example Media Study/Buffalo.
2. See Hocking (1980), http://www.experimentaltvcenter.org/raster-manipulation-unit-operation-and-construction
3. Available at http://www.vasulka.org/archive/Publications/FormattedPublications/DRIFT.pdf . The Vasulka document appears to be an earlier version of Lucinda Furlong's (1983), 'Notes Toward a History of Image-Processed Video: Steina and Woody Vasulka', *Afterimage*, 11: 5 (December), pp. 12–17.

ETC's System

Hank Rudolph

The text below was originally an introduction to a lecture on the ETC studio system in May 2005 as part of the Experimental Television Center International Student Residency. The ISR was a college-level course offered through Alfred University and co-taught by me and its director, Pamela Hawkins.

The two-week summer program ran for seven years, from 2000–06, and as an unaccredited workshop for four years prior to this. It was conducted at the ETC studio in Owego, NY, with students participating from several schools, including Atlanta College of Art, the University of Buffalo, the Rhode Island School of Design, the University of Georgia, Syracuse University and Alfred. For many of these years, a team of media artists, including Aaron Miller, Monica Duncan, Matt Underwood and Annie Langdon, offered additional instruction to, and often collaborative productions with, the students. Aaron taught the Max/MSP/Jitter workshops, which he integrated into the ETC studio workflow. Carolyn Tennant transcribed the original talk, which I later revised for clarity.

The text does not attempt to address the history of the tools in the studio or interpret the intentions of the designers, but rather to offer a conceptual overview of the system as a whole, and its defining characteristics as a unique mode of working in the time-based visual arts. This view is based in part on my own observations of artists using the studio in my years as ETC program coordinator, as well as my own personal experiences with the system.

I knew that many of the students were familiar with Final Cut Pro and Adobe After Effects. Using this as a starting point, I wanted to pose the question of why one would use such a system as ETC's, and what were the parallels to, and departures from, the approaches they already knew.

Now that the ETC studio has closed its doors, and the issues of materiality and process in video have shape-shifted with high-definition, a larger goal in revising this is to offer a blueprint for future modes of working and to address what types of studios, collaborations and tool sets (both hardware and software) have since happened and may yet still be needed.

Introduction

Before I go into the technical aspects of the system, I'd like to give a brief conceptual introduction to the ETC environment. I wanted to start by asking: Why would one want to work this way? Why use this type of studio? This model of working is not for everybody. What type of information will you get out of this residency that you can apply elsewhere? Is this workshop going to be only a long list of arcane instructions for operating a set of machines that you'll never encounter again? In addition to a body of work, I'm hoping that you come out of here with a way of rethinking the moving image, and that you apply that new perspective to whatever tool sets you use or even invent through software or circuit-bending.

There are many aesthetic and philosophical approaches to working with time-based media, but there are basically three technical approaches. Film production is the first. The second is the type of post-production software that many of you have worked with, such as Final Cut Pro, Pro Tools and After Effects. The third area is the one represented by the tools behind me. These tools have never had an adequate label. I'm still searching for one. Collectively the technology has been called 'video synthesis' and 'image processing' at various times.

I don't think it's productive to pit these approaches against one another or to decide which is the best way to work. Even if you never wind up using film, I hope you'll eventually learn about the process of filmmaking, and study the history of experimental film practices. Knowing more about each one of these areas can inform how you approach the others. Each field of study helps one develop a concept of raw material; each offers its own unique technological systems for working with that material, and each of those systems involves the artist in a markedly creative process.

In making distinctions and comparisons among these ways of working, I don't necessarily want to create a dichotomy between 'analog' and 'digital', because I think such a division obscures the real issue. That issue has to do with the underlying characteristics of the system as a whole, and how those characteristics add up to a radically different creative dynamic for the user. While most of these devices are in fact analog electronic tools, some, such as the frame buffer, are more of a hybrid digital and analog technology. In addition, certain programs such as Max/MSP/Jitter, have far more in common with the features of ETC's analog system than they do with post-production software.

I'm discussing the system as a whole, and taking a snapshot of where it is now, comparing it to other systems that exist now, rather than discussing how it got here. I'm not going into the very important context of the history of the development of the individual tools. This could be considered a synchronic rather than diachronic perspective.

When the TV Center first came about in 1971, there was of course film, but there were no digital video tools and the existing analog ones were mostly diluted consumer versions of those used in the television industry, notably the video switcher, or special effects generator. We have a few of those in the system.

Not only were there no blueprints for building individual machines, there was no concept of the personal studio as an electronic image-making environment in the artists' vernacular. There was just a sense of invention from the individual designers and from the artists with whom they communicated or collaborated. First and foremost, the ETC environment was an early model for what a personal electronic studio might look like. Now people have personal studios for electronic image-making, although clearly they are not at all based on this environment. The electronic studio that we know of today is a very different construct. It can be the laptop, camcorder and external hard drive, something very compact and even portable, and expandable mostly within the domain of the software. The environment you see here is much messier, more sprawling, sculptural and open-ended. This particular model of a studio never entered the vocabulary of the rapidly expanding media artist population, and the tool sets here never wound up proliferating in the consumer marketplace. Designed out of the natural curiosity of creative engineers, with hopes of eventually becoming more commonplace, these machines instead continued to be rare and eventually took on the status of 'precious'. Over the years I feel as if the image of the ETC studio somehow shifted from a paradigm of a personal artist's studio into a sort of hands-on museum of obscure audio-video devices. This was not the original direction.

I'd like to offer an overview of what to expect from this workshop. I like making lists. I'm going to outline six fundamental characteristics of the ETC environment, look at them individually, and compare them to the other two approaches of time-based image making: film and post-production software.

The six characteristics are:

Real time
Open-ended architecture
Indeterminacy
Interactivity
Sound-image synchronization
Electronically-generated, or camera-less images

Real time

Real time can have many meanings, but in this case it simply means that the artist can immediately witness the results of parameters being changed with knobs, switches or other external controls. It can also mean that some of the source material, such as camera images, can be live.

Real time does not have some absolute value. It only has meaning relative to the body, or to our experience or perception of the electronic events unfolding. Those events are not actually simultaneous. They're causal. They're happening in sequence but very quickly. It takes time for the signal to travel from source to destination, or from a studio camera to a display. It takes time to make changes to that signal. But to us, they have the illusion of simultaneity.

Why would that experience be useful in the creative process? The significance of real time is apparent for live performance and also in interactive installations, both of which are site-specific. The audience has to be there. Why does the artist have to be here to produce something that will result in a single channel prerecorded work to be experienced by an audience at some later time? How does working in real time contribute to that final piece? Are different modes of working, or processes, relevant in the reception of the final product? When you are sitting there, caught up in the unfolding experience of a completed time-based work, trying to make sense and meaning of layered images, does it matter whether those images were compiled through laborious filmic techniques in optical printing, or rendered with key frames in After Effects, or performed as a continuous take in a dynamic electronic patch?

It depends upon the type of work and the artist's intentions. In some cases it does and often it does not. But does this imply that the system is designed to produce only certain types of work? On the contrary, a large variety of works are made here. The productions of those works share a common creative dynamic, the most important aspect of which is the spontaneity offered by these real-time systems. I think that it radically alters the decision-making process. It adds a performative element to image making.

Working in this studio is like putting yourself in an installation, and then setting the parameters of that installation. There are certain sets of choices: the combination of image sources, some live, some not; the layering of those images; the length of recording time; and the changes that will take place over that time – choices that do not fall neatly into the categories of production or postproduction. You have a recorded block of continuous time, like a document of a performance. Next you must decide what to do with this block of time. The process of getting from that experience to a finished piece can entail a whole other set of editing decisions. Are you faithful to the idea of a performance, editing very little if at all? Or do you chop up what you have, resulting in a work completely out of the context of the original performance and taking the images in a very different direction? Artists like Andrew Deutsch and Matthew Schlanger stay within the integrity of that performance, and edit very little. That might not be your approach, nor does it have to be. But working here will raise these questions and likely result in a final product that you would not have made otherwise using other processes such as rendering or compositing. (See Color Plate 44.)

Open-ended architecture

Open-ended architecture is another important characteristic of this studio. Rather than thinking of the system as delivering a series of effects, consider how it works as a whole. How can you break it down into some very simple discrete ideas and then build these back up into larger structures with many combinatorial ideas available? In analog electronic hardware, the most useful model for this has been modularity, and in software, perhaps it has been the visual programming languages of Max/MSP/Jitter and Processing.

Aesthetic assumptions are built into every piece of hardware and software we use to make art, and often tools are packaged to presuppose certain applications, perhaps even designed as metaphors or emulations of other existing systems.

Many of the television industry's early techniques for combining images were developed as electronic emulations of filmic processes: keying for matting, mixing for double exposure, and so forth. These were built into hardware designs that best suited the formulaic applications of broadcasting. When consumer video technology was first marketed in the late 1960s and early 1970s, the few tools available were scaled-down versions of these broadcast devices, called the video switcher or special effects generator (SEG). A defining characteristic of the SEG was that these techniques for collage and montage were mutually exclusive options. You either keyed between image A and B or you mixed, or switched, or used a wipe pattern.

An altogether different technology with completely distinct aesthetic concerns was developing in parallel to the consumer marketing of video: analog electronic music. It offered two important models for rethinking the architecture of video signal processing: modularity and voltage control. Applying modularity to video on the simplest level meant that a keyer, or mixer, or switcher could be distinct machines, each with its own inputs and outputs. Video systems like the Sandin Image Processor broke down functions further into modules, such as the comparator or adder/multiplier. As separate modules, the order in which you placed these devices to create a signal path determined how images were layered, and greatly increased the number of visual configurations.

But the new designs went beyond this – they found common elements among processes that were previously considered disparate techniques. When the concepts of voltage control and analog-generated signals were borrowed from electronic music and applied to the unique time-based characteristics of video, larger patterns emerged. Keying was, in fact, another type of switching, and wipes were, in turn, another variation of keying. Within this framework, collage and montage were more of a continuum. People may have understood that the video frame was made up of two fields, and the field was divided into lines, but it was largely an abstract concept. Now, through these tools, that concept was experiential. You could apply that concept to your understanding of the material and the ability to make works.

So, the open-ended architecture has two considerations. The first invites a strong educational component to the experience of working, which could potentially be carried over to the experience of those viewing the work. It is about articulating processes rather than mystifying the viewer with effects. The second allows more choices and the ability to decide if and how those choices can manifest themselves as signature gestures of the artist working. Within this larger system, when does a particular subsystem or 'patch' become a personal expression?

Finally all of these qualities begin to merge. Being able to understand the architecture, preconceive a patch, and then perform with it in real time while allowing for elements of chance is all part of the creative dynamic. But there's more.

Indeterminacy

Indeterminacy involves the ability to put something into the system which incorporates a strong element of chance in the outcome. Indeterminacy is not randomness. Many parameters are fixed and some are deliberately left open.

Although indeterminacy is often associated with real time, particularly in the context of music as in the works of John Cage, it has counterparts in all experimental media practices. When you scratch, draw or paint across the frames of a film, use certain approaches to hand processing, or take multiple exposures by back-winding film in the camera, you are combining elements of control and chance that are unique to the photochemical and mechanical properties of filmmaking. Tony Conrad did a series in which he cooked film. William Burroughs used his cut-up techniques in writing for combinatory approaches to text. It is the pairing of indeterminacy and real time in electronic systems that offers a unique dimension for combining and modulating images and sounds.

There are many permutations of chance techniques in the ETC system, and they can quickly multiply in complexity depending on the number of devices that you add to your patch. On the simplest level, you can combine more than one tape or Quicktime file for basic collage and montage. Source images may be starting or looping at various points in time. The mix between these sources may add up to completely different combinations as these distinct loops repeat in and out of phase with one another. Other devices, such as oscillators, may be determining their own cyclical patterns of varying rates and rhythms for mixing or keying between these sources. This is why five minutes of source footage can easily generate thirty minutes of recorded material from the system without repeating the same results.

This approach is a departure from having clips locked together on the tracks of a timeline, with key frames determining the precise transition point between clips. Computers can offer many elegant approaches to indeterminacy if the software is designed to take advantage of it, as with Max/MSP/Jitter. However, the emphasis in software is often on minute details of control, grounded in conventional notions of postproduction. The design is based on the assumption that you always know what you want ahead of time, and sometimes you do. But a system should provide a balance between implementing preconceived notions and allowing a sense of play that can pave the way for happy accidents.

Interactivity, sound-image synchronization and electronically-generated images

The last three characteristics are closely related. The fourth important idea is the system's ability to allow variable and simultaneous modes of control or interactivity. There is manual control – the interactivity between person and machine, and there is voltage control – the potential interactivity among machines. The former may include knobs, switches, sliders or body movements in front of live cameras. The latter can take many forms. Paralleling their use in electronic music, oscillators allow for cyclical changes in the parameters of an image. Those parameters could include the brightness, contrast or color of an image, or the transition between two images. Those cycles of change could be happening over the course of several minutes, or at flicker rates, or faster than each field of video. Several events, or changes in parameters, could be synchronous or asynchronous. They could be completely automated while you are in front of the camera, or they can be continuously readjusted by you at the same time. These parameters could also have a very wide range of modulation, unlike controls you customarily use on a video monitor. For example, the brightness control could swing from a completely black screen through the 'normal' video image to a fully white screen. The chroma phase, or hue control, may shift the colors of an image completely around the color wheel.

The fifth characteristic of the system is its ability to establish synchronous relationships between sound and image. The desire to do this has long had roots in the concept of synaesthesia. Synaesthesia is a neurologically based phenomenon, but there is a history of trying to realize this concept in media. It includes color organs, theories of paintings by Kandinsky and Delaunay, and various approaches of early-twentieth-century European and post-war American filmmakers. With video, this was arguably the first time that sound and image had been reduced, or transduced, to the same medium – analog electronics – and that this relationship could be established in real time, where the artist could potentially interact with her own voice or image.

Before I expand upon the ways this can happen, I'd like to mention the last important idea of this system, which is the ability for images to be camera-less, or generated from within the raw material of the medium. This isn't a new idea in itself and parallels techniques in other media. In photography, there are photograms. In film, there are numerous techniques that encompass drawing and painting on clear leader or scratching on emulsion. In computers there is a whole genre of generative software. Camera-less images in video are probably most influenced by the parallel practice in audio synthesis – the ability to generate sound internally, without a microphone or recording device. All of these techniques share a common concept: that the physical properties of these media have a world unto themselves separate from their function as representational or reproductive instruments. In all camera systems, there is the question of what happens between the camera and the display, or the event represented and the representation of the event. In some ways, what we refer to as 'processing' is the questioning of that process, or a search for ways to interrupt that continuum from camera to display. The logical extension of that question is to explore what happens when we take the camera, or real event, out of the equation.

In some ways, this brings us back full circle to the first trait of the system – its real-time capability. While experimental film has dealt with these same issues of process, the ability to simultaneously and in close proximity see the event represented by the camera and its representation adds its own unique dimension. Likewise, modes of interactivity, sound-image relationship and camera-less imagery all merge with the placement of our body in a real-time environment.

Sound and image can be combined in the following ways:

- Images and sounds can be generated by the same electronic source. You can send the same oscillator (or combination of oscillators) that you have sent to the video system to see, to the audio system to hear.
- Parameters of a sound can control parameters of an image. The sound can originate from a live microphone or from a prerecorded or electronically generated source. In any of these cases, changes in the volume of the sound can be used to modulate the image.
- Parameters of an image can be used to control parameters of a sound. One way is for one or more light sensors to be attached to the front of a monitor to detect changes of brightness at specific points on a video image.
- Whether electronically generated or not, the parameters of both sound and image can be modulated by a third source, such as an oscillator, resulting in synchronized modulations of sound and image.

In any of these applications, the viewer of prerecorded work may experience the synchronization of sound and image without knowing the specific causes and effects involved. In the live image-making environment of much installation and performance, those causal relationships are much clearer to those present, either because they know the patch or they are interacting with their bodies. Sometimes it's a challenge to articulate that relationship to an audience watching and hearing the work after the fact.

Materiality/conclusion

The notion of materiality is an elusive thing in electronic media. With film, issues of physicality are obvious. It is very tangible and visible. You can hold a strip of film to your eye, punch holes in it and mark it, and see it move through a projector. You know why an image is displayed and how that image was formed by mechanical and chemical processes. You must know how and why processes happen in order to make an image at all. You cannot make film and not know something about the process. In video you can. You can shoot and edit with no idea about the process involved, because cameras and post-production software are designed to mask that very process. The result is a tendency for people not to think about the materiality of video at all. In many ways, we have to communicate with and rely on creative engineers who make machines that can be placed between the camera and the display and alter that process, so that we can develop an understanding of video's raw material.

By the time we move on to software, the processes become even more abstract. We are pushing around icons that represent our images. With most software, we are working with these highly developed metaphors based on other systems (painting, music composition, printmaking, animation, postproduction), and they inform us how to interact with the machine. Physicality becomes irrelevant because we are completely in the realm of emulation. While these programs are powerful and useful, you have to come to terms with what is gained and lost by moving from one medium to another.

An important component to this experience is the concept of signal in video. While this concept may seem initially abstract to us, our perception of it is aided in two ways: by our ability to see changes made to the signal in real time, and by the use of flow charts to document their configurations.

The ability to turn a knob, utter a sound, or move in front of a camera and see results instantaneously is the closest thing we have to tactility in analog video. It is still very different from the physicality of film, but more discernible, less remote than how we experience most computer software. This is where all of the previous elements (interactivity, indeterminacy, architecture, image-sound, etc.) come into play to help us develop a sense of materiality in electronics.

Signals can have a great deal of flexibility in how they are configured with a few basic guidelines: 1. Each signal has an origin, and in the case of video, it can either be generated from an electronic device, such as an oscillator, or converted to electrical energy from another source, such as a camera. 2. Signals have direction, and can travel in a single serial path, or split off into multiple paths. 3. Multiple signals from different sources can converge at a single point. In the case of video, this convergence point could be a device, such as a mixer or keyer. 4. Signals have a destination, and in video, these are usually the display, recording and capturing devices.

These variations determine how images will be layered, blended, sequenced, displayed and documented. The configurations of signals are called patches. Flow charts are graphic representations of patches. They are the blueprints for understanding the logic of collage and montage in analog video. Tools such as the matrix switcher and the patch bay are used to construct those patches, and are called routing systems. These tools don't process the video signals as such, but guide those signals to the video processors, such as keyers, sequencers and colorizers. Their designs allow you to split and converge signals in countless variations. Developing a sense of syntax with this system requires the skill of translating what we see on the screen into the way we read and write the flow chart of a patch.

Our understanding of how analog video works is not usually empirical in the way our knowledge of film can be. We can talk about the relationship of voltage to light, the linearity of video information, the direction of the signal, or how the two-dimensional raster is formed in the cathode ray tube; as raw material goes, video still isn't tactile, and the process isn't visible. The ETC studio gives you an excellent opportunity to experience that process and consider materiality in live electronic media.

On Voltage Control: Interview With Hank Rudolph

Kathy High and Mona Jimenez

Hank Rudolph served as the Arts Coordinator at the Experimental TV Center from 1984 until 2012, providing individualized instruction to artists participating in the Residency program. He is also a media artist creatively using both analog and digital systems to produce his own work.

Mona Jimenez: Could you explain voltage control as a concept that was and is used in the Experimental Television Center (ETC)?

Hank Rudolph: Voltage control was borrowed from audio synthesis and electronic music – as opposed to manual control. Instead of turning a knob (a continuous parameter) or flipping a switch (on/off), you could do this with an electronic signal. And that electronic signal, for something that changes continuously, could be the brightness or contrast of the signal. One source of voltage control is an oscillator, which is cyclical in nature. It's going up and down, and up and down. You could have different oscillators that are not synchronized to one another, changing different parameters in and out of phase, to create a more complex rhythmic situation. Another source of voltage control is preexisting audio – a tape or a live microphone or something, that goes through a device called an 'envelope follower', and that basically translates changes in volume of the sound to changes in voltage. So as I speak louder or softer, it can change those parameters, like brightness and contrast or whatever, the same as an oscillator can, but it's synced to the sound. But only with the parameter of volume; it doesn't change by tone or pitch. There is something called 'frequency voltage converters', but unless the sound is relatively simple, it gets confused pretty easily. Certain sounds work better than others.

MJ: How does that relate to the plus and minus system?

HR: Our system is referred to as the plus/minus-five-volt system, which is a cryptic name, but it's kind of a generic term for this system that's not quite audio, it's not quite video, but it can be applied to all of those things. I think ETC came up with this voltage range because it was compatible with preexisting audio synthesis devices. I know others use zero to five or things like that. The Sandin [Image Processor] uses plus/minus a half volt. That's closer to what video is, because video is around one volt peak-to-peak.

The Sandin really is a different kind of architecture, unlike the Jones modules. We use the matrix switcher, but it's all regular video, two volts – you know, two volts unterminated, one volt terminated – going through the video devices; and then all the control voltage inputs are mini-jacks on the front panels that take plus/minus five. So they're two completely different standards. And there are some cases where you can take a plus/minus five signal and attenuate it to two volts, so that it can go directly into the matrix as an image source; but for the most part, David [Jones] devices were designed to take the control voltages in through the mini-jack. And that's very different from the Sandin, where everything is in the same kind of plus/minus-half-a-volt soup. And there might not even be specific things on there that say 'control voltage'. If you want to pulse an image, you might take an oscillator and a video image and put them through a mixer. And then how much of one or the other is on there will determine how it pulses. So it's a little different that way.

I went to school here [Cinema Department, Binghamton University] in the mid to late seventies, when the Center was in Binghamton. I still managed to volunteer [at the Center] in exchange for using the equipment, but I think Neil Zusman and Isaac Jackson and I were among the last students to do that. Rich Brewster was building yellow boxes [for voltage control] – I was a student – and he was also building some video modules. Initially, the Center had these big army-surplus oscillators. They were these giant silver things that put out square waves and stuff. And there was this modified Sony special effects generator – I think it was modified by David – so it had other features like keyers, and then there was a Jones keyer. So I just kind of came in, would put that together with some black-and-white cameras and just use it as such. I'm trying to remember, when I first came here, what had voltage control. For some devices, voltage control was an option, but some devices don't do anything without voltage control. The Wobbulator is an example of a device that has to have voltage control. And I think when I came here, the Wobbulator did have those big army-surplus oscillators plugged into it. So the first voltage control devices were the [Rich Brewster] yellow boxes; that I can remember. (See Color Plate 41)

At the time I was trying to understand it, there was a course offered in the music department at Binghamton, with a big Moog Synthesizer. So I took that course and was learning voltage control there. There was this great essay on voltage-control synthesis by Joel Chadabe (1975). I really understood from that what voltage control did and how there are second levels of control voltages and things like that, and how to read a flow chart and, you know, all that good stuff. So then from there, I was able to apply it to ideas in video, once those modules were finished at the Center.

MJ: It does seem like those ideas were floating around. People will talk about, 'Yeah, I was a teenager and tried to make my TV image be weird by applying some voltages to it.' Or, you know, of course, Nam June Paik, with the magnets. What was your perception or experience of those ideas floating around?

HR: Well, it definitely had its foundations in music, in audio. Peer [Bode]'s father [Harald Bode] wrote a pivotal essay about modularity in voltage control in the early sixties. It's interesting that – you know, jumping ahead to Max/MSP and Jitter, and going back to voltage control – that in both cases, these started off as audio systems. This very elaborate architecture was devised for working with audio, and that the video aspect was an afterthought. The system was already in play, and then visuals, moving images, were kind of plugged into that concept. I was very interested in the idea of connections between audio and video. I remember at that point there wasn't that much to read; there wasn't that much written information on audio synthesis, and there was *nothing* on video synthesis. I was in Wisconsin in '73 and David Bordwell, a film theorist who taught there, told me about this guy, Nam June Paik, who was coming, and he uses a thing called 'video synthesizers'. That was the first time I'd ever heard of it. I saw him speak and I was just really fascinated by it. That was one of the reasons I eventually wound up at school in Binghamton.

MJ: You mentioned the Serge modules. Is that what the yellow boxes were built on? You also mentioned *Electronotes*…

HR: *Electronotes* was a newsletter published by Bernie Hutchins, who I think was an engineering student and professor at Cornell [University] in Ithaca [NY].[1] This was very, very DIY stuff. You could make your own oscillators and voltage-control amplifiers and stuff like that. It was at the same time that Bob Moog was in Trumansburg [NY].

MJ: What were the Serge modules?

HR: They were very modular audio synthesizers. There were different schools of thought about audio synthesis, and Bob Moog's machines were by far the most popular. I've read stuff about how he started out, and he didn't have any preconceived ideas of whether or not there'd be a keyboard as a control. I *think* what happened was that [users] would request certain things. And then slowly, it began to evolve into something more along the lines of conventional music. There was keyboard control. Sometimes oscillators, three oscillators that generated the sound had a common control voltage from a keyboard, so that was like a chord. Sometimes the sequencers, the devices that would sequence notes, could pick up in the middle of a sequence, so that was like a fugue. It seemed like the Moog Synthesizer, even with its great sound, was gravitating more and more towards conventional music ideas. The Serge was a *lot* more modular. In fact, with some of the devices on the yellow boxes, in order to get it to oscillate, you have to do a little feedback loop, where you have to take the pulse output of it and feed it back into the input just to get it to oscillate. So it was really modular.

MJ: Those yellow boxes were really the first boxes that were in [the ETC studio] that were built by Rich Brewster.

HR: They were used for control voltages for video, and they were also used to generate audio. But they were all, I think, based on other designs in audio synthesis. And what that also meant is that the oscillators only have a certain frequency range. When you use oscillators as a video source [in the ETC studio], when you plug an oscillator directly into that place on the matrix that cuts it down to two volts, and you can see it right through the output amp as a raw signal, when it's low voltage, it's just going from black to white. If it's a square wave, it's just black for a while, then it's white. If it's a sine wave, it's gradually rising up and gradually coming down. And there's that threshold point called '60 cycles'. That's where the oscillation, that's where the frequency, is happening faster than each field of video. So then what happens is it starts to break the image up within the field, so that so many scan lines are white; if it's a sine wave, so many scan lines are white, so many scan lines are middle gray, and so many are black. And then when you go from there, you start getting more and more horizontal lines. Then the next threshold point is when the frequency happens faster than each line of video. So whatever that frequency is, like 525 times 30. That's up around 16 kHz. And that's where it gets very chaotic and it wants to oscillate within each line of video. And that's usually where oscillators have to have a sync input. You can give it horizontal sync in order to stabilize it, in order to see these vertical divisions which occur when the oscillation happens at the same time on each line.

Those 16 kHz frequencies are already starting to get out of the audio frequency range. I mean, the oscillators that were built for musical purposes, including the Doepfer modules, weren't really designed to do video. I think the next generation of oscillators that David came up with when he built the bank of oscillators had an external sync input; and the oscillators were high enough to divide up so you start getting vertical shapes. It's the mixing of the vertical shapes and the horizontal shapes that you start making more complex shapes in oscillators.

MJ: And then from there, people would use a keyer to assign certain video to certain parts of the tonal range in the image.

HR: Yeah. It can be sent to the keyers or the colorizer or any of those things. People were already doing that; for example, Steve Beck. The Sandin had its own oscillators. And those were already up in the high frequency, where they could start to divide up the stuff. At the Center, two of the oscillators that are on the yellow boxes have a three-position sync switch that's either free-floating or horizontal sync or vertical sync.

MJ: I think the keyer and the colorizer are probably more easily understood by people who are less familiar with the [ETC] system. It refers back to regular old video language. But how do you describe the sequencer when people come to work, simply?

HR: I start off by saying it's kind of a voltage controllable switcher; and if they don't know what voltage control means yet, I say it's kind of an automatic switcher. But that's a really simple explanation, because switching can happen below and above the field rate. So you can actually start switching within the image. Especially with the binary control, once you start putting in an oscillator you can start to build up a split screen of various images. So a sequencer does a lot more than just switch. And that needs voltage control. You can manually switch, but that's not particularly interesting. With the keyer and the colorizer, I think voltage control adds a lot to it, but it's not necessary to use them; whereas on the sequencer and the Wobbulator, it is necessary to have some sort of voltage control.

MJ: And people are making more complex shapes with the sequencer – with a combination of devices, really, with the sequencer and the keyer.

HR: Yeah. A lot of these devices – the keyer and the sequencer – are really simple. But because of the way it's set up at the Center, with the matrix switcher, and the fact that the system is very modular and open-ended, it doesn't presuppose any order things have to go in. You're really starting off with simple machines and building more complex ones. So that idea of modularity combined with voltage control are really both borrowed from audio synthesis.

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Notes

1. See http://electronotes.netfirms.com/. Accessed July 19, 2012.

“Insofar as the rose can remember…”

Carolyn Tennant

I had forgotten about the mayflies. But when I saw them outside the window, I quickly remembered the bats. And the stories of another artist who would hole up in a tent he set up in the studio during his residencies.

Barefoot, I walked towards the windows across the old wood floor strewn with cables, navigating my way through an arrangement of television monitors on rolling carts, light stands, and props used earlier in the day. A pink tinsel Christmas tree on loan from the Hand of Man, the holiday gift shop two floors below, was selected from the nutcrackers and nesting dolls spilling out of the upstairs stockroom.

It was June and we were in the attic of a riverfront store overlooking the Susquehanna, so they were no surprise. A swarm of these ephemeral insects might be taken as a positive sign, their presence considered an indicator of well-being in aquatic environments. But it was the angle and that perspective of looking into, rather than up at, the street light that captivated me and kept me at the window. Watching the frenzied mass it was hard to imagine, within such apparent chaos, how mid-flight reproduction could occur.

Down below, street vendors made last-minute preparations for the annual 'Strawberry Festival'. From the same spot, my husband J.T. and I would watch the parade the next day, as an endless procession of sports cars rounded the corner and continued their crawl down Front Street. And while we eventually made it outside, later that night we chose to watch the fireworks from the windows at the opposite end of the studio. Sitting at the edge of the bed we would take in the show's climax, a pyrotechnic strawberry that illuminated the bridge and the water below.

Among the last artists to visit the studio, we were, in a sense, present at the grand finale of a decades-old artist residency program. The significance of the opportunity and what we were there to witness was not lost on us. But to honor a space like this – equal parts electronic laboratory and artist retreat – required discovering our own methods of inquiry. We could do this by enacting its many functions for ourselves, not by attempting to retrace the ubiquitous signal that, like the river below, has run through this place.

I remember looking back at the system from the windows that night. Perhaps I was channeling the energy of those desperate mayflies, but once more I found myself consciously suppressing my desire to document every inch of the studio. I knew it was a project too Herculean to realize, and that it was compromised by an impulse to summarize something in the process of transformation.

Walking along the rough wood floors, I realized that neither mysticism nor mathematics could suggest that moment. Besides scraping a microphone along a wall, how does one sonically represent the texture of a brick? If we could map the space through abstraction, visualizing the electric hum through a palette built from the accumulated sounds of each machine, would we? Our commitment to participate in the moment – not in spite of, but because of its meaning – has thankfully relegated this fallacy to conceptual fantasy.

Insofar as the rose can remember, it has never seen a gardener die…

Like the mayflies that serve as a barometer of freshwater ecosystems, there are methodologies used to measure the effectiveness of organizations and to monitor their evolution. Matrices based on cost ratios and overhead are employed to determine the feasibility and sustainability of outcomes, but never to assess the needs that defy measurement.

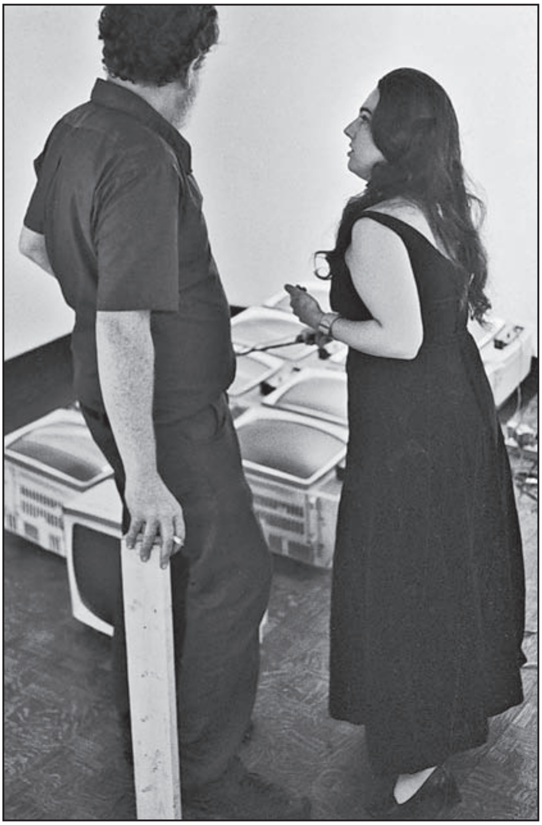

Figure 1. Ralph Hocking and Charlotte Moorman with the *TV Bed* at the Everson Museum of Art, Syracuse (1972). (courtesy. Estate of Evangelos Dousmanis).

Figure 2. Nam June Paik and Ralph Hocking, NYC (1971).
(courtesy. Estate of Evangelos Dousmanis).

When the Center began, it addressed a very clear need among those artists it served: access. At first it was access to the means of production. This was not granted by duplicating the keys to a broadcast studio, but by building new spaces, and offering artists an all-access pass to the tinkerer's workshop. It soon evolved into a home for customized technology and, in situ, a system developed over time from newly fabricated tools and repurposed machines. The Center provided a space for experimental pedagogy and experiential education. For some it was a place to work collectively, so the Center provided a temporary gathering place. For those who came to work alone, the space could accommodate intense production and solitude. Whether to create art or to experiment with new methods, successes and failures were valued equally at the Center.

Over the years many of the once-limited technologies came to be emulated through software programs. Still, the Center offered resources that for artists and cultural producers remain as scarce as ever: space, time, and a safe place where art is considered work and where experimentation, with all of its risks, fosters artistic progress. Meeting these needs was an original impulse that inspired the Center's residency program, and the resources it offered nurtured artists in a way that is hard to quantify. But though the needs have not diminished, the larger environment has changed. The systems once put in place to foster this type of cultural production are, today, less hospitable. But from where I stand in the studio, on this night, I attempt to stay present and focused, aware of my perspective and the gift that parallax brings.

Back with J.T. at the matrix, we dial in our newest portrait. Though most of our experiments have not dwelled on the circumstances, one project has offered us a way to visualize our feelings and honor the spirits who have created this space. Using the pictures of those who have played major roles at the Center – Ralph Hocking and Sherry Miller Hocking, Dave Jones and Hank Rudolph – we interweave layers, mixing in Conway's Game of Life. We unleash the simple cellular automaton to render the portraits, once recognizable representations, a degraded trace of what they were.

Using these images, J.T. reminds me, is a metaphor for the system itself. Like the work produced at the Center, once abstracted from its source, the work remains rich with meaning for the artist. But the initial and final states of the algorithm have no discernible relationship to each other. It is the process in-between where meaning is either gained or lost.

An image of Nam June Paik's death mask transforms into a constellation of flickering pixels. As we turn our attention to the Wobbulator we find that Charlotte, our spider who has cast her web across the modified television, is busy with a mayfly. With only minutes left in its short life, it was no doubt pulled into her snare by the flickering monitor. Replacing Paik's death mask with an image of his late collaborator and muse, Charlotte Moorman, we turn off the Game of Life and allow the hacked electronics to animate her image. Turning on the camera to capture the action on-screen and off, we watch as they spin and twist, both Charlottes at work.

Analog to Digital: Artists Using Technology

Yvonne Spielmann

With the formation of electronic media, namely television and video, a focus on the ways in which artists use technology reveals close interrelationships and shared creativity between artists and engineers. Technical developments from the 1960s to 1980s play an equal part with artistic-aesthetic interests in shaping the electronic medium of video and experimental television. Video is considered to be a 'live' medium because of the possibility of simultaneously recording and displaying the video information; for example, the artist can control the 'image' on a monitor at the same time as the signal is being recorded. The immediate and simultaneous realization of televisual and video sounds and images in different media devices – such as the camera and monitor – also separates video from film and photography, where the image has to be developed photochemically, and can only be seen with the passage of time. However, of greater importance to the experimental endeavors by artists and engineers are the modular structure and processual form of the novel medium of video – a medium that, differently from film, has no particular order to its apparatus; in other words, there is no fixed set or sequence of tools for the generation, transmission and display of electronic information.

In the usual television experience, the viewer receives images and sounds from camera- and sound-recording processes that are structured in a particular way. Television uses a formalized set of recording and transmission standards that predefine the format of the image according to the world zones: NTSC in the United States and Japan; PAL in Europe; SECAM in France. 'Transmission' can refer to transmission either through broadcast or through communication among devices like cameras and monitors. (Video conforming to the standards is referred to below as the standard televisual format.) Analog recording technologies, in that they represent continuously variable states that are analoguous to the depiction of physical processes that were in front of the camera, technically connect to film and photography. However, considering its standard characteristics, video's position in the media system should be described as bridging between analog recording technologies on the one hand and, on the other hand, digital processuality. Conceptually, electronic signal processes foreshadow digital processuality. Also, as the development of electronic and media tools by artists and engineers progressed, it was possible to build devices with computer components and digital functions. A number of these devices were primarily designed to give the user control to drive and reposition the flow of electronic signals that had been manipulated, altered and/or processed.

In general, artists and engineers who have investigated and constructed media instruments suitable for video processing have successfully demonstrated how conceptual and technical developments intersect. The common interest of artists and engineers lies in the exploration of an electronic vocabulary insofar as they create tools that perform variations to the standardized televisual format (PAL, NTSC or SECAM), and interfere with and/or modify the appearance of the televisual medium – recording, transmission and display of audiovisual information. The exploration involves the borrowing and blending of devices or modules that can be plugged together, and also by the application of concepts from other electronic processes, such as from analog synthesizers initially designed for the audio arts. The development of an electronic vocabulary also means the expansion of the electronic modes of expressing sounds and images to the limits of what can be heard and seen.

As an electronic medium, video shares properties with broadcast television both in terms of technical specifications and with regard to their shared apparatuses. Both the signal transmission and the information compiled in the image connote a fundamental instability of the audiovisual medium. The technology of the signal transmission – whether used for video or television – generates an image that comprises a flow, an uninterrupted stream of voltages or picture elements. The video signal transmitted by the camera comprises these constantly moving elements in lines across the surface presence, or raster; the synchronization of the lines creates the format of the screen. The raster thus expresses the flow of the electrical pulses. The process of the lines being 'written' is also referred to as scanning.

In addition, two interlocked half-images constitute an 'image' in video or television; all of the information in an image is in the even and odd lines – the half-images – that intersect. A 'frame' in video is the result of two image fields intersecting with each other. The standards for each field of an NTSC image call for 262.5 scan lines (usually 256 lines are visible) for each of the odd and even parts of the image. PAL video consists of 312.5 lines for each field of video. The technical need to scan two image fields inside a frame (odd numbers from above to below and then even numbers from above to below) is to prevent 'flicker'. Through the two interlocking sets of lines, the image on the display-surface of a screen appears constant.

One aspect of radical experimentation leads to the dismantling of representational video and television toward abstraction and video noise. For example, the signal stream as a horizontal line may drift out of sync and cause deflation and deformation in the visual appearance of an 'image'. Another aspect of this direction toward signal dismantling aims to control, repeat and adjust the way an external signal or voltage is applied in the course of temporal development; the use of external signals to affect video is referred to as voltage control. It is important to rescan images that have been set drifting and to lock the signal at the end of a line of video, thus reestablishing synchronization with the image format. Among the functions of custom media instruments was to stabilize and lock manipulated images so that they could be stored and displayed using machines conforming to the standard televisual format. From early on, custom-built instruments that control, repeat and readjust altered televisual/video imagery demonstrate an internal correlation between analog and digital building blocks.

Interference with signal processing and transmission by artists has happened through the design of an instrument or has been externally executed, such as by applying electromagnetic objects to television monitors. For example, artists Steina and Woody Vasulka deliberately 'unlocked' the image, setting the signal to drift horizontally. With *Calligrams* (1970), the Vasulkas demonstrate how the horizontal hold of a video input is purposely maladjusted and the image is then rescanned. Also, in this work the camera for rescanning is set up at a 90° angle to the monitor screen, which forces the electronic structure into the vertical and stresses the instability of the electronic frame. *Demagnetizer* (1965) by Nam June Paik is also noteworthy because of the interference with the internal structure of video, but from outside. In this respect it is interesting to recall Nam June Paik's pioneering experiment to apply an electromagnetic object – a circular magnet – to the television image displayed on the screen.

