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Video and Computer:
The Aesthetics of Steina and Woody Vasulka

"After we got the computer, the concerns became totally different. Before we could even perfect the control of analog tools, we plunged into digital ones where, in fact, everything is a product of control. It is in 'interactive real time' that I feel video becomes a category apart from the others (film on one side and computer graphics on the other)."[1]

Introduction

It is the aim of my article to situate video in technological, aesthetic, and media cultural perspectives and to underline that video is a medium of its own and not an intermedium that became obsolete with the advent of digital technologies. On the contrary, early examples by Steina and Woody Vasulka, Nam June Paik, Jud Yalkut, Stan Vanderbeek, and Ed Emshwiller demonstrate that there is a tight and inherent connection from video to computer, so that on the whole, the introduction of digital technologies continues to enrich the medium and its aesthetic-cultural potential. From this perspective, digital tools can be seen as an evolutionary step in the development of electronic tools, which together in video foster the articulation of an original electronic vocabulary of image.

By the same token, it would be shortsighted to classify video as the new medium that simply took over from film. Rather, video relies conceptually on experimental film practices and pursues similar formal approaches and explorations of vision and visuality (i.e., the quality or state of the visual imagery). Of course, the results differ due to the function of the apparatus specific to each medium. However, a closer look at the two media reveals that, strictly speaking, video has no apparatus function comparable to film. More precisely, the notion of film as a medium can be attributed to a fixed apparatus: the *dispositif* defines a spatial order consisting of projector, spectator, and screen onto which previously recorded transparent images (developed on a fixed film strip) are vertically projected in continuous motion creating the impression of moving images. In contrast, video does not engage a consistent spatial order but arises in immediate presence equally in the camera and screen, and often in scanning and synthesizing devices as well. Furthermore, video does not consist of a proper "image." Video is defined by its manipulation of electronic signals: that is to say, it is a simulation of an image.

In a didactic approach toward the new medium Dan Sandin demonstrates the phenomenology in his videotape, *How TV Works* (U.S., 1977), and he explains the mechanism of the electronic medium in contrast to film: "The simplest video system to understand is a camera that produces an electronic signal, sends it along a cable to a monitor, which reconstructs the image... Now, light that hits the front surface of the lens is focussed into an image down in the camera itself. In the case of a film camera, that image is projected onto a sensitive chemical surface, the film itself. In the case of a video camera, it is projected on the front surface of a vidicon and an electron beam inside the vidicon scans the front surface, scans the pattern of light and dark projected onto the front surface, and creates the video image... The reflection yoke magnetically positions the electron beam that scans the image and creates the video signal." Later, when Sandin describes the vertical retracing of the signal at the end of the bottom line (vertical synchronization pulse) and how the camera also generates the synchronization information needed to retrace horizontally (horizontal synchronization pulse), he concludes by saying, "The actual video information is encoded only in the scanning lines from left to right."[2]

Apparently, there is no coherent image—neither in the scanning within the camera nor inside the surface of the screen—but a stream of imagery capable of moving not only in vertical directions (such as a film strip) but also in horizontal directions. In fact, the impression of an image results from incoming information that through a scanning device is transformed into electronic signals uninterruptedly transmitted in scanning lines, which on a normal screen run from left to right and top to bottom—like writing on a page in Western culture. While the moving image of film in recording and projection is bound to the restrictions of the vertical order of single frames, video supersedes such requirements: the signal travels vertically *and* horizontally, thereby constructing and reconstructing images. Drawing a distinction between the temporal-spatial unity of an image as "frame" or "tableau" (as in painting, photography, and film) and the electronic information "encoded" in scanning lines that generate transformative video images, I characterize the flexible image forms of electronic transformation as "imagery."

I am sympathetic to Sandin's notion of "encoding" regarding the analog processing of images because this aspect of video closely relates to the digital encoding carried out through the use of binary numerical system calculations. I like to stress features that analog video and digital image processing commonly share and that differentiate video from other recording media images, namely, photography and film.

Departing from William J. Mitchell's discussion of "the digitally encoded, computer-processable image as simply a new nonchemical form of photography or as single-frame video"[3] (which basically refers to the still image) I find that in the field of still images the shift from chemical to digital can be seen as a replacement of pixel for emulsion, but in the moving image the matter becomes more complex: particularly, because the digital inherits the technology of analog video. Therefore, I note an intermediate link between analog and digital in the use of image processors in video, which have programming functions and belong to the nomenclature of analog computers.[4]

Again, it is Sandin describing the early steps of programming in video through his development of an analog Image Processor in 1972: "In brief, the Image Processor (I-P) is a patch progammable general purpose analog computer, optimized for the real-time processing of video images... The I-P accepts naturalistic images, modifies and combines them in complex ways and displays or stores the result. A television camera, film chain, videotape recorder or similar device can be used to encode moving images into a form the I-P 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 videotape recorder."[5] The Image Processor is a modular device operating at the same time with plug-in and patch-programmable functions that are performed by control voltage and can be multiplied: processes that can be done in black and white and color, such as fades and switches, changing the transfer of gray level, adjusting the continuous transfer for solarization effects, and differentiating value information to control each single area of a value region. Taken together, such effects establish the distinction between the unity of the image and the in-principle unlimited forms of imagery on the basis of process-oriented image generating devices.

The non-fixity, fluidity, and transformative characteristics of video are furthermore highlighted through the possibility that in the electronic medium the image can arise in different places of the technical setting: such as camera, screen, and multiple scanning and synthesizing devices. Early experiments with “closed circuit” between camera and monitor and with other processing devices (without videotape recorder) revealed that the fixity of electronic imagery on magnetic tape connotes but one possible way of displaying video. Alternately, in video processing, the real-time visual effects can be directly presented on the screen, as with Scan Processors, and, in contrast to film, the screen is not solely a display surface for “projection” but becomes the very locale of the video’s creation—a place where video making and displaying converge.

Though film can be generated without camera (scratch, chemical baths, etc.) it cannot avoid its material basis. However, video can exist without videotape and recording is not a fundamental requirement of the medium. There are multiple choices for input before recording, but more importantly, video can be simply “signal processing” without recording at all. Of interest in the case of the Scan Processor, which affects the time-based structure of video through re-timing the electronic signal, signal processing interferes with and dislocates the television raster. The Scan Processor, built by Steve Rutt, Bill and Louise Etra in 1973,[6] was an analog system used in video to modulate the deflection signals of the monitor through control voltages in real time. It must be noted that the resultant imagery from the Scan Processor could not be *directly* recorded, but an external camera had to be pointed at the screen of the Scan Processor to rescan this information and fit it back into the television raster. As signal processing demonstrates, there is no fixed place or determined setting for producing, transmitting, and displaying electronic imagery; instead, video engages multiple aural and visual options.