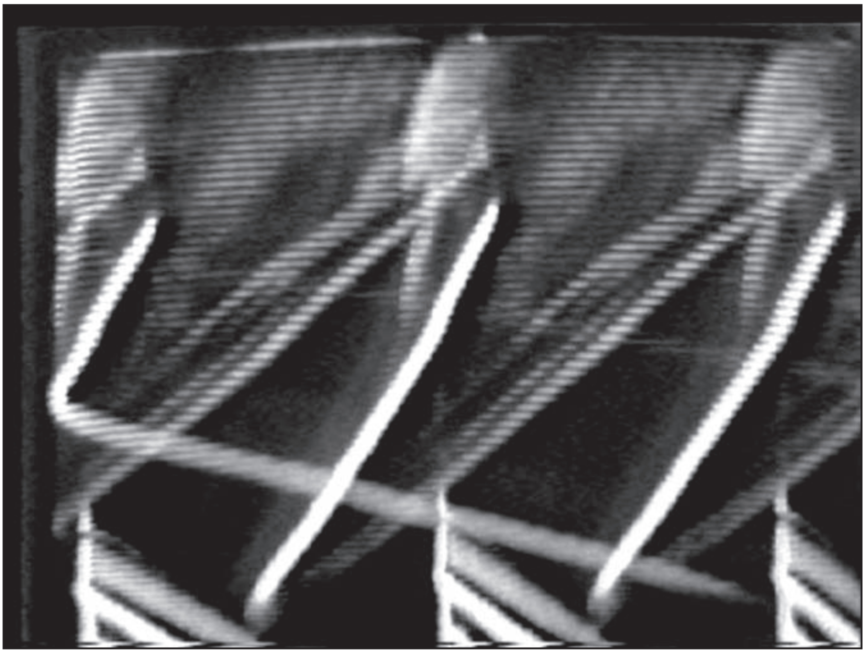

Figure 1. Still from *Calligrams* by Steina and Woody Vasulka (1970).
(courtesy. Steina and Woody Vasulka).

In the mid-1960s, the beginning era of the development of custom electronic media tools, many artists were interested in this deflection of scan lines and the violation of conventional signal transfer. With Nam June Paik's use of electromagnets applied externally to the television screen with *Demagnetizer*, he caused electromagnetic disturbances, transforming the rectangular shape of the standard broadcast image into a spinning circle. As a result, the scan lines became apparent and the two half images broke away from their usual televisual appearance as a coherent unit. In *Magnet TV* (1965), Paik also uses a strong magnet to bend the scan lines on the screen, which visually deforms the broadcasted television image so that the horizontally running electronic lines, usually invisible, are bent and twisted and become visible.

Similarly, the instrument Paik Raster Manipulation Unit (1970) is an altered television that allows the user to perform modulations of live or recorded video images, where the deflection of the course of scan lines (ordinarily left to right, top to bottom) can be reversed and become variable. Video works made on this device resemble the previous artistic manipulations with external electromagnetic distortion by Paik and others; the electronic signal appears as dancing lines. Inside this modified television set, additional magnetic fields are made possible by added deflection yokes and controls that allow the user to direct the flow of the video stream onto the screen and thus affect the shape of the scan lines. These modifications, along with the application of external audio signals, extend the possibilities of deflection, making it possible for the scan lines to be bent into various shapes, including circular shapes.

In the 1970s, Woody Vasulka was also interested in the visualization of line processing, and in the visibility of electronic waveforms in video. In *No. 25* (1975), he uses a scan processor, a video instrument that controls the width and height of an image, the intensity of bright areas of an image, and also the horizontal and vertical positions of the image on the screen. Vasulka used the Rutt/Etra Video Synthesizer (1973) to create *No. 25*. By adding an external waveform at a certain frequency, the scan processor can transform the image field, giving the illusion of a three-dimensional object; in *No. 25*, the lines were bent and stretched into a cylindrical form.

The Rutt/Etra Video Synthesizer takes an external input and, in the case of *No. 25*, the electronic information in the video image is taken from the rewinding of a videocassette. This information is treated in the scan processor, displayed on a high-resolution monitor and finally filmed by pointing a camera at the monitor. (The synthesizer has no video output. In the early days of video, some artists used a film camera and not a video camera to capture the image shot off a monitor. Vasulka thought the resolution would have been too low if recorded on video.) With the scan processor, this 'image' information is shrunk and modified to take on a cylindrical shape, which then appears as an abstract object rescanned into the 'empty' form of the electronic image (the 'video void'). The image does not convey anything beyond the presentation of the information appearing in the video void.

In addition, this video information – voltage-controlled waveforms – is at the same time displayed auditively. When the 'empty' image is curved, stretched and compressed,

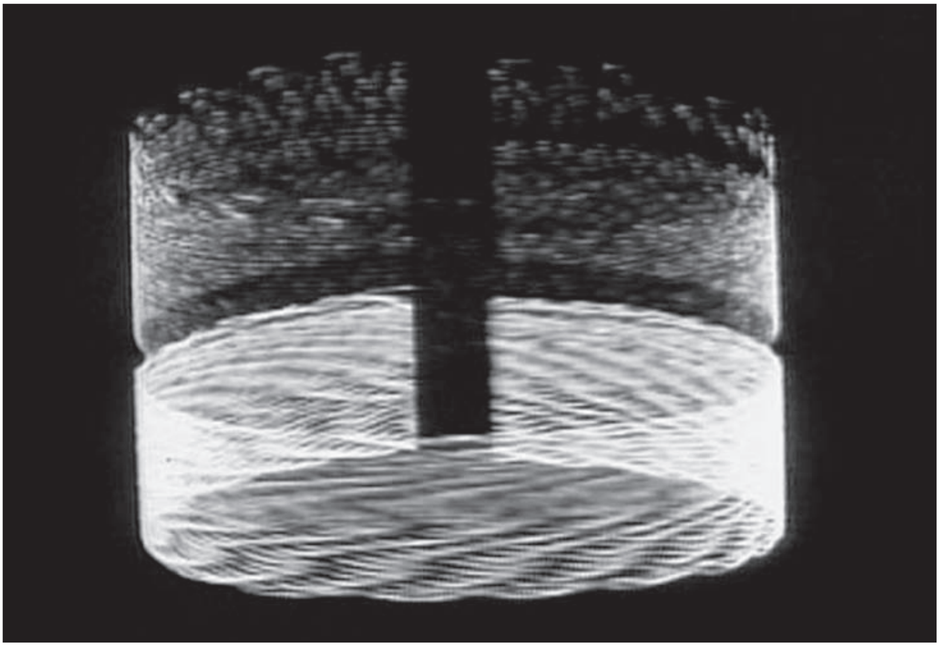

Figure 2. Still from *No.* 25 by Woody Vasulka (1975).
(courtesy. Woody Vasulka).

we see and hear at the same time 'video noise'. This video noise is grounded in the essentially audiovisual potential of the electronic medium of video. The information in the video signal can be transmitted both auditively and visually. Video is an audiovisual medium, meaning that audio signals, such as those generated by an audio synthesizer or oscillator, can be used to affect video. Vice versa, video signals can have either audio or visual outputs. More importantly, video-audio and video can be transformed into one another, and the electronic information can at the same time be heard and seen. In other words, as *No. 25* demonstrates, we hear what we see and see what we hear.

What we see in *No. 25* is a film of the scan processing of the video image and its adjustment by internal timing mechanisms, or clocks, within the scan processor. In the scan processor, one temporal operation is created by oscillators putting out audio signals at particular frequencies and voltages, a process referred to as voltage control of video. The control voltages are responsible for the cylindrical form. The effects become visible on the surface of the monitor screen when the Rutt/Etra adds synchronization pulses; in other words, the visual effects of violated signal operations occur once they are retimed/readjusted by the operation of sync that locks the violated form. Thus, the horizontal drift of the displayed lines are adjusted to the defined frame of the standard raster form. In the end, the synchronization of modified images in video to the standard broadcast signal generator is always necessary to be able to display the altered images with standard monitors. The image on the monitor electronically represents the temporal movement of the scan lines affected by processing, while the synchronization provides the timing of the flow of scan lines on the monitor. The voltage-control clock and synchronization signals are building blocks that define video's position in the media system. Here, basic programmable modules are introduced that provide the technical link between computers and video; connection exists through a clock as a pulse generator that permits the controlling of individual frames.

Another function of the instrument regards the horizontal drifting that allows the image to move horizontally through the processor. This results in stark deflation of

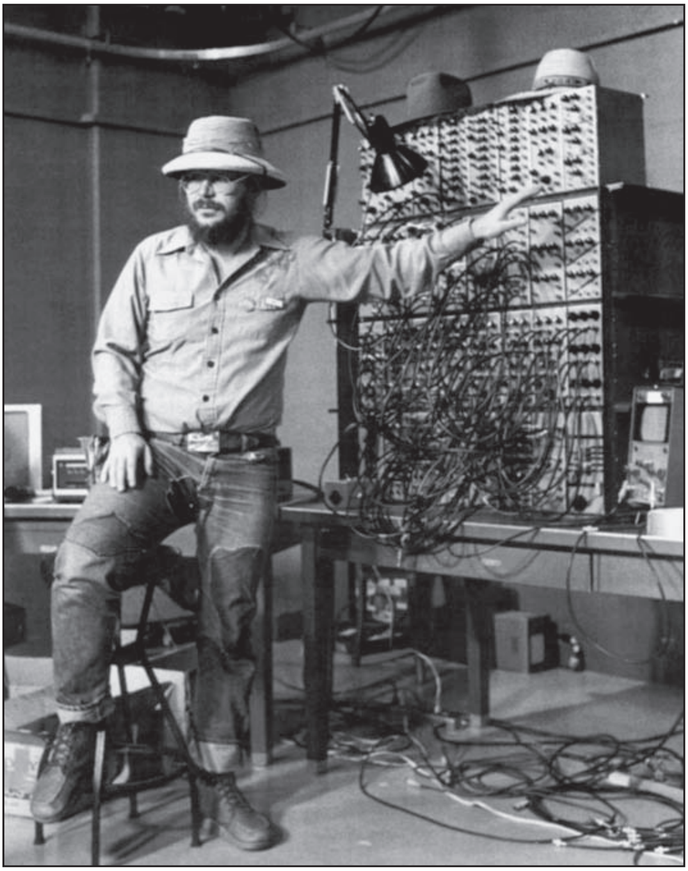

Figure 3. Dan Sandin with the Sandin Image Processor (c. 1973).
(courtesy. Dan Sandin).

the lines and causes the image to appear in the shape of waveforms. As Sherry Miller Hocking and Richard Brewster explain:

> The concept of graphic representation of waveforms is crucial to the understanding of an image-processing system [...]. The basic XY format can also be extended to incorporate a third parameter representing along the Z axis which can be conceived of as a vector extending out into space [...]. Woody Vasulka developed a technique using this type of vector diagram to locate parameters of the time frame of a video image, employing the Rutt/Etra Scan Processor.[1] This graphic representation defines the line rate, field rate and intensity information. (Hocking and Brewster 1986: 170)

Signal processing through the application of electronic voltages at particular frequencies causes changes in the shape of the raster. With one effect, when a particular control voltage is applied, individual scan lines are stretched, bent and lifted up. The brightest parts of the image are raised vertically and, as they are stretched vertically, appear wider. The contours of the image in this case mimic the graphical representation of the signal on a waveform monitor, where bright areas are higher on the scale and dark areas are lower.

By 1978, it had become possible to change the format, scale, resolution and size of the image field in individually programmed steps. With the development of the Digital Image Articulator (1978), Jeffrey Schier and Woody Vasulka constructed a machine that allowed digital processing, within which the electronic signals were sampled and constructed into discrete elements. Here, Boolean logic functions determine the interaction of signals and, through encoded processes, the look of 'images'. The digital display of the inner structure of signals differs from the display of analog signal processing and the effects of voltage control insofar as time-controlled images can now be stored and retrieved. Nevertheless, a correlation can be drawn between the analog video clock and the digital clock with regard to controlling time.

It is important to keep in mind here that, as opposed to the analog processing of signals in real time where shape and pattern of video are altered by frequency and voltage, digital processes require coding and commands in the computer through mathematical functions. Analog processors work principally with variables that are set by existing electronic voltages, and are expressed as a flow of these varying voltages over a certain time period. Real-time processes and sequences are set up through patch programming, for example with Dan Sandin's analog Image Processor [IP] (1972). Such processors or synthesizers were built to enable the user to patch modules with specific functions, thereby increasing the capacity for modifications of video signals. Although the tools are analog, they can be discussed under the rubric of machines with programmable functions. In this respect, video processing means a kind of computation, and certain optimized processors, such as the Image Processor, function as analog computers.

When Sandin describes his tool, he stresses the optional functions of computing but also makes clear that the instrument – like the scan processor – needs an external input. Such an external input is not required with a digital computer. Sandin describes the Image Processor as an analog computer as follows:

> In brief, the Image Processor (IP) is a patch-programmable general-purpose analog computer, optimized for the real-time processing of video images. […] The IP accepts naturalistic images, modifies or combines them in complex ways and displays or stores the result. A television camera, film chain or video tape recorder or similar device can be used to encode moving images into a form which the IP accepts. A television monitor decodes the signal and displays the modified image. The instrument is programmed by routing the image through various processing modules and then out to a monitor or video tape recorder. The modules are designed to maximize the possibility of interconnection, thereby maximizing the number of possible modifications of the image. The IP is designed to accept external signals from such devices as biological and environmental sensors. (Sandin 1973)

When further discussing computation in relation to video tools, it is important on the one hand to stress the connection between patchable tools (which do offer a form of programming) and tools that are programmable through software. However, on the other hand, one must also maintain the distinction between analog and digital in order to identify the specificity and 'advantage' of digital control of the video image. What defines the Digital Image Articulator as digital is that the machine has numerical functions, and is based on binary codes and Boolean algebra. The conversion of analog to digital is thus defined: 'The procedure implies the installation of an extension card reserved for converting the video signal. Rendering in numbers can be effected continuously or image by image' (Poissant 1997: 238).[2] Here the analog signal of video is converted into discrete values that are operated on by the computer as numerical values: 'It is a case of a mode of presenting given values in the form of physical quantities (voltage, current) where the signal follows the same laws as the variations in the phenomenon studied' (Poissant 1997: 10).

It is helpful to acknowledge processing machines as analog computers 'where problem variables are represented by electronic voltages which can vary continuously within a certain range, usually -10 to +10 volts for a transistor-based machine. Electronic circuit modules allow the variables to be added, integrated (with respect to time) and multiplied by a constant' (Computer Museum 2012). The point of difference is that although analog and digital computers both operate on Boolean logic, the program can be changed dynamically with a digital computer. The results of analog computation can be shown graphically 'or be digitized for being stored or further processed by a digital computer in a hybrid system' (Computer Museum 2012). In digital computers it is the bits that define the information of a pixel, which possesses a locatable address and a definable content and color value. With the above definition of analog computers, we can, on the one hand, categorize analog tools that have programming functions and operate on the basis of plug and switch connections as computers. And we can identify digital image processing as based upon numerical methods of control, and codification and algorithmic manipulation of discrete units. At the same time, we can also distinguish between these two types of computer functions, and make their connections evident.

It should be clear by now that the borders between analog and digital computers are permeable. In a historical view, the development of computers along with other media tools needs to be contextualized within the dynamic field of media evolution that is characterized by intermedial encounters. In this respect, the new spirit of collaboration between art, science and technology that emerged with video goes hand in hand with the possibilities of modular tools – such as image processors that have patch-programmable connections and can be plugged together in a different order each time. With the introduction of the general-purpose analog Image Processor, Sandin already, in the early phase of video, managed to demonstrate a high complexity of processing video in real time, one where the patching of modules maximizes the possible combinations. And in this context of analog programming as it foregrounds the digital, the artistic exploration of both video and audio, and the experiments with their interchangeability in the electronic medium of video, just adds another dimension to the basic conditions of video as a medium of its own. The modification of electronic signals provides the medium with an optionality that is further reinforced with the optional use of instruments that can be combined and plugged together in variable order.

Shaping electronic media

Electronic culture

In the early days of experimental video, explorations into specific features of a real-time medium that could be processed live, led to the invention of multipurpose video machines that could be combined and plugged together in variable order. Shortly after the technical system of a portapak video camera and video recorder was introduced, video praxis was enhanced with a wide range of analog tools. (The date of 'birth' of the portapak as 1965 is debated.[3]) The new analog tools included audio synthesizers, video synthesizers, multi-keyers, colorizers and sequencers. In many cases, these tools were meant to be plugged together to enhance video processing, and the development of smaller and more mobile devices departed from the equipment available in TV stations.

Regarding the variety of tools, video synthesizers, analog image processors, keyers and sequencers were among the tools constructed and explored by many artists and engineers in close collaboration with each other and parallel in time to video pioneers. Particularly in the early 1970s, many of the tools were introduced in live performances to continuously shift waveforms, frequency and voltage and to alter synchronization of the flow of video signals. A common goal was to express technological determinations that were specific to video, and could express video as distinct from the languages of previously conceived media, namely television and film. And besides the possibility to continuously and dynamically change the appearance of video in analog computation, which differs from the recording of 'images' in film and photography, it was this graphical function of the processors to view the operation of amplifiers that certainly attracted video pioneers to explore analog computers for use in video. It instigated the construction of new tools but also the incorporation of digital elements into analog machines, which marked the transition from analog to digital within the medium of video and essentially foregrounded digital video.

Interestingly, the debate over analog and digital was not an issue in the 1970s when the first digital tools were available. Rather, the concern at that time was more with maintaining a position of electronic arts as art against the technical supremacy of film and photography. Both were believed to be visually of superior representational quality to the 'poor' black-and-white, rather gray and unstable video imagery. Considering the overall picture of the plethora of experiments that rework and remediate existing media settings with applications of new tools, one is struck with the observation that video pioneers were more interested in aesthetic-technical experimentation with the visual, audiovisual properties of video than in the creation of 'images' as confined through the representational tradition of painting, photography and film. Even though imbalance and tension between experimental film and elecronic arts were strongly felt (video in the first decades considered technologically imperfect compared to film), the challenging environment for video development needs to be seen in the context of the larger emerging electronic culture. The culture started off with television, a medium that, according to video pioneer and promoter of satellite television Nam June Paik, had opened a new dimension to produce 'art for 25 million people' (Paik 1984).

This direction of public media begins with the introduction of television and its leading role after the 1950s. The richness of electronic endeavors in tool development and art making also benefited from an optimistic and visionary spirit as expressed in the writings on media theory by Marshall McLuhan and Buckminster Fuller. The climate of emerging electronic culture instigated not only in-depth discussions and hands-on collaborations among artists, scientists and engineers, it also led to the groundbreaking machine performances in the 1960s of the group Experiments in Art and Technology (EAT). The theoretical reflections of EAT paved the way to an understanding of cybernetics, intermedial relationships and modular processes in a rapidly changing and interconnected media world, whereas the artists' experiments with technology envisioned the future of an electronic culture. This environment of theory and experimentation would lead to interactive and collaborative media arts and would overcome divisions of artist, artwork and spectator. The breakdown of art and media borders (through divisions of high art and low culture) also meant a more natural dealing with the quotidian use of new technologies for multiple purposes, as proposed in Buckminster Fuller's comprehensive thinking that provided a cybernetic model for hands-on production and networked machines.

So when video technology was first imported from Japan to the United States, with Sony's 1965 release of the first model CV-2000 video decks, the cultural field converging art and technology – be it in open-ended and multimedia events, performances with machines or with wearable devices like microphones and transmitters – was largely established. Influential milestone events in this direction were Jean Tinguely's staging of the self-destroying machine in the garden of the Museum of Modern Art New York in 1960 (*Homage to New York*) and performances of the EAT group led by Billy Klüver and Robert Rauschenberg. For the EAT performance series '9 Evenings: Theatre and Engineering' in 1966 (Klüver and Martin 2003), Rauschenberg had made an interactive environment from five AM radios where he asked the viewers/visitors to alter the frequencies. Rauschenberg's work offers an early example of how to use technology as both medium and tool in the participatory setting of an open art piece.

Not unlike Rauschenberg's initiative, Nam June Paik responds to McLuhan's vision of networked media communication with the videotape *Global Groove* (1973), asking the viewer to actively participate in the video process of dissection. Paik encourages the viewer to close one's eyes or half-close one's eyes when regarding the material of filtered images and sounds from television programs, programs that Paik had deformed with the Rutt/Etra Scan Processor and multiplied and modularly rearranged with the Paik/Abe Video Synthesizer. The synthesizer was designed by Nam June Paik and Shuye Abe in 1969; the one used by Paik for *Global Groove* was built at the Experimental Television Center in 1973 by Abe with Bob Diamond. Different from the standard use of synthesizers to generate the means to synthesize audio and video internally, Paik was more interested to employ his tool like a processor for the manipulation and decomposition of incoming televisual images. When viewed together, Rauschenberg's and Paik's alterations of media transmission represent different ways to perform live with the technology of mass media communication in a way aberrant from the technologies' usual institutionalized appearances. These alterations happen by defamilarizing their audiences with standardized tools, presenting radio (Rauschenberg) and television (Paik) without broadcasting.

In view of the audiovisual correspondances in video, another piece of Rauschenberg's from the same '9 Evenings' series provides an equally far-reaching concept, where the combination of audio and visual effects foreshadows audiovisual interactivity, specifically electronic interactivity. In Rauschenberg's piece, a tennis match was carried out with tennis racquets that were each equipped with a radio transmitter, microphone and antenna. When the ball hit the racquet, the vibrations were transmitted to speakers and their sounds caused the lights to dim gradually until the space was dark and the performance ended. This incorporation of radio, electronic transmitters and audio waves in the performative arts not only led the path to the early incorporation of design elements from audio synthesizers into custom video tools; it also provided an example of the intermedial nature of audiovisual technology and its crucial performative qualities.

This approach to interactivity with video was in particular highlighted in the music and machine performances by Steina Vasulka that intentionally departed electronic pictorality from the image form as an entity formal unit. In performances of *Violin Power* (1970–78), Steina used primarily the Rutt/Etra Video Synthesizer in conjunction with the Frequency Shifter designed by Harold Bode (1964), and the Multi-Level Keyer designed by George Brown (1973). The performances demonstrate how the sound of a violin performed live governs the display of the video signal: the signal displayed on the monitor screen is a deflection created by the sound of the violin simultaneously with its performance.[4] Not only are the audio and video interacting, also the artist performs the internal linear signal structure of the electronics through the tool of the processor in such a way that the performative capacity – essentially the live video medium – is forced into visible and audible appearance and expression. Experimentation with televisual behavior of images and sounds, in the strict sense of performing the specificities of a medium, necessarily drives video apart from representation toward abstraction. The tools that were built to support this direction amplify the scaling, speed and pattern of the electronic process, and cause disturbances to the standard televisual image.

Returning to Experiments in Art and Technology, the group's public events formed the path to media artists interconnecting experimental performance and innovative machines. Billy Klüver set the tone when describing the balancing act of involving industry support from Bell Telephone Laboratories for '9 Evenings', and 'modifying custom-built equipment'. As the program notes reveal, the most ambitious tool was a Theatre Electronic Environmental Modulator (TEEM), designed by Per Bjorn and Robby Robinson specifically for use with '9 Evenings'. As Klüver explains:

> It would, however, be foolish and irresponsible, to describe this equipment as terribly extraordinary in technical terms. Compared to the missiles at Cape Kennedy and the large computers it is peanuts. This is rightly so. The artist cannot be expected to make use of the most sophisticated aspects of technology, even if he [has] access to these, since he is confronted with a new material. What gives our equipment its unique value is that it was built for no other function but to be part of the performances. The equipment is built from scratch and is a result of direct interaction between artists and engineers. (Klüver 1966).

As noted above, by as early as 1973, several image processors and keyers had been built from scratch as specifically designed video tools, and as opposed to modifications of machines that were already in use. These novel machines were built in small numbers and by artists themselves, or by others in close consultation with artists who requested specific features for modifying and controlling electronic processes. One problem artists and engineers were trying to solve was to be able to duplicate, repeat or capture a processes that could only occur live. For example, some artists were interested in tools that allowed for the repositioning of the frame or that could repeat effects such as the horizontal drifting of scan lines.

One of the early tools to help control the effect of 'unlocking' the video stream from its conventional state was the Horizontal Drift Variable Clock by George Brown (1972). This device is a pulse generator, which determines the extent of the horizontal drifting and allows the user to control the deflection of the horizontal synchronization signal. Without sync the image deviates from the raster of the standard television format. Once the video 'image' is altered and set adrift, it needs to be repositioned through a rescanning process in order to be displayed in conventional video systems. As already described above, the clock, generating synchronization signals through an oscillator, is a necessary step in the development of media tools for the retiming of violated images. The clock is also necessary for the repositioning of images with, for example, the Multi-Level Keyer, when many input sources are arranged in layers according to changing priorities. As noted above, in 1973 George Brown developed the Multi-Level Keyer; this tool has a built-in clock and possesses a form of elementary programming to define a hierarchical arrangement of as many as six different layers of source video.

In summary, these unique tools – together with the adaption of existing equipment such as audio synthesizers – express the spirit of electronic art making, and served the need of some video pioneers to deliberately control the flow of electronic waveforms. These artists wanted to take advantage of modules with different functions that could be plugged together in a variable order. By the end of the 1970s, these general-purpose analog computers were enriched, and digital imaging machines were built that would emulate the analog processes but would produce video systematically, as a result of programming systems based on software. An interesting novelty that occured around 1980 was that analog-digital converters became available and could transform video information into numerical code that could be modulated regardless of its original form. By cutting off the relationship of information to its original physical manifestation, we enter the area of technical simulation, and as a result, video is completely set free from camera obscura and pinhole perspectives. Remember, this freeing of video was already an achievable goal in most of the custom electronic tools. However, simulated, nonrepresentational images, sounds and synthesis were not fully controllable through features in analog synthesizers; digital design elements would add accuracy and repetition, and allow for storage.

Artists and engineers

As noted above, video experiments of the 1960s to 1980s, particularly those that connect and incorporate both analog and digital image processes, exemplify the specific position of video in the media system as a bridge between analog and digital tools. The connection of video processes is from analog systems (patch-programmable) to digital programming systems (with the capacity to emulate the analog computer on a digital machine). This connection proves itself most relevant for the articulation of an electronic vocabulary. In this respect, video experiments utilizing such tools as synthesizers and keyers that are based on fundamental variations of waveform, synchronization and feedback contribute to the specificity of video. The vocabulary of video is further enhanced and enriched with digital tools which build upon such experiments.

In light of the attempt to articulate the specificity of the video medium, a detailed discussion makes sense concerning art making using equipment embedded in the larger media system during the period of the 1960s to 1980s. During this time span, new instruments for use with audio and video were conceived and built, which interconnect and exchange the auditive and visual energy of the electronic signal. To fully understand the audiovisual nature of the electronic media, one can look to the underlying conception of sounds as introduced by John Cage in the 1950s. For Cage, the composition 'of' sounds would be of higher relevance than the composition 'with' sounds. Prior to the 1950s, Henry Cowell had analyzed noise-sounds and in 1930, coined the term 'clusters' to characterize the phenomenon of chords of tones that merge and cause noise effects (Cowell 1969). The understanding of noisy sounds was influential in audio experiments that focused on sounds and clustering of tones rather than on music with a traditional sense of composition. What connects sounds and visuals at the structural level is the processual nature of the electronic technology that characterizes the raw material as noise. In this respect, video is just another kind of noisy sound, and experimentation in electronic music can be seen as a precursor to video experimentation. This is especially true in that synthesizers and various oscillator-based tools were used in audio arts for the modification of sounds.

Figure 4. Still from *Artifacts* by Woody Vasulka (1980).
(courtesy. Woody Vasulka).

Regarding video's raw material of noise, as discussed above, input and output energies of audio and video can be dealt with as interchangeable impulses to process the waveforms of electronic signals, and instruments can be connected at the same time to hear and see the graphically displayed modulation of frequency and voltage, the point being that tools for manipulating the size and form of the waveforms colorize the image and/or multiply the possible modifications and number of sources that can be layered (such as with keyers). When viewed together they express an operational mode that aims to control the smallest information unit, which is the electronic (audiovisual) signal.

On a structural level, analog instruments can be compared to computer programs which control bits and digitally alter the address data (location) and value of pixels. The link between analog and digital processuality of the smallest unit in each mode can be seen in the control functions of machines of both types. It can be argued that the more analog machine operations result in control over the maneuverability of the smallest units, the more these operations can systematically interfere with the standard televisual raster format. In addition, the more effectively these operations manipulate and even violate the inner structure of the electronic medium, the more they lay the groundwork for digitally controlled effects, respectively the maneuverability for discrete processing of individual image segments.

One interesting link between analog and digital tools is the incorporation of the clock in the early keyers of the 1970s, whereby they control shifting priorities. In particular, George Brown's Horizontal Drift Variable Clock described above belongs to a category of programmable devices designed to provide an external source, or clock, for synchronization of a video signal that controls the speed and extent of horizontal drifting of the image. The device's programmable function secures the repositioning of the image after it has been set adrift, and allows the subsequent relocating and layering of image sources. Finally, a control clock is needed for keyers to solve the task of prioritizing a number of sources that are being layered. Furthermore, synchronization of the video signal through clocked pulses is necessary for any raster to appear in the standard television format. Thus, the clock function means that the synchronizing signal pulses can be demonstrated and repeated in every video display system.

To conclude, I would now like to discuss tools that are at the core of the passage from analog to digital; these are tools that permit control of real-time processes which are inherent to video. In this context, control means to systematically carry out the same set of functions and be able to repeat the same effects of those functions.

As demonstrated above, similar to any other new technical medium, video developed from technology to medium in various steps. In particular, the establishment of video's media aesthetic as an art form with an electronic language of its own paved the way for the informative intersection of analog with digital media tools. The development of this new art form resulted in the conception and construction of digital functions of devices that were not attached to, but built into, video equipment. The aim of building novel devices was to enlarge video's capacity and thereby also distinguish the manifestations of video from related technical analog media, such as film and photography, in terms of the scale of the form, the tempo of display, and the pattern of appearance. This direction of tool development naturally leads towards the convergence of analog and digital computers.

In particular, video devices, such as clocks and keyers that incorporate elements of digital control, point to the direction of processing smaller units. But where the analog clock's synchronization operates within the linear mode of the electronic waveform, digital computers' operation on bits affects pixels as the smallest digital units. What becomes evident in early video instruments is that these analog devices have programming functions through plug and switch connections. As noted above, basic programming functions were built into real-time processors such as George Brown's Multi-Level Keyer and Dan Sandin's Image Processor.

The IP's analog programmable functions become evident in Sandin's videotape *Triangle in Front of Square in Front of Circle in Front of Triangle* (1973). Sandin performs keying involving image prioritization with simple geometric forms. Through their arrangement in the Image Processor, the geometric objects display layering that appears logically incompatible. Sandin describes the video as:

> [A] demonstration of the fact that thinking of video keying as putting one thing in front of another is inaccurate and limiting. The Analog Image Processor was programmed to implement the logic equations: if triangle and square show triangle, if square and circle show square, if triangle and circle show circle. (Sandin 2004)

While Sandin presents the concept behind keying using the IP, the main creative source for his tool invention was the shared research environment of artists and engineers. Sandin, an artist and educator, started the Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago Circle Campus in 1973 with computer scientist Tom DeFanti. From long experience Sandin argues for the necessity of converging the expertise of artists and scientists as follows:

> The idea of artists bringing creativity to scientists is insulting to the engineers and the scientists, who think they are already creative. In our view, media artists should be supported by sciences because media artists share visualization technology with science; artists are trained in this technology; artists are trained in a range of visual studies; artists know about presentation, and artists are good project organizers. Finally, artists create new media, new ways of working with media. These are the reasons why artists should be supported within the research environment. (Sandin, DeFanti, Kauffman and Spielmann 2006: 220)

Another far-reaching example of collaborative research is the collaboration between video pioneer Woody Vasulka and programmer Jeffrey Schier on a fully digital device, the Digital Image Articulator. The instrument was developed during 1978–80, and the tool contributes substantially to the transition from analog modulation to digital processing. The leading concept of the collaboration was to create a tool to display the inner structure of images and sounds. Here, microprocessors were capable of real-time image processing, and the Digital Image Articulator was an approach to 'look behind the images'. The point was that the system could treat the analog-to-digital converted image information as encoded processes, and change the pattern of appearance on the matrix level of algorithmic information. Finally, the machine displays patterns of instantly moving images that allow for a wide range of different densities, and through the insertion of color and texture allow a certain number of bits to be processed in real time. The Digital Image Articulator displays the binary codes in the same interlaced fashion as analog video, with two fields of 262.5 lines per field, the standard televisual image format. In addition, one can say the tool demonstrates the distinction between switching and programming. Plug-in tools characterize analog technology, whereas digital computing is defined by encoding and by programming through all-purpose microprocessors.

To further explain this distinction, we can look more closely at Sandin's Image Processor, which uses cables and plugs to patch, and whose effects could be performed live. To stress the distinction, patching is an early or simple form of programming. Another step toward programming is taken with the Digital Image Articulator, whereby the interface to the LSI-11 microcomputer allows connection between its microprocessor and the video processor to request usage of a particular buffer. As stated in the manual for the Digital Image Articulator, digital encoding differs from analog plugging and switching not only technically but also conceptually.

In raster scan graphics, two schools of thought were prevalent when dealing with image formation. One is the processing view, where signals are seen as real-time signals that may be delayed, modified, or switched, but must conform to the restrictions of 'real time'. The other approach is the buffer or storage mode, where information is taken in and stored as sequences of still photographs and replayed or recalculated as a memory array. (Vasulka, Schier and Moxon 1979)

Once the buffer request sequence is successful, a block of data may be written into or read from the buffer. The control of the computer and the code also means that the LSI-11 is responsible for setting the buffer priority registers on the eight image buffers. In light of the technical level of digital image processing that was available at the time, Woody Vasulka has rightly expressed his view in the work *Artifacts* (1980), a series of studies to demonstrate the digital tool – a tool where one had to share the creative process with the machine.

Categories of instruments

The categorization of instruments needs to be further differentiated, as some of the tools created in the early days of experimental video have misleading names. There is a lack of precision in definitions to differentiate synthesizers from processors, which has its roots in the naming of instruments by the creators. These pioneers knew exactly what their tools were capable of, and were less interested in categorial determinations that exist in the debate around video. For a better understanding of the different functions of the tools, we need to keep in mind that an audio synthesizer is a device with which sounds can be generated; as noted above, audio sources can be used to synthesize the video signal as well. Furthermore, synthesizers (audio and video) are essentially used for compositional processes which happen inside the machine and generate a video signal at the output. In contrast, a scan processor works with external input (which is also needed in the keyer), and is designed to analyze and modulate the incoming light values. It processes electronically the information coming in from outside. Both systems, synthesizers and scan processors, have functions to cause a shifting and drifting of the signal processes in time, and can manipulate them live and continuously.

Given this definition of different kinds of instruments, predominantly the devices of Eric Siegel (Electronic-Video-Synthesizer [1970]), Stephen Beck (Direct Video Synthesizer [1970]) and Dan Sandin (Analog Image Processor) would be included in the category of synthesizers. In the synthesizer, the signal passes through various interlinked modules, all of which have input and output connections, which means that they are received and transmitted. Once we look closer at the actual instruments, their operations and the ways in which they are employed in video practices, it is necessary to further differentiate. If, by definition, a synthesizer is designed to usually generate and synthesize the signal, then we have to limit the category of synthesizer to the devices designed by Beck and Siegel. By contrast, the devices of Dan Sandin and the Paik/Abe Video Synthesizer (1969) work with external inputs and do not generate signals. From this viewpoint, it seems more appropriate and less confusing to place Sandin's Image Processor and the Paik/Abe Synthesizer – despite the name of the tool – into the category of processors. They do not synthesize a signal but depend on an external input signal, an external source of imagery like any processor.

In view of these peculiarites, the so-called Paik/Abe Video Synthesizer – which was conceived by Korean fluxus artist Nam June Paik and Japanese engineer Shuya Abe – works like a processor with video inputs and thus external image material. The ways in which Paik uses the instrument are best expressed in the WGBH studio sessions of *9/23/69 Experiment with David Atwood* (1969). (WGBH is a public television station in Boston, Massachusetts that offered residencies to artists from the late 1960s to late 1990s in the New Television Workshop.) The Paik/Abe Synthesizer produces a visual collage from manipulated electronic signals and recorded television material. The television material is cut up, deconstructed, defamilarized and compressed, with superimpositions and segments altered in intensity and color using luminance values. The result is an abstract, colored, moving texture. Generally, Paik was not interested in analyzing and manipulating signal processes themselves, for which a processor is usually applied, since he rather works with the premise of decomposition and recomposition of existing medial images taken from television programs. In describing the Paik/Abe Synthesizer, Jim Wiseman states:

> Basically, the Paik/Abe Synthesizer is a device designed to accept 14 different inputs from either black-and-white video cameras or audio tone generators. It translates these images into color video images and/or patterns which may be displayed on a color video monitor or recorded on videotape. Controls are provided for mixing up to 7 inputs at one time and for altering the character and color of the final image which can range in tone and color from exaggerated black and white through pastels, to highly saturated electronic colors found nowhere else in nature. Alterations in strength and character of any of these inputs or changes in setting of the controls will produce obvious changes in the whole output image. (Sandin 1973)

In view of novel devices that were built specifically for the performance of video, Bill Etra's description of the analog Rutt/Etra Video Synthesizer reflects a pioneer spirit in developing these custom machines, which were intended to be marketed as a standard tool, but were not successful commercially or in the mass media:

> I knew almost nothing when I started. I knew you had to sum the waveforms. That was obvious from the oscillators. I knew you had to attenuate them, which is multiplication. Steve [Rutt] knew about diodes, resistance networks etc. The first machine we built was really deflection on a regular oscilloscope. […] I thought it was going to cost under $5000 and be sold to artists and schools. […] The price went up because we tried to sell it to broadcast engineers who couldn't use it anyway. They didn't have the initiative to use that sort of complex equipment. (Etra and Rutt 1973: 136)

The Rutt/Etra Scan Processor and Dan Sandin's Image Processor were each only produced in less than 20 units. While Sandin – who also made the IP schmatics available for free to the general public – used the tool in his own individual video works, the Rutt/Etra was largely used by video artists. Gary Hill employs the tool in *Picture Story* (1979), recombining dissociated linguistic elements (text, image and language) and corresponding visual and reading processes by reversing the left-to-right orientation and presenting the text upside down. (See Color Plates 24 and 25.) The Vasulkas were more concerned to study the deflection of scan lines, and to present waveforms as three-dimensional configurations. The geometrical forms resulting from experiments by the Vasulkas resemble distorted screen surfaces, the outlines of which can represent, among other things, rectangles, ellipses, cubes and cylinders.

The Rutt/Etra Scan Processor manipulates the information of the camera input in real time, processually and electromagnetically, and allows the electronic signal to deviate from the usual linear sequence and the raster form of the frame. As discussed above, through one effect used by the Vasulkas, the brighter parts of the 'image' information are lifted up so that the horizontal lines deflect vertically and create sculptural forms. The deviated 'image' then needs to be controlled through synchronization within the raster frame. Bill Etra explains:

> The important contribution of the Rutt/Etra was in the concept of retiming of the image frame relative to the incoming sync. [...] The standard modules consisted of waveform generators, summing amplifier, and ramp generator. The ramp programmer was optional, allowing the user to do more than one move. The Joystick X, Y, Z controlled was also an option; it was a manual interface which could be assigned to control other devices. (Hocking 1986)

A decisive advantage of a graphic system like the Rutt/ Etra Scan Processor consists in the ability to reposition the image. This function has a spectrum of variations including the zoom, rotation of the image, and reversing of the right-left and upper-lower relationships in the image raster. The visual results of adding energy and multiplying variables in the scan processor, for example, are shown in real time on an oscilloscope which is built into the device.

Inside the Rutt/Etra, a 'ramp generator' governs the voltage in the synthesizing function, and is responsible for generating sound and image, an audiovisual simultaneity of the electronic information from the same source. This source creates at the same time

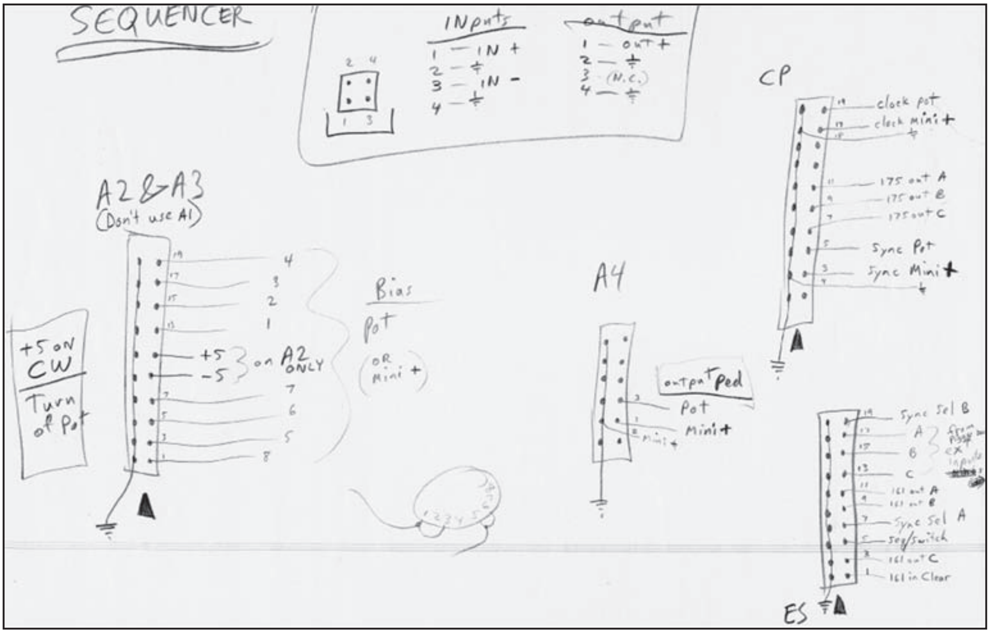

Figure 5. Drawings by Dave Jones for the Jones Sequencer (c. 1980).
(courtesy. Dave Jones).

the shape of the visual pattern and the electronic sound of this particular visual signal. An oscillator, or waveshape generator, is responsible for reshaping the pattern of the source: 'These waveforms are also used to reshape and animate external images being processed in the synthesizer. When used in combination with other waveform generators or ramp generators, it produces waveforms that are constantly moving, or ones that change from one state to another upon command' (Etra and Rutt n.d.). Thus, the same source is affecting sound and image simultaneously.

In this phase of cocreativity, artists and engineers wanted at the same time to understand and shape the specific mechanisms of the developing medium, and thereby dynamically define the range of its aesthetic language both within and through modification of the technological settings. For example, the tool designer Dave Jones was involved at Experimental Television Center in Binghamton, New York in making the connection between analog and digital processes. He participated in research to interface the LSI-11 computer into the Center's studio in an attempt to have the computer create and control video.

In addition, Jones designed the Jones Sequencer in 1975–76, which could take voltage control inputs as well as be operated manually. The Sequencer instrument can switch and select from eight separate inputs. Not unlike the above-described processors and keyers, if not being manually operated, the sequencer needs a clock (a pulse generated from an oscillator) to define the positioning of the images in time and to vary the rate of switching. As the system manual explains:

> When using voltage control, the rate of the sequence, as determined by an external clock such as an oscillator, can range from extremely slow with vertical interval switching, up to several multiples of the horizontal frequency which allows juxtaposition of signals within the divisions of the raster. (Hocking, Brewster, Bode, Rudolph and Schlanger 1980a)

Interestingly, different artists, such as Nam June Paik, Steina and Woody Vasulka, and Gary Hill in the United States; Robert Cahen in France; and Peter Donebauer in the United Kingdom had used similar or even the same type of effects machines to generate electronic pulses, synthesize images, and manipulate time – that is, control – the interlacing of different parts of the image. For these artists it was interesting to work with video because of its processual structure. In this context, tools were applied mainly to use video's brightness for alterations in the appearance of the visual form, to shift frequencies for feedback and delay effects, separate the scan lines, and unlock the signal as it runs in lines during the scanning process, such as horizontal drifting in Vasulkas' *Discs* (1971) and other segments of the videotape/installation series *Matrix* (1970–72). Like the Vasulkas and Hill using the Rutt/Etra Scan Processor in the United States, Cahen was interested in the aesthetic display of oscilloscope effects and worked with waveforms which were combined modularly. In the United Kingdom in 1975, Peter Donebauer, with his Videokalos Colour Synthesizer, conceived a device that enabled him to perform

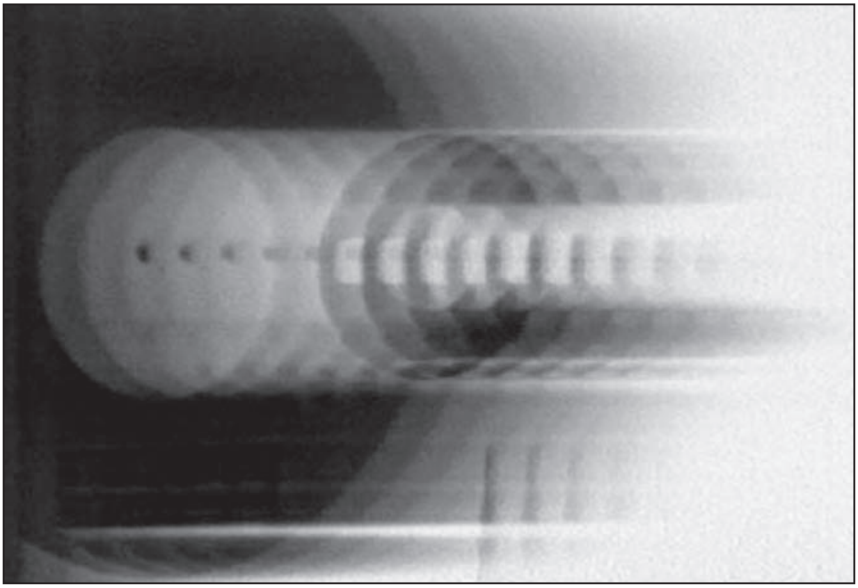

Figure 6. Still from *Discs* by Woody Vasulka (1971).
(courtesy. Woody Vasulka).

video live. In open processes, he demonstrated the synchronization of audio and visual elements towards an electronic syntax.

A striking example of image processing can be found in Woody Vasulka's study *Vocabulary* (1973), which combined the Rutt/Etra Video Synthesizer and a keyer. The work already belonged to the dimension of simulation and thus foreshadowed effects with digital machines. A keyer operates with changing luminosity values and defines the threshold between two video sources combined in the same image. With such a luminance keyer, certain bright or dark values can be removed and replaced with a second video source. As a result, new spatial relations between represented objects emerge that are based on light values, and depart from the actual positoning of the objects in space. There is a simulation of spatial appearance within the constraints of time-based analog media, made possible by tools such as keyers which provide early steps of programming and thereby bridge analog and digital.

In the broader sense of computer-driven simulation, we need to specify the relation of processing with analog electronics to the programming, adding and multiplying in the binary mode. Connections in digitial modes are made of 'or' and 'and' commands, and they also include the possibilty to reverse the processes – as in digital morphing. This option for reversal is not possible in the analog realm where the analogous relation to something in the physical world (the light information that is translated into the video signal, for example) cannot be negated. In the digital realm, it is possible to endlessly multiply and reverse applications in all directions and dimensions. In contrast, the analog process is bound to linearity, and analog video belongs to the category of time-based media. More important when comparing analog and digital media machines is the fact that, with algorithms controlling the commands for carrying out mathematical-logical processes, the artist's creativity shifts. He or she does not need to know how the program is translated into a sequence of commands which the machine performs. In this categorization, analog media tools are bound to a physical relation between the represented information (light) and the representation (the signal). Here 'analog' means in accordance with events in physical reality; the artist can interfere directly and alter, distort and almost destroy this relation, visible in the disturbing images of physical objects such as a hand and a sphere in seemingly impossible physical relations in *Vocabulary*. These kinds of relations – representing 'something' – are not relevant with the mathematical-logical expression of audiovisuality in digital computers.

Plug-in and programming

Once the 'image' had been recognized by artists as a real-time event, and defined at its most basic level by values of intensity, it could be organized according to any priority. Other kinds of instruments with specific purposes were needed as digital systems to control real-time processing, and to store and retrieve the larger amounts of information needed for real-time video than, for example, text. The Frame Buffer (1977) designed by Dave Jones, provides a necessary function in digital video processing for storing information in memory. When an image has been converted from analog to digital, and a discrete numeric value is assigned to each luminance value, the digitized information

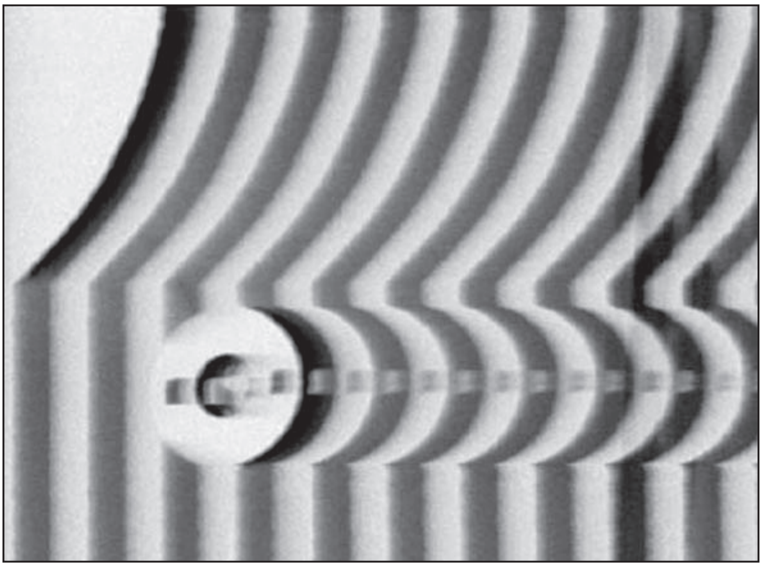

Figure 7. Still from *Discs* by Woody Vasulka (1971). (courtesy. Woody Vasulka).

needs to be stored by memory buffers. A buffer that temporarily held a complete frame of video was referred to as a 'frame buffer'. As the 'Studio System Manual' of Jones's Frame Buffer reads:

> By a process called selective storage, the buffer can grab a single whole image or selective sections of an image. Using a second video input image as a reference, a keyer-like device determines what part of the image, in terms of gray levels, will be updated with new information to be stored and what part will remain from the last storage process. Using the computer, you can also write on top of the stored information or create and paint new images. (Hocking, Brewster, Bode, Rudolph and Schlanger 1980b)

Since before desktop computers were invented there was no way to store video digitally; any digital signal needed to be converted back to analog. The signal would then be further processed, if desired, with other electronic media tools and recorded to videotape and/or displayed. The question of an image, then, that was inherited from frame-bound filmmaking and had already been challenged in electronic transformations, loses its importance. The digital task is to build an image system with its own vocuabulary. With foresight, Woody Vasulka had made the prognosis of abstract, nonrepresentational, digitally-processed video information in 1978 when he said: 'At this point it may sound almost popular-cultural, but that's the fight between reality, and the beauty of the real, and the beauty of the artificial. In some instances the beauty of the artificial has already won' (Hagen 1978: 23).

In the context of electronic culture, clearly video's position should be stated as deviant from the pictorial image, and with critical reference to any generic determination of text, image or sound. More precisely, the general positon of video culture can be formulated in light of technical simulation. Simulation is assigned to the digital where it means the potential to all images made possible through numeric processes. To differentiate the specifics of electronic and digital media forms, French media theorist Edmond Couchot (1998) reserves the attribute 'simulation' to a digital image of simulation because digital is based on computing operations. It is further assumed that when all possible forms of images are realizable in the digital, the specific electronic position of image and sound signal processing can be restructured as technical simulation. It is possible to shift an image constituted through analog processes to a numerical image by breaking its luminance values down into numbers.

On a numerical basis, then, endless variations and combinations confirm the concept of 'every image' that contains the potential infinity of all images. Gene Youngblood has made the fundamental distinction between the analog recording principle shared by electronic and cinematic registration of light pulses on the one hand and, on the other hand, the digital processing of encoded information shared by digital video processing and computer graphics. He states:

> In electronic cinema the frame is not an object but a time segment of a continuous signal. This makes possible a syntax based on transformation, not transition. Analog image processing is one vehicle of this particular art – for example, Scan Processors. But it becomes even more significant in digital image synthesis, where the image is a database. (Youngblood 1989: 28)

The concept of image synthesis was explored in synthesizers and processors: the electronic medium could be perceived as signal-based and its raw material was identified as pure energy, noise. In this respect, both electronic music of the 1950s and video art of the 1970s worked with time energy in waveforms toward abstraction.

Also, media philosopher Vilém Flusser (1985) has identitifed an essential musicalization in the electronic medium because of its tendency to abstraction. As distinct from categories of optical inscription and iconic images of film and photography, musicalization stems from the mathematical-abstract model and concerns abstract principles of organization in musical composition and technical images. The tendency to abstraction is rooted in structural relationships between image and music. When video is understood as being the signal, its inherent property is the energy that can be circulated (closed-circuit), fed back into the system (to cause feedback effects), and alternatively realized as video and as audio output. The resultant energy images are not necessarily pictorial but express abstraction. In following Flusser, it would be appropriate to abandon the model of the frame and discuss synthesized video and any operational modes of video instruments in terms of musicalization, which means working with signal processes, image or energy fields and transformation imagery.

Analog to digital

In sum, processual elements in video systems show structural analogies that connect electronic and digital tools on the level of shared modular systems and comparable processual transformations. Also, because of the interchangeability of audio and video signals and in view of video's technical option to synthesize a television signal from raw electronics, it can be argued video and computer tools have more characteristics in common than video and other analog media, namely film. There is no such thing as a 'fixed' frame (unavoidable in any photo-chemical treatment and camera-less recording of light on the film strip) and no indissoluble interval in the electronic medium – only the deliberately adjusted form of electronic information that is displayed according to agreed-upon parameters of the standarized televisual format. The video image is essentially open to drifting unless locked, respectively non-adjusted. As discussed above, discovery of video's behavior led to a series of experiments with horizontal drifting (in the Vasulkas' videotape *Discs*, in addition to those noted above), and has been formulated into the statement that video is not restricted to frame-bound images, such as film, but generically frame-unbound.

When viewed together, video's distinct features became apparent in image processors that would rearrange electronic processes, show deflection of the raw material of video noise, and express the electronic signal's potential of audio and video. With the use of synthesizers, electronic information could be generated internally, and the information could be displayed optionally as audio and/or video. In the broader context of electronic culture, media-specific art practices are embedded in two parallel approaches toward technology: one being the incorporation and modification of existing instruments in electronic arts, such as radio frequencies and audio synthesizers, and the other the development of new devices, such as processors and other analog computers. Taken together, these approaches demonstrate that artists' curiosity with regard to emerging technologies is not satisfied by adding new tools or using them solely externally or as an extension to the artwork. On the contrary, whether the creative use of electronic tools that were designed for specific purposes, or the use of standard equipment against the grain, both determine the roots of electronic culture – open processes of experimental film installation, Fluxus, happenings, performance, sound and noise arts. All are set against the cultural dominant genres of painting, sculpture, music and film.

The major task of media tools seems to be to control the function and appearance of video: to manipulate, repeat and reposition the effects and build machines to systematize and maximize the possibilities of interconnection and modification – not unlike digital systems. In many applications of the 1970s and 1980s, the extended use of abstract waveforms in video goes hand in hand with extended feedback, which at the time was understood as creating a true videographic image, different from other types of media images. This difference was understood because of the abstraction from the pinhole perspective – video's permanent transformation and immediate presence as a constant flow of signals. In its circular structure, feedback can lead to the multiplication of an image's waveform, but it can also effect distortion, and it can be used in conjunction with other effects.

First of all, the invention of media tools was a dynamic phenomenon that amplified and liberated the flow of the electronic information from the constraints of the televisual broadcast standard. And that was a rather uncontrollable effect. When more programming functions were incorporated into electronic manipulation, the visual forms were maneuverable in all possible ways and finally entered the digital mode.

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Notes

1. The Rutt/Etra Video Synthesizer and the Rutt/Etra Scan Processor are used interchangeably for the same device.
2. Poissant quotes are translations from original text in French.
3. It has been argued that Paik could actually have recorded the first video with a portapak as early as 1965 (Sherman 2007). Clearly he could not have rewound the tape, but would have needed to use the industrial broadcast standard video recorder of a TV station. It is also established that before Paik recorded and presented his 'first' videotape in October 1965, Andy Warhol produced his first videotape in August 1965 with Norelco video equipment, which he included in his first double-screen film showing, *Outer and Inner Space* (1965), where Edie Sedgwick's image on video is presented in dialogue with her image on film (Angell 2002: 19–33).
4. For a closer examination of the Vasulkas' experiments with electronic sound-image manipulation, see Jean Gagnon (2006).

Analog Meets Digital In and Around the Experimental Television Center

Kathy High, Mona Jimenez and Dave Jones

Dave Jones was one of the key people who witnessed how computer processes were integrated into the artist studio at the Experimental Television Center (ETC), and he played a central role in designing and building elements of the system. Other designers/programmers/builders included Don McArthur, Walter Wright, Paul Davis, Richard Brewster, Peer Bode and Matthew Schlanger. Jones was exploring image capture in the early 1970s, which eventually led to his invention of the Jones Frame Buffer, as he explains in the first part of the interview. In these early days (ETC was founded in 1971), the computer was most successfully used in the studio as an accurate and repeatable source for control voltages, continuing with the Center's focus on using audio signals and waveforms to affect video. Image capture was a research goal, albeit an elusive one and not necessarily an end in itself. Rather, research with image capture was deeply connected to ETC's emphasis on experimentation in real time.

Interview with Dave Jones by Kathy High and Mona Jimenez, July 31, 2007

Mona Jimenez: I remember that you built your first A to D converter sometime in the early Seventies.

Dave Jones: I was designing my Jones Colorizer. And in the process of doing that, I decided it needed some sort of a keyer in it that would take the image, for anything above or below a certain shade of gray; it would clip that image. So I had worked out a fairly clean circuit for clipping the video image. In reading a little bit about conversion, A-to-D conversion and digital conversion in general electronics magazines and stuff, I realized that a series of these clipping circuits tied together would give me basically an A-to-D converter for video that would slice the image up into shades of gray and then turn it into a digital number, a multi-bit digital number. And then feeding it back into a D-to-A circuit would get it back to video. The electronics magazines I'd been reading were about audio conversion analog to digital, and were using much slower types of converters. There weren't really any single chips available at that point that would do video A-to-D conversion, although there were some that came out around that time and were extremely expensive.

MJ: What year would this have been?

DJ: ’75. I think there was a chip that came out around that time, and it was 600-and-something dollars for the chip. There was no way I could buy that. So I was using these cheap little comparator chips and feeding them into a digital chip that combined the outputs of sixteen of them. And this was something that I’d developed at home on my own. It wasn’t part of stuff at the TV Center.

And so I built this circuit that divided the image into 16 shades of gray, and then basically put it back together again. So you got back out the original video image, but now the shades of gray were stable. So everything between black and one-sixteenth of the image was now just black; and everything from that point to the next threshold was the next shade of gray. So it quantized the image, divided it into bands. And I played around with it a little bit, because between the A-to-D and the A, you had the four bits, where it was converted into a binary number; and by reversing those bits, you totally scrambled the shades of gray. So the 16 shades of gray were not consecutive black to white, they were dumping all over the place. So it was black and then middle gray, and then dark gray, and then almost white, and so on. So it gave this kind of zebra-striped appearance to an image. It ended up showing all sorts of little detail. Because in the original image, where you had minor steps from shade to shade, now you had major steps in the shades of gray, from shade to shade. So all the little detail, and all the noise and any other parts of the image now kind of stood out and were this kind of jumble of shades of gray.

So I played around with that idea a bit, and then decided that once it was a digital number, a four-bit number, that maybe I could feed it into a memory chip and store it and hold it for a period of time. Because all this conversion was real time, so there was a lot of detail in the image. It was digitized as far as shades of gray, but not as far as time.

So I got a very small memory chip, and I would just store the shade of gray for a few pixels, and then I would grab the next shade of gray, and then the next shade of gray. And I divided the image into 64 points across the line. So now the image was, like, 64 columns. And in each column, on each scan line, was a shade of gray for that portion of the scan line. So it had the full resolution vertically; but horizontally, it was divided into little segments. And then, by changing the way that the memory chip was timed, as it grabbed those 64 points across the line, I grabbed on one line and played it back for the next set of lines. And that divided the image into 64 x 64 blocks, where each block was then holding the shade of gray that came from the upper corner of that block. So it was a live image, but it was now heavily pixelated. It was now just this big, blocky image. And the circuit that did this was called a ‘line buffer’, that basically just stored one line of the image, 64 points on that line, repeated it for – I forget – 16 or eight lines, and then it grabbed the next line and repeated it again. So it created this kind of a big, blocky, pixel-looking image.

[…] In the beginning of ’77, I moved to the Catskills, and Gary Hill and I shared a place there for a while. And the intention was, he was going to put me up and pay for the materials, and I was going to design some equipment that he could then have and use;

and at the same time, teach him how to duplicate the equipment, so he could make more copies and have big piles of equipment…

I sold him the A-to-D because I needed cash. And so I sold him the 16 shades of gray A to D. And then there was a surplus electronics company across the river. We were living in Barrytown, NY. And in Kingston was this surplus electronics place that had a big cardboard box, about this big, full of chips, most of them leftovers from projects at IBM, where they pulled parts and threw them in the box, and then they sold all their surplus stuff to this place. And I went in there one day and, for forty dollars, I bought probably 2000 used integrated circuits from these guys, and brought them back and started sorting through. And there were some memory chips in there. They weren't very *big* memory chips, but you know, they were more than 64 points; they were a 1000 points, and 2000, 4000 points, things like that.

So I built a circuit using those, to make a 64 x 64 frame buffer. So that instead of just capturing one line, it would capture 64 lines and grab an entire frame. And I played around with that a bit. Basically, you could digitize the image through it. And you would see live images at 64 x 64; and then at any point, you could hit the button and freeze an image, and it would hold it. And I believe the first time that I showed it to Gary, he wasn't there, and I pointed a camera at my face and froze the image of my face. And then I left and went somewhere else. And he came in later that afternoon into the studio, and there was my face frozen on the monitor. He reused that trick a few months later, when Steina [Vasulka] came to visit. And he froze his face on the monitor before bringing her back to the house to take a look at some equipment.

Kathy High: So this was actually a big deal. I mean, obviously.

DJ: Yeah, this was something that, you know…

KH: …was mind-boggling.

DJ: You would see it on TV, maybe, but it wasn't something that was readily available to the small-video person. So, you know, we were definitely blown away by the fact that it worked. And the A-to-D by itself, separate from the 64 x 64, by that point, was finely tuned to where it would actually – because it was so real time – pass color and rearrange the color. So besides turning out 16 shades of gray, you could feed a color image in and the subcarrier shape of the video would get chopped up and the shades rearranged, and now you had wild colors all over the place. Or depending on the shades of gray you chose, when you rearranged it you'd get subtle colors or strong colors or a mix of both.

I built a circuit in between the A-to-D and D-to-A called an ALU [arithmetic logic unit], which is a sort of a very simple mathematical digital chip used in digital processing. It basically adds two numbers, subtracts two numbers – very simple types of math type functions. And so I fed the A-to-D into one side of it and fed some switches into the other side of it, and then the output went to the D-to-A. And by changing the switches, you could change how the shades of gray got rearranged. And so you could end up with a positive, a negative, or just totally scrambled shades of gray.

And when you did that with a color image, or even just a subtle amount of color mixed in with a black-and-white image, you would end up with all of these different colors instead of just a shade of gray, but still in this kind of quantized look. So you'd have large areas of an image, and they would all be this, like pastel – kind of a beige or something – and then another shade of gray next to that might be a bright red. So it was some fun stuff. Gary did a videotape, I think called *Bathing*…that used that A-to-D and ALU unit. (See Color Plate 23.)

Spatial and Intensity Digitizer

Accounts vary on what Dr. Donald E. McArthur intended to invent when he designed the Spatial and Intensity Digitizer (SAID) in Binghamton, NY, in 1974 or 1975. Some say he was designing a time base corrector,[1] a highly desirable broadcast device for the stabilization of signals from various low-end video sources; a device that was too expensive for an artist's space like the ETC to acquire. Design engineer Jeffrey Schier recalls that McArthur was trying to design a low-cost analog-to-digital converter for video (Dunn 1992: 143).

A rather obtuse description from ETC's 1975 application to the National Endowment for the Arts suggests that the SAID did more than act as an analog to digital convertor: 'The SAID reproduced a black-and-white camera image which is constructed from memory by horizontal and vertical structures varying in gray level which are controllable' (ETC 1975b: 1). ETC's Studio Manager, Hank Rudolph, remembers that the excitement of the SAID was in seeing the whole cycle – analog to digital and back to analog – rather than the fact that it could convert an analog signal into digital form. The SAID did not store bits; rather in Rudolph's words it would 'signify digitization' (Rudolph 2010: 26). Woody Vasulka calls the SAID a 'moment of change in an esthetic norm in one's mind […] looking at a digital image broken down into the numbers and reassembled again in real time' (Dunn 1992: 142).

The presence of McArthur, who was a visiting professor at the State University of New York (SUNY) at Binghamton, brought new skills to the Center in the early days of ETC's engagement with digital devices. In a 1974 ETC funding proposal to the New York State Council on the Arts (NYSCA) for 'Systems Approach to Video Art' MacArthur is described as key to 'the development of a system for synthesizing, processing and controlling video images with greater flexibility, reproducibility and precision than is presently possible' (ETC 1974a: 1).

The SAID was installed in the ETC studio for a number of years, but little documentation remains of the machine. McArthur later collaborated with designer Jeffrey Schier to create the McArthur/Schier Digital Image Generator for Steina and Woody Vasulka.

MJ: Were you in contact with other people who were trying to build A-to-D [devices], line buffers and frame buffers?

DJ: I don't remember. Around that same time, people were discovering computers. And so there was that side of digital that people were discovering, but it wasn't for image generating.

MJ: What would they have been discovering about computers at that point?

DJ: It was *very* simplistic kind of stuff. Chuck Kennedy [of the Videofreex] got a hold of a computer. And I remember sitting there watching him having to key programs in one byte at a time on switches on the front panel, where he would have a reference sheet, and he would have to put these eight switches in a specific pattern, and then hit a button, and that stored one byte. And then he would change the switches to another pattern, hit the button; that would store the next byte. And he would have to do that 200, 300, 500 times to get a very small, simple little program in the computer, before it would actually run anything.

MJ: And that wasn't necessarily running graphics.

DJ: No, I mean, those were running very simple things. In some cases, they were maybe putting out a square wave that would be used like an oscillator. And there were some plug-in cards that some people had together around that time, I think around '76 or '77, that were very simple kind of graphics cards…character generator type stuff, and very crude patterns of images. But that assumed that you managed to get a hold of one of those kinds of video cards, which were fairly rare…

MJ: So I'm hearing three different things. One is your work with the capture of a frame, which is a very big deal. The other is generating computer graphics that could be used with video. But I also understand there was computer control of video. Are those three of the main themes that were [present at the time]?

DJ: The first computer the TV Center got, which was also in '76 or '77 – I think it might've been '77 – was the LSI-11, which was a single-board version of the DEC PDP-11. And its basic function was recording and playing back control voltages. It wasn't really capable of making video. But because a lot of things in the studio at that point were control voltage – I built my colorizer all with control voltages; the SEG [special effects generator] had a control voltage input for adjusting of the wipes; the Wobbulator could take oscillators. So there were a number of things that had control voltages…

And so the computer was set up with some voltage inputs and a number of voltage outputs, and some very simple software that was able to record and edit patterns of voltages. So you could – instead of just playing an oscillator that was one repeating shape like a triangle wave or a sine wave – you could make a much more complicated pattern of voltages going up and down, and then play them back from the computer. And you could speed that up and slow that down. And that was the primary function of the LSI-11 at the studio. It was basically not making video, but making control voltages and being able to play them back, and feed a control voltage in and record it, play it back faster or slower; or define a pattern and then play that pattern back.

MJ: I understand that part of the introduction of the LSI-11 into the Center was not just to put the computer in there, but also provide an interface that was useful to the artists, so they could deal with it on a knob kind of level, on a physical level versus a programming level. Is that right?

DJ: Right. We were writing the software that would make it work; and then once it was up and running, [artists] would be able to just run the program and throw a couple of switches or turn knobs, and be able to play back the control-voltage sequences. So they would be able to go into record mode and turn a knob in various patterns, and then throw the switch back and that pattern would come out through the control-voltage output.

MJ: So would you be able to actually send a pattern or a sequence of control voltages, or just individual control voltages, individual patterns?

DJ: Well, each output, you could adjust the waveshape, basically, and record a voltage pattern. And I can't remember how many outputs the LSI-11 had, but it had multiple control-voltage outputs. So you could have several outputs happening at the same time, going to different places in the system. It wasn't particularly easy to use. The software was fairly crude. The computer itself was a real pain to get booted in the first place. And so there were probably not a lot of people that used it. Probably only a handful really did anything with it…

DJ: I would come back to Binghamton every week or two and check in, and write a little code, and you know, see what the project was up to. At that point, Paul Davis was doing a lot of the work on the [LSI-11]. He did a lot of the assembly. Walter Wright was there doing a lot of the layout and assembly.[2] And I was just coming in and helping out and throwing my two cents in every once in a while.

It started in '77, went through, like, '78, '79, around in that range. The TV Center moved [from Binghamton] to Owego in the middle of '79. And I don't really remember the [LSI-11] computer surviving much beyond that, as far as being used. Sometime around '80 or '81, Ralph said to Paul Davis, 'We need to go to the next step here and, you know, get something a little more useful.' Plus, [Ralph] wanted something for his own use at home in his studio, which he had been building up.

And so Paul put together a computer system similar to something he'd been working with at [SUNY] Binghamton, which was a Cromemco Z-2 computer. This was a kind of a more modern microcomputer. The LSI-11 was made by one of these big companies that made computers for Boeing and all these other kind of places; whereas the Cromemco was kind of part of the small microcomputer generation and revolution that started in the late Seventies. It was the next step beyond the kind that Chuck Kennedy had, with the switches on the front, where you had to really work at it to get a simple program in. This one actually had disk drives. And it had a graphics card and it had serial ports and…you know, it had most of the kind of things that a normal computer these days has. It had an operating system called CP/M that was becoming very popular back then. And there was a plug-in card for it that was available, which we got, called the D+7A, which was digital plus seven analog. And it allowed you to feed analog voltages out and have switches that went in, analog voltages that would go in, and digital pulses that would come out. So it basically was switches and knobs going in and pulses and analog voltages coming out.

And so we used that and made a little box to interface with it and bring it out to jacks and knobs that we could turn and interface into the system. And then started writing different types of programs to work with it to do things, to feed voltages out and to record them – similar to what the LSI-11 had done. It was much easier to write programs. So we ended up doing many more variations of programs using it.

And then at some point around then, once we started doing that, Ralph came across a video frame buffer board from a company out in California that would plug into this computer. And it would capture frames of video into the computer. And so we started writing programs that would control that board using the knobs from the interface box. So you could adjust the speed of how often it captured an image or how fast it played back, and slow it down, speed it up. You could use it to adjust the resolution of the captured image. Things like that. So [the interface] became…physical knobs to control the software that was controlling the hardware inside the computer.

MJ: So was another difference between the LSI and this Cromemco that the graphics card would enable the storing and playing back of images, versus just control voltages?

DJ: Yeah. There was a graphics card, which was in the computer for going on the screen, just so you could see what the computer was doing. But then there was also the frame buffer card. And the frame buffer card was something that had video in and video out, and could actually capture frames of video and put them back out. The computer graphics card wasn't something that had a video output; it just was something that stored and displayed the characters when you type at the keyboard and that kind of stuff. It was the computer screen for controlling it.

And actually, now that I think of it, there was something in between those two. After we got the Cromemco – I don't remember if we got this right away, or fairly shortly afterwards – there was a plug-in board for it called the Dazzler. The Dazzler was a graphics type of a

Language (Software) Development

> I think software must be concerned with composition, first of all. First must be the elements and attributes of design. Second, the software must be capable of both analyzing and synthesizing images. Third, the software should have a mind of its own. It should be capable of reprogramming the synthesizer and reprogramming itself. Fourth, it must interact in real time with the artist. And fifth, it has to cost almost nothing. (Wright 1977: 6)

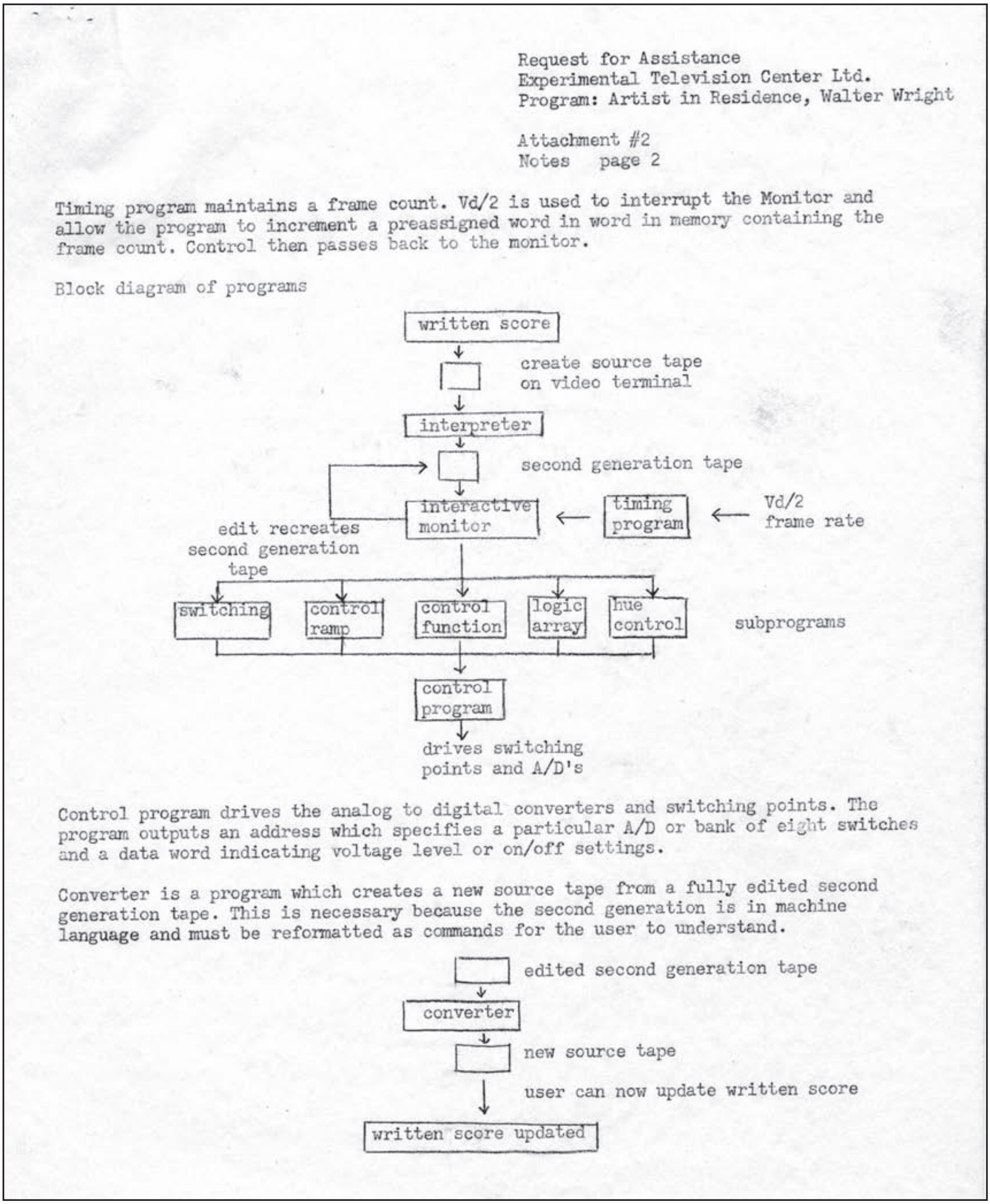
ETC staff and collaborators used programming, as David Jones notes, as soon as computers entered the picture. What is surprising is the extent to which software development was part of ETC's early years. In 1974, ETC submitted its first request for software development to NYSCA as part of a proposal for an artist's residency for Walter Wright. Wright's activities were intended to expand ETC's workshops and studio facilities to interface between computers and other video instruments. The plan was for Wright's software programs to be accessible through an interface external to the computer and more akin to the knobs and switches video artists were used to, as opposed to through the more indirect and non-intuitive command line interface coupled with a keyboard. (See also below 'Interfaces for Computers: The D+7A Box'.)

The computer would allow the artist to make quick and automated moves that were impossible with human hands:

> The computer will be used to preprogram a series of images and transformations which would be impossible to achieve with manual controls. The programs can be edited and combined to build completed scores for the synthesizer. Programs will be stored on audiocassettes […]. The ability to program will require the development of a special language for the computer and a visual notation system for composition. (ETC 1974b: 2)

There were six areas in which Wright planned to develop software programs. Interpreter was to translate between human recognizable commands (a score) and machine language; Interactive Monitor would allow for playback and editing of the score; Timing was to maintain a frame count; while a Control Program would handle the sequence for analog-to-digital conversion. Converter would have translated back from machine language to a form that the user could update and edit, and Composition would have allowed for scores on larger computer systems and would have automated and organized images or scores.

Wright's residency was intended to create software and hardware and to create documentation to be distributed at cost to the public. While Wright never created distributable software, he did report on his research, including programming he was working on with Woody Vasulka, at the 'Design/Electronic Arts' conference that was held in Buffalo, NY, in March 1977. His focus was on the computer as an external control to video synthesizers, planning for 'predictable unpredictability'. He explains: 'You may not be able to predict exactly what each image will look like, but you will be able to predict certain properties of them […] the artist interacts most effectively with the system by controlling those probabilities in real time' (Vasulka 1977: 8).



Request for Assistance
Experimental Television Center Ltd.
Program: Artist in Residence, Walter Wright

Attachment #2
Notes page 2

Timing program maintains a frame count. Vd/2 is used to interrupt the Monitor and allow the program to increment a preassigned word in word in memory containing the frame count. Control then passes back to the monitor.

Block diagram of programs

Control program drives the analog to digital converters and switching points. The program outputs an address which specifies a particular A/D or bank of eight switches and a data word indicating voltage level or on/off settings.

Converter is a program which creates a new source tape from a fully edited second generation tape. This is necessary because the second generation is in machine language and must be reformatted as commands for the user to understand.

Figure 1. A page of ETC's application to the New York State Council on the Arts for Walter Wright's software development project (1974). (courtesy. Walter Wright and the Experimental Television Center).

card, not very high resolution, but easily controllable, and it put out standard video. So it had a recordable output, which the normal character generator–type graphics card did not have. And the Dazzler could display maybe 64 x 64 graphics. And so we were able to create patterns on this, and put those patterns out as standard video and be able to record them and feed them into the system. It didn't have any way of really capturing video, but it was basically a pattern generator. It was for making colored patterns and squares.

And I remember writing some software where you'd turn the knobs on the analog box to adjust the kind of oscillations moving through the Dazzler to make patterns. And the Dazzler had enough memory in it that you could do sequences. So you could store a pattern and then bring up another page with a different pattern, and then another page with a different pattern. And so it was possible to sequence the different frames in the Dazzler while you were drawing on each of the frames, and create moving patterns on the screen. As they sequenced, the pattern would repeat as a moving pattern.

Then we got the [Cromemco] frame buffer, which had much higher resolution and did real video in and out. And it was, I think, 256 x 256. And I remember capturing some images with that, and then through software, reducing the resolution and putting them into the Dazzler. Because the frame buffer would capture a frame and play a frame. But because the Dazzler had this low-res repetition of multiple frames, we could capture images in the frame buffer and then put those images in the Dazzler and, in low-res, sequence the images and get this kind of motion playback through that. So it was similar to the resolution of the buffer that I made at Gary's place in the Catskills, except this was color. And because it had sixteen frames, you could play these patterns and repeat motion and stuff. That kind of led me to build my next frame buffer with multiple frames.

MJ: And that would've been what year, you started working on your frame buffer?

DJ: I think in '79, I built the next version up from what I had made at Gary's place. Peer [Bode] supplied the money to buy the parts, and we did a 256 x 256 single-frame frame buffer. So it was much better resolution than the 64 x 64 that was at Gary's.

MJ: So you were capturing, then, these single frames, and then you were trying to play them back at faster and faster rates over time?

DJ: Well, you couldn't really – I mean, it was basically about capturing single frames or keying a portion of an image onto that single frame. So we would cut out some portion of the image using a key clip, and the static frame would then have this image moving over it. But it was a single frame. It didn't have multiple frames, so there was no repeating motion. There was no sequencing that happened of time capture.

It was just building up kind of a composite image by layering parts of the live image on top of the stored image. And then from there, we decided that multiple frames were definitely needed. And the TV Center came up with the funding to do the frame

Interfaces for Computers: The D+7A Box

> I just can't do mathematics…I said, 'I do not want to sit at a keyboard and punch an H or something, and have it mean something else up there on the screen. Give me something to get a hold of. At least let me turn a knob or throw a switch.' That's where the D+7A Box came from, that push when we first started playing with computers. I wouldn't sit with keyboards and learn a language because with language, I'm right back to mathematics. I can't do languages either. 'Qué pasa?' is about as far as I get. (Hocking 2005: 9)

As early as 1974, ETC had articulated the importance of a useable interface between computers and image-processing tools in funding proposals to NYSCA. Also, through Sunday meetings where he cooked and worked the philosophy 'keep 'em high, keep 'em happy', Hocking started a conversation about how to make computers part of the ETC toolset (Hocking 2005). Paul Davis, who worked with Hocking at SUNY Binghamton, became an integral part of the Center. Around 1979–80, ETC acquired the Cromemco computer with a Z-80 microprocessor and several commercial add-ons; a 'CAT' Buffer that could capture a single field of video at 256 x 256 pixels and 16 colors; and a D+7A interface box (ETC 1997).

The D+7A box had seven channels for analog-to-digital and digital-to-analog conversion but a nonintuitive interface. The interface provided switches, potentiometers and input jacks for ease of use.