In view of the open structure of its “apparatus” I will not discuss video in relation to the conceptual term *dispositif* but prefer to distinguish between common and experimental ways of doing video. In experimental approaches, the relationship between the image and the electronic signal—where the signal is in principle endlessly transmitted—allows for another step of transformation that lies in the inherent possibility of making imagery audible and audio signals visible. Imagery in the electronic medium, first of all, needs to be considered as flexible and open to multiple forms of transformation.

In the following examination of experimental approaches, an introduction to some fundamental principles of video is needed in order to discuss the experiments in signal processing that, to my mind, represent the essence of video as an electronic medium. A second level of discourse relates to the general media debate involving consideration of the surface (or content) of video images, which is generally the focus of art history if video is discussed there at all. What I find needs further discussion is the status of the electronic image with regard to similarities and differences between analog and digital image processing. This leads to considerations of the medium’s specificity in order to discuss video in a larger media setting: I build my argument that video is essentially transformative, omnidirectional, and multidimensional by relying on media theories that reflect on electronic and digital forms of “matrix” imagery. The third level of inquiry here deals with a description of selected works by Steina and Woody Vasulka: works that highlight various phases in the development of video from technology to medium, and that incorporate, in exemplary ways, analog and digital computers as a tool in image processing. These three levels are closely intermingled below, as I find it necessary to analyze the technical and aesthetic components together, in order to understand the essential character of the electronic audio/visual medium, video.

Image as process

In the series, *Six Programs for Television,* realized by the Vasulkas[7] in 1978 at WNED, in Buffalo, New York, Woody demonstrates the audiovisual events explored in making the early videotape installations entitled *Matrix* (1970-1972). *Matrix I* (black and white) and *Matrix II* (color) are single-channel video installations that exhibit the phenomenon of the frame running through a matrix of monitors. The video signal coming from camera and internally generated input is directly processed so that the interchange of sound and image becomes apparent, which includes "controlling the sounds with images and vice versa." In order to achieve these interfering effects the video signal is interfaced with an audio synthesizer (Putney Audio Synthesizer) which renders the "energy content audible."[8] The imagery can be feedback (*Distant Activities*), an oscillator generated pattern (*Heraldic View*), or abstract pattern (*Discs*), but the task is to interrelate the imagery traveling up and down and sideways between a larger number of monitors. "*Matrix* is a series of multi-monitor works that explores the relationship of sound and image in electronic signals: sound as generated by the electronic image; sound that creates an image; and sound and image created simultaneously. Here, the Vasulkas realize sound visually, generating abstract aural and visual images simultaneously. Shapes and forms skid, roll, and metamorphose across multiple screens like sound traveling through geometric space to our ear. In these matrices, the Vasulkas reduce the image and sound to their bare essentials in order to examine the essence of the electronic image and sound—the signal. A phenomenological exercise on the construction of electronic image and sound, this series is also a playful study of movement in which abstract forms travel across multiple screens to symbolize the kinetics of electronic signals."[9]

In the segment *Discs,* the Vasulkas were particularly interested in examining the horizontal traveling of the image once they discovered that video, in contrast to the verticality of the film strip, allows horizontal movement. "By time errors we could see that the frame was delayed, but we could never see its structure moving through any particular frame."[10] The Vasulkas then worked with this incident in multiple ways, for example, a camera image of a reel set in motion by re-timing to the horizontal frequency. This resulted in a time delay deriving from re-entering the signal into the raster system. For example, the horizontal shift is demonstrated when the visual motif of an open reel of the video gets delayed in high density, so that a repetitive abstract pattern in motion fills the screen. Furthermore, the horizontal drift travels across a stacked array of screens thereby adding a vertical dimension to the horizontal expansion. Video, in this case, moves equally in temporal and spatial directions, to transgress the notion of a frame.

These examples of the *Matrix* demonstrate essential characteristics of the electronic medium that bring the structural components of an electronic vocabulary to visibility—encompassing, of course, its audibility. In another segment of *Matrix I, Black Sunrise,* the sound again comes solely from the video signal, which has been interfaced with a sound synthesizer. Together, "image" and "sound" are the structural expressions of video noise, which I consider a matrix phenomenon in the broader sense of media discourse. My argument is, first of all, based on the assumption that in all video the raw material is "noise"—a term borrowed from audio. Noise is the electronic energy of video signals from which any form of expression arises. Noise is video's potential: its information being an unstructured, formless matrix.[11]

In investigating the structure of any matrix, it is important to note that the technical description and the media discourse on the issue of the matrix image have a conceptual parallel in the broader philosophical debate on the matrix. The matrix is regarded as a metaphor for a paradoxical visual order. Both media and philosophical discourse on matrix phenomenon agree that the matrix refers to an invisible structure that becomes recognizable only when malfunctions appear and the matrix is forced to attain structure in a visual order. In connecting the two different discourses, I refer to Rosalind Krauss's discussion of pulse and rhythm as the underlying structure of modernity, which becomes visible only when the interval is revealed. In her theoretical debate discussing Jean-François Lyotard's study on *Discours, Figure*,[12] Krauss concludes that the matrix refers to an order "that operates beyond the reach of the visible, an order that works entirely underground, out of sight."[13] Furthermore, "simultaneity is the peculiar temporality of the matrix," which means that the separation of opposites is superseded—similar to what I identify as the merging of vertical and horizontal in the Vasulkas' *Matrix*. Krauss continues, where "Lyotard compare[s] the matrix figure of the unconscious to the structuralist's system," it becomes evident that even though they share "the properties of invisibility and synchrony," the matrix is not a function of structure because it does not operate with differences. "The elements of the matrix, Lyotard thinks, do not form a system but a block." For Lyotard, "Fantasy is the perfect matrix figure," exactly because it "overlays contradiction and creates the simultaneity of logically incompatible situations."[14] And also for Lyotard, that particular matrix's invisibility is a function of the repressive work that undermines the productive work of structure.

In applying this philosophical insight to media specific components of the electronic vocabulary, it can be added that the matrix of the audiovisual medium is the place where paradoxical events emerge, because "logically incompatible situations" become technically possible. Moreover, as the Vasulkas' *Matrix* clarifies, image-as-process is essentially paradoxical. And, as a transformative image that needs to be horizontally and vertically synchronized in order to appear at all, the electronic process expresses the matrix phenomenon that constantly "overlays contradiction." The simultaneity of multidirectionality, which becomes apparent in experimental approaches, thus characterizes a grounding feature of video that usually remains invisible. So it is that with exploration into the technology of the electronic medium (comparable to structuralist/materialist film), construction principles of simultaneity and synchrony are rendered recognizable in matrix experiments. And the paradoxical situations that are possible in video—when the medium is understood as process-oriented and transformative—also foreground the matrix potential of the digital.

In view of experimental film, the goal in video is not to adapt film concepts but to follow up with the same kind of formal questions in scrutinizing what is image and what is sound. Noteworthy, beginning in the late 1960s early 1970s, Emshwiller, Yalkut, Vanderbeek, and also Pat O'Neill and Larry Cuba, were experimenting on the edge of film and computer with image processing and computer graphics to develop flicker, layer, solarization, stroboscobic, and further effects of transformative imagery and sound including video feedback and the electronic flow of the image. Preceding attempts in abstract film, and its complement in electronic music, were carried out in the experimental films of the West Coast from the 1940s to the 1960s and further pursued with the use of computer by James and John Whitney. Since 1962 John Whitney has made computer films, at first with analog computer, in order to explore "the dynamics of graphic pattern arrays and their harmonic relationships... I was beginning to conceive of the basis for a graphic 'scale' evolving from harmonies, and I saw that there was a way beyond monolithic emotional stasis of so much abstract film and video with which I was familiar."[15] This interest is shared in the field of video where the overriding drive is toward the creation of a "lexicon of electronic vocabulary" as Woody describes it.

In their *Matrix* experiments, John Whitney and the Vasulkas realized strategies to work with synthetic imagery—though operating differently in film and video—that result in geometrically abstract imagery and spatial representation. Both the computer-generated films by John Whitney, and the video installations by the Vasulkas work with simple graphic forms to represent mobility of the image field more or less independently from the "frame." Beyond the coincidence of titles, aesthetic coherence between the explorations with film (Whitney) and with video (the Vasulkas) is to be found regarding the issue of what is a visual matrix, particularly as expressed in the flexibility to "record" and "display" structural characteristics. Both, the *Matrix* works in film and video demonstrate scale, pattern, and dimensionality of the moving image as variable parameters. John Whitney in *Matrix III* (1972) shows the shape of a triangle that is built upon inter-layered lines. Through turning and adding density, the in-principle "endlessly" repeated elements are multiple layered to the point that basic forms collapse into dissolution of the abstract figure (triangle) and re-appear as multidimensional figuration (pattern). Similar to these film experiments with dimensional inversion, the videotape installations *Matrix I* by the Vasulkas show how simple camerafed imagery—for example, a black dot on a cardboard *(Black Sunrise*) and the image of a reel—can be de-familiarized and set in repetitive-pattern motion through the use of an audio synthesizer that immediately processes and displays the input in horizontal drift. What happens is that the boundaries of the image frames float as if the stream of electronic imagery were maladjusted on the screen. These "violations" of the horizontal drift are enabled by the George Brown Variable Clock (1972), a pulse generator that alters the timing of the drift apart from the preset television signal. These clock variations basically allow the image to perform in any system that can be visible on television. And, because a clock always belongs to a programmatic category of tool, it becomes clear that the intended shifting out of synchrony in the analog medium is also a step towards processing smaller time-sequences, namely pixels in digital image processing.[16]

The video work of the Vasulkas is grounded in an approach to synthesizing and streaming imagery that conceptually relates to previous radical image perception experiments in abstract film. The analytical approach towards defining a video vocabulary can be seen as paralleling the filmic engagement of graphic notation and computer by James and John Whitney—who, in similar ways to Woody, have pursued and analyzed the vocabulary of abstraction. When John Whitney translates the articulation of a graphically abstract film concept into image programming using a computer, he makes a statement that, even on the basis of film, the incorporation of programmable tools is possible—which means that the computer, though structurally different from film technology, can be used to expand and newly manipulate the potentials for abstract film. From a media historical perspective, we may conclude that the early interlinking of film and video, of analog computers and other programmable tools with digital devices, as pursued by the Vasulkas, was not a step outside the medium. On the contrary, the introduction of the digital computer to technically carry out ideas using algorithms for audio-visual experiments needs to be seen as a logically subsequent step for fully exploring and developing abstract imagery in motion in any direction and dimension. The focus in later works with algorithms carries on the reflexive scrutiny of the matrix of a medium.

The Reflexive Medium

Another parallel between experimental film and video can be seen in the performance-oriented multimedia works of Jud Yalkut and Nam June Paik and their commonly conceived *Film-Video-Works* (1966-1969) and *Video-Film-Concert* (1966-1972). Here, the media languages of film, television, performance, and video are intermingled in such ways that, from a video perspective, Yalkut uses the new medium to multiply and manipulate other media forms. “In other videofilms made with Paik, including the *Cinema Metaphysique* films of 1966 and 1967, issues of scale, framing, and screen are explored in juxtapositions of film and video screens, on large-scale, the other a small square in which images are sometimes split in two or appear running along the bottom edge of the screen.”[17] These explorations of video in a spatial setting foreshadow video-performance installations, and can be compared to Steina’s closed-circuit investigation of multiplying spaces in *Orbital Obsessions* (1977), where she poses two cameras facing each other while incorporating the surrounding studio.

Orbital Obsessions superimposes and alters the different image sources through processing, keying, and sequencing devices that simultaneously “record” and “play” the effects as they occur. In using two cameras in different positions, the twice depicted space of the studio (including Steina maneuvering the machines) appears segmented, multiplied, and as if moving on different axes at the same time. Spatial complexity results, for example, from the image of a camera looking at a monitor that interferes with the zooming-in and-out of a second camera pointing to the reflected image of the camera on the monitor. The camera that is looking at itself on the monitor is part of a feedback structure where the multiplication of the image creates distortion through seemingly endless replications of the same image.[18] The feedback is also audible here so that the circuit of internal response self-reflexively builds up machine interaction. While this frame-within-frame setting resembles the construction of *mise-en-abyme* familiar to painting and film, spatial distortion more specific to the electronic medium happens when, through a switcher, the divergent movements of one horizontally and another vertically turning camera converge, thereby confirming that the electronic signal moves in both directions.

In another setting the spatially moving image of a camera on a turntable is juxtaposed with a stationary camera that focuses on the first camera. In the imagery presented through frequency modulation and keying, the interrelated presentations of image fields are variable in speed and can revert from positive to negative. Using the Video Sequencer (George Brown, 1972) Steina shifts the voltage and manages to speed up or slow down the switching speed of two or more image sources that present differing views, which are switched in such ways that they produce flicker effects. That is because the Video Sequencer allowed very rapid switching up to the point where the switching that technically occurs during the vertical synchronization becomes almost “invisible.”

Once more, the image operation transgresses any notion of a "coherent" single image. In addition to this visual distortion, cameras tracking each other creates a spatial disorientation, in particular when one camera rotates at 360 degrees from floor to ceiling and Steina walks into this setting of temporally flickering and spatially distorted imagery.