Signals were brought into the computer from a Jones Keyer, a Jones Colorizer or a special effects generator. The user had to boot the program using the keyboard and choose a program to run, but then the interface bypassed the normal command line interface to enable the user to change parameters manually. In other words, the D+7A box gave artists an interface that resembled those of analog devices in the system. An ETC-created reference, 'The Digital Imaging System' gave instructions to users (ETC 1977b). The concept was repeating in numerous devices, such as the General Purpose Interface Board, created with NYCSA funds in 1983.

buffer project. And so that was the same 256 x 256 converter, but with multiple frames. And that used a memory card that had 16 frames per memory card. And so if you had multiple memory cards, you had multiples of 16. 16, 32, 64 frames. And then you got *real* motion. And that's what we've had at the TV Center since around that time, since the mid-Eighties. I think we proposed it and tried to get the funding around '82. And we finally got the funding and finally actually built the boards around '85 for that.

MJ: So your first version, the one that captured single frames, you called the Jones Buffer, as well?

DJ: Well, I don't think – I mean, Ralph is the one who added my name onto the ends of all the machines that I built. And, you know, the 64 x 64 one was just the 64 x 64 frame grabber. The other one was the 256 x 256 frame grabber, or Peer's frame grabber. And then by the time we etched the boards and started making multiples of the final one in the Eighties, Ralph had decided that was the Jones Buffer. So like the Jones Colorizer, it got my name tacked onto it.

MJ: Good idea.

DJ: Yeah.

MJ: So I think I read somewhere that you bought your first desktop computer in 1985. And I was wondering when the Amiga [computer] started to appear, and how that got integrated. Was it around the same time, the mid-Eighties?

DJ: It was in the mid-Eighties. My first computer that I bought was a PC clone, which I bought because I had seen some computer-generated printouts to make circuit boards in the mid-Eighties at Alfred University. And actually, one of the boards that I made at that

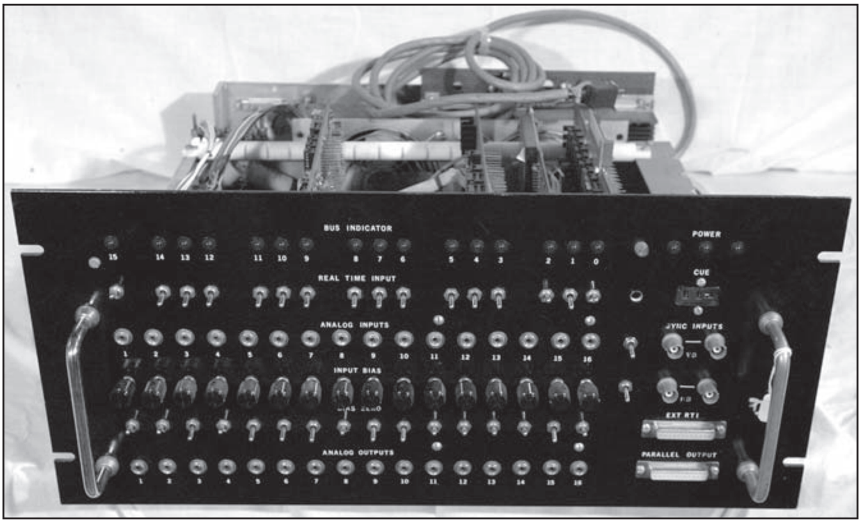


Figure 2. A 16-channel interface box for the LSI-11 computer designed by Paul Davis and built by Paul Davis and Richard Brewster (c. 1977). (photo. Sherry Miller Hocking. courtesy. Experimental Television Center).

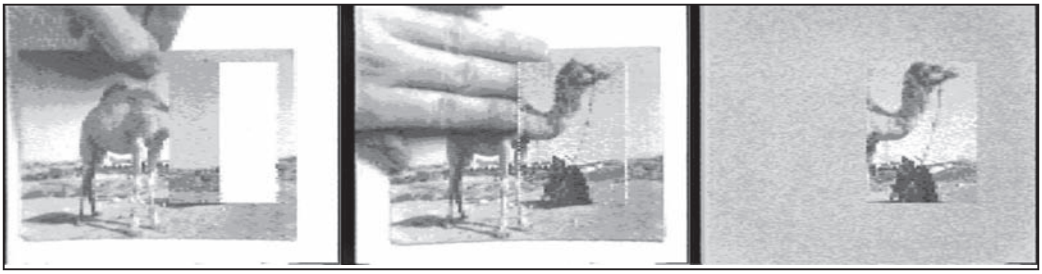


Figure 3. Three stills from *Camel with Window Memory* by Peer Bode (1983). The tape was made using a frame buffer built by Bode and Dave Jones that allowed capture of one still zone and one live zone, creating the illusion that the still zone (the small rectangle) is in front of the live image of the postcard. (courtesy. Peer Bode and the Experimental Television Center).

time was a printout on their big CAD system. And so I figured, 'Well, that's kind of the way things are going; I need a CAD system'. So I bought a PC clone, and I bought one of the first versions of AutoCAD that came out back then, and started designing my circuit boards on the computer and printing them out on a little pen plotter, using felt pens; and then taking those pieces of paper down to a photo lab in Binghamton, and they would photograph them into double-sized lithos; and then I would send them to a circuit board house to have them made as circuit boards. I think that was around '85, when I got that machine.

I don't remember exactly what month the Amiga became available. I think I got mine about '86. Like the end of '86, something like that. There were a few people that had started to get them and were playing with them. And the graphics on them were incredible for the day. And so I couldn't afford to buy a complete system, but I met somebody who wanted a monitor, and I wanted the computer. Since it put out normal video, I could use my own video monitor for the computer monitor. And so I bought the complete system and sold him the monitor, and kept the computer part and started playing around with that.

MJ: So obviously, the Amiga offered the paintbox functions…

DJ: It had animation. Over time, it added a lot of other things.

MJ: And digitizing…

DJ: It had sound cards, it had video capture, and it had a genlock. There was 3D software made for it. There was animation software made for it, both vector-based animation, as well as frame-based animation.

MJ: So that was kind of a shift in the way computers were used at the Center? And also by people like you?

DJ: Well, no, there probably was one fairly early at the TV Center. But it was separate. I mean, the Cromemco was still used at the Center for a long time. And the Amiga didn't replace that. The Amiga was all about doing graphics and doing colored shapes moving around and stuff like that. I can't remember when the Center got its first Amiga, but it was maybe a year or two after that. It was like '87, '88, I'm guessing.[3] But I'm not really sure. And I think the first uses were basically flying triangles and ovals and things like that moving around, and then moving on to capturing video and doing sequences of video and stuff like that. So [the Amiga] did eventually replace the frame buffer part of the Cromemco, because the frame buffer was always kind of cranky and had loose wires, and never was really 100 per cent predictable. Would work great for a while, and then it would start screwing up, and you'd have to go and wiggle wires and move connectors around. And then you'd get it working again, and you know, a few months later, then something would come loose again.

MJ: So could you talk about the similarities and differences between the [earlier] frame buffer, your Jones Frame Buffer and the image capture parts of the Amiga? Were they kind of just several different tools that did the same thing?

DJ: Well, they were fairly different. The Amiga was actually a color device. You know, my frame buffer was never a color device. It was black-and-white in, initially black-and-white out, although I did make a colorizing type of a card for it, a color map card that assigned colors to the different shades of gray. So you had an alternate output that was like quantized color.

MJ: When would that have been?

DJ: It was done around the same time. By the time we finished the main boards, I think that board came months later. So it was probably, you know, around '86, something like that. Before I got my Amiga. And there were some other kind of computers and graphics systems that were happening around that time. Like the Z-GRASS system, through Tom DeFanti and the people in Chicago. Which was basically a Bally video arcade game that had special software running on it.

MJ: I wanted to actually ask you about that, because it seemed like [the Z-GRASS] was really a graphical device…

DJ: Right.

MJ: As opposed to the initial interest by the Center more toward control voltages, controlling video. [ETC was] less about development of graphical systems but also had an interest in frame grabbing and capture.

DJ: Well, it was kind of an evolution of what the computer was capable of. The early computers weren't capable of grabbing frames or putting out video. But they were capable of manipulating voltages. And then the second generation ones started with the control voltages, because since it worked on the first one, that was where we obviously kind of saw it going, to begin with. But then as different add-on cards became available for the second computer, then we added those features to it. So it then became much more about being able to make video with it.

MJ: So what about the vector graphics? Was it that the vector systems were just not affordable, but they were perhaps in Chicago because it was the university lab that [Tom DeFanti and Dan Sandin] were using? Or do you think there just happened to be different personalities interested in different [things]?

The Center for Microprocessor Research

ETC envisioned a Center for Microprocessor Research that would study software and hardware development for microprocessors to enable interfacing with video and audio synthesizers, including 'consulting with artists and arts organizations concerning the construction of small-format computer systems and their applications in video and other arts' and 'workshops on theoretical and practical aspects of the design, construction and uses of microprocessors' (ETC 1977a: 1).

In addition to enabling artists to integrate video, audio and computer tools, the ambitious project would have produced software and hardware to give control over '(2) lighting systems for use by performance centers (3) control over animation processes in filming and direct generation of images on film (4) control over mechanical devices for application in sculptural and environmental works' (ETC 1977a: 1).

Areas of research included a 'programmable filter bank for image modification and enhancement', a frame buffer, a color encoder, 'pseudo content addressable memory with variable drift', character generation and a 'raster partitioning system' (ETC 1977a: 2).

Periodically ETC pitched other concepts that went unrealized. In 1975, ETC applied to NYSCA for a 'Technical Innovation Project' to build 'a Digital Raster Manipulation (video storage unit) that combined frame storage with moving sections of the raster, collapsing and reversing the raster, and enlarging and reducing, combining aspects of the Raster Manipulation Unit and the Rutt/Etra Video Synthesizer' (ETC 1975c: 1).

DJ: You mean full vector systems?

MJ: Well, what they were doing with the Z-GRASS.

DJ: Because they were developing that based on, I think, some commercial input that they had had and projects that they were working on, and [the Z-GRASS] was kind of applying it to a small computer to make similar kinds of things happen. Whereas we didn't really have that commercial input, influence. We were just kind of coming up with things on our own or adapting what we could find off the shelf…to do something different.

MJ: So it was probably more serendipitous and less philosophical.

DJ: Yeah. I think it was just a matter of situation and influences that were around the different groups of people. What resources they had available to them and, you know, directions they got pushed in by the places that were providing funding.

MJ: Right.

DJ: And we were mostly funded by arts organizations and by ourselves…

MJ: And the [New York State Council on the Arts], which was open to development of tools.

DJ: Right. And so basically, we'd throw out ideas, and once in a while they would say OK. We threw a few out that they didn't say OK, so you know… It happened both ways.

MJ: Eventually, I guess, the control voltage part of computers just kind of faded away.

DJ: As computers progressed, things like MIDI came out, which were really designed around getting music, and then control voltages for audio synthesizers. Or just the types of audio synthesizer devices and modules that were available really could provide a lot of the same kind of functions that we had been trying to do with the computer with control voltages. So it really ultimately came down to [the computer] not being as useful for doing the control voltages, just because there were other ways of doing it. It wasn't that the computer wasn't good at it, but there were other devices that would do that same kind of thing.

MJ: And they were integrated into the system at the Center.

DJ: Eventually, yeah. I mean, as we added different parts of the system. We had our own control voltage boxes that we did a lot with. And then we added various outside commercial synthesizers, like the Korg control voltage processing and audio-processing box. Stuff like that. And eventually, some MIDI interfaces that were control voltage in and out to MIDI. So you know, the computer became less targeted towards control voltages, and it made much more interesting video images.

MJ: You did the frame buffer and were still working on kind of custom tools, even though there had been this shift, where there were desktop computers and the Amiga with improved graphics and interfacing with video. Were there still custom devices that were being built? Or was there really no need for that at that point?

DJ: There were, but they were kind of shifting direction. You weren't really seeing much in the way of, like, analog video processing or anything like that coming out as custom devices. You were seeing people doing stand-alone devices for a specific application or for a specific artwork. There were some people that built video frame buffers and colorizer-type circuitry – or not really colorizers, but sort of that same color look-up type stuff that I was talking about doing with the color outputs of the black-and-white buffer. But building that type of thing into a box, and then selling that as part of an artwork, so that the artwork had this kind of black box that the video camera went through and created the effect with whatever was happening on the camera.

MJ: So was it more at a software level, then, than a hardware level?

DJ: Well, at that point, it was still hardware, because software wasn't fast. It's only been very recently that software can go fast enough to actually create video.

KH: Recently, as of?

DJ: Well, I'd say the last five, six years; it's been fast enough. And it's only even the last couple years where it's fast enough to really go at full speed. Even five years ago, you could get video images out, but if you did much processing to them, you were down to 15 frames or ten frames a second. Whereas now the computers are fast enough you can get a full 30 frames a second, and still process the image a reasonable amount in real time, without losing the quality or giving up the frame rate. And the computers are still escalating in speed, you know, year-by-year. So now you're getting to the point where you could be doing HD or doing multiple channels of video, and still pretty much keeping up with the full video rate going through it. But, you know, up until I would say the early twenty-first century, the computer could only really control hardware that would process video. It couldn't really do the video in software directly. It couldn't create the pixels in real time, or you know, not at full resolution, full speed.

MJ: Right. So I guess I'm trying to link what was happening at the Center [in the twentieth century] – if there is a link – to some of the tool development now. There's a lot of software development, perhaps some hardware as well.

DJ: Yeah, I don't think there's a direct link, in a way, but there's a lot of influence. I think that a lot of people that were developing software for doing image manipulation saw things that came out of the Center, or saw things that came out of other places like that, and that was their sense: What do we want to make the computer do in processing an image? Because, you know, I mean, a lot of them, the software begins by emulating your classic SEG. And then when the designer of the software sees something more complicated coming from somewhere else, then they start adding that. A lot of the software development hasn't been totally out-of-the-blue development, you know, based on [the designer's] own pure concepts. Some of it has, but I would say the majority of it hasn't. Most of it is mimicking things that they've seen somewhere else.

MJ: People that are related to the Center? Or are you just saying in general?

DJ: No, I'm talking in general, with software that's being developed all around the world that's being used to create or process video images. And you could even see it in the Eighties, when things like the Video Toaster were being created. And the capabilities of the Video Toaster were based very largely on your classic SEG from a TV studio, because that's what the designers had seen. And so that's where they got their ideas, and that's what they then created, a kind of a new version of it. And then as they saw other types of devices and other images that were created, that came out of places like the TV Center, then those designers added features like that to their software and hardware. And the same thing's happening now with the pure software version of image manipulation. They're seeing old videotapes, or current videotapes, being processed with analog control-voltage type video stuff, and then they're building those types of effects into their software.

MJ: Right, MSP and Jitter.

DJ: Yeah, Jitter. And some of the overlays and processes there, some of them are taken from kind of classic video synthesizer-types of effects. They each design a little module to do some core effect, and then that adds to the features of the whole system. But a lot of the initial effects were just a basic keying or colorizing, and then they've grown from there. So I think that it isn't that the designers of that kind of software ever went to the TV Center, but I'm fairly certain that they saw tapes that came out of the TV Center, or places like the TV Center.

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Notes

1. In correspondence with NYSCA, ETC wrote that McArthur's 'original interest was to build a low-cost time base corrector using a theoretical approach.' The letter also refers to a videotape produced using the SAID. See Experimental Television Center (ETC) (1975a).
2. Paul Davis was the director of the student computer lab and an instructor at the School for Advanced Technology at the State University of New York (SUNY) at Binghamton. Artist Walter Wright was involved with the Center on many projects, including hardware and software development and education.
3. ETC had an Amiga computer in the studio by the fiscal year 1984–85 (ETC 1997).

Multi-tracking Control Voltages: HARPO

Carl Geiger and Mona Jimenez

Carl Geiger received arts funding for three years running (1974–77) for ‘technical development’ and ‘computer-video research’. With one of the grants, Geiger hired Rod Fountain to write HARPO, a computer language intended for distribution among artists with interests in video and image processing. Geiger had already built a video synthesizer: ‘my electronic imaging system […] had parts of the Sandin Image Processor, parts of the Rutt/Etra [Video Synthesizer], and parts of various ideas, but it was never particularly one kind’ (Geiger 2011).

While Fountain wrote the software, Geiger built a custom interface to the computer ‘with knobs that were big and nice and sweet and smooth’ (Geiger 2011). The artist could send impulses to an Altair computer using the knobs or a joystick. The computer would record the ‘commands’ on a 5¼" floppy for recall later. The real value of HARPO was in the ability to record multiple ‘tracks’ called ‘SCORES’, and to be able to edit and store them in the computer’s memory.

While the idea of using programming to record and play back control voltages was circulating in the media arts community (see ‘On Voltage Control’ and ‘Analog Meets Digital In and Around the Experimental Television Center’ in this book), Geiger managed to produce a finished product complete with a manual. Geiger had the best of intentions for wide distribution, but in practice the software was used locally in the Syracuse, New York area.

Interview with Carl Geiger by Mona Jimenez, February 5, 2011

Carl Geiger: [With my synthesizer], so often you would just have an idea and patch it together and see what it looked like and turn the dials, and say ‘Oh, that’s interesting,’ or say ‘Oh, that’s terrible.’

Mona Jimenez: So it was a real-time experience.

CG: Yeah, it was very interactive. You’d immediately get feedback, but then it also was terrible because the next day you’d say, ‘Oh, that was really great, I’ve got to show that to Frank’, and then you couldn’t get back there. So in time what happened was it got so complex that you are looking at an image – perhaps I had a person in front of a camera and I was trying to do something – and you are trying to turn these knobs, and you just couldn’t turn enough knobs accurately enough to make things work. So what I did was I got a grant from the National Endowment for the Arts to build a computer system that could record control voltages, in effect record the turning of a knob over time. And then you could play the recently recorded control voltages… and then do another. Adjust the control voltages over time while the other ones played back. So it was multi-track – it was layer upon layer of control voltages.

MJ: I hate to repeat [the word] control again, but could you then control use of the oscillators, the use of the control voltages, in a repeatable way?

CG: Yeah, the idea was that I could have an idea of something, a thing that I wanted to do – but I couldn't physically, accurately, turn the knobs in the right sequence. Over ten seconds, or over one minute, or over ten minutes. I couldn't physically turn eight different knobs accurately in any way, shape or form, so [HARPO] allowed me to have an idea and in effect do just one little part of it. Play through, record it, play it back, and then do the next knob while the computer played back what I had done previously and recorded a new version. I could do layering and then, in effect, could very accurately get repeatable results of the machine. You could say, 'I want this to transform from this shape into this shape and these colors to shift this way,' and all of a sudden it would jump over to this effect that looks like snow or whatever. You could make things over time that were repeatable.

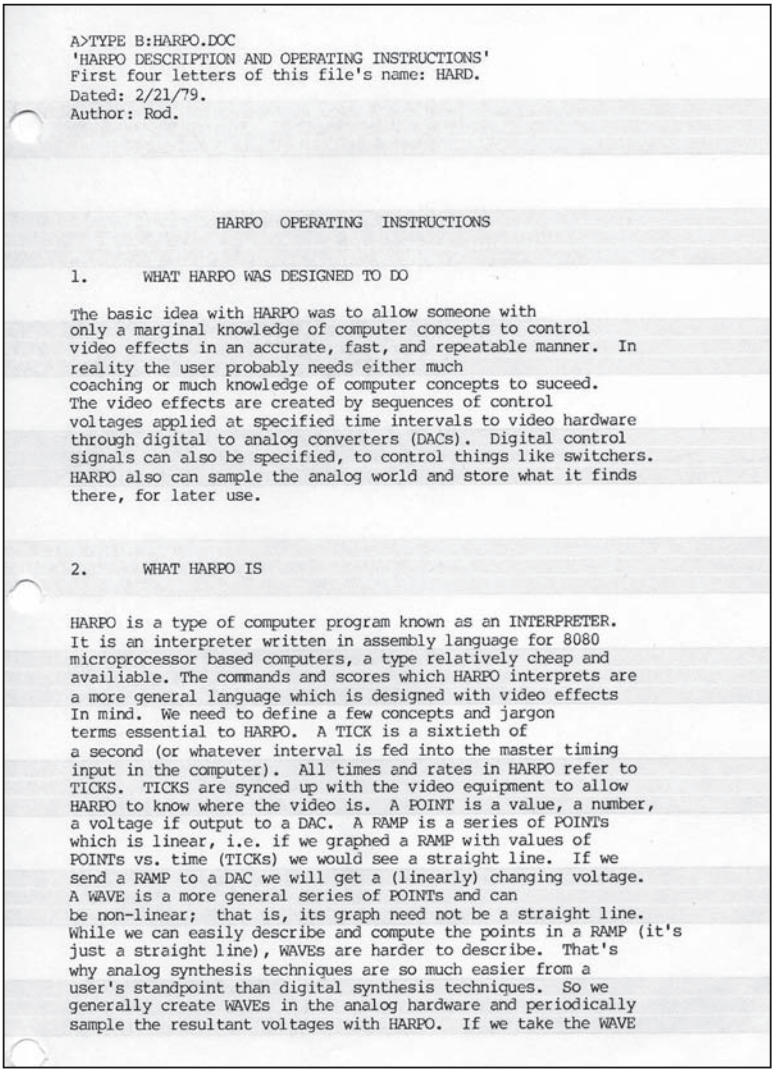
MJ: So when you wrote HARPO, what operating system and platform… what computer were you using?

CG: So, this is the Altair Computer...to get this computer started you had to put in 23 bytes of information and then you would hit RUN and it would be smart enough to load its operating system off an audio cassette. Hit RUN, then you push PLAY on the audiocassette, and it would go and would be able to start the operating system. And then after a while I traded my senior year at Syracuse University for this dual 5¼" inch floppy disk drive. This thing held 125K of information and it was a godsend. Because the computer would start right off of this.

MJ: So you set up a keyboard interface to the synthesizer?

CG: Yeah, the synthesizer had a keyboard. The keyboard just generates control voltages, and so with the control voltages you could patch into anything that related to the image. And that's the whole beauty of this whole synthesizer because you could patch anything into anything, so you could do unexpected and unplanned and untraditional things.

MJ: That is one of the interesting things that I have been finding out in talking to people [for this project]. Really [in the 1970s] it wasn't about analog-to-digital conversion; it was about analog to digital to analog.



A>TYPE B:HARPO.DOC
'HARPO DESCRIPTION AND OPERATING INSTRUCTIONS'
First four letters of this file's name: HARD.
Dated: 2/21/79.
Author: Rod.

HARPO OPERATING INSTRUCTIONS

1. WHAT HARPO WAS DESIGNED TO DO

The basic idea with HARPO was to allow someone with only a marginal knowledge of computer concepts to control video effects in an accurate, fast, and repeatable manner. In reality the user probably needs either much coaching or much knowledge of computer concepts to suceed. The video effects are created by sequences of control voltages applied at specified time intervals to video hardware through digital to analog converters (DACs). Digital control signals can also be specified, to control things like switchers. HARPO also can sample the analog world and store what it finds there, for later use.

2. WHAT HARPO IS

HARPO is a type of computer program known as an INTERPRETER. It is an interpreter written in assembly language for 8080 microprocessor based computers, a type relatively cheap and availiable. The commands and scores which HARPO interprets are a more general language which is designed with video effects In mind. We need to define a few concepts and jargon terms essential to HARPO. A TICK is a sixtieth of a second (or whatever interval is fed into the master timing input in the computer). All times and rates in HARPO refer to TICKS. TICKS are synced up with the video equipment to allow HARPO to know where the video is. A POINT is a value, a number, a voltage if output to a DAC. A RAMP is a series of POINTs which is linear, i.e. if we graphed a RAMP with values of POINTs vs. time (TICKs) we would see a straight line. If we send a RAMP to a DAC we will get a (linearly) changing voltage. A WAVE is a more general series of POINTs and can be non-linear; that is, its graph need not be a straight line. While we can easily describe and compute the points in a RAMP (it's just a straight line), WAVEs are harder to describe. That's why analog synthesis techniques are so much easier from a user's standpoint than digital synthesis techniques. So we generally create WAVEs in the analog hardware and periodically sample the resultant voltages with HARPO. If we take the WAVE

Figure 1. Page 1 of the HARPO operating manual (1979). (courtesy. Carl Geiger).

CG: Well, yeah, until just recently all of our display systems have been analog. I mean we haven't had digital televisions for what, more than ten years or so.

MJ: But I guess what I'm saying is that in the beginning of video artists using computers – I guess the capability wasn't there to do more graphical work – it was more about using control voltages. So like you said, you could turn a knob faster, and then go back out to an analog device.

which HARPO saves, and send it to a DAC, we will get an analog approximation of the original series of voltages.

3. HOW USERS COMMUNICATE WITH HARPO

HARPO can operate in two modes. As an INTERACTIVE interpreter, HARPO accepts commands the user enters from a keyboard and executes the commands immediately. In SCORE mode a list of commands (a SCORE) is specifed ahead of time using another computer program called an EDITOR. The user then can tell HARPO to interpret the SCORE s/he has created. The SCORE can be saved and reexecuted later. Most command lines are interpreted identically in both modes, but in SCORE mode, command lines can be interpreted much faster than a user could type. This allows rapid changes in signals controling video hardware, which is what video effects usually consist of. In addition, the user can talk to HARPO via an analog device by using the MAKEWave command.
INWAVe commands.

4. HOW WE HAVE USED HARPO SO FAR

In our imaging system we use HARPO to control 13 DACs, which in turn direct various analog devices. We also use HARPO to control a switcher, and to provide precise timing for our effects. We usually work in this sequence:
We decide what we want our effect to look like, and what the time relationships are to be. Then we think about how we could produce these images using the video hardware we've got. Then if these pieces of hardware need to be controlled precisely, or quickly, or if there are more things to control than we have hands, or some combination of these, then we turn to HARPO to execute a series of commands to do these things. We can easily try out various pieces of the puzzle in interactive mode. Then we have to write a SCORE (a list of commands) with the EDITOR program, and make all the necessary patches between the computer and the video hardware. HARPO interprets the score, controls the video hardware, and we tape the results. Often while HARPO is controlling part of the hardware needed for the effects, we are controlling other devices manually, because many effects are more easily controled by hand than by machine. Typically our first attempts are lousy, and we have to re-edit the score (again using the EDITOR) and have HARPO try again with the revised score.

5. WHAT HARPO COMMANDS LOOK LIKE

Figure 2. Page 2 of the HARPO operating manual (1979).
(courtesy. Carl Geiger).

CG: Right. Initially… well, I guess digital in my system developed in parallel. I mean, you could do cool stuff with just digital on/off things into video and it could make interesting images just in pure digital. And that's digital circuitry going into analog. But the thing I just described – which is the computer language HARPO – there's no direct digital involvement with the image. All that the synthesizer sees is control voltages and in effect they're not coming from the keyboard or me turning a knob; they're coming from the computer. And so the real digital circuits don't have a direct impact on [the video]. They're just analog voltages that are controlling analog circuits in an accurate way.

MJ: So were you thinking of the synthesizer or the software being available to other people? Or was it mostly as an exploration as an individual artist for your own work?

CG: The computer language HARPO we totally designed for other artists to use. I mean, we were excited about the concept. As far as I knew nothing like that existed, and it could make a complicated thing of running this computer relatively simple for someone to do. I mean, there's actually that kind of stuff being done now in open-source software. There's performance video and performance software that anyone can use for free that is the same idea.

MJ: Like [the software] Jitter, for instance…When you say we, do you mean Synapse,[1] or…?

CG: Well, when I was developing HARPO, I could program but I wasn't that good at programming. So when I got the grant from the National Endowment for the Arts I went and hired a programmer. I worked with this guy, Rod Fountain. He was a very good programmer and he had worked in industry and he was done, was sick of industry, so he was psyched to have a project that was creative. So I would build the circuitry and he would write the software, and we'd go back and forth to make it all work. But the idea was ultimately, and when we wrote the grant: 'Hey look, we're trying to make a computer language for artists to do performances and control video and stuff in real time.'

MJ: So how was it used ultimately? How and where?

CG: I used it for my work and we would use it on occasion with some video artists who would come through Synapse. But the truth is not much was really done publicly. Computers evolved very quickly and, probably, I had to spend way more of my time making a living and I wasn't really able to… I mean the idea was to make it simple, but the truth is it wasn't really that simple. And it wasn't nearly as easy as our computers with graphical interfaces now where you don't have to know much about anything. You just have to move a few icons around – but in those days it was a simple idea but it wasn't as simple as it should have been.

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Geiger, Carl (2011), 'Interview with Carl Geiger by Mona Jimenez', February 5, Lafayette, NY: Experimental Television Center Archives.

Notes

1. Synapse was a media arts center that Carl Geiger and Lance Wisniewski started in 1970 at Syracuse University (SU) in Syracuse, NY, along with other SU students, including Gail Waldron and Bob Burns. Among the resources available to artists at Synapse in the 1970s were a broadcast studio, an in-house cable system and portable video equipment (Geiger 2011). Organizational records on Synapse, including videotapes, can be found in the SU Library Special Collections Research Center. Jitter is software that allows for real-time processing of video and is made by the company Cycling '74. See http://cycling74.com/products/max/video-jitter/.

Finding the Tiny Dot: Designing Pantomation

Mona Jimenez

In the late 1960s, Phil Edelstein and Tom DeWitt both found themselves in the Electronic Music Studio (EMS) at the State University of New York (SUNY) at Albany. The Coordinated Electronic Music Studio System (CEMS), an audio synthesizer built by Robert Moog to EMS director Joel Chadabe's specifications, hadn't been in place very long. State universities were expanding, and SUNY Albany had invested in a brand new state-of-the-art performing arts center. With state arts funding on the rise Chadabe was able to bring in big names in the avant-garde: Merce Cunningham, John Cage, David Tudor. Edelstein's interest in theatre, music and electronics was growing, and he was a 'gearhead' and a student of computer science.

When he arrived at SUNY Albany, DeWitt was in the middle of his film *LEAP*, which needed a soundtrack. He had apprenticed with the filmmaker Stan Vanderbeek, who knew Chadabe; this connection got DeWitt access to the CEMS. DeWitt had some cachet, as he had made several award-winning films in San Francisco and had been one of the filmmakers Gene Youngblood had written about in his book *Expanded Cinema*.

For Edelstein and DeWitt, their artistic practices and aesthetics could not have been more different. In Edelstein's view:

> [Tom] was looking for additional tools to tell stories. I was looking for additional tools to establish processes and establish places where people would interact in environments where the system, where the algorithm, would essentially identify the ways the participants – both the performers and the audience – were interacting with each other. (Edelstein 2012)

Edelstein understood electronic music, but he was introduced to electronic image making from DeWitt. Edelstein became intrigued when he saw DeWitt was feeding audio signals from the CEMS into an oscilloscope and recording the oscilloscope's image with a video camera. Edelstein and DeWitt began working on each other's projects and collaborating artistically, eventually working with George Kindler, Maude Baum, and others as the sound-image-dance group, Electronic Body Arts, also based in the Albany, New York area.

By 1973, DeWitt had a residency at the Television Laboratory, a new program at WNET, New York City's public television station, where artists were offered use of broadcast facilities for experimental projects. Nam June Paik had been the first artist-in-residence at the TV Lab and his new video instrument, the Paik/Abe Video Synthesizer, was part of the tool set available to visiting artists. DeWitt was working on *Philharmonia*

(1974), and he and Edelstein would make regular trips to New York City. The TV Lab had a PDP-8 computer, and WNET had received funds from the New York State Council on the Arts to interface it with the Paik/Abe (NYSCA 1973); in fact the TV Lab staff were trying to use it to automate a video switcher. Edelstein got hired by WNET to do the programming for the interface from the PDP-8 to the switcher, but ultimately the experiment failed. Edelstein and DeWitt ended up taking the PDP-8 back to Albany for repair, where they found a use for it:

> We realized we could start doing image capture. We were looking for better and better ways of doing man-machine interfaces. […] It also became clear that we could take an image and derive useful information from an image for controlling an audio processer or patch or additional images. […] You might put lines on a page and interpret how those lines go sonically. Tom came along and recognized that there was skyline notation, which is a series of stairsteps. He said 'We can build a reader that would allow a composer to set those stairsteps. [Then we could] point a camera at it and it would play that score'. (Edelstein 2012) [1]

The process of interpreting marks on paper as sounds involved keying and counting:

> You're taking a pitch over time. The simple engineering involved was that if you realize that [one area] was white and [one area] was black, [I] turn it on its side and I then count how many pulses there were before it went from white to black. And then I would find out if it was six pulses or 128 pulses, and we'd put out that number at that voltage. The farther the black went, the higher the voltage, the higher the pitch. And then I could take a piece of paper which had a series of stairsteps, put it in front of a camera and I would get different tone rows out based on those relationships. (Edelstein 2012)

From that process, a whole new set of ideas came to the forefront. The marks became points on a television screen: positions on an x-y axis.

> We knew that we could look at a point and find that point from a graph reader. We also knew that we could color encode things because we used chroma key at WNET. So it was just one of those things where you reverse the paradigm and instead of looking at the background and blocking it out, you look at a tiny little color foreground and extract that. […] That had the convenience of lowering the demand on the dull, slow computer, the PDP-8. […] We'd throw away everything except you grab this *tiny* little bit of relevant stuff. (Ditto 2012)

Anyone who has watched broadcast television has seen chroma keying. It allows the combination of two video sources; for example, it makes video appear in the box next to a television newscaster, or creates the illusion that the weather reporter is standing in front of a map. With conventional chroma key, the weather reporter stands in front of a screen of a particular blue hue. The blue screen is replaced by a second video source, the map. Edelstein and DeWitt isolated a very small dot as the key color, and they had the beginning of an input device that tracked motion. (See Color Plate 29.)

> Once you had that basic circuit running, then you could put a dancer, a human body in front of that, and you could detect one edge of the body. And then you could start capturing gesture. Now we're on to something. [...] Same basic circuit, but instead of some simple stairsteps I'm now going to point it at a body moving in space and I'm going to have this whole richer opportunity for woman-machine interaction. I'm winding up with a set of values defining their edge. [...] And that's just enough to start capturing gesture. And that was the beginnings of Pantomation. (Edelstein 2012)

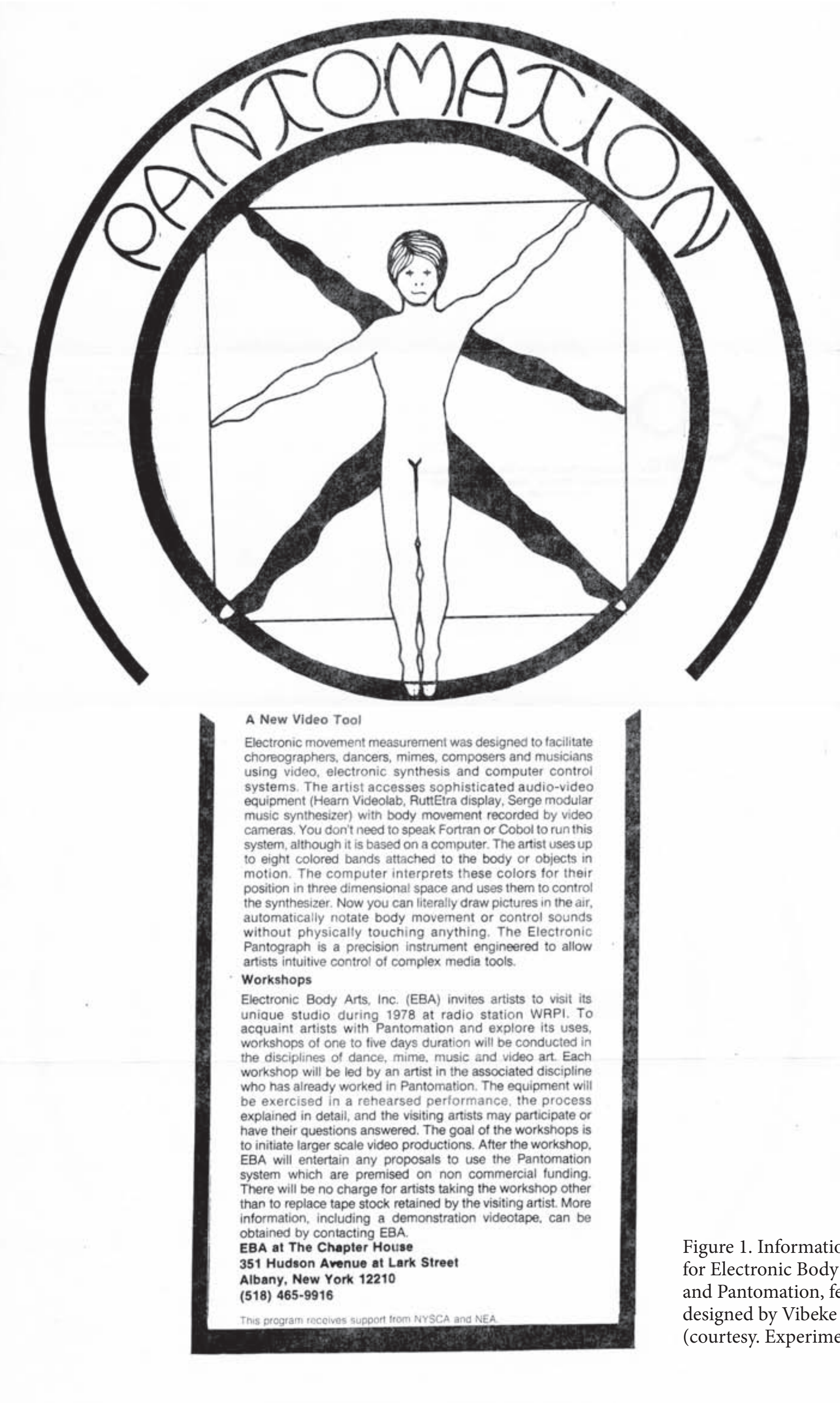
With performers holding a tiny colored dot of a certain hue, the synthesizer could capture incremental points along the arc of a gesture, and superimpose theses traces over live video. Edelstein described the process broadly as 'deriving information from video images based on the position of a key signal relative to the video frame', which enables both 'generative and manipulative processes' (Edelstein n.d.).

In 1975, Edelstein and DeWitt wrote a proposal for the Design Device, a comprehensive system for image processing or a 'Graphic Guitar' (DeWitt 1975). The Design Device proposed to take what Edelstein and DeWitt thought were the best ideas in video instrument design and combine them into one. However, DeWitt's proposals to the National Endowment for the Arts and NYSCA did not deliver what they expected. They were forced to scale down the project and build only the motion-sensing part of the system, which became Pantomation.

Pantomation incorporated a Hearn Videolab (a synthesizer that included colorizer and chroma key circuits) with Serge audio modules, parts of a Rutt/Etra Video Synthesizer (a scan modulator) and newly designed components. The Pantomation team included Edelstein, DeWitt, Kindler, Richard Lanehart and Roger Myers:

> We had a little nugget of a team and then we had an *éminence grise* Joel [Chadabe], who let us do all these things, and kind of cheered us on and gave us this thought that we were kind of realizing in his own little, tiny little technical room what Bob Moog was doing in a great big factory. (Ditto 2012)

Pantomation debuted at the WNET TV Lab in a performance on New Year's Eve 1976 into New Year's Day 1977, with DeWitt appearing as the character Zierot le Fou in his new work *Outta Space*.[2] The PDP-8 went permanently back to Albany and Pantomation had its first live public presentation at SUNY Albany in September 1977.



A New Video Tool

Electronic movement measurement was designed to facilitate choreographers, dancers, mimes, composers and musicians using video, electronic synthesis and computer control systems. The artist accesses sophisticated audio-video equipment (Hearn Videolab, RuttEtra display, Serge modular music synthesizer) with body movement recorded by video cameras. You don't need to speak Fortran or Cobol to run this system, although it is based on a computer. The artist uses up to eight colored bands attached to the body or objects in motion. The computer interprets these colors for their position in three dimensional space and uses them to control the synthesizer. Now you can literally draw pictures in the air, automatically notate body movement or control sounds without physically touching anything. The Electronic Pantograph is a precision instrument engineered to allow artists intuitive control of complex media tools.

Workshops

Electronic Body Arts, Inc. (EBA) invites artists to visit its unique studio during 1978 at radio station WRPI. To acquaint artists with Pantomation and explore its uses, workshops of one to five days duration will be conducted in the disciplines of dance, mime, music and video art. Each workshop will be led by an artist in the associated discipline who has already worked in Pantomation. The equipment will be exercised in a rehearsed performance, the process explained in detail, and the visiting artists may participate or have their questions answered. The goal of the workshops is to initiate larger scale video productions. After the workshop, EBA will entertain any proposals to use the Pantomation system which are premised on non commercial funding. There will be no charge for artists taking the workshop other than to replace tape stock retained by the visiting artist. More information, including a demonstration videotape, can be obtained by contacting EBA.

EBA at The Chapter House
351 Hudson Avenue at Lark Street
Albany, New York 12210
(518) 465-9916

This program receives support from NYSCA and NEA.

Figure 1. Informational material for Electronic Body Arts (EBA) and Pantomation, featuring the EBA logo designed by Vibeke Sorensen (c. 1970s). (courtesy. Experimental Television Center).

DeWitt later ported the system to an Apple II computer for better computing power and for ease of transport. DeWitt describes the 1980s version as a 'tracking chroma key system' that is 'similar to a light pen interface for a computer but uses a color video source and chromakeyer [sic] to detect positional information'. (DeWitt 1982: 61)[3]

DeWitt went on to make video works through various artistic collaborations, including as part of Electronic Body Arts and at Pantomation's new home in the Video Synthesis Laboratory at Rensselaer Polytechnic Institute in Troy, New York. DeWitt (now known as Tom Ditto) has continued with art making and with imaging inventions, most recently involving 3D spectroscopy. Edelstein went on to pursue computer programming, video, and electronic music composition and performance, including with the group Composers Inside Electronics. The moment of invention of the Pantomation is remembered by both Edelstein and Ditto as a time of intense experimentation and cross-pollination.

> Magic happened! And we were doing great stuff. No one of us was really responsible for any of this. A bunch of young people that had a lot of ambition to create things and no ambition to get rich. So that resulted in some really fine art-technology collaborations. (Ditto 2012)

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Notes

1. DeWitt explains his idea of using stairsteps in Tom DeWitt (1987), 'Visual Music: Searching for an Aesthetic', *Leonardo*, 20: 2, p. 116.
2. Dewitt gives a more full accounting of this night in Howard Weinberg's essay 'TV Lab: Image-making Tools' in this book.
3. The article (DeWitt and Edelstein 1982) has detailed explanations of the concepts and functions of Pantomation and includes block diagram and circuits. Additional information can be found on the Experimental Television Center's Video History Project website – http://www.experimentaltvcenter.org/history. Videos of Pantomation can be found on YouTube.

Preserving Machines

Mona Jimenez

> I think of the Rutt/Etra [Video Synthesizer] and Hearn [Videolab] combination as a guitar. […] The sounding board was the Rutt/Etra and the strings and the neck were the analog synthesizers and the video synthesizers that drove them. And you could sit there and string your little wires together and come up with compelling abstract works of art. And I see no reason not to continue in that direction. And to teach people how that's done even though it's arcane. Well, let's face it; these wooden instruments are arcane too. […] The piano got invented and it didn't mean they should throw away the clarinet. (Ditto 2012)

Conservation and restoration happen within the walls of museums and archives, with the creators and designers of objects, and within the garages and studios of enthusiasts and collectors. Each group or individual has its own networks, goals, philosophies and practices. There is no doubt tremendous variation in the way protective and restorative practices are carried out, depending on one's concerns, aesthetics, training, and orientation to professional bodies or communities of interest.

This essay attempts to cast light on the efforts of different communities of interest that are working to extend the life of electronic video instruments, or those who might be pressed into service. For the purpose of this essay, electronic video instruments are custom devices developed in the United States from the late 1960s to the mid-1980s that were used to make video art or other forms of time-based media or were used in performance. The devices include synthesizers, colorizers, keyers, sequencers, video-capture devices, computer interfaces and oscillators, to name a few.[1] They may be modified off-the-shelf devices or machines built from scratch. They were (or are) used in artists' studios, in media arts centers, in television laboratories, in educational settings, in arts exhibitions, for motion graphics and for live performance by artists and designers from many different disciplines. The instruments have been used to create thousands of time-based media art works by hundreds of artists. The art works are in museums and arts centers internationally, and are used widely in exhibition, education, and public programming, and for research.[2]

Electronic video instruments have been included in research initiatives such as DOCAM (Documentation and Conservation of Media Arts Heritage) based in Canada, and in exhibitions; for example, the 1992 exhibition 'Eigenwelt der Apparatewelt: Pioneers of Electronic Art' organized as part of the festival 'Ars Electronica' in Linz, Austria. Some tools are still used in art schools in analog/digital labs, such as at the California Institute of the Arts, the San Francisco Art Institute, Alfred University (New York State), the University of Illinois at Chicago Circle Campus, and the Chicago Art Institute. The tools are part of the history of technology and the history of media art.

One may ask, why save art-making machines? Isn't the point the art work itself? By another token, one might ask why pianos or oboes are collected in instrument collections; why museums of technology collect Apple computers; why science museums collect printing presses; why design museums collect cameras; or why games are collected at the Museum of the Moving Image? Video instruments are image making and sonic devices, performance-enabling objects, evidence of electronic design, forms of industrial craft, and remnants of a do-it-yourself ethic. They are part of the balance against media histories that privilege the hegemony of broadcast television or those that trivialize the material and labor processes of art and media.

In 1992, Woody Vasulka accurately observed that in comparison to electronic audio instruments such as the Moog Modular Synthesizer, 'There's no comparable or intellectual protocol to even consider the video instruments as cultural artifacts' (Dunn 1992: 11). Twenty years later this may still be true, if we check the United States major institutions of art, science, technology, industry and history. The early video tools, like many forms of noncommercial

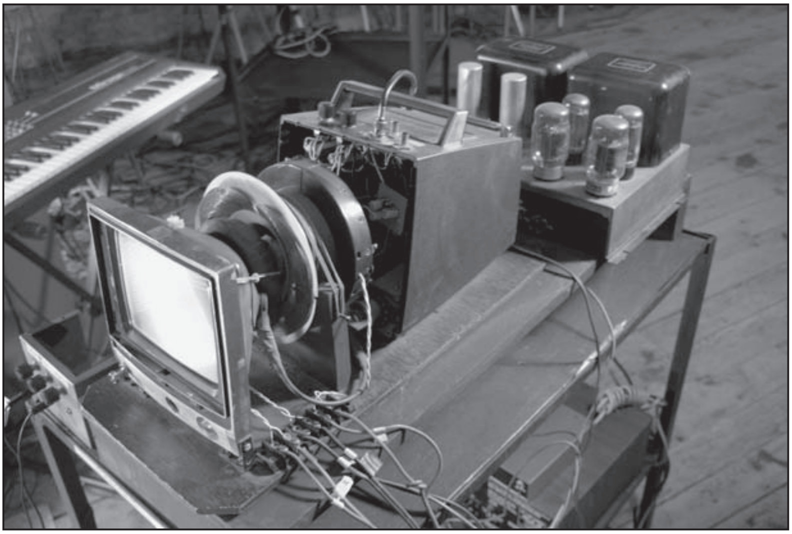

Figure 1. A Raster Manipulation Unit (aka the Wobbulator) in the studio of the Experimental Television Center (2007). (photo. Olivia Robinson; courtesy. Experimental Television Center). See Color Plates 35 and 36.

media technologies, do not fall neatly into a known category of history and have not been collected by memory institutions. They seem to fall through the cracks of the collecting missions of existing museums for television, computers and other related technologies.

Yet one must consider popular response. In 2010, when artist Blair Neal produced a short videotape about one of the very earliest video instruments, the Raster Manipulation Unit (popularly known as the Wobbulator) and posted it to the Internet, the video went viral (Neal 2010). The tape shows a 1960s black-and-white TV that has been broken apart, modified and hooked up to an amplifier and oscillators. Neal captured how the Wobbulator turns a familiar household consumer object into an image-generating device, and he found that his peers were fascinated.

A similar viral response happened when a friend of Tom Ditto's (the artist formerly known as Tom DeWitt) posted the following announcement in a technology forum: 'Kinect's Grandaddy Running On an Apple IIe In 1978'. The grandchild, the Kinect, is a phenomenally popular motion-sensing input device for PCs and the Xbox video game consoles made by Microsoft. The "grandaddy" is a video instrument called Pantomation that was designed with public arts funds by Ditto and Phil Edelstein – artists and technologists – in 1974 in the Electronic Music Studio of the State University of New York at Albany. The device, used by video artists and dancers, was a synthesizer that tracked and captured an object in motion, and combined the synthesized object with video in real time.

In addition to the attention garnered by older devices, designers such as Dave Jones[3] are still at work on new custom analog instruments. Thus, while some of us ponder the physical preservation of older machines, simultaneously the concepts and processes they represent are being incorporated into new analog devices. The processes that once involved numerous bulky devices are embodied in units that can be held in one hand.

In this essay, we will first look at conservation efforts under way among inventors, enthusiasts and caretakers, followed by a discussion of the practices and guiding principles of potential allies in conservation, and a discussion of new video instruments. Lastly, proposals will be made for a way forward. Although the essay talks in detail about conservation theory, only a few of the machines have been collected by cultural heritage institutions, and artists are still looking for real-time video tools. Thus, it will be proposed that the most appropriate site within which to advance preservation practices for the instruments will be one where art making, tool development, and conservation are carried out together.

A resurrection party

When I met Daniel Summer in September 2007, he was hunched over the open chassis of the power supply and amplifier unit of a Rutt/Etra Video Synthesizer. Matt Schlanger had opened up his company in New York City, Black Hammer, for a 'Rutt/Etra Restoration Party'. (Rutt/Etra is the synthesizer's affectionate nickname.) The synthesizer Daniel was

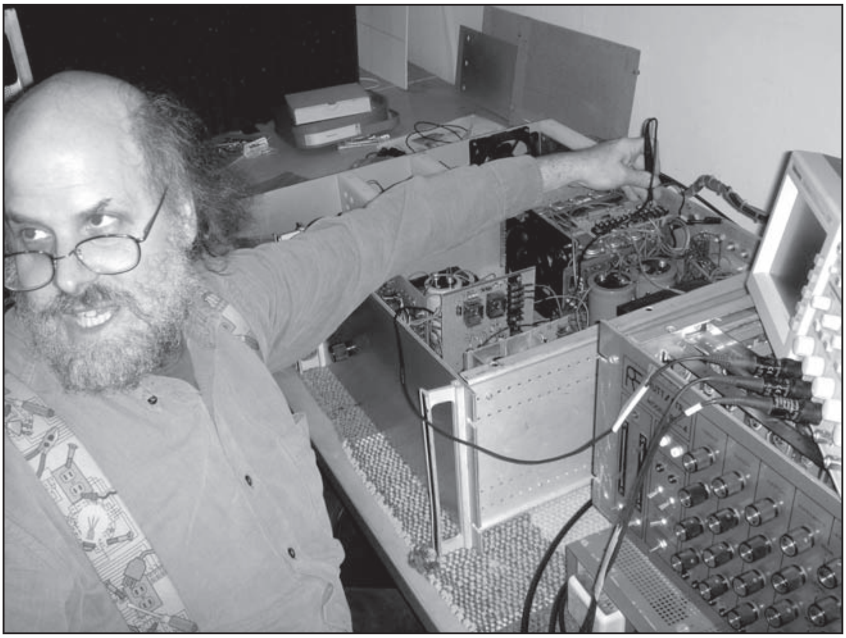

Figure 2. Jeffrey Schier trouble-shooting a Rutt-Etra
Video Synthesizer at the Rutt/Etra Restoration Party (2007).
(photo & copyright. Daniel Summer; courtesy. Daniel Summer).

working on had a WNET property tag on it – it was one of the first Rutt/Etras to be built in the early 1970s.

In 1972, New York's public television station, WNET, commissioned Steve Rutt of Rutt Electrophysics to build a synthesizer to add to the tool set for the Television Laboratory, an artist-in-residence program. The synthesizer would add a new tool to the conventional broadcast television studio that already held a Paik/Abe Video Synthesizer, a switcher and some video decks. Bill Etra had convinced the powers that be at WNET that he and Rutt could design a new, powerful machine to add to the arsenal. No doubt they had the enthusiastic support of the lab's artist-in-residence, Nam June Paik.

At the restoration party, Summer was swapping out electrolytic capacitors and checking the power supply. The changing of capacitors was preventive and being done before the machines were turned on. Summer handed me a bag of leaky capacitors and explained: 'When they go bang, it's sort of an ugly thing – they leak a chemical, and then there's a small explosion which can sometimes at a minimum make a big mess; at worst, knock out a bunch of components next to them' (Summer 2007a: 2).

A few feet away, Steve Rutt and Kyle Lapidus were troubleshooting a Rutt/Etra that had previously been owned by the musician Todd Rundgren. (Both this unit and the one with the WNET tag belonged to artist Gary Hill.) The Rundgren unit had been built in 1978 as a special deal, four years after Rutt Electrophysics had stopped producing the synthesizer; it had standard parts but also had been modified from the classic Rutt/Etra with some hand-wired, custom boards. Rutt was trying to figure out why one power supply was not getting warm and one was running hot. He was trying to avoid blowing out the high-resolution display, a rather pricey item. The old power supplies had been connected with wires covered with gaffer's tape that was rotting off.

Rutt hadn't been able to stay away from the party:

> I think I've never seen a room with this many Rutt/Etras. Because when we'd build them it would be a combination of somebody really anxious to get their hands on it, and we were always concerned about getting paid… we have, like, an entire farm full of them *here*. (Rutt 2007: 9)

There were two more in the room: a unit that was Bill Etra's that he had given to Summer, and a partial unit that Tom Ditto and Phil Edelstein had built as part of Pantomation.

At this point, the restoration party was about two weeks in. Summer had the idea for the gathering, spurred on by a need for Bill Etra to be able to have a working machine for a project that had come his way. Etra's machine had been in use by Summer and friends Benton Bainbridge and Owen Bush for much of the earlier decade. Rutt Electrophysics had built sixteen machines between 1972 and 1974, and the one in 1978 for Rundgren. Still, Summer couldn't find any other functioning machine for Etra to use and Summer's unit needed attention.

> The idea was to consolidate knowledge [about] the machines […] to extend the useful lives of the machines, and leave behind documents and knowledge which might increase the possibility of machines being serviced in the future after the original engineers were no longer around to help. Even with schematics available, there was a lot of variation between the machines so there was less reverse engineering to do having the designers present along with engineers who are currently active. The mix of talent and experience was pretty remarkable. (Summer 2012)

I returned on October 3, and they had another unit: Rutt's own machine had been dug out of storage. The group had made some progress with Rundgren's machine, most importantly because they had discovered that it had been modified by someone very well known in the network of designers and builders of 1970s video instruments – Dave Jones. Jones is renowned in these circles and beyond for his custom video tools such as the Jones Frame Buffer and the Jones Colorizer. (Jones also worked with Hill on custom hardware and software for many of Hill's video installations, so their connection did not come as a surprise.) Jones remembered a good deal of the details of the Rundgren machine and made extensive notes on his modifications for the restoration team's use.

That day the Rutt/Etra that Summer and friends had been working on was ready to fire up. Summer had been warned by Rutt to stand away from the machine, as the 10,000-volt power supply had the potential of arcing: ‘Rutt assures me it can’t go more than a few inches, but still I prefer to stay more than a few feet from it’ (Summer 2007: 3). Summer was looking for some activity on the display, but as soon as he hit the power we heard a popping noise. He wasn’t happy with the ‘snap, crackle and pop’. Summer, a collector but not an engineer, decided he had reached the limit of his knowledge about old power supplies. He would change them out with some he found on eBay that he hoped were close enough to work. The old ones he would box up and send off to an expert to see if they could be repaired.

Summer said that the team had decided that installing contemporary power supplies was not an option:

> It’s probably the case that modern power supply designs would be an improvement on these machines. But we’ve decided that rather than go that route, [we would go] in the direction of making [the Rutt/Etras] ‘as good as they could have been given their design’ […]. I look at this as an instrument. And I know if this were a musical amplifier, the power supply would be one of the most important parts in the tonality of the amplifier and in this case, it’s a video instrument. I think these [power supplies] actually play a role in the look that’s made by the machine. (Summer 2007b: 5)

The ‘Rutt/Etra Restoration Party’ continued, lasting roughly five weeks, and by the end Summer’s unit and both of Hill’s machines were fully functional and calibrated. Rutt’s machine, which was a prototype, ‘went from totally nonfunctional, incomplete and infested with rats to functional’ (Summer 2012). Artists Woody Vasulka and Ditto participated, and these efforts may lead to their machines eventually being restored. Documentation of the event, which included video, audio, photos and technical documentation, is being managed by Summer.

Individual restorations of other video instruments may also be under way. According to the website documenting KQED San Francisco’s National Center for Experiments in Television (NCET), in 2008 Larry Templeton, Rick Davis and Bob Pacelli restored a Templeton Mixer to working order.[4] Templeton, a video engineer, invented the Mixer, which was a colorizer, keyer and mixer in one, for NCET in 1970. The report on the restoration is in the context of a site that collects stories from the former NCET community; it is unclear whether additional documentation exists.

Institutional efforts

In 2011, a major cultural institution took up a project with a smaller and more specialized team for restoration of a Paik/Abe Video Synthesizer. The synthesizer was coinvented by Nam June Paik and engineer Shuya Abe in 1969 or 1970, for installation in the New Television Workshop, a program of the public television station WGBH in Boston, MA.[5]

The synthesizer was in essence a seven-channel mixer and colorizer, producing layers of wild, saturated colors that are characteristic of Paik's work at the time.

At the Nam June Paik Art Center in Yongin, Korea, Shuya Abe, technical advisor Jung Sung Lee, media artist Kumlyun Lee, technical expert Ki Jun Lee, and archivist Sang Ae Park collaborated on the 'Abe Video Synthesizer Restoration Project'. The restoration team identified three early models of the Paik/Abe Video Synthesizer and seven that are considered compact models. Five of the compact models were built by students at the California Institute for the Arts, and one of the students, Sharon Grace, made her machine available for the project.[6]

Although the Paik/Abe Video Synthesizer is commonly known in the United States as a stand-alone device, the restoration involved a whole set of related devices that were organized into several racks. These devices included a color encoder, a scan converter, a function generator, an audio signal generator, an audio amplifier, an audio mixer, and a video switcher. The goal of the project was achieved: to restore the compact version to functionality based on the original design. Taking place over a six-month period, the project culminated in a workshop where the audience had hands-on access to the controls, to 'provide the digital generation with opportunities to experience an early analog video synthesizing' (Park and Lee 2011). The resulting catalog, *Paik-Abe Video Synthesizer: As freely as Picasso, as colorfully as Renoir*, is full of photos and diagrams, suggesting that documentation is plentiful.[7]

In a much earlier effort, for the 1992 exhibition 'Eigenwelt der Apparatewelt: Pioneers of Electronic Art' numerous custom video tools developed in the United States in the 1970s and 1980s were gathered from disparate sources by curators Woody Vasulka and Steina Vasulka and their team. Nearly twenty machines were represented in the exhibition and many were installed and brought into service for the occasion.

Given the delicacy of the instruments, external interfaces were built for the working machines that enabled viewers to have hands-on access with video synthesis. In the exhibition catalog, several of the instruments are wishfully listed as 'awaiting restoration'. Documentation of the process for 'Eigenwelt der Apparatewelt', including technical documentation, is part of the Steina and Woody Vasulka fonds at the Cinémathèque québécoise in Montreal, Canada. In addition, many, if not all, of the documents can be found on the Vasulka's personal website.[8]

The Experimental Television Center (ETC) recently released an eight-disc DVD set, *Early Media Instruments,* that allows viewers to see eight custom video instruments in operation. The DVDs show a technical expert demonstrating the tool with the image output of the device superimposed on-screen. The videos are a very valuable way to gain information about the capabilities of each machine, its key components, and how the tool was integrated with other devices. As part of the production of the DVDs, ETC restored a number of devices to working order.

Also, as part of the ETC Residency program, many examples of video instruments were maintained, repaired and restored over the years. Director Ralph Hocking and associate director Sherry Miller Hocking have close ties with former staffers, volunteers

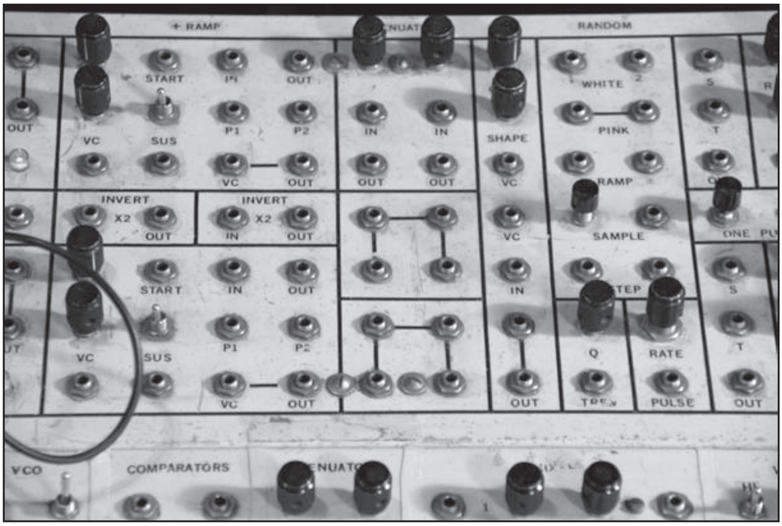

Figure 3. The top panel of an Analog Control Box that was built by Richard Brewster in 1977–78 for the ETC artists' studio. The boxes generated waveforms and other audio signals that were used to alter video images and were in use until the ETC studio closed in 2011. (photo. Olivia Robinson; courtesy. Experimental Television Center).

and visiting artists who hold knowledge about custom video tools. Miller Hocking has been meticulous about collecting documentation and sharing it through the 'Video History Project' website, and many important and revealing documents have been deposited at the Cinémathèque québécoise.[9]

All of the efforts described above are very encouraging and need to be continued. They come from the same impulse and passion – to keep the video tools accessible and to ensure that they become part of the historical record – even if caretakers follow different approaches, have different aims, and choose different methods of documentation and accessibility to that documentation. What is most important is action. However, thinking carefully about the needs of the machines, what's important to conserve, and the quality of our decision-making is also important. Documentation of the machines and any conservation and restoration actions must be captured and shared widely if the instruments are to be maintained and used in the short term, and in the long term to be understood by future researchers, educators and artists.

As noted above, these custom tools have not been collected by cultural heritage organizations, and whether they should be at this juncture is subject to debate. The likelihood is very slim that artists will have access to these tools to make new work once they are officially deemed legacy technology and historical artifacts. However, without institutional homes, it is also very unlikely that the machines will become accessible to researchers, educators, students and curators as part of the history of media art and the history of technology.

The troubles of video instruments

As noted above, machines don't take well to storage and disuse. Without the warmth of electricity and the movement it generates, mechanical parts stick in place; lubricants, meant to ease friction, become sludge. Once pliable, rubber rollers and belts dry and crack. Connectors oxidize and capacitors reach the end of their useful life, threatening to explode when the machine is fired up. Batteries begin to ooze and contaminate. Software becomes inaccessible when the hardware or software it depends on becomes unusable, and obsolescence makes portability to a newer computer system unfeasible. Whether the machine is well documented or scantily described (as is more often the case with custom-designed tools) shifts in electronics design and materials make maintenance, repair and reconstruction difficult or even impossible.

The video instruments that are the subject of this essay are largely out of use. Inventors, collectors and artists hold the machines in varying states of wholeness and usability in their closets, barns and studios. Stories like Dan Summer's above from the 'Rutt/Etra Restoration Party' remind us of the issues facing these devices: physical deterioration, the lack of parts, the incongruities between basic components from the past and now, and how a simple decision about the swapping out of a power supply may affect the 'tonality' of the instrument.

Until 2011, the Experimental Television Center (ETC) maintained a residency program and a hybrid analog/digital studio where an artist could generate new video and sound works by patching together legacy tools – such as 1970s colorizers, keyers and capture devices – with newer computer-based hardware and software. The studio offered both custom machines and off-the-shelf devices, and spanned tool development during ETC's 40-year history with media art. At the writing of this essay, the studio is dismantled and the machines are packed up and in storage; their disposition is unclear. Following the studio closure, ETC director Ralph Hocking put out a call for proposals for use of the devices, soliciting an entity or person that has the capacity to keep them functioning and available for creative use. In other words, to keep them functioning as 'living machines'. Hocking's call underlines the fact that reconstructing an electronic studio from stored equipment is not for the faint hearted:

> Be aware that very few of the machines are immediately usable. Most of them need connections to synchronization signals, signal routing and display. Some need time base corrected input signals, it's not just plug the camera in. Audio machines might need amplifiers and speakers at least. These machines need someone capable of defining and maintaining their purpose. Repair parts might not be readily available. (Hocking 2011)

Hocking's warnings allude to the knowledge needed to maintain older devices, and to integrate them with more contemporary machines in the service of creative expression. Mixed in with his cautions about the dependencies of the machines – that they need external devices for synchronization signals or for stabilization and display – is his pointed comment about the necessity of understanding a tool's function, limitations and possibilities; the tools need 'someone capable of defining and maintaining their purpose'. Simultaneous attention is needed not only to meet physical requirements and care, but also to maintain a tool's purpose and potential.

While each custom device in the ETC studio has its own set of functions, most were intentionally designed as general-purpose machines; that is, to have multiple uses and applications as determined by the artist. Many are physically programmable, where the artist's physical patching between a device's modules serves as aesthetic or conceptual instructions. For example, in a simple set up on the Sandin Image Processor, two separate video images could be combined by patching signals from two different cameras into an adder/multiplier module, thus layering or 'keying' the two images by, say, substituting all of the blackest parts of the first image with the second image. By patching the output of that module into another module, the composite image could be made negative. By patching in a waveform from a third module, an oscillator, the artist could automate a switch from a negative to positive and determine the rate of the switching.

Figure 4. Phil Morton (standing right) adjusting a camera as an image source for the Sandin Image Processor at the Sacramento Electronic Visualization Workshop, California State University, led by him and Jane Veeder (1978). The unidentified men are documenting the workshop. (photo & courtesy. Jane Veeder).

In ETC's studio, the integrated tool set enabled a much broader form of programming, in which the output of any one device could be patched to any another device through selections on a matrix. Therefore, the artist chose and interpreted the functions of individual devices and of the system, both to achieve predetermined effects and to freely explore images and sound through the interplay among the various component parts. Thus, replicating ETC's studio would require knowledge not only of how to set up signal flow among multiple devices, but also the requirements of each device that would allow its full functionality to be available to the user. The idea of a flexible system-as-tool set was used in many different settings, from NCET to the Circle Graphics Habitat (University of Illinois at Chicago Circle Campus) or media arts centers like the Electron Movers in Providence, Rhode Island.

A distinguishing feature of these early analog devices is that the artist can work in real time – turning knobs, making switches, setting up sequences of images – and can see, hear and respond immediately. (Affecting digital video in real time has only recently become possible as a result of faster computer processors, and has been made easy by software such as Cycling '74's program, Jitter.[10]) In this way, the tools function as instruments. A musician hears a note and makes tonal adjustments on a musical instrument; an artist using electronic tools can see, for a simple example, the impact on the tint of an image of turning a knob on a colorizer. The artist can then turn the knob to shift the hue. Also, some devices are generative, whereby a set of instructions sets into motion a process where images are created over time. These generative and real-time design characteristics, along with the possibility to have one device impact and/or control another, gave the artist options for performativity that could not be found in off-the-shelf image-making devices of the 1960s to 1980s.

It remains to be seen if the living lab that was the Experimental Television Center studio will be reconstituted. If not, physical deterioration and the disappearance of those with knowledge of the tools' intricacies will take its toll. Machines that were working when the system was packed up in 2011 will become part of the category 'awaiting restoration'. As in the situation with early media art works themselves, which have been preserved in great part through advocacy and by bringing the knowledge of the media arts community to bear upon the larger media preservation field, the custodial role that collectors and artists assume for these instruments will make the difference between future use and obscurity.

Relevant areas of conservation practice

There is no single conservation practice that neatly encompasses the issues present with custom video instruments. However, we will see that there are potential overlaps with conservators of time-based media art and more conventional instruments; in addition, there is potential shared interest with conservators of science and technology. In each of these disciplines, caretakers have begun to flesh out key issues, including what risks and values there are in maintaining working objects.

Given the instrumentality and performability of the custom machines, conventional instrument conservation is one place to look for guidance. All instruments have an aesthetic dimension as objects, but they also have an experiential dimension. One may admire a violin for its graceful construction, but it is through the laying on of hands that one experiences its purpose. Custom video instruments have a physical presence and can be quite appealing as objects, but without the artist's choices remain undefined and dormant.

In addition to the aesthetics of the object, conventional instruments have a sort of qualitative ideal, a 'sound' that is brought out through the action of playing. Each video instrument also has its unique visual character as a generator of images and sounds, and can be thought of as having a certain range of potentiality that is enacted by the artist. For example, just as conventional musical instruments of different eras have a different sound, images created through the 1970s' Paik/Abe Video Synthesizer have a different visual quality than those made with a Jones Colorizer from the 1980s, although they are both custom devices that allow for color shifts.

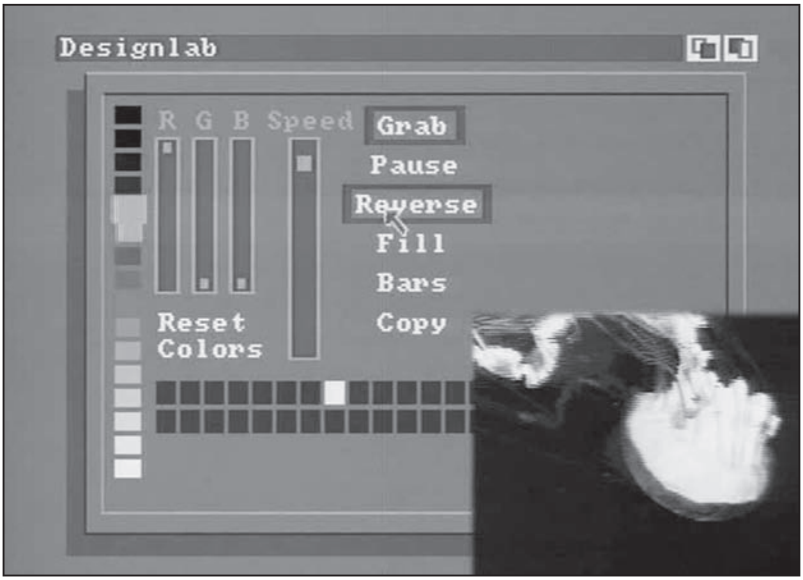

Figure 5. Still from *Early Media Instruments*. 'Jones Frame Buffer' (2010). Pictured is the Amiga computer-based software used to control the buffer, an image capture and layering device designed by Dave Jones (c. 1980s). (courtesy. Experimental Television Center).

Custom video tools also have commonality with (and in fact could be considered part of) the artifacts of industry and technology, which are the purview of industrial conservation.[11] Whether a tractor, a printing press or a video device, industrial and technological artifacts have both a dimension of craft and a dimension of process. The design and structure of the object can communicate much about an artifact's place in technological or industrial history, but without operation, the breadth of the artifact is diminished. One can admire a machine's external design but miss its internal distinctiveness. For example, the Jones Frame Buffer is an elegantly designed red box that is a product of craft, and the name 'frame buffer' evokes one of its principal features – the capture of individual video frames – but by no means describes its full potential. It is through the 'playing' of a working unit that the underlying processes of image layering that are unique to the tool are revealed. Furthermore, its operation is dependent on custom software developed by Jones for the Amiga computer platform; the software also has unique design features (see Figure 5).

Conservators of contemporary art have also been concerned with machines and equipment as components of time-based media art works. Often, to maintain a media art work's integrity, underlying technologies must be preserved that are critical to the work's functioning or to its meaning.[12] In the literature for time-based media art conservation, however, research has largely focused on the most common off-the-shelf devices: video playback decks, projectors, monitors, and the like.[13]

What keeps a video instrument alive and mysterious, versus codified and narrowly defined, is also a shared concern; what constitutes 'aliveness' has been an ongoing theme in time-based media art conservation. For example, analogies are common between media art installation and performance, where the ideas and processes of the work, rather than any particular manifestations, may be considered the essence of the work. If the artist is not available, the conservator might rely too rigidly upon previous components and insist upon certain parameters that deaden the piece.

Unfortunately, there is little literature to draw upon about conservation that directly addresses maintaining technological devices. One of the few articles concerns the ENIAC computer, completed in 1946 and considered the first electronic computer in the United States. Owned by the Smithsonian, the ENIAC was the object of conservation in the early 1990s, yet the emphasis for its conservation treatment was only on the external characteristics of the machine. (Understandably, bringing the ENIAC to working order would be a monumental task.) Treatments focused on restoring the 'in-use appearance' by replacing plugs and cables that visually matched those that would have been present if the unit was functional, such as giving careful attention to the vacuum tubes that were such a predominant part of the computer (Ecklund and Richwine 2004: 255).

Developing standards and practices for industrial conservation hold promise, and the warning bells sounded by this community sound very familiar. Speaking in 1989 to the loss of engineers and technicians who understand older industrial and technological machines, Jonathan Minns of the British Engineerium predicted a future of 'the blind leading the blinkered' (Minns 1989: 55). At the conference 'Industrial Collections: Care and Conservation', Sir Neal Cossons alluded to the meaning of machines beyond their technological story: 'Their messages and metaphors are as yet unexplored and they lie much deeper in the national subconscious than a simplistic taxonomy of machines might at first sight lead us to believe' (Cossons 1999: 9). Cossons called for 'a rational system of support and management'. Bénédicte Roland-Villemont and Claude Forrières, speaking at the same conference, outlined an interdisciplinary approach that incorporated various specialists and included assessment, treatments and documentation.

These themes – the threat of loss of technical knowledge, the need for standards and practices, and the value of an interdisciplinary approach – are reminiscent of discussions that have been occurring for decades among media preservationists, who rely upon obsolete playback equipment to transfer older tapes and maintain technology-dependent installations. Cross-departmental working groups in contemporary art museums focused on time-based media have sprung up and are dedicated to interdisciplinary approaches.

A theme that is central to the conservation of video instruments, and one that is common to both industrial conservation and conventional instrument conservation, is whether, when, and under what conditions an object should be operated (referred to as 'worked' for industrial conservation) or played (in the case of conventional instruments). In other words, are there dangers to keeping video instruments in working studios, if one is truly interested in having future generations understand the processes of twentieth century media artists? Or by not 'working' the instruments do we reduce their meaning and complexities and make them less understood and thus even more subject to loss?

To work or not to work

Jay Scott Odell and Cary Karp define instruments as functional objects, and place object function and design on an even par with aesthetics. In fact, for Odell and Karp the three characteristics cannot be separated. They point out that instruments 'require physical interaction to fulfill the purposes for which they were made' (Odell and Karp 1997: 1). Musical instruments and electronic-imaging instruments share these attributes of function, design and aesthetics.

Odell and Karp stress that use (and any restoration necessary to enable use) is risky and must not eliminate options for interpretation by future researchers and the public. In other words, would the restoration erase the cultural and material context in which the instrument was made? One could argue the reverse: that not allowing use would close off avenues of interpretation. Both types of instruments produce aesthetic experiences that are reliant upon interaction and both are silent and may be experienced as mundane without use. (While conventional instruments are often seen to have an aesthetic dimension, this may not be the case with video instruments. Although the devices are in some cases highly designed, others may appear to be without an aesthetic dimension – simply metal boxes with generic inputs and outputs, recycled parts and jumbles of cables.)

However, with instruments, restoration may need to precede use or even valuation. Odell and Karp caution that decision making should not be taken lightly:

> Restoring an instrument to functioning condition should not be considered unless an extremely important historic, technical or aesthetic quality can only be determined by actually operating the artifact, and only if this information cannot be gained in some other manner (Odell and Karp 1997: 4)

Odell and Karp also set out criteria that conservators can use to determine whether an instrument should be restored to functionality: the instrument's uniqueness or ubiquity, its ephemeral features and condition, the expected impact of use, the information to be gained through use, and whether expertise exists for restoration and maintenance.

Industrial conservator Richard Gibbon asserts that working is necessary for an object to reveal 'its function or the principles under which it operates' (Gibbon 1999: 18). In *Larger and Working Objects: A Guide to Their Preservation and Care* (1997), Stephen Ball, a conservator at the Royal Scottish Museum, wrote what appears to be the first written standards (in English) on the conservation of machines. Ball recognizes that as soon as an object is brought into operation, there are changes to its physical state – and these changes can occur both before and after the object's becoming part of a personal or institutional collection. In Ball's view, if a machine stops working or is retired:

> To a greater or lesser extent, the 'original' object is gone; what remains is a continuity of operation, usage and working practice. In other words, the essence of the working object is what it *does*. According to this argument, the body that operates the object is following good conservation practice, but it is conserving the form and function of the object rather than its physical make-up. (Ball 1997: 26)

Ball implies that simply restoring a machine to use still leaves much critical information hidden and at risk of loss; the machine has designs and processes that are not immediately seen and understood. In other words, by seeing a custom video instrument in action we can understand certain parts of the design, but there is much to know about its invention as expressed in unseen processes. Also, custom video tools reflect a certain period of circuit design, where hand-drawn and hand-taped circuits were the norm, a process now replaced by later computer-aided design.

On the subject of underlying processes, with a conventional instrument such as a violin, the full scope of its potential – what the instruments is capable of producing sonically – is only revealed by someone with deep knowledge of string instruments. With custom tools, this is also true; a machine can be turned on, but only its most obvious capabilities may be seen. For example, a colorizer, with its labeled knobs for hue and chroma, can be

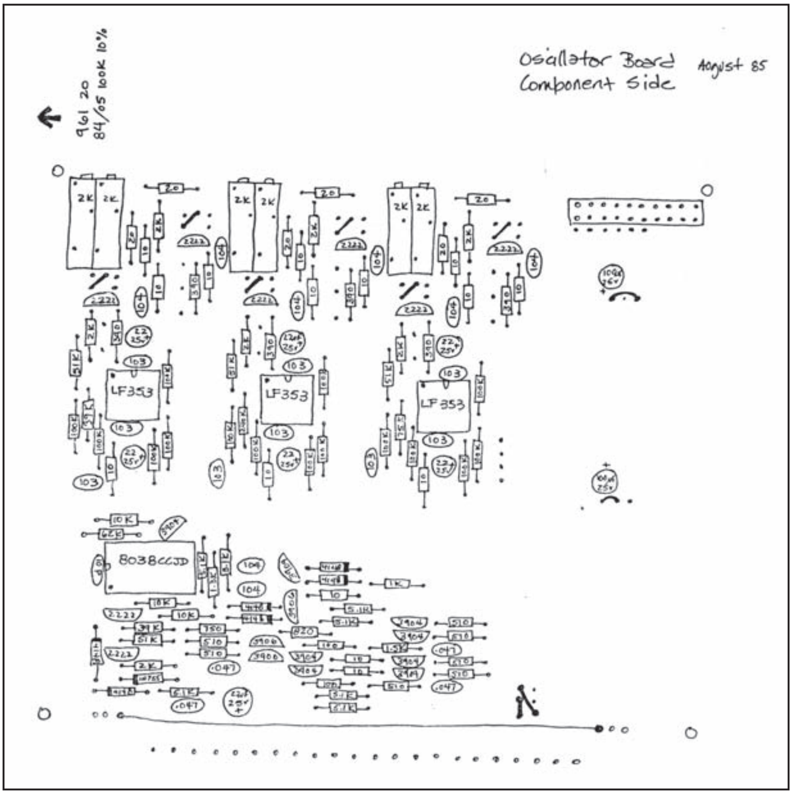

Figure 6. A drawing by Connie Coleman of a board in the Jones Oscillator Bank designed by Dave Jones for the Experimental Television Center (1985). (courtesy. Experimental Television Center).

assumed to output color images – an obvious function. However, an essential function of the Jones Colorizer, part of the tool set in the artists' studio at ETC – is its capability to automate and repeat changes in hue and other visual parameters through the application external waveforms. Without an oscillator to feed waveforms to the Jones Colorizer, and an artist aware of the potentiality, the tool is reduced from an unpredictable instrument (one that has open possibilities and gives the artist many choices) to a very predictable effects generator (a device that simply colorizes).

For Ball, human and financial resources are other factors that will determine whether an industrial artifact can be worked. While he states that the safest route (especially for objects that are one of a kind) is not to operate, Ball notes that the museum may need to choose between 'object conservation' and 'operation conservation'. Ball differentiates between works acquired for the long term and those whose purpose is 'research, public enjoyment or education', which he thinks may be more appropriate for operation conservation (Ball 1997: 26). Video instruments could easily be seen as objects of research or education, whether used by artists or the public.

Ball, Odell and Karp all assert that if an object is unique, there is a strong argument against functional restoration and use. The authors see risk both through use and through the risk of damage (Odell and Karp) and loss (Ball) during restoration and maintenance. With the 'Eigenwelt der Apparatewelt' exhibition, that's precisely why external interfaces were used. If one strictly followed the recommendations of these conservators, however, custom video instruments would never be restored or used, as most of the tools were produced in very small quantities and are scattered among numerous collections.

In a subsequent article, Mimi S. Waitzman and others lay out an ideal set of criteria for deciding whether an instrument should be worked, taking into consideration that:

- the instrument is already in working condition and its continuing use will not detract from its technical and cultural value;
- the instrument is in stable and safe condition;
- qualified expertise is available for regular tuning, maintenance, consultation and monitoring;
- the owner or custodian has a clearly articulated policy on the instrument's use, which meets the standards of ethics and practice of an appropriate national conservation or museum organization;
- the instrument is not to be treated as a working tool in the everyday world, but its historic value is understood and appreciated; and
- every effort is made to make players and audiences aware of the speculative nature of the instrument's 'original sound' […]. (Waitzman et al. 1997: 83)

These are all common-sense instructions. Guidelines for instrument and industrial conservation, and for that matter the conservation of machines and equipment associated with time-based media work, are not substantially different from each other. In all three areas of conservation, an audit or assessment of a machine guides a care and treatment plan, and specifies how, when and by whom operation can occur. Also, each conservation discipline has standards of documentation. Ball is particularly thorough on this, calling for an operating manual that specifies the 'procedures, requirements, and conditions' under which it is to be operated, and noting that every time an object is worked, a record should be made (Ball 1997: 6). For video instruments, for example for the Paik/Abe Video Synthesizers at the Nam June Paik Center, a manual could guide the staff to the care of the machines by tracking when a machine is used in exhibition and for education.