Incoherency is further increased when Steina, in addition to altering from positive to negative in the same segment, operates the Multikeyer that keys and layers vertical segments in real time. The last sequence also works with superimposition, as a layering technique, so that we see Steina multiplied in slightly different positions. Zero-interval keying decides on the visibility of the image. The tool, the Multikeyer (George Brown, 1973) allows up to six video sources to be manipulated and layered into one single video output, as if they had "real" foreground/background relations. Interestingly, this real-time process, which allows the re-assignment of the plane-location, has a digital element that, like any other programmable tool, operates with a built-in clock and enables basic programming and storage applications. Although in the early seventies almost every tool was analog, the Multikeyer with integrated circuit chips had memory, so it signifies the introduction of a digital tool: "An example of elaborate digital control of an analog video keyer is the George Brown Multikeyer. It consists of a programmable digital sequencer wired to an analog processing rack, where a digital 'key priority encoder' combines with multiple analog keyer/mixers... The analog keyer/mixer prioritizes the six video sources, sorting them into multiple image planes, which are routed to a single output... This multi-level keyer was built for the Vasulkas in the early 1970s... A computer interface was appended in 1977 to allow remote storing, loading and control of the program sequences."[19] Most important to analog video was the "unique aspect of the keyer" which allows hierarchical over-layering of multiple inputs resulting in a coherent final output. It is the encoding key element that determines the "image planes" according to brightness: "This stacking and sequencing of image priority and key, makes for an image layering not easily attained in conventional video mixers, without using multi-generation tape loops."[20]

Doubtless, *Orbital Obsessions* provides an early technical-aesthetic statement that video processing from the beginning involved image devices, in this case the Multikeyer and the Video Sequencer. The Vasulkas' experimentation (they prefer to call it "play") is equally important regarding the transformation of electronic video and audio signals. Sound is produced by the video signal itself and accompanied by the actual sounds and noises in the studio. Corresponding to the real-time presentation of the visual performances of two cameras, the aural part of the video is also in real time, reflecting the processes of the making of the video. *Orbital Obsessions,* in a way, is obsessively experimental in its modulation of the signal itself: that is, its voltage and frequency and the ways the signal could be translated from video to audio and could directly affect the "content" of the image, which in these segments is shown congruent with its form. Similarly, sound sources are interfered with, namely the noise of the manipulation of the audio/video signal are layered with environmental sounds from the studio, such as an off-conversation between Steina and Woody, classical music on radio, and the ring of the telephone. Because these sounds appear as noises[21] they self-reflexively create the aural "content" which on the level of noise reflects the ambivalence between electronic space and real space in the different segments of *Orbital Obsessions.*

Self-reflexivity in video happens on several levels: First, the construction of an apparatus to produce processable images that simultaneously reflect the performance of the process. Second, video is revealed as an electronic medium insofar as the electronic signal can become equally an aural and a visual output, which manifests the technical interchangeability of audio and video and states the truly audio/visual quality of video. Third, the modulations of the signal in the output of light and sound are the true "content" of the performance, which in return has the specificity of video as its meaning, so that, in principle, the video-performance demonstrates self-reflexivity of the medium in endless regressions.

In attributing the term video-performance to this installation process of audio/video experiments, I like to emphasize the performative aspect in Steina's approach to video, which is driven by her experiences performing classical music and expands into research of the "performability" of the new medium with its technical devices. Performance, in this view, means an activity embedded in and not added to the medium video, which the artist shares with a set of technical devices, the machines. Thus, *Orbital Obsessions* is just one part of a larger series of works (videotapes and installations, including *Allvision,* 1975, *Urban Episodes,* 1980, and *Summer Salt,* 1982) in which Steina "plays" with her idea of *Machine Vision.* There are two major focuses of this work: one concern is with dissociating the point of view from the human perspective of the eye, while the other is to create spatial mapping through closed-circuit devices.

Earlier, in the conceptually related performances of *Violin Power,*[22] Steina directly produced image effects in the course of the performance. In *Violin Power,* the sound of the violin is fed into different devices such as the Frequency Shifter (Harold Bode, 1975), a keyer, and the Scan Processor. In the violin performance, Steina connects to the tool to alter the image of her performance, which is recorded by two cameras and, simultaneously, through manipulation of the Scan Processor (or sometimes through a keyer and audio-synthesizer) is displayed on a screen. In two sequences, the sound of the violin is captured by a microphone and sent to a keyer that mediates the priority of two camera views. Alternately, in the following four segments, the Scan Processor is used to create an image where the bow of the violin seems to interfere with the scan lines and bend the image. But in order to achieve these results, the high pitch of the violin signal needed to be shifted to a lower frequency beforehand (which sounded more like a cello) because the high pitch could not be dealt with in keying and processing devices.

Both performative works, *Violin Power* and *Orbital Obsessions,* exemplify the use of real time in video, which stresses the interactive capacity of the medium similar to computer digital processing, where interactivity and reversibility are common tools. In this context, playing a musical instrument live needs to be seen as a further, if not the most important, element that can be used self-reflexively in video to realize the medium's inherent capacity for interactive expression. This notion of interactivity, first of all, is grounded in the interchangeability of image and sound "noise" and is carried out by "playing the image" with instruments that demonstrate the fluid character of image and sound as it evolves and fill the performance space. What Steina does when "playing video on a violin" is a reversible process, where the sound of the violin interacts with video, which in real time interacts with the sound of the violin. "The tools we use, videotape recorders, cameras, 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 such that it resembles the playing of a musical instrument, which also gives you a great amount of variations and immense capacity to discard unnecessary themes. So 'real time' in our context does not mean the infinite take, but the observation of image-forming processes, which look to us perceptually continuous, yet interactive in all modes including the image forming."[23] And in *Violin Power* as in *Orbital Obsessions* the performability of video is displayed in spatial disorientation.

In the first closed-circuit audio/video performances of *Violin Power* (1970 to 1978) the primary effect observed was the actual movements of the bow on the strings of the violin immediately deflecting the image position of exactly this gesture. Besides being the performer, Steina plays the violin and the video so that in intermediary ways the observer and the observed converge. The languages of the two media, music and video, are interconnected according to their abstractness where the sound creates the waveforms of the image. Furthermore, music is visually explored as a medium developing temporal and spatial features: not only does the sound spread the scan lines so that they become horizontally visible thereby exploring temporal dimensionality, but Steina also uses the Scan Processor to modulate the soundwaves until they build up spatial forms of the image. Through the Scan Processor, brighter parts of the "image" are lifted so that the horizontal lines also vertically deflect and create sculptural pattern. While Steina, in the beginning, interfaced the sounds of her acoustic violin via microphone, since 1991 she performs with a MIDI violin to increase the variety of programs: "The Zeta Violin is a five-stringed electric violin with a MIDI output. The assignment at the moment is that stops on A and E string point to frame locations on the disk. The D and G strings control speed and direction and the C string is a master controller assigned to address segments on the disk. In another programming scheme, the C string controls which upper strings get assigned their function, as I experiment to make the performance more musical."[24] While this setting was originally used for performing with a laser disk player, since the late nineties other schemes and string assignments are performed on a PowerBook using the software program Image/ine, developed in 1997 by Tom Demayer at Steim, Amsterdam, in consultation with Steina.

In taking the processing of music as an input in video, the performances of *Violin Power* points toward the Vasulkas' broader interest in abstraction, or "video noise." For example, in using the Scan Processor in *Time/Energy/Objects* (1975/76), which are various studies in line and raster processing, the idea was to explore the interplay of visual and aural abstraction from scratch and to create objects purely out of scan lines. The purest way of creating video through "video noise" is exemplified in the study *No. 25* (1975) where the signal actually scans the field from top to bottom. The *Time/Energy/Objects* were films of video experiments in black and white. They needed to be films because the visual output on the small screen of the Scan Processor was so low in resolution that a specially manufactured film camera was employed to film the tube in the higher resolution of 30-frame-per-second. In this regard, the ways in which *Time/Energy/Objects* are films of video signal processing can be compared to a film image from the optical printer where the speed frame can also be altered. However, the production process of *No. 25* is exceptional, because in other video experiments, such as *The Matter, Explanation,* and *C-Trend,* Woody did rescan, but not film from the screen of the Scan Processor. A Dual Colorizer (Eric Siegel, 1972)[25] was used so that the small screen image would be less visible with added color.

In *No. 25,* we see on the screen recorded accidents of the signal as it's shaped through voltage and frequency. In saying that the image derives from "noise," according to Woody we need to understand noise as all frequencies together, which means unstructured energy that bears the "potential" of all video. Surprisingly, the imagery that arises from the deflection of 525 lines is not made through a camera lens but rather the empty television frame. The Scan Processor affects this information electromagnetically, so that the whole information of the empty TV is shrunk and bent into a 360 degree shape that appears as an abstract object in video void. The density of scan lines is spread until the structuring of the lines is brought to visibility. The image source in *No. 25* is the rewinding of a videotape and this signal of random noise is processed in the Scan Processor, where it is then rescanned according to the raster system, and finally filmed. Before it can be filmed or rescanned, the distorted "image" needs to be stabilized and locked in order to stop drifting so that it matches with the constraints of the preset raster frame and therefore can be recorded. This happens through a clock operation, which, in case of the Scan Processor, is carried out by an internal oscillator. The newly "created" image self-reflexively refers to signal processing, because in its internal movement from top to bottom it verifies the vertical synchronization jump, usually invisible. The visual demonstration of how drifting scan lines are locked in the internal form of the presented image as frame reveals the function of the clock to adjust random noise so that we can see *and* hear an image. The modulation of frequency and voltage into a cylindrical form also demonstrates how dimension and direction of electronic imagery can be easily manipulated. The transformative potential of the empty screen also reveals that the visual part of video can take any form and even become a spatial object, thereby foregrounding 3-D computer graphics. By the same token, *Time/Energy/Objects* falls into the category of "noise objects" because the transformations that occur in the Scan Processor through the modulations of waveforms not only produce an endless visual process consisting of the interplay of horizontal and vertical synchronization pulses, but at the same time, bring forth the "noise" of a void image as it is bent, spread, and compressed. Where Woody regards these "energy objects" as models of images, it can be added that these experiments reveal the meaning of the "matrix" of electronic imagery, which lies in unstructured energy and encompasses the potential of all possible forms of imagery.

With the Scan Processor, abstract imagery that has no external source can be generated from the "magnetic material" itself. For Woody, this tool allowed deeper research into the appearance of the "frame structure" of the electronic image. His electronic experiments are, in a way, comparable to the notational experiments in natural sciences, because Woody's aim is to define a syntax of organizing energy where the operation and the apparent forms are related to each other in a syntactic order. In his notes on *Didactic Video: Organizational Models of the Electronic Image,* Woody explains the role of the Scan Processor regarding the possibility to control video processes: "Emphasis has shifted towards recognition of a *time/energy/object* and its programmable building element—*the waveform*... The majority of images, still or moving, are based on their capture from the visible world with the help of the *camera-obscura* principle through a process involving the interaction of light with a photo-emulsion surface... Contrary to this, the conversion of light into energy potentials during electronic image forming is achieved *sequentially*, giving particular significance to the construction of the referential time frame... The possibility of disregarding this organizational principle and realizing instead a total absence of such a process in certain modes of electronic image forming has interested me the most. The result has been an inevitable descent into the analysis of smaller and smaller time-sequences, a process necessary to understanding wave formations, their components, and the process of their synthesis and programmability. To me this indicates a point of departure from light/space image models closely linked to and dependent upon visual-perceptual references and maintained through media based on the *camera-obscura* principle. It now becomes possible to move precisely and directly between a conceptual model and a constructed image."[26]

Absence of the difference between camerafed and wavegenerated imagery increased the possibilities for maneuvering electronic imagery. Models of this new kind of "image" behavior, as exemplified in *Time/Energy/Objects,* can also be found in some of Woody's previous works: in *The Matter* and *Explanation* using the Scan Processor, and in *Noisefields* (with Steina, all 1974). Notably, *The Matter* and *Explanation,* and also *Soundsize* (by Woody and Steina, 1974) use the test screen pattern (crosshatch, dots, colorbar) of a Broadcast Signal Generator, which is a mathematical tool, a clock, that was needed in early television to generate the broadcast signal of NTSC. Slightly different, in *Noisefields,* as there was no instrument available to generate a circle, a camera was pointed at a sphere. But once the circle was created, electronic snow is keyed through the abstract shape of the circle and a Video Sequencer is used for positive/negative switching at various speeds. This imagery, which merges camerafed and camera-less input sources, is further processed through the Dual Colorizer that changes the color and its intensity.

Noisefields is comparable to *Orbital Obsessions* because here as well the Video Sequencer is used to switch between two video sources to create similar flickering effects. However, differently from the interplay of self-reflexive visual input that in *Orbital Obsessions* arises from recording the scene of the location, *Noisefields* reveals the source of every electronic input. The imagery presented refers to its detecting of electronic signals and does not carry any other information, except that the Colorizer is used for variation. The circular form introduces a simple division into an inner and an outer field of interrelated pulsation, so that on the whole, the "content" of this work is an audiovisual modulation of "video noise." In two other related experiments, *The Matter* and *Explanation,* Woody uses the pattern of the Broadcast Signal Generator, whose shapes are displayed on the Scan Processor deflected in shape and scale through processing of the audio/video signal. Here both audio and video equally present the transformative processes affecting the initial form, a dot or a crosshatch. In this case, the "image" is keyed (using the Multikeyer) over an artificial "landscape" and fed through the "ramp processor" inside the Scan Processor, which changes the voltage in the synthesizing function and is responsible for the simultaneity in generating sound and image from the same source—a source that at once shapes the visual pattern and the electronic sound of this particular "image" signal. It is exactly the oscillator (i.e., waveform generator) that is responsible for reshaping the source pattern. As the "Operating Manual" for the Scan Processor further explains: "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."[27] So finally, it is the same source moving sound and image simultaneously.