Larger and Working Objects also gives very detailed guidelines for documenting maintenance, repairs and the working of machines. Because Ball believes that loss occurs most dramatically at the point of restoration, most of his recommendations concern the documentation of the object's assembly and disassembly, which he recommends be done only when no other options are present (Ball 1997: 15). It should be noted that Ball's colleague in industrial conservation, Richard Gibbon, sees restoration as a point not just of risk but of opportunity: 'the restoration process reveals undiscovered knowledge about the object' (Gibbon 1999: 23). This knowledge must be captured in a form that can be shared with not just other custodians and conservators, but with researchers as well. We saw this earlier when the 'Rutt/Etra Restoration Party' understood that Dave Jones had done the substantial modifications; it opened up a whole area of information about the machine that would not have been known otherwise – information essential to its conservation.

Ball makes detailed recommendations, covering such topics as an operating log ('a document recording the details of every occasion on which an object is worked') and an operating manual ('a document setting out the procedures, requirements and conditions attendant upon the operation of a working object') (Ball 1997: 6). He goes into great detail about the contents of each of these documents, down to saving removed parts; he instructs: 'record in detail what was found, what was removed, how this was done and with what it was replaced' (Ball 1997: 25). He also makes a checklist of condition assessment, noting such problems as corrosion, rot or mold, cracks or splits from temperature and humidity changes, and stress faults.

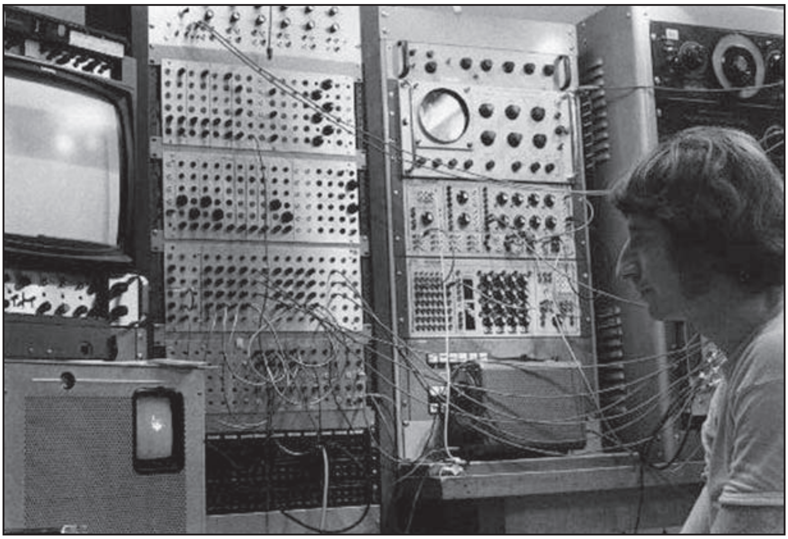

Figure 7. Tom DeWitt at the WRPI Video Synthesis Laboratory in front of Pantomation, a synthesizer system for motion capture that included a Rutt/Etra synthesizer and a Hearn Videolab (c. 1979). (photo. Vibeke Sorensen. courtesy. Experimental Television Center).

Guidelines for use of musical instruments are much more developed, although at this point they may have little relevance for video instruments. The International Committee for Musical Instrument Collections (CIMCIM) of the ICOM (the International Council of Museums) produced *Recommendations for Regulating the Access to Musical Instruments in Public Collections: 1985* that addresses the issue of instrument use.

With conservation there is no static, ideal object that is recreated through restoration. As mentioned above, time-based media art conservation is concerned with works of art, not art-making devices; therefore existing guidelines do not fit neatly for custom video tools. However, one could apply decision-making models usually reserved for media art to these devices. For example, drawing off of recent literature, Pip Laurenson has proposed a risk-assessment process whereby one looks at the anatomy of an art work, considering its key components and their relative value, in addition to any loss already sustained by the work and whether it can be reversed or mitigated. Considered as part of key components are its qualities, behaviors, look and feel, and interactivity (Laurenson 2007).

The key components and qualities in art works are analogous to key processes and characteristics of a given video instrument. If one analyzes a custom tool in the way Laurenson suggests, it may help to sort out the layers of meaning and value that are implicit in the conservation approaches above. Such an analysis would also be very useful for devices that have component hardware and software necessary for the tools' functioning, or where the 'feel' is part of the experience.

Designer Dave Jones remembers and associates the tactility of analog tools as a key component of the early instruments:

> People will make a digital device that simulates the way certain things looked in general, or in some cases, their interpretation of the way something looked. […]They might say, 'Well that thing made it red, green and orange, so here is this software that makes it red, green and orange.' But that may not be what the original machine could really do. Plus a lot of the digital equipment doesn't have that physical feeling of a bank of knobs, or the real-time interaction of turning a knob and watching what's happening. Even the digital knobs available through MIDI and stuff like that, they don't have the same level of sensitivity as the real analog knobs. Even though you feel like you're turning something, you may be turning something with a couple hundred or maybe a thousand steps to it, whereas the original knob might have tens of thousands of steps because it was smooth analog. (Jones 2005)

Taken together, the conservation practices above suggest that the video instruments can be evaluated quite differently considering different institutional contexts. In an arts and culture context, the machines may be seen as key to understanding the early days of video art, and as sharing attributes with media art works. In a science and technology museum, the same tools may represent a certain period in electronic circuit design or in the development of imaging devices. In the context of an instrument collection, they may be seen as an extension of the development of electronic audio instruments. The point is that although these tools grew out of the media arts, they may eventually find their home in any number of institutions. Each institution will have a particular orientation toward the tools, how they should be conserved, whether they should be used, and what form of documentation is adequate to their understanding and interpretation.

Tools and emulators

As noted in the introduction, analog tool development has not completely stopped. Among those making analog tools is Dave Jones – designer of the Jones Colorizer, Jones Buffer and other media arts tools – who has just released an image-making device, the MVIP or Mini Video Image Processor. (See Color Plate 32.) The MVIP will fit in the palm of one's hand and replaces several of the devices in the ETC Studio. Jones intends to recreate all of the custom devices in the old ETC studio with palm-sized devices to complete a Modular Video Synth series.

Modules from the Sandin Image Processor are also being recreated in miniature form by Lars Larsen and Ed Leckie of LZX Industries,[14] based on Dan Sandin's original designs (see Figure 8). Both the MVIP and the LZX modules retain analog attributes on input and output and have the knob interface typical of earlier video instruments.

These efforts are exciting because they represent a continuation of the idea of open-ended imaging systems such as those in the ETC artists' studio. These efforts do not need to be seen as an alternative to a living lab on the model of ETC, or as a reason not to pursue conservation of the early video instruments. In fact, if the ETC residency program were still operating, the MVIP would be installed in a rack next to audio tools built in the early 1970s, as it was when ETC closed. In the spirit of maintaining old and new, analog and digital, at ETC, there's no reason to close off one strategy for maintaining media history in favor of another.

Jones distinguishes his analog device from digital hardware or software that imitates analog equipment or processes; with the MVIP, Jones has made a new analog instrument. Emulation has a visually different quality for Jones:

> [I]n some cases, emulation is a little too perfect. Part of the reality of the tools was those imperfections in the machines and in the video itself, little distortions that happen to video that created an additional look and feel to the image. If you emulate what the device was intended to do, you get the majority of the effect but you don't get those subtle things that happen, which weren't necessarily intentional but that came along with the fact that you built it and it was in an analog world […] maybe there were color artifacts or little distortions to the image, like changes in the linearity of the

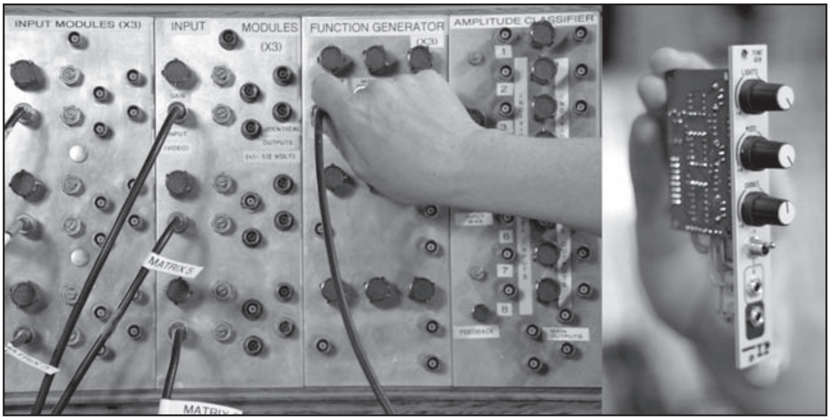

Figure 8. (l) Original modules from a Sandin Image Processor (IP) built by Dick Sippel (photo. Olivia Robinson. courtesy. Experimental Television Center); (r) a contemporary module for a function generator, one of the IP modules, designed by Lars Larsen and Ed Leckie based on original designs by Dan Sandin (2013). (photo. Lars Larsen; courtesy. LZX Industries).

> grey scale – noise, which gave character to the image processing. In some cases, the emulation is too smooth. (Jones 2005)

Here again, what one considers success hinges upon the key qualities that one associates with a particular instrument. Those key qualities are tied to certain processes within the instrument, and dependent on certain material conditions. Jones predicts that the emulations could eventually incorporate noise and aberrations, bringing their effects closer to the original devices. One would have to have deep knowledge of the qualities to be emulated:

> As emulation and the digital tools get better and better, you can probably start emulating the distortions and problems, and get even closer to what some of the original results were. This would be going beyond what the concept of the original machine was by trying to actually mimic the reality of the original machine. But at this point, that is still in the future. It's hard enough to even emulate the basic concepts of what the machine was trying to do, let alone emulate the reality of the small artifacts it had. (Jones 2005)

Emulation can mean much different things to different people. Bill Etra, the co-inventor of the Rutt/Etra Video Synthesizer, has released a software emulator of the 1970 hardware that was developed by him and Anton Marini, better known as Vade. As Vade explains:

> v002 Rutt/Etra is an attempt to capture some of the beauty of the original hardware. It's almost impossible to emulate an entire Rutt/Etra, as modern graphics and computer systems make fundamentally different assumptions from analog video systems. This plugin is a work in progress, and we will try our best to make it as faithful as possible to the original while exploring new creative possibilities. (Marini 2008)

v002 Rutt/Etra works in the software Quark Composer, a Mac-based visual programming language. Also, reportedly as a tribute to Steve Rutt (the other half of Rutt/Etra), Felix Turner of Airtight Interactive created a still-image 'emulator'. The Rutt-Etra-Izer is WebGL-based software that lets you drop an image into a browser window and change it to resemble an iconic effect (nicknamed the Z-displacement) that was possible with the classic Rutt/Etra (Turner 2011).

Digital preservationists point out what may be obvious: emulators that create digital objects that will also need to be preserved. Of course these emulators are not meant as a means of preservation. What they do is draw attention to the historical tool, and offer a direct way to communicate its concepts and processes. The downside is that the emulators popularize one effect of the synthesizer, and they don't do justice to the very wide range of possibilities of the tool. If emulators were the only form of documentation of a tool, not much would be left of a very complex and influential invention.

A short list of proposals

A studio with an expanded mission: A studio of working electronic tools is the best environment within which to test theories and practices of machine preservation. The Residency program of the Experimental Television Center was aimed at artists, but ETC ran a parallel project in the 'Video History Project', which continues today. Through the 'Video History Project', much information has been gathered that provides a context for the tools and that provides details on their development and operation: oral histories, schematics, operating manuals, manifestos, funding proposals and the like. If ETC finds a home for the studio, the space could both provide artist access and be a center for learning about tool development and tool conservation. Theories of what constitutes a restoration and whether it is possible could be debated and tested. Machines could be analyzed and restored. All of the resources of the various efforts described above could be brought to bear on real, live machines. The home could be an arts center or a museum, but there would be great value in involving like-minded people from science and technology conservation. Just as artists and tool designers of the past drew from the knowledge of each other's disciplines, so could the information that is generated from such a center be useful for conservators of industrial and technology collections, electronic instrument collections and time-based media art.

A survey of video instruments: The exhibition 'Eigenwelt der Apparatewelt: Pioneers of Electronic Art' and the efforts of ETC have done much to locate many of the custom video tools developed in the late 1960s through the 1980s. Research for this book has located even more. An interdisciplinary team, including conservators from the areas discussed above, collectors and technical experts could be created to advise an up-to-date survey. The survey would not just locate the machines, but determine if they are in working condition or 'awaiting restoration'. Informed decisions could then be made about each tool's disposition and further documentation could be collected. The Artists Instrumentation Database, developed for cataloguing machines, could be used to record the information; a simplified version of the template and a cataloguing record for the Raster Manipulation Unit can be found following this essay.[15] Through a survey, the most characteristic tools may surface, and key attributes may emerge that are important to preserve relating to underlying concepts, circuit design or processes. The 'Video History Project' of ETC continues to be a hub for primary documents about custom tool development, and is open to contributions.

Tapping into do-it-yourselfers, inventors and the like: The positive impact of people actively concerned about the longevity of legacy video instruments, especially a community that is networked and engaged, can't be underestimated. Machines, parts and knowledge can be circulated and connections made between generations of tool designers, artists and technical experts.

The idea of DIY has proliferated in technological realms as strongly as any other sector. Art departments are teaching bottom-up device and circuit design. The spirit of the Resurrection Bus – hitting the road in service to media art – and the 1980s Tuesday Afternoon Club – artists gathering to build custom machines – still persists and needs to continue. It is found through a Fixers Collective, in the volunteer staff at a science museum, in online forums, or at video synth gatherings. New ideas for cross-discipline problem solving are needed and can be successful.

Testing the concept of copying: Both industrial and instrument conservation recommend copying for one-of-a-kind or very fragile objects. The original is safeguarded and the new object is used. Copying, where possible, also aligns with the spirit of many of those involved with tool development in the 1970s and 1980s. As Phil Morton said, 'COPY-IT-RIGHT'.

Tapping into a science and technology museum may also be a prospect for copying. Ball expresses enthusiasm for the craft associated with machines that could be useful both for custom electronic tools and for video playback decks, seeing the copying process as:

> [A] marvelous opportunity to recover and demonstrate vanishing crafts […] the popular view sees a museum's function overwhelmingly in terms of objects. It does not see, or it ignores, the operating, manufacturing and repair skills preserved and sometimes rediscovered by research into working objects. (Ball 1997: 29)

Organizations and schools that are teaching circuit bending and hardware hacking may also be intrigued by the challenge of copying an analog imaging tool.

Document, document, document: Resources like the tools section of the 'Video History Project' and the online archives of the website of The Daniel Langlois Foundation for Art, Science and Technology[16] hold the documents and photographs that fit Ball's idea of enduring evidence of how the tools operated, were used and contributed to art practice. A computer catalog of videotapes, as opposed to a jumble of unidentified tapes, makes for an increased likelihood that an archive will take notice; so does a rich collection of documentation surrounding a custom tool make it more likely that a machine will find an institutional home.

ETC's DVD set *Early Media Instruments* needs to be widely circulated.[17] The laser discs from 'Eigenwelt der Apparatewelt: Pioneers of Electronic Art' contain video documentation of the instruments from that exhibit and associated artists' works. The contents of the discs need to be located, reformatted and uploaded to the 'Video History Project' website. The survey mentioned above and continued documentation go hand in hand. The survey can set a minimum standard for documentation and assess how complete the existing documentation is for a given tool. The information can guide efforts to accumulate as full documentation as possible in physical and web-based archives. A central spot for manuals will be important; the 'Video History Project' website is already functioning in this way.

In the end, theories and proposals only go so far. Custodians will need to continue with their passion and their labor, whether as individuals or as institutions. The progress that has been made on saving 1970s and 1980s noncommercial, independent videotape collections has largely been a matter of the maintenance of ad hoc archives; becoming self-taught conservators and preservationists; making friends in cultural heritage organizations, with technical experts and creative thinkers; and lots of cultural advocacy. Time will tell if the artifacts of this slice of media art history – custom electronic video instruments – will survive through the same care, collaboration and advocacy.

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Notes

1. For the purposes of this essay, 'instrument', 'tool', 'device' and 'machine' are used interchangeably. The term 'electronic instrument' is used to refer to custom video instruments, not electronic instruments in general, such as drum machines. For a discussion of the use of the term 'instrument' for the custom video tools, see Jean Gagnon's 'Instruments, Apparel and Apparatus: An Essay on Definitions' in this book. References to instruments were not uncommon for designers of custom electronic tools. Dan Sandin resisted labeling of modules on the Sandin Image Processor, saying 'nobody puts the letters on the keys of a piano and nobody puts the letters on a saxophone' (Sandin 2003: 13).
2. For a selection of artists served by the Center, see Experimental Television Center (2011). ETC has produced a DVD set of artworks that were made using the ETC studio: for more information, see Experimental Television Center (2010).
3. Dave Jones's most recent inventions can be seen at Dave Jones Design: http://www.djdesign.com/.
4. See the story, with photos and drawings, in the section 'The Templeton Mixer' at http://ncet.torusgallery.com/mixer/tempmix.html.
5. Technically, the program did not have the name New Television Workshop until 1974. However, the same basic structure – artists using television studios for experimental video – was in place in 1972 (WGBH n.d.).
6. In addition to building a Paik/Abe as a student, Grace later traveled with Paik and Abe, building and troubleshooting synthesizers. See Kathy High's essay 'Mods, Pods and Designs: Designing Tools and Systems' in this book. Grace is one of a handful of women who were tool builders in the 1970s and 1980s.
7. This summary of the restoration work is drawn from the catalog Park and Lee (2011) and the website for the center: http://www.njpartcenter.kr/en/.
8. The Vasulka online archive can be found at http://www.vasulka.org/.
9. The collection at the Cinémathèque québécoise was formerly held at The Daniel Langlois Foundation for Art, Science and Technology, also in Montreal. At the time of this writing, many collection documents and research guides were still being hosted on the foundation's web site: http://www.fondation-langlois.org/html/e/.
10. Jitter is a product of Cycling '74 that is used for real-time video processing. See http://cycling74.com/products/max/video-jitter/.
11. There are a number of organizations for caretakers of industrial, technology and science collections, including the International Committee for the Conservation of the Industrial Heritage (TICCIH) (http://www.mnactec.cat/ticcih/industrial_heritage.htm) and the Association for Industrial Archaeology (website: http://industrial-archaeology.org/). See also, the Computer Conservation Society (http://www.computerconservationsociety.org/).
12. See Laurenson (2007) for a decision-making process for preserving machines and equipment within time-based media installation.
13. In 2009–11, the Flemish arts organization PACKED and the Netherlands Media Arts Institute collaborated on an Obsolete Equipment Project; see http://nimk.nl/eng/obsolete-equipment. See also Pip Laurenson (2005), 'The Management of Display Equipment in Time-Based Media Installation', London: Tate Gallery of Art.
14. See http://www.lzxindustries.net/.
15. The cataloguing example for the Raster Manipulation Unit is modified from the Artist Instrumentation Database Template. The original template and description can be found on the website of The Daniel Langlois Foundation for Art, Science and Technology http://www.fondation-langlois.org/html/e/page.php?NumPage=710.
16. See the 'Video History Project', http://www.experimentaltvcenter.org/video-history-project; and The Daniel Langlois Foundation for Art, Science and Technology http://www.fondation-langlois.org/html/e/.

A Catalog Record for the Raster Manipulation Unit

Mona Jimenez

Raster Manipulation Unit

Collection of the Experimental Television Center

Date Device Was Invented	c. 1972
Date Machine Was Manfactured/Built	c. 1979

Alternate Name(s)

Wobbulator
Scan Modulator

Inventor/Designer		Role:	
Other Production/Design Credits	Richard Brewster	Role:	Builder; designer for SONY 760 version
Manufacturer or Builder	Richard Brewster	Place of Manufacture	Binghamton NY
	Walter Wright	Place of Manufacture	Binghamton NY
	David Jones	Place of Manufacture	Binghamton NY

Extent

1 altered television with 1 mono audio amplifier, 1 stereo audio amplifier, 1 input unit for audio signals, a toggle power switch, a terminal/barrier switch, wires and cables.

Summary Description

The Raster Manipulation Unit is a "prepared television" made from a SONY 760 black and .white television set with a 9" screen. This machine is one of several made at the Experimental Television Center (ETC) starting in the early 1970s based on principles defined by Nam June Paik's early television experiments such as *Dancing Patterns*. This Raster Manipulation Unit was built by Richard Brewster, David Jones and Walter Wright. The devices were nicknamed "Wobbulators" by Walter Wright.

Television sets have deflection yokes that under normal operations guide a stream of voltages in a predictable pattern—in lines from left to right and top to bottom—to create a conventional image. The process of "writing" the lines is referred to as scanning and the resulting pattern of lines on the TV screen is called the raster. The Raster Manipulation Unit, by adding several additional yokes on top of the original ones and allowing the application of various electrical currents (or no current) to one or more of the yokes, changes the conventional scanning pattern and causes image distortions.

The Raster Manipulation Unit takes a video input from a camera or tape, and has presets that allow the user to reverse the image or to collapse the image to a single horizontal line, vertical line or point. In addition, audio signals passed through audio amplifiers can result in the image shifting to the left or right or up or down. There is also a preset that causes a "S" curve in the image. or a rotation of the image around a central point. Any of the effects can also be used in combination, and effects can impact portions of the image or the whole image. In addition the distorted image can be "locked", creating a still image. The Raster Manipulation Unit does not have a video output, so still or moving images are captured through the use of a camera pointed at the TV screen.

The Raster Manipulation Unit was significant in a number of ways. With the Raster Manipulation Unit, one could produce results that could be to some degree controlled and repeatable. In addition, the device marked the beginning of a vocabulary about image processing using external controls, the illusion of a 3D space and the concept of instrumentality. Nam June Paik helped to popularize concepts of raster manipulation; however, the principle of manipulation of the video scanning process was practiced by many artists and inventors and is present in other electronic tools such as the Rutt/Etra Video Synthesizer.

All of the Center's units were made from the SONY 760 set. After the initial Raster Manipulation Unit was built, Brewster designed simple circuitry for that television that helped stabilize the signal. Between 1978 and 1980, Sherry Hocking and Brewster with assistance from Walter Wright wrote documentation for operating and building the device. The documentation was funded by the New York State Council on the Arts and the National Endowment for the Arts. This unit was still in operation in the ETC Studio in 2011.

Device Type: customized/off-the-shelf

Operational Status: operational

Components Description

The major component is a customized television SONY Model 760 9" black and white television set. The set has been disassembled and expanded so that its deflection circuits are exposed. Two deflection yokes have been added on top of the original ones: one yoke from a color television monitor and one wound from enameled copper wire covered with black tape that is referred to in the documentation as the "continuous wind yoke". (Paik used a different design in his raster manipulation units; however, Sherry Miller Hocking remembers him saying that to properly wind a copper wire coil for a prepared TV, one should count to 100 in Korean.)

The television is mounted on a piece of wood. The normal power/volume knob, the UHF and VHF switches and the channel select have been removed or are inaccessible. The brightness and contrast knobs on lower front of the set remain and are functional. The normal connectors on the back of the set are unaltered but are not utilized. Mounted to the wood to the left of the set is a toggle on/off power switch.

There are two BNC connectors mounted on the top of the chassis that are bridged composite video inputs. Behind them is a mounted BNC connector for composite video out (functionality unknown). Next to the video connectors are two mini phone jacks for analog audio in (front) and audio out (back) (functionality unknown). Next to the audio jacks are two black knobs. The right knob controls horizontal deflection of the raster and the left knob controls vertical deflection of the raster. Both knobs have three positions (right to left) normal, reverse, collapse. Reverse flips the raster 180º from normal. Collapse causes all of the lines to be written in one place—a single vertical line in the case of the right knob, and a single horizontal line in the case of the left knob. Used together the raster can be collapsed into a single point.
The audio input unit is a metal mount to the left of the TV. There are three mini phone jacks for input of the control voltages or other external audio signals; these signals are fed into amplifiers. Above the jacks are three black knobs that serve as gain controls for the signals going to the inputs of the amplifiers. They are labeled (left to right) VERT, "S" and HORIZ.

Mounted on the wood to the right of the picture tube is a six position terminal/barrier strip with wires connected to the outputs of two amplifiers. The amplifiers provide strong signals to the deflection yokes. A 60 watt McIntosh 60 mono tube amplifier provides current to the hand wound coil which is adjusted through the "S" gain control. The magnetic fields created by this coil rotate the raster around the center of the image, creating S curves. A Kenwood Model KA -5700 stereo amplifier provides current to the color yoke which is adjusted through the VERT and/or HORIZ controls. These controls allow the raster to be shifted up and down (VERT) or left and right (HORIZ). As noted above, the control voltage inputs can be used alone or in combination, and also with the normal, reverse and collapse functions. Frequencies of control voltages used with this device are generally between 30 Hz and several hundred Hz.

Related Technical Documents & Texts

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Related Audiovisual Documentation

Neal, Blair, 2010. "The Paik Abe Raster Manipulation Unit a.k.a. The Wobbulator" [video] Availablr at http://vimeo.com/16906546 [Accessed 31 July 2012.

Early Media Instruments: Raster Manipulation Unit 8 DVD set. (Experimental Television Center, 2010))

General Note

In "Raster Manipulation Unit" (see above in Related Documents) the original unit included a monaural amplifier, a stereo amplifier and three audio generators. Also at the time of cataloging, the audio input box was being bypassed.

Copying-It-Right: Archiving the Media Art of Phil Morton

Jon Cates

In 2007 I initiated the Phil Morton Memorial Research Archive in the Department of Film, Video, New Media and Animation at The School of the Art Institute of Chicago (SAIC), through a generous donation from Morton's surviving partner, the late Barb Abramo. This archive contains Phil Morton's 'personal video databank' which stretches across 30 years of media art histories that are specific to the early video art and new media art communities in Chicago. These communities were organized around shared ethical commitments and theory-practice, one of those being Morton's COPY-IT-RIGHT ethic.

During the early 1970s, the work of media artists in Chicago anticipated and developed open-source approaches to free culture, foregrounding collaborative experimentation. Phil Morton's COPY-IT-RIGHT ethic motivated the early video art communities in Chicago and beyond to share resources, widely distribute media and create transparent, decentralized, and open systems.

In 1971, Dan Sandin developed the Sandin Image Processor (IP), a patch-programmable analog computer optimized for video processing and synthesis. Morton, who was a friend and neighbor, asked Sandin if he could build the first copy of Sandin's original Image Processor, and Sandin and Morton began to work together creating the schematic plans for the IP. They named this document the 'Distribution Religion'.[1] Through this philosophy, Sandin open-sourced his unparalleled innovation, giving the plans away for only the cost of the Xerox copies and postage, while simultaneously incorporating any additions or modifications made by those who built their own Image Processors into any further releases of the 'Distibution Religion'. This proto-open-source project gave an international community of artists unprecedented abilities to process and perform real-time audio and video projects.

During this time, Morton developed COPY-IT-RIGHT, an anti-copyright approach to making and freely sharing media art. The 'Distribution Religion' and Morton's individual and collaborative media art works were released under his COPY-IT-RIGHT license. COPY-IT-RIGHT encouraged people to make faithful copies, and to care for and distribute media art works as widely as possible. A close-knit community of collaborators, including Phil Morton, Dan Sandin, Tom DeFanti, Bob Snyder, Jane Veeder, Jamie Fenton and others, worked together in Chicago on the new media of their time, incorporating digital and analog computing with real-time audio and video synthesis, processing, programming and performance. Many of these individuals, as well as Morton's students, adopted the COPY-IT-RIGHT ethic, applying and modifying it in their own projects. (See Color Plate 27.)

Schools such as SAIC and The University of Illinois at Chicago – Circle Campus acted as incubators for the ideas and approaches that these early media art communities shared. Students and faculty formed new departments and organizations that would develop into internationally recognized homes of artistic experimentation and technological development. At SAIC, Phil Morton founded the Video Area and the Video Data Bank. During this same time period, Dan Sandin and Tom Defanti founded the Electronic Visualization Lab at the The University of Illinois at Chicago – Circle Campus. The faculty and students of these two schools and their freshly founded departments worked together informally and publicly to build various forms of inter-institutional collaboration.

Phil Morton arrived in Chicago in 1969, joining the Faculty at SAIC. Only one year later Morton founded the Video Area, which was the first department in the United States to offer a BA and MFA degree in video art. Within the Video Area, Morton founded The Video Data Bank, which has now become one of the world's leading collections of video art. The Video Area later became the Video Department, which then merged with the Film Department to form the Department of Film, Video, New Media and Animation. Frequent guests in the Video Area during the 1970s included Steina and Woody Vasulka, who established The Kitchen in New York City, and Gene Youngblood, who published *Expanded Cinema* in 1970. Graduate students such as Lyn Blumenthal, Kate Horsfield, Christine Tamblyn and Jane Veeder helped to form the early video art community at SAIC, and also became important contributers and developers of the early culture of media art in Chicago.

In 1969 Dan Sandin was, in his own words, 'hired to bring computers into the art curriculum' (criticalartware 2003a) of the University of Illinois at Chicago Circle Campus, then referred to as Chicago Circle Campus. Tom DeFanti (originally hired as faculty in the Chemistry Department) joined Sandin and they co-founded the Circle Graphics Habitat at Chicago Circle Campus in 1973. The Circle Graphics Habitat would soon be renamed the Electronic Visualization Laboratory (Electronic Visualization Lab), and would continue functioning into the present at the leading edge of the intersections of art and engineering. When DeFanti joined the faculty at Chicago Circle Campus and cofounded the Electronic Visualization Lab with Sandin, he brought with him the Graphic Symbiosis System (GRASS) that he had developed as a PhD student at Ohio State University while working with Charles Csuri, a pioneer in the field of computer art (Rivlin 1986: 15). GRASS was a real-time computer graphics programming system that allowed for real-time interactions, allowing programs to be written or altered interactively while the visual graphics output of those programs was rendered on-screen. During this time, Ted Nelson, who is famous for his coining of the terms 'hypertext' and 'hypermedia', also joined the faculty at Chicago Circle Campus. Nelson was roommates with DeFanti and self-published his now famous *Computer Lib/Dream Machines* (1987) in 1974 while living in Chicago with DeFanti.

During the highly active period in the 1970s, artists, educators, innovators and organizers paths crossed and became deeply interwoven in Chicago, forming the closely knit fabric of these media art communities. These individuals included those already mentioned in this text and others to form an impressive set of pioneers: Dan Sandin (who additionally cocreated the CAVE Virtual Reality system); Tom DeFanti (cocreator of CAVE Virtual Reality system); Bob Snyder (founder of the sound department at the SAIC); Jane Veeder (early digital artist recognized by 'Ars Electronica' and SIGGRAPH); Jamie Fenton (cofounder of MacroMind, which would become MacroMedia; computer programmer and developer of the software that would become Adobe Director); Larry Cuba (accomplished media artist who contributed to early computer animation); Ted Nelson (who in addition to hypermedia and hypertext also invented the concept of Xanadu); Timothy Leary (the countercultural futurist and provocateur); Gene Youngblood; Steina and Woody Vasulka (media artists who importantly contributed to early video art); Sonia Landy Sheridan (whose work on generative systems at SAIC has been documented by Kathryn Farley for The Daniel Langlois Foundation); and Kate Horsfield and Lyn Blumenthal (who took over the direction of the Video Data Bank at SAIC and transformed the organization into a world leader of video art collection and distribution). The stories and histories of those individuals and their achievements have all been fairly well documented and incorporated into media art histories; however, Phil Morton's work – which literally connected and brought into conversation many of those above – has remained little discussed.

Phil Morton's absence triggered my interest in this alternative media art histories project. I was familiar with the work of many of the above-mentioned artist-educators but mostly unfamiliar with Morton and gained access to some of his work through my position in the Department of Film, Video, New Media and Animation at SAIC. As I watched and read through the materials that I unearthed, I became excited and surprised by Morton's work and wanted to see as much as possible. Uncovering this material, I began to wonder how this aspect of media art history had been lost, forgotten or repressed in the media art historical account in general and also within SAIC's institutional memory.

I have been able to theorize a few of the reasons for this situation. Morton vehemently advocated for free culture and open-source approaches to media art before such ideas were understood or such terms were in use. He experimented relentlessly with boundaries, ignoring as many distinctions between personal, professional, political, aesthetic and technological categories as possible. He quickly moved to include analog and digital computing in his artistic work and academic curriculum with very few antecedents to rely on or refer to. In doing so, he purposefully and playfully explored what we would now refer to as new media art, an art that was radically open, remixed, collaborative and conversational. As such, his projects were innovative and anticipatory as well as hybrid in form, difficult to categorize, anticommercial, anticorporate and sprawling in their cyber-psychedelic sensibilities.

Both having arrived in Chicago in 1969, Morton and Sandin met on Chicago's South Side, in the Pilsen neighborhood where they had neighboring artist studios. Morton and Sandin became friends and collaborators in 1971 while Sandin was in the early stages of developing his IP. As Sandin explains, the IP is a 'general purpose patch-programmable analog computer […] optimized for processing video information' which can also 'process sound or any other signal' (Sandin 1973). By 1973, when complete, fully documented and copyable, the Sandin Image Processor offered artists new abilities to create, control, affect and transform video and audio signals in real time, enabling live audio-video performances and the production of work that would become collectively known as 'image processing' and associated with the early media art community in Chicago. 'Image processing' is a subgenre of video art historicized and documented in detail in the 'Performance of Video-Imaging Tools' section of *Surveying the First Decade: Video Art and Alternative Media in the U.S.* (1995), the Video Data Bank's historical collection of video art. As Chris Hill writes in an essay that accompanies the video collection, an interest in developing systems and tools, such as the IP, was shared among many of those in the video art movement across the United States. Hill writes that 'Throughout this period, artists, usually in conjunction with independent engineers, modified and invented video "instruments" or imaging tools, making possible the construction of new video and audio systems shaped by their individual aesthetic agendas' (Hill 1996). The IP is one of the most well known and well documented of these instruments.

In 2003, Mona Jimenez developed 'The Artist Instrumentation Database Project' as a researcher-in-residence with The Daniel Langlois Foundation (Jimenez 2005). The Artist Instrumentation Database Project is among recent studies of the activity of instrument building in the early video art communities of the United States. Jimenez compared two custom-built tools developed and used by artists during this period, referring to 'technological devices as art-making tools and as components of electronic art works' thus linking the artist-inventors' work of technological innovation in the creation of these instruments with their placement within works of art (2005: 1). If these devices are developed by artist-inventors and used not only to make art but as components of electronic art works, then they may also be considered, at least in part, as art works in and of themselves. The two instruments that Jimenez details in her research are the Rutt/Etra Scan Processor and the Sandin Image Processor. As Jimenez states, these two instruments were actively used in the 1970s and 1980s in and for the production of 'time-based media art and performance incorporating media' (2005: 1). Jimenez recounts that both instruments were inspired by previous developments in media art and electronic music, such as Nam June Paik and Shuya Abe's Paik/Abe Video Synthesizer and Bob Moog's audio synthesizers. Still, each artist-developer of video instruments took fundamentally different approaches to the conceptual and technical structures of the instruments and the cultural or commercial distribution of these devices or systems.

The IP is an open system of which ‘numerous versions were built’ (Jimenez 2005: 3). As Jimenez has documented, those that copied the Sandin Image Processor undertook this work themselves, often extending and expanding upon the functionality of the system. This kind of versioning, extension and expansion was possible due to the ‘early model of open source’ (Jimenez 2005: 1) that Sandin used to distribute the system. Sandin himself also notes a similarity to, and anticipation of, open-source software in his approach to the distribution of the Image Processor, saying, ‘it is very much like the open-source development that we have today in software’ (criticalartware 2003a).

The IP became open source because of Morton’s interest in making the first copy of the IP. Consequently, the documentation of the system that Sandin and Morton developed together (in order for Morton’s first copy to be created) made the wider media arts community aware of the IP. This documentation is known as the ‘Distribution Religion’. Morton proudly referred to himself as the ‘first copier’ of an IP (Morton 1973: 2) and his first act of copying enabled an entire community to develop. As Sandin recalls in a 2002 interview with criticalartware, when Morton first asked Sandin if he could copy the IP, Sandin said yes but was not sure it was technically possible:

> [Y]ou definitely have permission to build a copy, but I actually don’t know if you can build a copy. I didn’t want to be insulting, but I didn’t really know what it took, because you’re so immersed in this stuff, in designing and building it, it’s hard to figure out what resources are actually necessary to do a copy. We talked about it a little bit and he built the first copy. As part of that process of building the first copy we did a documentation that was sufficient so that other people could copy it. It took a year’s worth of Friday afternoons where I’d show up at Phil’s house and we’d work on his IP for a while and he’d produce part of the documentation and I’d work on it. We developed a format and a way of doing it. I won’t say it was intensive work every Friday afternoon but it took a year of getting together and fiddling at it. By the end of that we actually accomplished a document which enabled a large number of people. In a period of a few years, twenty or so copies of the IP were built, almost all of them by individuals or small arts institutions. (criticalartware 2003a)

‘Distribution Religion’ contains all of the schematic plans and electronic diagrams necessary to build an Image Processor in its ‘classic’ configuration, and also documents any significant contributions made by those who extended or modified the system. Thus, the ‘Distribution Religion’ not only anticipated artists’ current approaches to free and open-source software development, but also distribution methods and do-it-together (DIT) collaborations.

Although primarily a technical document, ‘Distribution Religion’ also offers articulations of the techno-social and media-philosophical positions of Sandin and Morton. These philosophies introduce and conceptually enframe the technical plans. In the introduction, Sandin wrote: 'I think culture has to learn to use high-tek machines for personal aesthetic, religious, intuitive, comprehensive, exploratory growth. The development of machines like the Image Processor is part of this evolution' (Morton 1973: 1). Morton goes on to write 'NOTES ON THE AESTHETICS OF "copying-an-Image Processor"', saying that he is a 'copier of many things' and 'the first copier of an Image Processor' so that his notes and observations that follow should be meaningful to 'future copiers' (Morton 1973: 2).

Morton wrote with emphatic enthusiasm that:

> First, it's okay to copy! Believe in the process of copying as much as you can; with all your heart is a good place to start – get into it as straight and honestly as possible. Copying is as good (I think better from this vector-view) as any other way of getting 'there'. (Morton 1973)

Morton articulated an ethical position on the act of copying in 'Distribution Religion'. He holds that copying is right, morally correct and good, and in the case of the IP, necessary for its distribution as an instrument that was conceived of (conceptually and technically), through an implementation of Morton's concept of COPY-IT-RIGHT, as expandable, decentralized, free and open source.

The IP is a system that is expandable or extendable via the creation of new modules, components and plug-ins developed by the community of codevelopers who reimagined the possibilities of the system. Thus structurally Sandin's system is open and decentralized; the decentralization of the system echoes a technical, structural and philosophical position outlined in 'Distribution Religion'. Christine Tamblyn states in her history of image processing (as a subgenre of video art made in Chicago) that 'Sandin eschewed the hierarchical organizational mode favored by television engineers that places all components under the control of one centralized unit' (Tamblyn 1991: 304). The classic configuration of the IP allows all basic functions to operate, but the modules can be arranged and rearranged to achieve highly customized effects and personalized styles, to attain what Tamblyn calls 'unpredictable and unprecedented results' (1991: 304).

Many of Morton's projects relied heavily on the Sandin Image Processor, as can be seen online via the 'Phil Morton Memorial Research Archive', where Morton's works are freely available for viewing and download.[2] The Archive contains over five hundred videotapes from the early 1970s and 1980s in U-Matic tape, ½" open-reel and VHS formats, as well as videotapes from the 1990s and associated paper files, notes, and other documentation. Many of the videotapes are process-oriented, consisting of raw materials, various versions, final edits and subsequent remixes. The availability of the process materials is what makes the Archive particularly useful for research. Morton's process from initial acquisition of footage through various forms of image processing of the footage and its incorporation into edited versions, final edits and remixes can be studied.

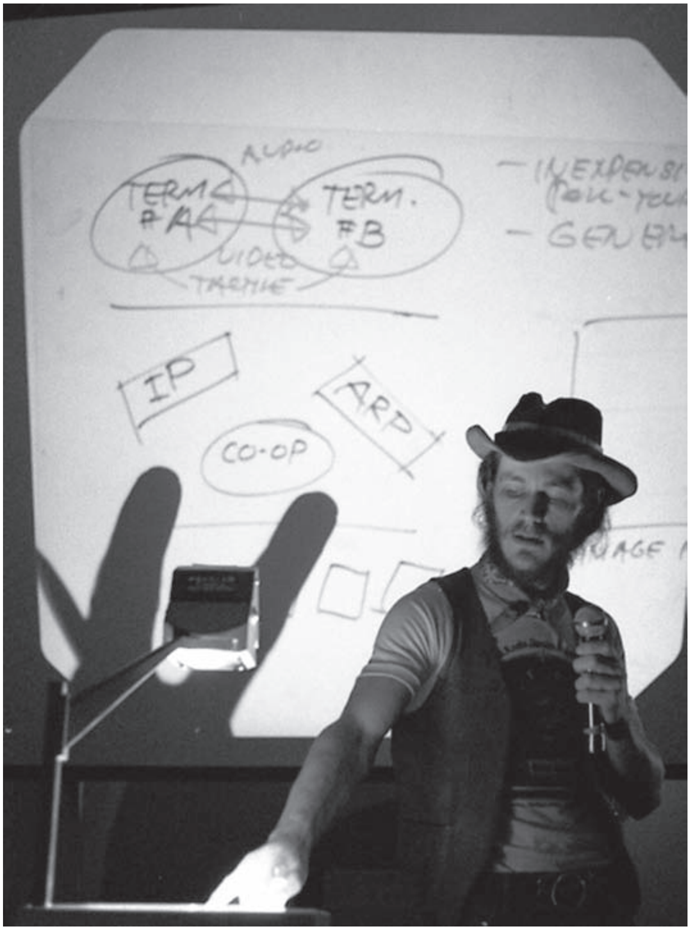

Figure 1. Phil Morton lecturing at 'Design/Electronic Arts', a conference in Buffalo, New York (1977). (photo & courtesy. Jane Veeder).