Alternatively, in *Soundsize* and *Heraldic View* (both 1974) the pattern will be modulated through sounds that are generated from an audio synthesizer to affect the form and shape of the visual expression of electronic sound. Nevertheless, interfacing image and sound is not an absolute state of interchangeability. For example, in *Heraldic View,* the pattern is generated with an oscillator and some behavior of the image is controlled with an audio synthesizer, while other effects result from keying and therefore involve a level of programming. *Soundgated Images* (1974) is another version of these experiments, where Multikeyer and Scan Processor are combined to create the abstract imagery that while manipulated and fed back was generated through sound. It moves horizontally through retiming of the horizontal drift. In contrast, the visual and aural pattern in *The Matter* is created by the waveform generator as it is displayed on the screen of the Scan Processor. "In *The Matter,* as an example, generated sine, triangle, and square waves are used to reshape the display raster, and the image of the dot pattern alters accordingly into analogous waveshapes. The altered Rutt-Etra image must then be recorded by a second camera pointed at its display screen, in order to impart the proper TV timing information that allows us to review the image on a standard monitor."[28] The waveform that emerges with vertical aberration of horizontal scan lines is also a way to demonstrate the variability of time and energy in video. Waveforms are another possibility for multiplying the demonstrable functions of video, especially with regard to presenting time as space. "Waveforms are normally an acoustic product, but when you create them as frames you can deal with them as image objects."[29]

This procedure is also applied to real imagery when Woody, in *C-Trend* (1974), rescans documentary live footage and modulates the deflection line structure causing it to build a floating image object that seems to be freely moving in electronic "snow." Thereby, the image abandons the x/y-coordinates of the frame that normally confine the scaling of regular video images. The videotape depicts the experiment of recording images and sounds with a camera pointing out of the window and onto street traffic. But while the visual material is retimed and processed in the Scan Processor– where it is reshaped, compressed, and eventually divided in two differently shaped segments and finally presented as an unfamiliar form—the recorded sound remains unaltered, i.e., "real" street noise. In *C-Trend,* when the visual information is taken out of the television frame and set adrift, what happens is that the frame itself is exposed to horizontal and vertical blanking. Through raster manipulation, the image content becomes "object" and collapses upside-down. *C-Trend,* in exemplary ways, interrelates the two different functions of the Scan Processor: one being raster manipulation and the other line deflection. Remember that in *Violin Power* scan processing only manipulated the line, not the raster. Line manipulation of the Scan Processor implies that the black areas of the image will not be affected (these areas are neutral because they lack voltage) but the white areas are the energy content and can be heightened or depressed. In *C-Trend,* the resultant effect of this operation, together with raster manipulation, produces a constant tension between the live character of the sound that maintains relations to the "real" world, and the artificial object, that in its freely traveling abstractness nevertheless refers to the depicted scene. For example, the viewer tries to "see" the cars that they can hear, as the cars move through the image. In earlier works, the deflection of the lines (through adding energy to standard scan processes) lifted or pulled down lighter areas, but it was still possible to recognize the "real" objects of the recorded material according to their movement. However, in *C-Trend,* with the technology available at the time, Woody visualized the tension between what he describes as "frame-bound" and "frame-unbound" video. Additionally, when modulating the magnetic energy in the scan process according to brightness, the resultant image object appears in 3-D, regardless of wavegenerated or camerfed input.

Again, in using the deflection processes of the Scan Processor, a comparable experiment in *Reminiscence* (1974) is driven by a slightly different concept. The real-life material that Woody records with a Portapak camera during his visit to a farmhouse in Moravia (where he spent some time in childhood) is later processed in such a way as to de-familiarize the encounter with his past. However, the deflection does not change the scale of the image, so that the frame-bound imagery and the visuality of the topographic environment sustain a permeable relation to reality. This approach demonstrates an overriding concept in the work of the Vasulkas, where the focus is not so much on the linear passage of but on interference and transformation. The results of such operations are to build up tension: they are incoherent, and paradoxical.

For the Vasulkas, a questioning of the medium starts with scrutinizing the performability of the machine and the control of process manipulation. The experiments deliberately abandon the human eye's point of view and introduce "malfunction" and repetition to force the scan lines to build structures that resemble abstract objects in motion instead of recognizable representational forms: "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 asynchronous overlays on the first generation half-inch video equipment (CV) and practiced all methods of camera/monitor rescan, the only way for us to capture and preserve the violated state of standard television signal."[30] The videotape *Calligrams* (1970) involves such practice when, in the rescanned image, the horizontal drift is "deliberately maladjusted" (Steina) causing the image to repeat vertically. While the horizontal visual "violation" of stretching the image is reflected in the audio noises, the rescanning camera, set at a 90-degree angle to the screen, reinforces the electronic structure in its verticality, where the instability of the "frame" appears in transition to spatiality.

These and further experiments with the Scan Processor, Video Sequencer, and Multikeyer—to name the most important tools—demonstrate the Vasulkas' concept of video as it departs from photographic images and narrative references and forces the electronic medium into abstraction. One aspect of using the tools for sound-processing and image-processing modes is to treat the video signal in sculptural ways, for example, to create landscape-like features through a deviation from linear scan lines and in layering with a "key-priority encoder." The Vasulkas' interest in immediately processed and displayed video led them to the development of a vocabulary of video that includes the camerafed image as one possibility of the medium's language. Another is an exploration of the interchangeability of electronic sound and image in signal processing. With this dual approach, the Vasulkas articulate the behavior of video to discover what is an "image" and what is specific to the medium video.

In view of this, I will discuss abstract machine operations as "performance," insofar as the image effect is directly produced. Furthermore, regarding process-oriented and process-derived video, I reserve the term performance for presentation forms that are not representations of something else. The performance can be described as distortion of sound and image through machine processes and through the shared processable activity of performer and machine. The notion of processing, first of all, refers to real-time operations. For example, it must be noted that reflexivity is always embedded in the real-time violin performances by Steina, wherein feedback is involved when the sound source affects both the image and the resulting sound. Also, reflexivity of the medium here refers to the fact that Steina is interested in displaying the image of herself in performing live, but at the same time, that image is subject to temporal and spatial disjunction. The two levels converge in the video: first, the feedback effect of the audio/video interplay; and second, the self-reflexivity of the temporal-spatial distortion, operating as an endless "mirror-effect." Regarding the close interrelationship of machine and performance, this kind of performance video can be clearly defined as a reflexive medium of its own.

By reflexivity of video, I refer in general to the essential structural condition of the medium. Because video is grounded in the transmission of electronic signals, it allows a closed circuit of camera and screen, along with immediate control and manipulation of the image. Circular structures also arise in feedback loops where the scan signal (particularly when traveling through a series of devices) is transformed, deflated, compressed, and bent. Feedback and closed circuit can be regarded as grounding forms specific for the articulation of a video vocabulary builded to more complex effects. What is decisive is the immediate character of the processes that express the fundamental open-endedness of electronic imagery. The Vasulkas have, from their early experiments on, understood the medium as a variable set of tools for forming new languages for the arts. This type of video experimentation differs from experimental photography and abstract film insofar as the Vasulkas conceive of video not simply as another recording technology in the genealogy of media, but as a technology that is literally "new" because it involves processable non-photographic imagery.

Experimental Video

Experimental approaches to video generally focus on the self-reflexivity of the technical setting and on the development of an electronic vocabulary. Such practices consequently lead to the expansion of the medium into installations and a sculptural dimension. Looking at the early days of video, we can identify three major tendencies: video activists who were interested in using video technology for radically democratic and alternative television[31]; artists working in the realms of Happening, Fluxus, Intermedia, Performance, and Event Art who used video conceptually to expand and transgress the "white cube" and perform perceptual experiments[32]; and a third group of "image technicians" who were interested in the aesthetics of the technological capacities of the new medium.[33] Major representatives of the latter approach are Nam June Paik, Gary Hill, and Steina and Woody Vasulka. Their experiments in video build the fundaments for the development of an abstract visual language, because each pursues ways of creating an electronic vocabulary that is specific to the medium video.

The work of this group of artists, in particular, connotes a culturally semiotic definition of video, because the emergence of the new medium is understood as dialogically connecting aesthetics and technology. Both fields involve interlinking with previous and parallel media that are considered as the contextual environment from which a media system is built, wherein the specificity of video can be fully explored. Experiments with image techniques are thus regarded as possibilities for achieving a new visual language through working with the forms of the medium. The main objectives in the work of the

Vasulkas, Paik, and Hill manifest as analytical experiments towards the electronic vocabulary. For example, Paik in his *9/23/69 Experiment with David Atwood* uses the Paik-Abe Synthesizer at WGBH-TV to dissociate, collage, and recombine television imagery. In his electromagnetic manipulations of television and electronic signals, Paik, with a Fluxus-inspired attitude, reveals his strong interest in "distortion," as he sees television (and performance) as something to be deconstructed. And, except for the early television experiments that were filmed by Jud Yalkut, Paik's strategy is mainly remediation in that he reworks the resources of media images, for the most part television programs. In contrast, for the Vasulkas, the aim is not distortion but a dialectic process that encompasses both deconstruction *and* construction as necessarily interwoven.

Differing from Paik and more closely related to the Vasulkas' approach, Gary Hill is interested in the abstract "art" of video. However, unlike Steina and Paik, who provide structural interrelations between music and video through their own experiences (Steina as concert violinist and Paik as a Fluxus musician), Hill takes another path and develops his "electronic vocabulary" in relation to known language systems. Like the Vasulkas, Hill is interested in building up a systematic syntax of video. By using the recombination of primarily dissociated language elements (corresponding to the dissociation of scan lines), Hill linguistically expresses feedback, layering, and delay, particularly when combining reading aloud from left to right and right to left thereby reversing the spoken language and manipulating direction and velocity. And too, Hill's *Electronic Linguistics* (1978) translates aural signals into visual systematics. For Hill and the Vasulkas, a reliance on the interrelationship of machine and media in video implies a conceptual understanding of delay and feedback. This view distinguishes them from Paik, who deliberately uses multiplying effects in video-television performances for the purpose of staging media spectacles. Reflecting on the "new language" Hill explains: "Video allowed a kind of real-time play, the possibility to 'think out loud.' Here was a process immediately accessible and seemingly a much closer parallel to thinking... Time, this is what is central to video, is not seeing as its etymological roots imply. Video's intrinsic principal is feedback. So it is not linear time but a movement that is bound up in thinking—a typology of time that is accessible."[34]

It shall not be overlooked that the emerging medium video from the beginning[35] has maintained a dialogic relationship with neighboring media (mostly film and performance) while it shares basic technological principles with television. "The discourse of TV flow is 'present' in the sense that the viewer can enter into dialogue with the screen. Yet the broadcast flow is also a vanishing, a constant disappearing of what has just been shown. The electron scan builds up two images of each frame shown, the lines interlacing to form a 'complete picture.'"[36] Early experiments with television mainly refer to the "timeshift," which connects it with video on the level of cultural practices. Nevertheless, it is important to point out the differences between television and video: the one being primarily a pre-programmed broadcast medium, and the other an open-ended format for audio/visual exploration. Even though the same technological basis exists in video and television, manifesting in cultural connotations of flow and shifting time, video artists, such as Paik, deal with the remediation of television programming, and in parallel, the Vasulkas' attempt is directed toward media specific features of video that they discover by experimenting with the order of machines. In general, the Vasulkas have not been interested in single-box devices (such as the synthesizer),[37] but would rather begin with a signal and employ a set of various tools, for example keyers, colorizers, and processors, and in the end use a processing amplifier in order to reestablish the signal.

These different approaches are exemplified in early electromagnetic manipulations: Paik, in his 1965 experiments titled *Demagnitizer,* bends the scan lines of a television screen by externally applying a strong magnet that "massages" the TV image. In *McLuhan Caged* (1968), Paik references the medium of television and its program structure when he manipulates the broadcast image of Marshall McLuhan, while the leading media theorist of that time explains his key concept that the "message" of the new medium is the content of the languages of preceding media.[38] The languages of the preceding media are retained, he explains, through modes of transformation, which, in short, means that the message of the new medium is the "massage" of the other media. In direct response to the content of McLuhan's message, Paik electromagnetically transforms, that is to say "massages" McLuhan's television interview through exterior interference so that a magnetic distortion transforms the "content" of television by its own means. The violent audiovisual disruption is also meant to distort McLuhan's content, of which Paik is critical.[39]

Where the demonstration of *message* as *massage* is applied to already existing program structures in television, the Vasulkas are, by contrast, more interested in revealing the internal transformative and "massaging" capacities of the new medium. Their work fosters a structural, more formal, understanding of the medium, starting with the empty television screen—the video void. Massaging of the message gains a twofold meaning here because such explorations into the construction principles of the new medium at the same time involve "deconstruction" of the processes. Massaging the medium thereby becomes an intermedial process, wherein the new medium, video, establishes its relation to previous media—such as music and film—in a dialogic encounter with those media languages in order to evolve the specificity of video.