Much of Morton's material is collaborative, involving projects with Sandin, DeFanti, Snyder and Jane Veeder. The collaborative work is almost always explicitly positioned as anti-copyright, as it is released under Morton's COPY-IT-RIGHT ethic in much the same manner as the release of 'Distribution Religion'. I will now contextualize Morton's principle and practice of COPY-IT-RIGHT in relation to current forms of resistance to copyright and intellectual property regimes. The continuum of alternatives to copyright provides a set of contemporary comparisons to COPY-IT-RIGHT and serves to illustrate the ways in which Morton's COPY-IT-RIGHT ethic anticipated, and has several different relationships to, these current models.

As noted above, Morton used his anti-copyright COPY-IT-RIGHT ethic, or what one could call his licensing system, for his individual and collaborative media art works during the period when he was developing his IP and the 'Distribution Religion'. 'NOTES ON THE AESTHETICS OF "copying-an-Image Processor"' appears to be the first fully formed articulation of Morton's COPY-IT-RIGHT ethic. In the years that followed, Morton would continue to define COPY-IT-RIGHT through his writings and his collaborative media art projects. By the late 1970s and early 1980s, his COPY-IT-RIGHT ethic would be visibly and fully articulated in his works. Furthermore, his students, colleagues and collaborators would use this ethic during this time period, taking up his collaborative and anti-copyright approaches to making and distributing experimental media art. Not only did they share their projects with one another, but in the folk technology tradition initiated and promoted by 'Distribution Religion', they openly shared their methods for the production of their work and came to feel strongly that their work was operating simultaneously as media art and community building.

Morton's former artistic collaborator and partner Jane Veeder explains Morton's COPY-IT-RIGHT ethic:

> Phil was really famous at the time for copying everybody's work, he was always famous for copying people's tapes. There was that early counterculture sense, and it's strong in the digital realm as well, that counterculture sense that information should be free. Now it's actually gaining momentum. Look at the open-source software development movement. Look at Linux. A lot of people find fault in Linux but nevertheless, it's certainly got a lot farther than people thought at the time, and I am sure there are many that are threatened by it. Phil had an expression that was, 'copy it right'. The idea was to make a faithful copy, take care of it, show it to people, and that justified making a copy of anything. (criticalartware 2003b)

Veeder was Morton's closest collaborator and partner during Morton's most artistically active period – the mid to end of the 1970s. Not only did they collaborate on experimental media art projects, they started new academic initiatives and media art organizations at SAIC, and traveled the United States together. Veeder's comments purposefully make it clear that Morton's stance could be thought of not only as anti-copyright and open source, but also as pro-piracy. The ethic of COPY-IT-RIGHT thereby emphasizes a multivalenced moral imperative to freely copy and openly distribute creative works as widely as possible, especially in the hostile environment of copyright and intellectual property regimes that would make such activities illegal.

My use of the phrase 'intellectual property regimes' points towards the techno-social roles of archives. Should archives function primarily as collections of protected intellectual property assets, locked and gated away behind layers of copyright protection; or should archives function as available resources that can allow materials to be further extended and engaged with in open and unforeseen ways? While these are simplified options, with the Phil Morton Memorial Research Archive my task is to facilitate the latter of the two. That is to say, the archive must not become another indexed and cataloged set of overly protected intellectual properties in a library science–style approach that would seal and stabilize the ownership of these media objects, but rather the objects must remain as they were intended to be when created – used, reused and understood as artistic dialog in processes of constant becoming.

As Janice T. Pilch states in her essay 'Collision or Coexistence? Copyright Law in the Digital Environment', intellectual property regimes are most 'often associated with efforts to wipe out music and film piracy' (2005: 80) such as those made possible by file sharing and copying of digital files online or in peer-to-peer networks. Morton's COPY-IT-RIGHT ethic and his formation of the Video Data Bank – which was initially designed as an open collection of copied and copyable resources – were conceived of to support digital sharing and distribution of media arts, thirty years before the possibility of exchanging video materials in, on or through online networks and personal computing devices. Even the globalized intellectual property regimes that exist today have been defined in the United States and filtered through a great deal of transnational corporate interest.

The current copyright laws began to be revised and firmly established during the 1980s through The General Agreement on Tariffs and Trade (The GATT); in the 1990s through the formation of the World Trade Organization (WTO) and the WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (the TRIPS Agreement); and most recently the Digital Millennium Copyright Act (DMCA). The development of these laws, legal systems and organizations are generally understood to have been landmark events in the process of globalization. The DMCA is the most digitally specific, wide-reaching and expansive of these laws, and has recieved widespread criticism for its severity, scope and enforcement.

Various forms of resistance to copyright have been identified by scholars such as Debora Jean Halbert in her work on intellectual property. Halbert seeks to find and highlight the strengths of 'alternatives to protecting knowledge resources that don't translate them into private property' (2005: 5) while investigating a number of areas in the legal expansion of copyright; her focus is on the ways in which intellectual property regimes limit creativity and the exchange of information while increasing suspicion among creators and distributors of content. One of the failures of imagination in the current globalized legal system of copyright and intellectual property is, in Halbert's words, the assumption that 'creation stems from the chance of monetary rewards' (2005: 5). Morton and his Chicago-based group of collaborators and students did not share this assumption, and considered their creative work to be for the moral, artistic, personal and political good of their communities, where they represented a formative core of artist-educators. As such, Halbert's search for alternatives and resistance to, as well as critiques of, copyright law and intellectual property regimes hold particular importance, underlining that the experimental work undertaken by these artist-developers is echoed in critical and scholarly analysis thirty years later. Over the course of these thirty years, the issues of copyright and intellectual property in media arts become even more pressing, as the digital forms that Morton and his collaborators developed and experimented with eventually became the basis by which almost all media is rendered, distributed and exchanged.

Figure 2. Phil Morton self-portrait. (courtesy. Phil Morton Memorial Research Archive).

Halbert notes that since the 1990s, with the commercial popularization of the Internet through the development of the World Wide Web and the availability of digital video, the United States Congress and the intellectual property industries (including the transnational corporations that own the rights to creative works, the Motion Picture Association of America, the Recording Industry Association of America, their legal teams, etc.) have responded by legally extending the concept of copyright 'as it confronted the new technologies of the information age' (2005: 1). These changes to the idea of copyright and the laws governing copyright and intellectual property articulate a 'desire to own what only has value through circulation and to control every possible exchange of this information' (2005: 3). Halbert refers to the resulting increase in suspicion 'as everyone starts worrying about property and not about sharing the results of their intellectual or creative work'

(2005: 3). Key to her critique of copyright and intellectual property law is that the increased suspicion is corrosive to creative communities.

Halbert suggests that the worry or suspicion is not irrational or unwarranted, and that alternatives need to be developed and explored. Halbert explains that as ‘solutions become increasingly draconian with each new lobbying round by major intellectual property interests’ (2005: 3), and the conceptual framework of property is the main way in which creative work is enframed or understood, more suspicion is produced. This suspicion has a destructive effect, causing people to worry about ‘how their work will be misused instead of used’ (2005: 3). Halbert continues, writing that ‘[c]oncerns about property protection do nothing to enhance the free exchange of ideas’ (2005: 3). Rather than promoting a culture in which the creative arts are valued in frameworks other than property, and artists are encouraged to freely exchange and share ideas, copyright law as enacted by the United States Congress has, according to Halbert, moved to ‘provide even stronger protective measures for copyright and patent owners’ (2005: 3). More directly, the United States Congress has enacted laws at ‘the behest of the entertainment industries’ (2005: 3) in order to further expand the definitions of copyright and intellectual property in favor of the industries, and in order to further protect these corporate interests rather than the public interest. In particular, the United States Congress and the corporations that this legislative government body has defended and acted at the request of, drafted the DMCA in part to respond to new digital technologies, but also as an opportunity to expand the definitions of copyright and intellectual property for the sake of corporate copyright owners. Halbert plainly states that these combined facts demonstrate that the DMCA ‘clearly illustrates that the law is not a neutral body of abstract principles, but is instead the codified will of those with economic and political power’ (2005: 3).

Matteo Pasquinelli has written on these issues in *The Ideology of Free Culture and the Grammar of Sabotage*. Pasquinelli analyzes alternatives to current copyright law such as the Creative Commons initiative. He states that Creative Commons faces ‘a growing criticism that comes especially from the European media culture’ (2008). The European media culture critics cited by Pasquinelli include Florian Cramer, Anna Nimus, Martin Hardie and Geert Lovink. Among the critiques, Pasquinelli defines two main positions. The first focuses on the fact that the producer-centered ethic of Creative Commons does not recognize or include a critical rethinking of the uses of media produced under a Creative Commons license and therefore continues to contribute to a sociopolitical imbalance in the techno-social creation/construction of ‘producers’ and ‘consumers’. The second position highlights that Creative Commons is consistent with existing copyright laws and therefore does not provide a real alternative. Pasquinelli advocates instead that ‘a tactical notion of autonomous commons can be imagined to include new projects and tendencies against the hyper-celebrated Creative Commons’ (2008).

To imagine an autonomous commons, Pasquinelli refers to the concept of ‘Copyfarleft‘ by Dmytri Kleiner. ‘Copyfarleft’ opposes systems of private control over the means of publication, distribution, promotion and media production. This opposition takes the form of a critique of ownership of material assets, recognizing class issues and allowing workers to reclaim production. Copyfarleft ensures that products such as media art works remain free, and as Pasquinelli states, 'can be used to make money only by those who do not exploit wage labour (like other workers or co-ops)' (2008: 7). This explicitly ethical sociopolitical position connects back to the concept of COPY-IT-RIGHT, as Morton's position was also an 'ethic' that opposed private property, ownership and economic exploitation on the basis of new technologies.

Also, Florian Cramer has addressed the ways in which current copyright and intellectual property laws are not neutral, and has suggested that alternatives need to be explicitly articulated in ethical terms. Furthermore, Cramer has consistently addressed these concerns to new media art communities through his writings and presentations at festivals such as 'Ars Electronica' and 'Wizards of OS', and his posts to lists such as nettime. Cramer advocates for new media artists to critically analyze the context of current copyright laws as they relate to creative and computational works. Cramer has detailed how the General Public License (GPL) and free and open-source software movement's strategies can be applied to more than simply software, and how these and other alternatives to copyright relate to media art.

As Cramer explains, the General Public License differs significantly from that of Creative Commons. Creative Commons has gained popularity among new media artists and in media art communities, while the GPL has not been as widely adopted as a way to distribute works. While the principle of openness may have popularity among new media artists, Cramer encourages these artists to weigh the differences, and carefully consider the implications and results of using variously open or closed approaches such as those presented by Creative Commons, the Free Software Foundation or the Open Source Initiative. Inke Arns (who has collaborated with Cramer on curatorial projects that address these topics of openness) has written on the art–historical practices and movements that have informed current forms of resistance to copyright. In her 2008 exhibition catalog text 'Use = Sue: On the Freedom of Art in the Age of "Intellectual Property"', Arns traces these histories through situationist detournement in the 1950s, the cut-up method of Brion Gysin and William S. Burroughs in the 1960s, the Neoist 'Festivals of Plagiarism' in the late 1980s, and what she calls 'a broad culture of appropriation' in art movements of the twentieth century such as Pop Art (Arns 2008). In these analog forms, including the film art subgenre of found footage, Arns states that artists engaged in these practices 'undermine concepts like originality and authenticity' and 'subvert the nineteenth-century Romantic concept of the artist-genius autonomously creating from within' (Arns 2008). Placed in this context, Morton's collaborative works and the COPY-IT-RIGHT ethic can be understood alongside these media art–historical moments, offering an available alternative approach.

When discussing the shifts that have occurred in the transition to the twenty-first century, Arns quotes philosopher Eberhard Ortland's analysis of the expansion of copyright law, stating that this situation is 'leading to an unparalleled concentration of resources in the hands of globally active quasi-monopolists in the media and IT markets' (Arns 2008). Arns applies Ortland's critique to the arts. Still, Arns does not directly address media art or include the video art histories in her text. I raise Arns's art–historical account at this point to again underscore that what Arns refers to as the 'Asymmetrical Expansion of Copyright to the Advantage of Exploiters' (2008) is an important, if often overlooked, aspect of media art histories relating to current new media art–theory practices, and free and open-source software cultures. Arns's example also serves to point out that even among those who are working and writing critically in the field of media art (and as someone with whom Cramer has collaborated), the realities of copyright, intellectual property and free and open-source software cultures provide important and often underrepresented critiques and alternatives that can be used in the education of new media artists.

Cramer similarly references art–historical trajectories and motivations for present-day interest in, and commitment to, resisting copyright, but is particularly concerned with the cultural implications of code and new media art as forms of anti-copyright activism. When Cramer compares options for openness in media art, he questions the options available under Creative Commons on the basis of their 'lack of an underlying ethical code, political constitution or philosophical manifesto such as the Free Software Foundation's Free Software Definition or Debian's Social Contract and the Open Source Initiative's Open Source Definition' (Cramer 2006). As he states, the lack of a fundamentally ethical, political or philosophical basis to their options undermines the effectiveness of Creative Commons from the onset. As has been noted above, Morton's COPY-IT-RIGHT concept is primarily an ethical, political and philosophical position, and as such remains on a firm basis if placed into the continuum of Cramer's analysis of comparative forms of openness in media art.

Cramer has defended the application of the Free Software Foundation's General Public License to non-software work; in other words, to artistic practice that is not explicitly or literally software art. The Free Software Foundation released Version 1 of the General Public License in 1989 in order to articulate and defend their position that software should be freely available (to distribute and change, improve or extend) to both developers and end users. The Free Software Foundation clearly maintains that this ability is a 'freedom' which should be 'guaranteed' and maintained in resistance to commercial software companies who 'try to keep users at the mercy of those companies' (Free Software Foundation 1989). As Cramer notes, the only reason that the General Public License has not been more quickly or widely applied to artistic practice is that this license 'speaks of the licensed work as "the program", not "the work"' (Cramer 2005). Still, as Cramer reminds the new media artists, theorists and critics to whom he addresses, 'many non-software works, such as manual pages, have been released under the GPL and continue to be released' (2005).

In the same text, Cramer continues by reiterating that the Creative Commons, despite its popularity, does not actually encourage the development of a commons or shared and freely accessible cultural space. The Creative Commons project is actually intended to maintain coherence with existing intellectual property and international copyright laws. These laws are based on the assumptions of a profit motive for creative work, and an assertion that creative works are private property – identifiable, distinct products made by those who claim authoritative authorship. This situation, which confuses the concept of the Commons with adherence to current intellectual property and international copyright law, according to Cramer, results bluntly 'in a big mess and confusion' (2005). As Cramer concludes: 'Perhaps one should start an advocacy effort for the GPL as the good, intellectually beautiful, standard license for free work' (2005). While Morton's COPY-IT-RIGHT may or may not fulfil the same criteria if it were to be considered by Cramer, COPY-IT-RIGHT certainly does provide a media art–historical example of an alternative to both copyright and similarly influential counter-cultural proposals introduced in the early 1970's such as Ted Nelson's Xanadu with its Creative Commons-like method of adhering to copyright while advocating for expanded flexibility (and commoditization of increasingly smaller transactions) in digital networks.

As has been explained above, Creative Commons is not an alternative or a form of resistance to copyright, but was intended from its inception to be offered as being consistent within existing copyright law and intellectual property regimes. However, the question of the historical perspective of Creative Commons remains relevant to understanding an alternative historical account, and in order to explain the absence (within the framework of Creative Commons) of an understanding of the types of resistance to copyright as have been outlined above. In 2002, Lawrence Lessig defined many of his ideas of Creative Commons in his *The Future of Ideas: The Fate of the Commons in a Connected World*. In 'Creativity in the Dark Ages', Lessig refers to the dark ages before the Internet, which he defines as the 1970s (Lessig 2002: 104). He claims to detail two forms of creativity – in 'The Arts' and in 'Commerce'. His claim to be discussing 'The Arts' is only through a very brief outline of the conditions of mainstream media, in particular the development of cable television in the United States. He does not engage with media art or video art histories that include alternative artist-made media of the late 1960s or 1970s.

This oversight puts Lessig at a disadvantage by limiting his ability to encounter work such as Morton's COPY-IT-RIGHT, which directly critiqued copyright prior to the popularity of free and open-source approaches or of Creative Commons. Lessig imagines Internet technologies to present radically new and unprecedented abilities for exchange, sharing and collaborative or collective authoring of media. The radically new and unprecedented status that Lessig asserts requires a denial of the alternative media art histories considered here. The physical and technologically mediated networks that Morton and his collaborators used to exchange (or in their own words 'bicycle')[3] tapes, and to copy them in order to further redistribute and remix them, is overlooked by Lessig; however, these acts provide an important foundation for current Internet-based, digital and new media art-related systems that are similar in their alternative forms of production, distribution, use, reuse and exhibition.

In contrast, Halbert advocates for an analysis, such as the one this study undertakes, into alternative media art histories, that can provide historical accounts of forms of resistance to copyright in media art cultures and communities. As Halbert writes, transnational corporations with desires for 'monopolistic control over content' have increasingly sought and received legal support for expanded control over creative content and 'the vehicles through which that content is provided', in order to envision a future wherein all content is exchanged within 'the framework of profit', and any other vision of possible futures is 'utopian' (Halbert 2005: 7). As Halbert states (and as the example of Morton's COPY-IT-RIGHT makes clear): 'There are thousands of people around the world who have developed their own ways of dealing with what we call intellectual property' (2005). Halbert concludes hopefully that these 'parallel systems, alternative paradigms, and small resistances prove that we do have a choice in how the future develops' (2005). This future, in which these alternatives to copyright can exist and flourish, relies on a recognition and critical inclusion of underrepresented, repressed, lost or forgotten histories (such as the subject of this study) in order to establish the past upon which a viable future of ideas can be based.

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Notes

1. The 'Distribution Religion' can be found in this book in Section 3: People.
2. The archive can be found at http://copyitright.org.
3. 'The only way you were able to see anybody's work wasn't through festivals. There weren't any festivals then, it was through what everybody called "bicycling". Somebody would send Phil Morton a tape and he would invite everybody over to his house to look at it' (criticalartware 2002).

Proposal for Low-cost Retrieval of Early Videotapes Produced on Obsolete Equipment and/or Videotape That Will Not Play Back, or Resurrection Bus (1980)

Ralph Hocking

Due to manufacturing errors, changes in videotape machinery and videotape formats, and not a hell of a lot of experience on anyone's part, there are some immediate, obvious problems that need solving when considering the transfer of early videotapes.

The tapes concerned are the reel-to-reel tapes made from the late 1960s to about 1975. This includes several formats of ½", ¼", and maybe some 1" videotape. Information on 2" tape needs only to be transferred by commercial services still currently available.

The tapes were the result of the invention of low-cost video production capability, and made by people who were concerned with the issues of their time. Resurrecting must be based on the tape-makers' views of the importance of the original intention, and not on current commercial or exhibition value, or collectability. Most, if not all, of these tapes can be identified in quick fashion. It is imperative to find the original tapes. That seems to be possible, also.

The focus should be on the tape-makers and whether or not the makers want the material to be salvaged. Collectors, including museums, galleries, media centers and individuals, should be resources for identifying the tapes and not primary sources of tapes for salvage in any preservation effort.

The makers should be actively involved in this preservation attempt as salvagers, financiers, or in any way they can. Otherwise our efforts are not reasonable.

The original material needs to be identified. The makers need to decide how and whether they want their work to be revived. We need to offer the possibility of help to that end.

Once the material is identified and the cooperation of the maker or current owner is obtained, then an attempt could be made to redo the old stuff as new stuff, keeping the original video intention intact.

A vehicle would be outfitted with all early formats. I think I have them. My machines need to be reconditioned, but I think I also have most parts needed. To facilitate transfer, frame synchronizers, ProcAmps, magic, candles and prayer rugs would be available. The transfers would be made to a current videotape format. The choice of what format to transfer to would be up to the owner of the material. All current videotape formats would be available.

The vehicle would travel to the tapes, cancelling the potential for loss of the original material. In the case of cities – i.e., New York – a place would be found to house the service for the time needed for the transfers.

To facilitate the transfers, it seems desirable to send ahead a tape-cleaning machine. The machine would be constructed so that the owners of the tapes could understand and use it to clean the tapes. Cleaning is the most time-consuming part of the process of

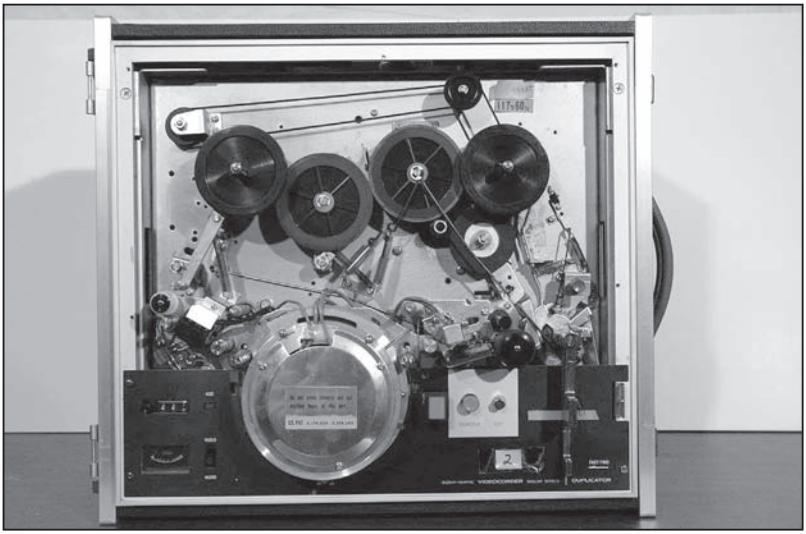


Figure 1. A Sony CV 2200 ½" open-reel deck with the top cover removed.

retrieving the information, and so could be the most expensive part of the process. The videotape makers/owners or their designees would be expected to be involved with the process. Perhaps regional media centers could offer this service at a low cost for owners who couldn't serve themselves. We would still supply the means of cleaning.

This would be a one-shot deal, not an ongoing service. Once the tapes are transferred to a current format there is no further need for the service.

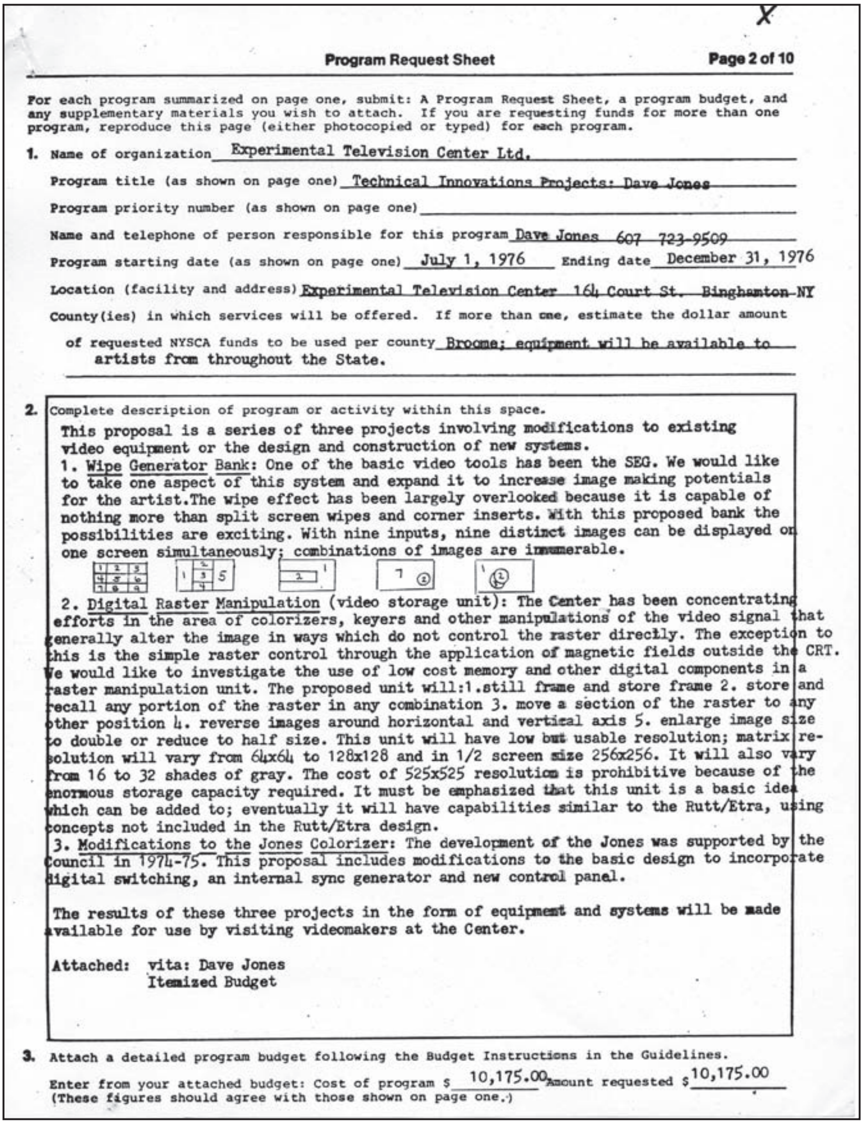
This service is offered in the spirit of the original intention of the tape-makers and of the times when the tapes were made. It is, in fact, an attempt to reclaim the past lost to the ambition of makers of machines and consumer hunger for new technology. The past was lost not only with hardware development, but also with faulty videotape. I don't blame the originators of the machines or gooey videotape manufacturers. None of us knew what we were doing. Do we ever? However, I would expect the makers of both to be spiritually and financially involved in this effort.

This is, of course, a rough proposal, but also a commitment on my part to develop the idea further if there is reason to do so. It seems to me that the project could be limited to this state or has a potential to cover the entire country. Interest and moneys available would determine the scale of involvement.

If the idea is sensible to this group, then I am willing to do the research, find out how much it will cost, and what else it takes to develop a workable definition of the idea.

If not, then I won't.

I can be reached by mail at the TV Center and by phone. I prefer [e]mail.



X

Program Request Sheet **Page 2 of 10**

For each program summarized on page one, submit: A Program Request Sheet, a program budget, and any supplementary materials you wish to attach. If you are requesting funds for more than one program, reproduce this page (either photocopied or typed) for each program.

1. Name of organization Experimental Television Center Ltd.

Program title (as shown on page one) Technical Innovations Projects: Dave Jones

Program priority number (as shown on page one)

Name and telephone of person responsible for this program Dave Jones 607 723-9509

Program starting date (as shown on page one) July 1, 1976 Ending date December 31, 1976

Location (facility and address) Experimental Television Center 164 Court St. Binghamton NY

County(ies) in which services will be offered. If more than one, estimate the dollar amount of requested NYSCA funds to be used per county Broome; equipment will be available to artists from throughout the State.

2. Complete description of program or activity within this space.

This proposal is a series of three projects involving modifications to existing video equipment or the design and construction of new systems.

1. Wipe Generator Bank: One of the basic video tools has been the SEG. We would like to take one aspect of this system and expand it to increase image making potentials for the artist.The wipe effect has been largely overlooked because it is capable of nothing more than split screen wipes and corner inserts. With this proposed bank the possibilities are exciting. With nine inputs, nine distinct images can be displayed on one screen simultaneously; combinations of images are immumerable.

2. Digital Raster Manipulation (video storage unit): The Center has been concentrating efforts in the area of colorizers, keyers and other manipulations of the video signal that generally alter the image in ways which do not control the raster direclly. The exception to this is the simple raster control through the application of magnetic fields outside the CRT. We would like to investigate the use of low cost memory and other digital components in a raster manipulation unit. The proposed unit will:1.still frame and store frame 2. store and recall any portion of the raster in any combination 3. move a section of the raster to any other position 4. reverse images around horizontal and vertical axis 5. enlarge image size to double or reduce to half size. This unit will have low but usable resolution; matrix resolution will vary from 64x64 to 128x128 and in 1/2 screen size 256x256. It will also vary from 16 to 32 shades of gray. The cost of 525x525 resolution is prohibitive because of the enormous storage capacity required. It must be emphasized that this unit is a basic idea which can be added to; eventually it will have capabilities similar to the Rutt/Etra, using concepts not included in the Rutt/Etra design.

3. Modifications to the Jones Colorizer: The development of the Jones was supported by the Council in 1974-75. This proposal includes modifications to the basic design to incorporate digital switching, an internal sync generator and new control panel.

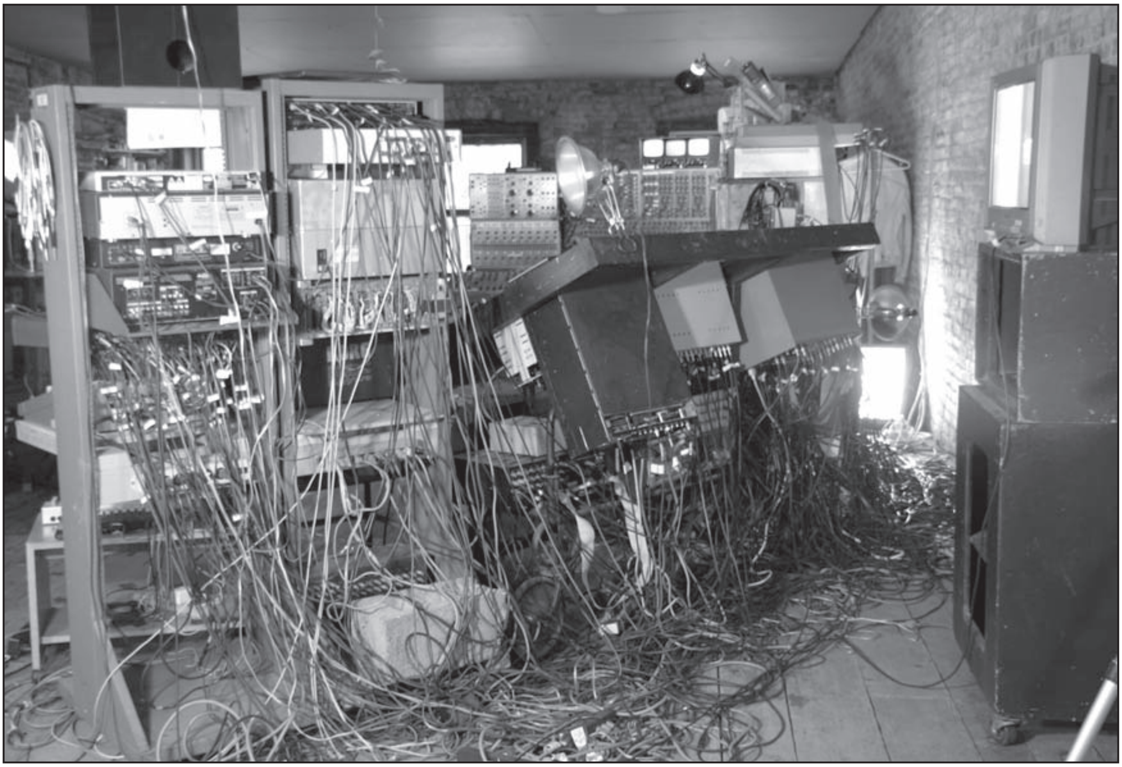
The results of these three projects in the form of equipment and systems will be made available for use by visiting videomakers at the Center.

Attached: vita: Dave Jones
Itemized Budget

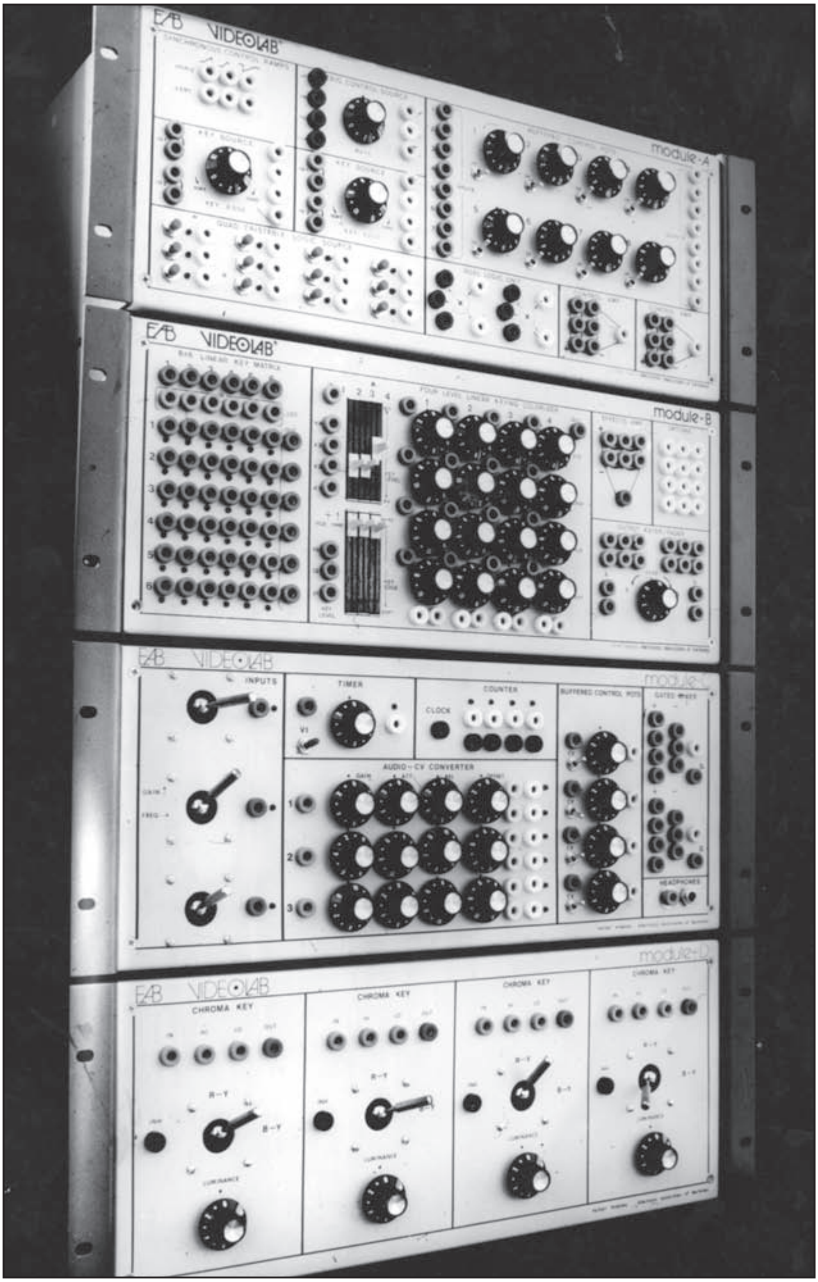
3. Attach a detailed program budget following the Budget Instructions in the Guidelines.

Enter from your attached budget: Cost of program $ 10,175.00 Amount requested $ 10,175.00
(These figures should agree with those shown on page one.)

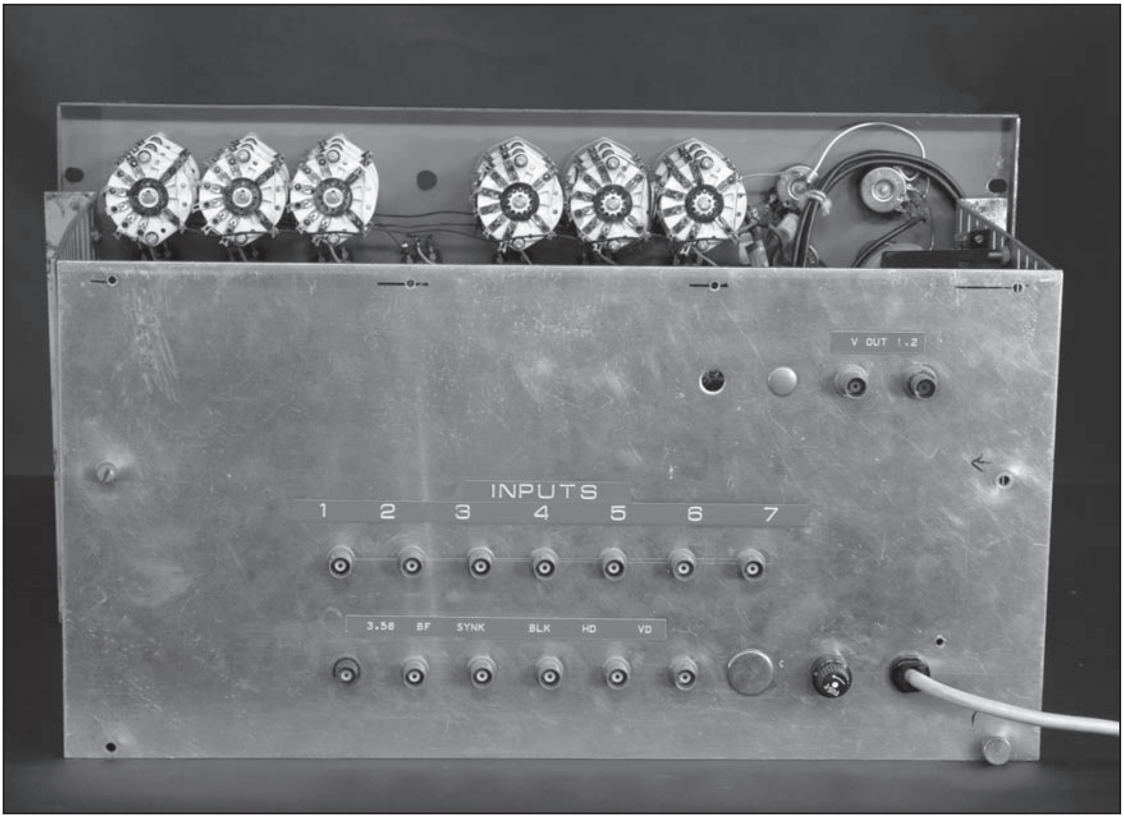
ETC proposal on behalf of Dave Jones to the New York State Council on the Arts in 1976 for a Wipe Generator Bank, the Digital Raster Manipulation Unit and modifications to Jones Colorizer.



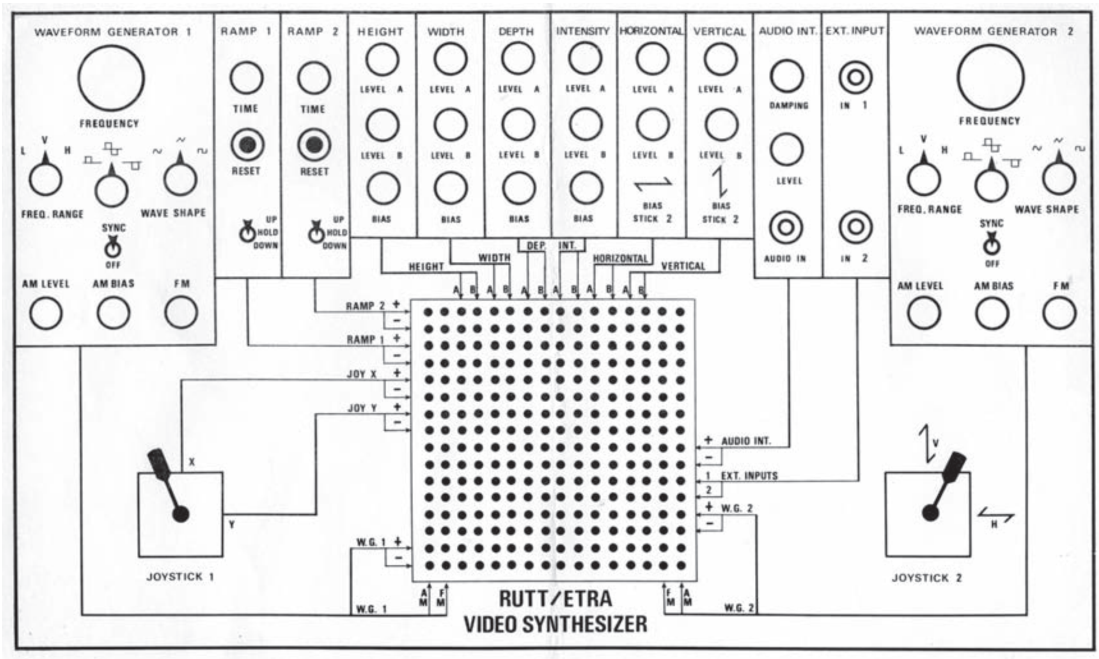
A look behind the Image Processing System at the ETC studio.
(photo. Olivia Robinson. courtesy. Experimental Television Center).
For another view please see Color Plate 43.



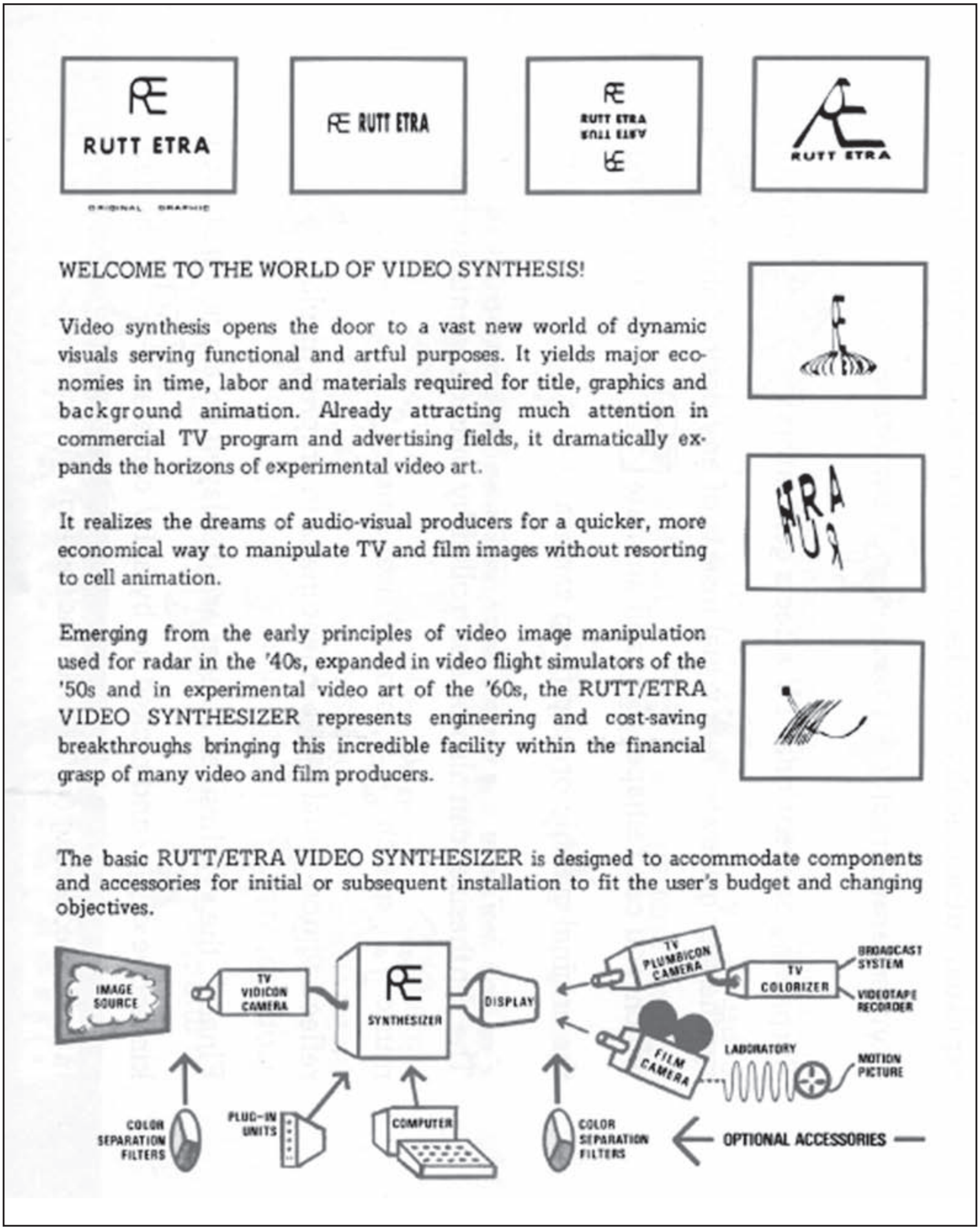
Product literature from Electronic Associates of Berkeley concerning the Hearn Video Lab, designed by Bill Hearn (n.d.). For photos of two of the modules please see Color Plates 33 and 34.



Back panel of Paik/Abe Video Synthesizer. (photo. Olivia Robinson.
courtesy. Experimental Television Center).



The front panel diagram for Rutt/Etra Video Synthesizer
from product sales literature (n.d.).
Also see Color Plate 31.



WELCOME TO THE WORLD OF VIDEO SYNTHESIS!

Video synthesis opens the door to a vast new world of dynamic visuals serving functional and artful purposes. It yields major economies in time, labor and materials required for title, graphics and background animation. Already attracting much attention in commercial TV program and advertising fields, it dramatically expands the horizons of experimental video art.

It realizes the dreams of audio-visual producers for a quicker, more economical way to manipulate TV and film images without resorting to cell animation.

Emerging from the early principles of video image manipulation used for radar in the '40s, expanded in video flight simulators of the '50s and in experimental video art of the '60s, the RUTT/ETRA VIDEO SYNTHESIZER represents engineering and cost-saving breakthroughs bringing this incredible facility within the financial grasp of many video and film producers.

The basic RUTT/ETRA VIDEO SYNTHESIZER is designed to accommodate components and accessories for initial or subsequent installation to fit the user's budget and changing objectives.

A description of the Rutt/Etra Video Synthesizer system from product sales literature (n.d.).

United States Patent

Siegel

[15] **3,647,942**

[45] **Mar. 7, 1972**

[54] **VIDEO COLOR SYNTHESIZER**

[72] Inventor: **Eric J. Siegel,** c/o Tom Tadlock 2143 Pine Street, San Francisco, Calif. 94115

[22] Filed: **Apr. 23, 1970**

[21] Appl. No.: **31,090**

[52] **U.S. Cl.** **178/5.4,** 178/6.8

[51] **Int. Cl.** **H04n 9/02**

[58] **Field of Search** .... 178/6.8, 5.2, 5.4, 69.5 CB

[56] **References Cited**

UNITED STATES PATENTS

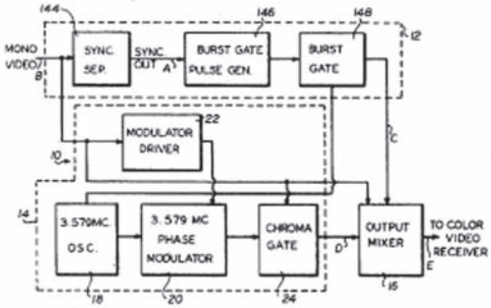
3,551,589	12/1970	Moskovitz	178/5.4
2,982,814	5/1961	Fine et al.	178/6.8
2,874,217	2/1959	Diehl	178/69.5 CB

Primary Examiner—Richard Murray
Attorney—Hubbell, Cohen & Stiefel

[57] **ABSTRACT**

An apparatus for synthesizing pseudocolor video signals from composite monochromatic video signals. Means are provided for producing a color burst signal on the back porch of the pseudocolor video signal from a monochromatic horizontal sync pulse. Such means includes a color subcarrier oscillator, a pulse generator which stretches the horizontal sync pulse to accommodate the proper period of the subcarrier frequency and slightly delay its occurrence, and a burst gate which produces the burst frequency from the subcarrier and stretched pulses. A pseudochrominance portion of the color video signal is produced by means which phase modulate the color subcarrier with the monochromatic video signal to produce a pseudohue signal and mix this hue signal with the video information portion of the monochromatic signal. An output mixer is also provided for mixing this pseudochrominance signal with the color burst and the monochromatic video signal to provide the pseudocolor video signal. Upon reception by a color video receiver, the monochromatic picture is reproduced in subjective color, the hues therein varying in accordance with the changes in the gray level of the monochromatic video information.

15 Claims, 3 Drawing Figures



The patent for Eric Siegel's Video Color Synthesizer, filed April 23, 1970.

Product literature showing the types of images that could be generated with the Sony Special Effects Generator, SEG-1, available in 1971 (n.d.).

AUTHOR BIOGRAPHIES

RICHARD BREWSTER

Richard Brewster has a degree in Computer Information Systems and has been working since 1993 as a software developer, currently in Charlottesville, Virginia. He has been involved with electronics since high school and in the early 1970s began building modular synthesizers. He worked for several years at the Experimental Television Center on many projects, among them the construction of an audio synthesizer and control tool for the ETC system. Today he builds customized analog synthesizer equipment for himself, and enjoys participating in the Internet community for analog synthesis. He occasionally performs electronic music with his synthesizer. He is the owner of Rabbit Software and offers independent software consulting services focusing on server-side application development.

JON CATES

Jon Cates is the Chair of the Film, Video, New Media & Animation Department at the School of the Art Institute of Chicago. His experimental new media art projects are presented internationally in exhibitions and events from Berlin to Beijing, Cairo to Chicago, Madrid to Mexico City and online. His writings on media art histories also appear online and in print publications, as in recent books from Gestalten, The Penn State University Press and Unsorted Books. He founded the Phil Morton Memorial Research Archive to freely and openly share Morton's original research into the origins of new media and video art.

MICHAEL CENTURY

Michael Century is Professor of New Media and Music in the Arts Department at Rensselaer Polytechnic Institute, joined in 2002. Long associated with The Banff Centre for the Arts, Century founded the Centre's Media Arts Division in 1988. In this position, he was the instigator of the 'Art and Virtual Environments' project (1991–1994). From 1993–1996, Century was a program manager at the Canadian Centre for Information Technology Innovation (CITI). From 1996-98, he served as policy advisor to the federal department of Canadian Heritage, and has been a consultant on new media and cultural policy for various public and university sector clients, including the Rockefeller Foundation.

MICHAEL CONNOR

Michael Connor is a New York–based writer and curator with a focus on artists' responses to cinema and new technologies. Connor previously worked as Curator at FACT, Liverpool, and Head of Exhibitions at BFI Southbank in London. While at the BFI, he developed an interactive moving-image archive designed by Adjaye/Associates as well as a gallery dedicated to artists' film, video, and new media. From 2002 to 2005, Connor worked as a curator at FACT in Liverpool. He is Visiting Curator at Cornerhouse (Manchester).

JEREMY CULLER

Jeremy Culler is an Adjunct Instructor at the State University of New York at Fredonia, where he teaches courses in art history and film studies. He holds a PhD in Art History from Binghamton University. Dr. Culler has recently presented papers at Alfred University, the Frick Collection, the Institute of Fine Arts at New York University and Binghamton University. His research focuses on the discursive field of electronic, time-based media.

LENKA DOLANOVA

Lenka Dolanova is a curator, journalist, and researcher, with interests in art, ecology, and media. She received her PhD at the Film and TV School of Academy of Performing Arts in Prague in 2009. She was Fulbright researcher at the School of the Art Institute in Chicago (2005–2006). Her book about video artists Steina and Woody Vasulka was published in 2011. She works as a curator at Regional Gallery of Vysočina, Czech Republic, and develops projects at the residency center Kravín Rural Arts in Bohemia.

CAROLINA ESPARRAGOZA

Carolina Esparragoza was born in Mexico City in 1977, where she currently lives and works. She studied Visual Arts at the Escuela Nacional de Pintura, Escultura y Grabado-ENPEG La Esmeralda in Mexico. Her work has been exhibited at the Feria Internacional de Arte Contemporáneo ARCO 05 in Madrid, Spain (2005), l'Institut du Mexique in Paris, France (2004), Caja Negra, MUCA-C.U. Universidad Nacional de México (2002), and Museo de la Ciudad de México (2000), among other venues in Mexico and abroad.

JEAN GAGNON

Jean Gagnon is the Director of Collections at the Cinémathèque québécoise. Previously, he served as Executive Director of the Daniel Langlois Foundation for Art, Science, and Technology for ten years. For the Foundation he organized, as curator, the exhibition 'The Body of the Line: Eisenstein's Drawings', presented in Montreal and New York in 1999–2000. He was also the producer of *Digital Snow*, a DVD-ROM on Michael Snow's work. Before joining the Foundation, he was the Associate Curator of Media Arts at the National Gallery of Canada in Ottawa.

KATHY HIGH

Kathy High is an interdisciplinary artist working with science and time-based arts. She produces videos, performances and installations about gender and technology, empathy and animal sentience. She has received awards including fellowships from Guggenheim Memorial Foundation (2010), Rockefeller Foundation, and National Endowment for the Arts, and has had artist residencies with SymbioticA at the University of Western Australia (2009–10), and in Hong Kong with the Asian Arts Council (2005). High is Professor of Video and New Media in the Department of Arts at Rensselaer Polytechnic Institute, Troy, New York – a department specializing in integrated electronic arts practices.

RALPH HOCKING

Ralph Hocking is Professor Emeritus of the Cinema Department at Binghamton University. He has been a leader in the field of video art since 1968, founding what was one of the first campus-based programs. In 1970 he established the independent, nonprofit Experimental Television Center. He has served as consultant, advisor and panelist with the Intercultural Film and Video Fellowship Program of the Rockefeller Foundation, Massachusetts Art and Humanities Foundation, Anthology Film Archives, New York State Council on the Arts, the Society for Photographic Education, the New York Foundation for the Arts and many museums and galleries. His personal creative work has been exhibited internationally, is included in Video Databank's *Surveying the First Decade* anthology and is in the collection of the Museum of Modern Art.

SHERRY MILLER HOCKING

Hocking has served as Assistant Director at the Experimental Television Center since 1972. She has been active in the field of video preservation since the 1980s, serving on the advisory board of Independent Media Arts Preservation Project and of Migrating Media. In 1993 she created and manages the Video History Project, a website featuring documents concerning the early history of video art and community television. Hocking served as project director and cocurator for *ETC: 1969–2009*, a DVD anthology of over 100 artists' works created through the Residency Program at ETC. She is presently collaborating with the Rose Goldsen Archive at Cornell University on the acquisition of the ETC tape and print archives.

MONA JIMENEZ

Mona Jimenez is an artist and educator who has been organizing and advocating for the preservation of media art and community media since the 1980s. She is an Associate Arts Professor and Associate Director in the Moving Image Archiving and Preservation Program at New York University, where she teaches collection management and the preservation of video and digital works, including time-based media art. Recent projects include developing a model for activist archiving of video collections and collaborating with colleagues in Ghana for training in audiovisual archiving and for development of a digital repository of audio and video materials.

DAVE JONES

Dave Jones is a video artist and engineer who has been involved in the video art field since 1971, starting with VideoHeads in Amsterdam, and then the Experimental Television Center several years later. He spent many years designing image-processing tools for video artists and custom equipment for art installations by some of the most famous artists in the field. His tools have been used by artists around the world, and his machines are in use at some of the largest museums worldwide. His latest venture is to manufacture digital versions of his early video image-processing designs.

LOVID

LoVid is an interdisciplinary artist duo composed of Tali Hinkis and Kyle Lapidus. Their work includes live video installations, sculptures, digital prints, patchworks, media projects, performances and video recordings. They combine many opposing elements in the work, contrasting hard electronics with soft patchworks, analog and digital, or handmade and machine-produced objects. This multidirectional approach is also reflected in the content of their work: romantic and aggressive, wireless and wire-full. They are interested in the ways in which the human body and mind observe, process, and respond to both natural and technological environments, and in the preservation of data, signals and memory.

DONALD McARTHUR

Don McArthur received his PhD in Theoretical Physics from the University of Nebraska. He taught physics at the University of Saskatchewan, the State University College at Cortland and Binghamton University. He was associated with the Experimental Television Center beginning in 1974 as a researcher in electronic design. He worked on collaborative projects with Walter Wright, Paul Davis, David Jones and Ralph Hocking of the Center, and with Steina, Woody Vasulka and Jeffrey Schier. He designed the Spatial and Intensity Digitizer, which was exhibited at Ars Electronica in Linz in 1992.

JOHN MINKOWSKY

John Minkowsky is an independent critic and curator of media art. He received undergraduate and graduate degrees from the Department of Media Study at the University of Buffalo. In 1976, he became the Video/Electronic Arts Curator and Music Programmer at Media Study/Buffalo, and his work has been widely published in exhibition catalogs and media arts journals such as *Afterimage* and *FilmQuarterly*. He has received recognition for his writing on media from the New York State Council on the Arts and the National Endowment for the Arts, and has been an Andrew Mellon Fellow in Critical Studies at the California Institute of the Arts. He is writing a history of the role of public television in the development of video art.

TIMOTHY MURRAY

Timothy Murray is Professor of Comparative Literature and English, Director of the Society for the Humanities, and Curator of the Rose Goldsen Archive of New Media Art at Cornell University. He is Managing Co-Moderator of the -empyre- new media listserv, and cocurator of CTHEORY MULTIMEDIA. His books include *Digital Baroque: New Media Art and Cinematic Folds* (Minnesota, 2008), *Zonas de Contacto: el arte en CD-Rom* (Centro de la Imagen, 1999), *Drama Trauma: Specters of Race and Sexuality in Performance, Video, Art* (Routledge, 1997), and *Like a Film: Ideological Fantasy on Screen, Camera, and Canvas* (Routledge, 1993).

MARISA OLSON

Marisa Olson's work combines performance, video, drawing, and installation to address the cultural history of technology, the politics of participation in pop culture and the aesthetics of failure. Her work has been presented by the Whitney Museum of American Art, Centre Georges Pompidou, the British Film Institute and the Sundance Film Festival, among many others. Her critiques of contemporary art and digital visual culture have extended to writing for *Flash Art*, *Art Review*, *Afterimage*, *Planet* and *Art on Paper* to curating exhibitions and programs at the Guggenheim, San Francisco MoMA, White Columns, Artists Space, the Performa Biennial, SF Camerawork and Rhizome. She lives in New York City.

CHRISTIANE PAUL

Christiane Paul is Associate Professor of Media Studies at The New School, New York, and Adjunct Curator of New Media Arts at the Whitney Museum of American Art. Her books include *Context Providers – Conditions of Meaning in Media Arts* (Intellect, 2011), coedited with Margot Lovejoy and Victoria Vesna; *New Media in the White Cube and Beyond* (University of California Press, 2008); *Digital Art* (Thames and Hudson 2003/2008). Among her exhibitions are 'Cory Arcangel: Pro Tools' (May 2011); 'Eduardo Kac: Biotopes, Lagoglyphs and Transgenic Works' (Rio de Janeiro, Brazil, 2010); and 'Feedforward - The Angel of History' (cocurated with Steve Dietz; Laboral Art Center, Gijon, Spain, 2009–2010).

HANK RUDOLPH

Hank Rudolph is a media artist living in Owego, New York. He was Arts Coordinator at the Experimental Television Center from 1984 until 2012, providing individualized instruction to artists participating in the Residency program. For over ten years, he was co-instructor at the International Summer Workshop, a college-credit course sponsored by the Center and the Institute for Electronic Arts (IEA). Rudolph has taught at Binghamton University and the New York State Summer School for Media Arts at Ithaca College. He is presently Technical Specialist at the Department of Cinema at Binghamton University and on the Board of Signal Culture, a new media arts organization.

DAN SANDIN

Daniel J. Sandin is an internationally recognized pioneer of electronic art and visualization. He is director emeritus of the Electronic Visualization Lab and a professor emeritus in the School of Art and Design at the University of Illinois at Chicago. He is continuing his professional activities with Tom DeFanti at Calit2, University of California at San Diego. As an artist, he has exhibited worldwide, and has received grants in support of his work from the Rockefeller Foundation, the Guggenheim Foundation, the National Science Foundation and the National Endowment for the Arts. His video animation *Spiral PTL* is in the inaugural collection of video art at the Museum of Modern Art in New York. In recent years, Sandin has been concentrating on the development of auto stereo VR displays (free viewing, no glasses), and on the creation of network-based tele-collaborative VR art works that involve video camera image materials, rich human interaction and mathematical systems.

TOM SHERMAN

Tom Sherman is an artist and writer working in video, radio and live performance. He founded the Media Arts Section of the Canada Council for the Arts in 1983. His interdisciplinary work has been exhibited and screened internationally, including shows at the Vancouver Art Gallery and the Museum of Modern Art. His most recent book is *Before and After the I-Bomb: An Artist in the Information Environment* (Banff Centre Press, 2002). Currently, Sherman is a professor in the Department of Transmedia at Syracuse University, where he teaches video research, video art history and communication and media theory.

YVONNE SPIELMANN

Yvonne Spielmann is the Dean of Faculty of Fine Arts at Lasalle College of the Arts in Singapore. Her work focuses on media and culture, technology, art, and communication, and in particular on Western/European and nonWestern/Southeast Asian interaction. Her book, *Video, the Reflexive Medium* (MIT Press 2008, Japanese edition by Sangen-sha Press, 2011) was awarded the 2009 Lewis Mumford Award for Outstanding Scholarship in the Ecology of Technics. Her most recent book, *Hybrid Culture*, was published in German by Suhrkamp Press, 2010, followed by the English edition by MIT Press in 2012. Spielmann's work has been translated into French, Polish, Croatian, Swedish, Japanese and Korean. She holds the 2011 Swedish Prize for Swedish-German scientific cooperation.

CAROLYN TENNANT

Carolyn Tennant is a media artist and curator based in Buffalo. Her interdisciplinary practice reflects interests in visual studies and the techno-cultural history of art. In 2006 she became Media Arts Director at Hallwalls Contemporary Arts Center, where she is responsible for overseeing programs including archival initiatives, digitization of analog records, and video preservation projects. In 2007 she helped coordinate Migrating Media, a statewide partnership project protecting our analog collections and audiovisual heritage. She has presented at international conferences and national venues on these projects as well as her research on the regional histories of electronic arts in upstate and western New York.

JACK TOOLIN

Jack Toolin is a transdisciplinary artist who works both independently and collaboratively. He teaches art history, media studies and photography at Pratt Institute and Pace University. He has lectured widely, at institutions such as the Rhode Island School of Design; the University of California at Berkeley; the San Francisco Art Institute; Emerson College, Boston; Kibla Multimedia Center, Slovenia; and the Museum of Contemporary Art Rijeka, Croatia. He was a founding member of the new media collective C5 (1997–2007), whose work has been exhibited nationally and internationally.

STEINA VASULKA

Steina Vasulka was born in Iceland and studied at the Music Conservatory in Prague, before coming to the United States in the 1960s. She was one of the cofounders of The Kitchen in New York and played an important role in the emergence of video art. Her art practice investigates video as a medium and takes the forms of tape and multiscreen installations. She has exhibited internationally at such venues as the Whitney Museum of American Art Biennial, Centre Georges Pompidou and at ZKM / Center for Art and Media in Austria.

WOODY VASULKA

Woody Vasulka was born in Czechoslovakia, where he studied engineering and film. Together with Steina, he produced a pioneering body of early video art works. His individual practice involves a precise investigation into the language and codes of the electronic image. His later works explore the meanings of history and memory, presented through processes of deconstruction of the video signal. His work has been exhibited around the world. Vasulka has taught at many institutions, including the University of Buffalo, and is the recipient of numerous awards for his art. Vasulka was awarded an honorary doctorate at the Academy of Performing Arts in Prague in 2011.

HOWARD WEINBERG

Howard Weinberg is a script-doctor, winning independent documentary filmmaker, journalist and educator. He has taught at Columbia University's Graduate School of Journalism and New York University. His PBS credits include *Sports for Sale, First Things First, net.LEARNING*, *"Topless Cellist" Charlotte Moorman* and *Sid at 90*. A Founding Producer of *The MacNeil/Lehrer Report*, he was Executive Producer of *Listening to America* with Bill Moyers and a producer-writer for CBS *Sunday Morning* and *Sixty*

Minutes. Volunteer president-emeritus and board member of The New York Film/ Video Council, his current project is *TV LAB: License to Create* – a documentary about an innovative era of public television from 1972–1984.

WALTER WRIGHT

Walter Wright is a multimedia artist whose practice includes music, video and dance improvisation. In the early 1970s, Wright worked as a video animator at Computer Image Corporation, collaborating with Ed Emschwiller, whose *Scapemates* won an Emmy in 1971. In 1973–1976, as artist-in-residence at the Experimental Television Center, he pioneered video performance, touring colleges and galleries with the Paik/ Abe Video Synthesizer. Walter develops software and hardware for artists, such as the Video Shredder, a desktop video processor for the TARGA2000. Currently, he is working with Max/MSP, softVNS, and VDMX. He is a cofounder in 1992 of 119 Gallery, the first digital art gallery on the World Wide Web.

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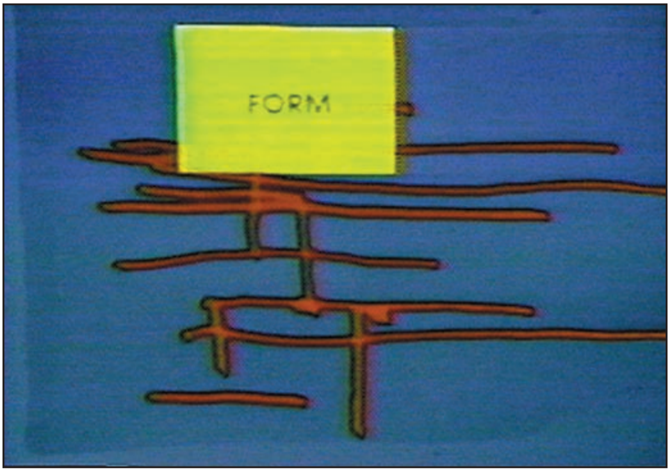
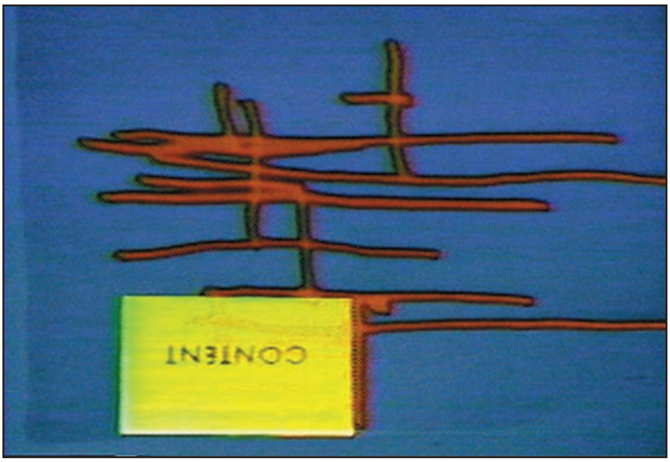
Color Plate 23. Video still from *Bathing* by Gary Hill (1977). (courtesy. Gary Hill).





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Color Plate 28. Stephen Beck with his Video Weaver instrument (1976). © Stephen Beck, 1976. All rights reserved. www.stevebeck.net. (photo. Steve Beck).

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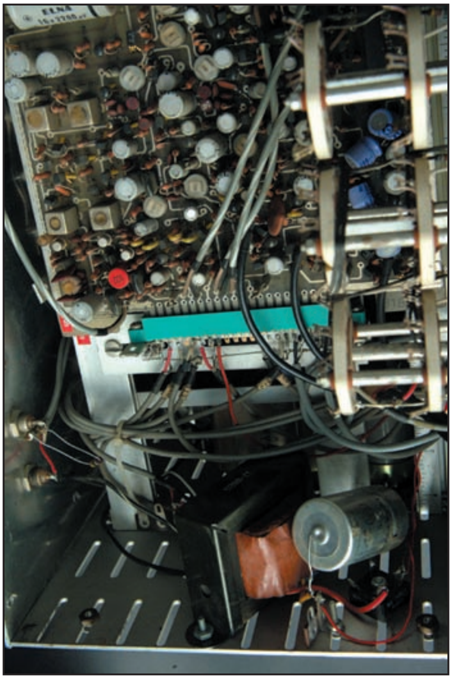
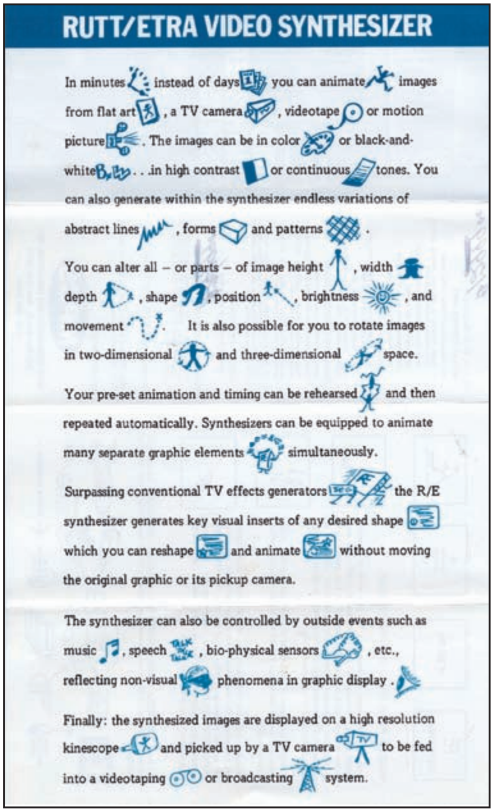




RUTT/ETRA VIDEO SYNTHESIZER

In minutes instead of days you can animate images from flat art, a TV camera, videotape or motion picture. The images can be in color or black-and-white ...in high contrast or continuous tones. You can also generate within the synthesizer endless variations of abstract lines, forms and patterns.

You can alter all – or parts – of image height, width depth, shape, position, brightness, and movement. It is also possible for you to rotate images in two-dimensional and three-dimensional space.

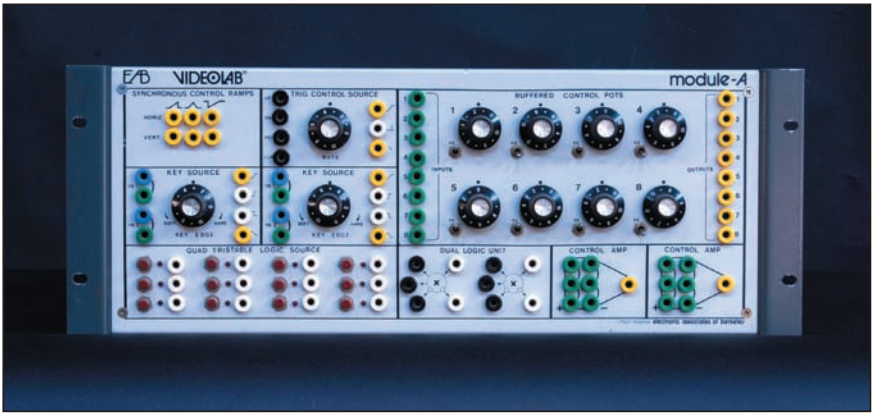
Your pre-set animation and timing can be rehearsed and then repeated automatically. Synthesizers can be equipped to animate many separate graphic elements simultaneously.

Surpassing conventional TV effects generators the R/E synthesizer generates key visual inserts of any desired shape which you can reshape and animate without moving the original graphic or its pickup camera.

The synthesizer can also be controlled by outside events such as music, speech, bio-physical sensors, etc., reflecting non-visual phenomena in graphic display.

Finally: the synthesized images are displayed on a high resolution kinescope and picked up by a TV camera to be fed into a videotaping or broadcasting system.

Color Plate 32. The MVIP (Mini Video Image Processor), designed by Dave Jones, is less than three inches wide (2011). (photo & courtesy. Dave Jones Design).



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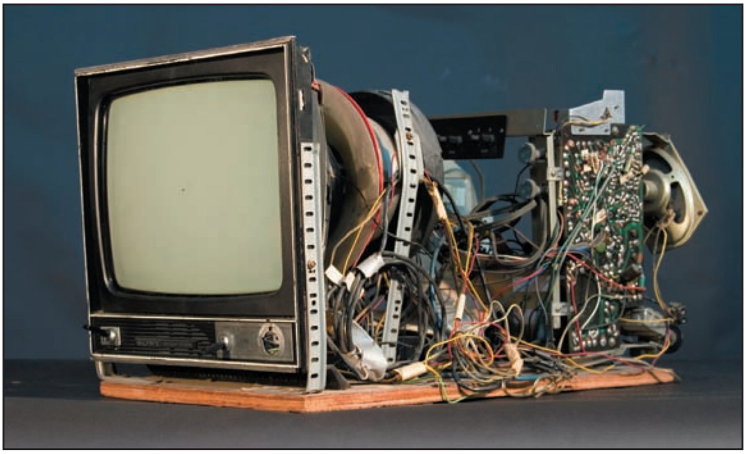

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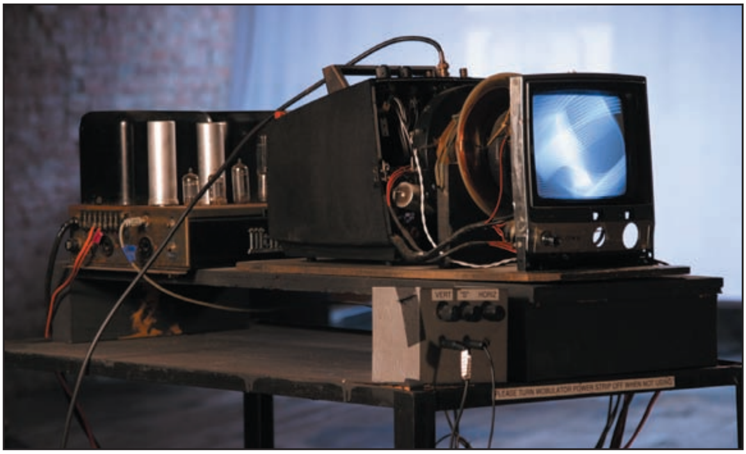
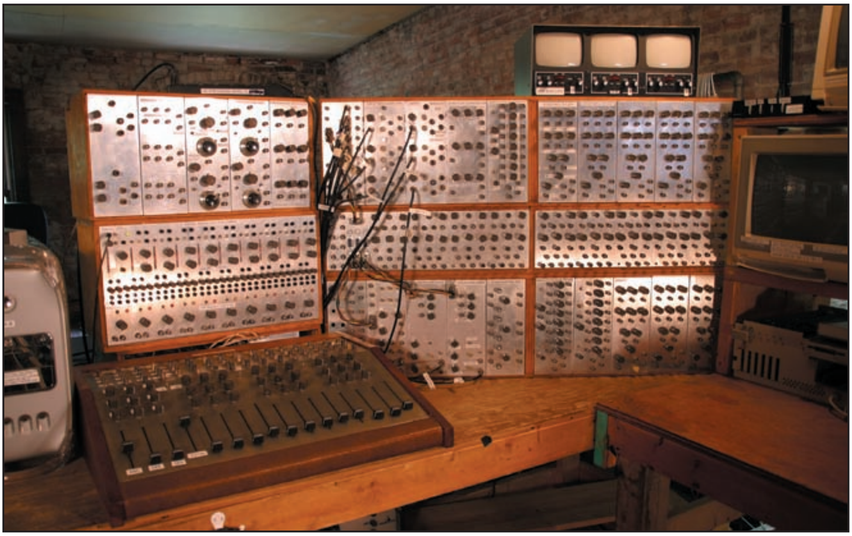


Color Plate 37. Detail of the first Jones Colorizer by Dave Jones, built at the Experimental Television Center. Control panel above, main unit with control voltage inputs below (c. 1974/75). (photo. Olivia Robinson. courtesy. Experimental Television Center).



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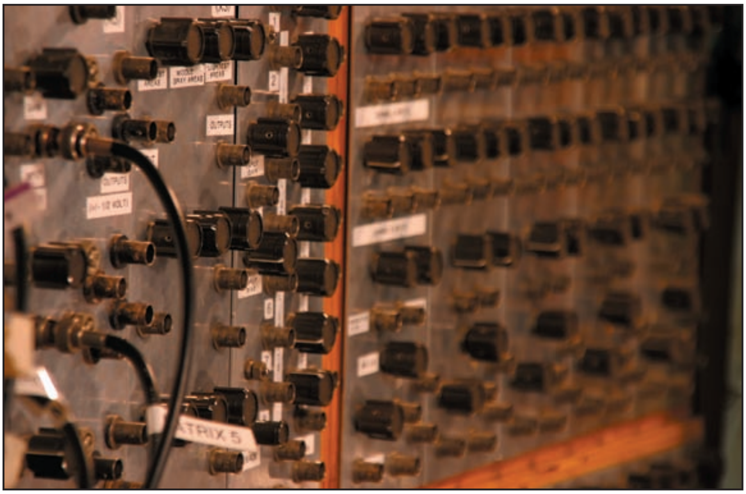

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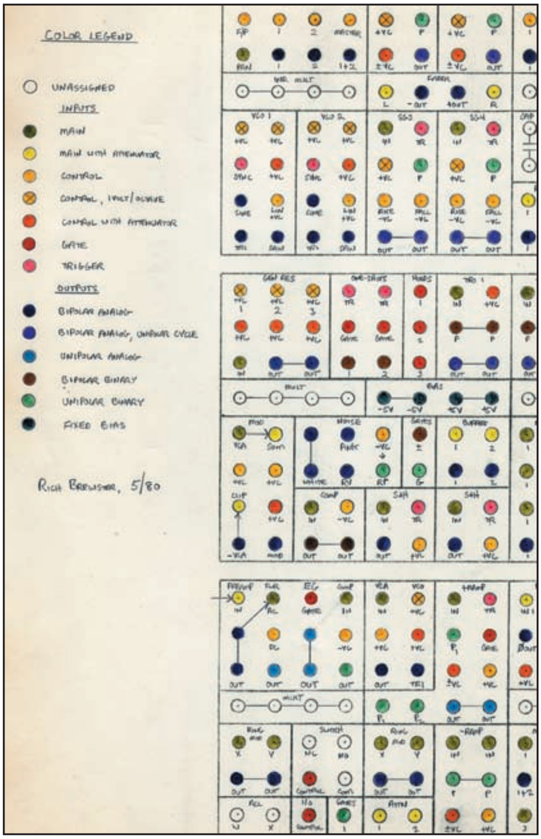

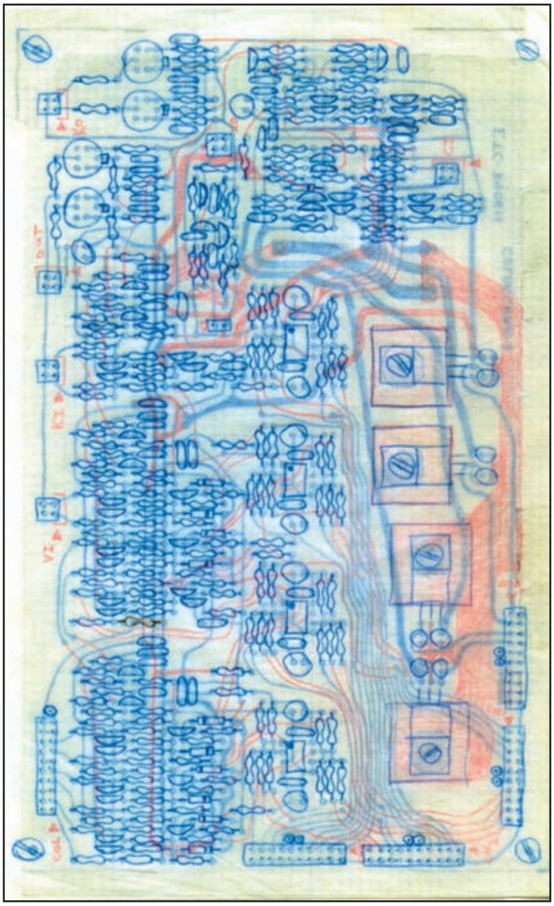

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THE EMERGENCE OF VIDEO PROCESSING TOOLS

TELEVISION BECOMING UNGLUED

Edited by KATHY HIGH, SHERRY MILLER HOCKING and MONA JIMENEZ

volume 2

A case study written with intimacy and commitment and from within a talented and seminal community of artists, technologists, and intellectuals, The Emergence of Video Processing Tools: Television Becoming Unglued *demonstrates the productive relations between artists, scientists, and the machines they use and develop. An enchanting, unique, and highly usable contribution to video history and technology studies, the anthology relies upon a lively mix of both new essays and archival documents, to historicize and theorize the development of early video tools. From the diverse and eclectic voices of artists, scientists, arts administrators, and scholars, organized with great care by its editors, arises a definitive history of video art, and its tools, from this period.*

– **Alexandra Juhasz, Ph.D, Professor of Media Studies, Pitzer College, and author of *Learning from YouTube* (2011).**

The Emergence of Video Processing Tools presents stories of the development of early video tools and systems designed and built by artists and technologists during the late 1960s and 1970s. Split over two volumes, the contributors examine the intersection of art and science and look at collaborations among inventors, designers, and artists trying to create new video tools to capture and manipulate images in fascinating and revolutionary ways. Volume Two includes the section 'Tools' that describes the particular collaborations and technologies that created these custom-made video instruments. The contributors include "video pioneers" who have been active since the emergence of the aesthetic, and technologists who continue to design, build, and hack media tools. The book also looks at contemporary tool makers and the relationship between these new tools and the past. Video and media production is a growing area of interest in art, and this collection will be an indispensable guide to its origins and its future.

Kathy High is Professor in the Department of Arts at Rensselaer Polytechnic Institute.
Sherry Miller Hocking is Assistant Director at the Experimental Television Center.
Mona Jimenez is Associate Arts Professor and Associate Director in the Moving Image Archiving and Preservation Program at New York University.

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