Video experimentation takes two directions: one is the deflection and distortion of "imagery" to the bottom line of electronic signals, and the other is the building up of an aesthetic vocabulary from the manipulative potential of video, which proves to be not limited to a certain order of "apparatus." In departing completely from the notion of *dispositif,* we can see that this approach evolves a dual perspective, because openness, on the one hand, implies the flexibility and instability of the electronic "imagery" and its interchangeability with sound. On the other hand, it involves a nonfixed, variable, and extendable set of machines. In this view, the performative practices, as well as the transgression of image into object, both need to be considered as logical developments of video that expresses self-reflexively.

As the early works demonstrate, the immediate presence and constant transformation in video signifies a new concept of imagery that goes beyond fixity and framing, which are challenged through processes of construction and deconstruction in endless variations of the grounding signal, aurally and visually. Woody Vasulka explains the principle: "Making involves deconstruction of technological devices."[40] And in rephrasing McLuhan's famous (and often misread) phrase "the medium is the message" where McLuhan specifically understands *message* as *massage,*[41] Woody defines his interest in exploring the specificity of video by saying, "a medium contains previous media as language."[42] Needless to say, previous media are regarded as messaged so that the "generic behavior" of the new medium is defined through transformation (manipulation) and immediate presence (transmission). For Steina and Woody, video means a point of departure from the camera image toward the new potential that lies in transformation and centrally in feedback. "Feedback was the first true image not related to pinhole,"[43] Steina explains about her interest in abstract pattern, in the shape and pace of the line, and in the scale of the videographic image field. Conceptual video art, along with videotapes and installation works, generally occupies the art scene, in contrast to experiments with "deconstructing" television (specifically in the work of Paik) or "constructing" video in experiments with the signal (as in the work of the Vasulkas). These "video artists" are literally "image technicians," working "against the grain" with abstraction and image technologies: the image is no longer seen as preproduction of anything—not even of the recording process (as in the photograms by Man Ray and in hand-painted film by Stan Brakhage). In contrast to representational image, electronic imagery is nothing but a process.

The Vasulkas' ongoing research into the syntax of video is a structural approach, because once intervention into the medium's surface appearance has stripped the signal off "content," it is forced to reveal its matrix "meaning." In view of this self-reflexive approach toward visuality, it comes as no surprise that the Vasulkas were always interested in building the bridge to digital media, an important step of which was connecting hand-built tools to standard tools. New hand-built tools, like the Image Processor, Video Sequencer, and Scan Processor, were wired to standard tools such as camera, videotape recorder, and monitor available on the market. In the search for basic tools that would allow the development of controllable reproducible effects, the Vasulkas step-by-step incorporated machines that perform multiple programmable functions. This logically led to the conceptual design and building of a digital imaging system that performs logic functions and generates images as data-structure. Here, another set of tools is needed in order to articulate this internal potential of the medium video.

Woody describes the state of art in the late seventies: "The system as a whole was unknown to me—I could not conceptualize an image through the system. But in various ways, by examining or violating certain rules of input and output, or by inserting certain unorthodox obstacles to the signal, eventually the signals, the images or sounds, started to display their own inner structure. I also understood, right from the beginning, that the systems I needed were not part of the available hardware."[44]

In bridging video and computer, a tool that was constructed for the Vasulkas was the George Brown Variable Clock, which controlled the speed of horizontal drift in aberration to the standard horizontal frequency. Another was the George Brown Multikeyer that had a programmable keyer to which a computer interface could be added. Already in analog experiments of video processing the Vasulkas were trying to create a typology of the medium which could exhaust the possibilities of the tools, for example, forcing the performance of the medium on the level of its interlaced fields and synchronized scan lines. With the introduction of computer-processed effects, video enters another level of operation, because effects are now controllable through calculation, and processed imagery can be stored and duplicated. Nevertheless, digital image processing is not simply a machine operation but also a media practice, which forces the artist to share creativity with the machine.

The building of digital tools evolved into the Digital Image Articulator (Jeffrey Schier and Woody Vasulka, 1978), designed as a creative machine tool for computer-processable visual effects. Here I'd like to reiterate the fundamental conceptual and technical differences between analog and digital media[45] that at once separate and connect them. It is exactly the processable character of electronically transformative imagery that enables video to play a key role in the passage from analog to digital technologies. Here again, the Vasulkas, in early experiments with programmable functions, already managed to demonstrate how, through the development of machine interfaces between video and computer, the limitations of linearity could be extended toward "object" behavior. In stressing transformation as a media quality specific to video, I wish to underscore the distinction between the transition of images in film and the electronic transmission of audio/video signals. Transition is grounded on interruption and difference between images as entities (frame), whereas the typical structure of scan lines, variable voltage, and multiple layers in video together express a kind of flexibility that may or may not follow the frame of an image. Electronic image technologies, with the discontinuous flow of flexible imagery, consequently negate and supersede the differential concept of film that is grounded on intervals between "frames." The electronic "image"—precisely because the signal needs to be horizontally and vertically synchronized at the end of each scan line and because the two half-images are interlaced—will always produce discontinuous imagery.[46] Synchronization and simultaneity are specific to video, even though video, like film, is a linear time-based medium.

In comparing different types of media images, Edmond Couchot reserves the characteristic of "time and space representation" to the film image, whereas the digital image has no representational function. The digitally processed image is a simulation image (*l'image simulée*) that assimilates representational features in favor of hypermedia branching. The digitally processed image is omnidirectional. Between the two (film and digital image) the electronic "image" in video is considered omnidirectional, producing simultaneity and density: "L'image, visuelle et sonore, que l'écran électronique introduit avec violence dans le lieu où il est placé, sans la transition du cadre, s'impose au spectateur au détriment de l'espace qui l'entourne et qu'il transforme 'en fond.'"[47] The omnidirectional quality defines the paradoxical structure of video, where it implodes at the place of its presence, so that temporal continuity collapses into the density of clustered scan lines. What happens is that the difference between images, the temporal dimension, is encompassed in a cluster thereby producing density as a spatial category. The resultant electronic simultaneity indicates a dramatic shift in the organization of any image.

As media theories dealing with video generally conclude, the essential characteristic of the electronic image lies in its immediate presence at the place of presentation, which is the surface of the screen. But, as I argue, the video image that is usually regarded as surface image, can be better understood as "image" without image because of its inherent omnidirectionality. And, in contrast to the analog recording media of film and photography, there is no material unity of an "image" but only signals producing "noise" that may or may not turn into something that resembles an image. Gilles Deleuze[48] states (explicitly referring to Edmond Couchot) that the electronic image—i.e., the television and video image—loses direction in favor of an omnidirectional space where it varies its angles and coordinates and exchanges the vertical and horizontal. According to Couchot, we need to differentiate between the electronic and the digital, because the digitally processed image does not represent parameters of time and space but presents nondirectional forms. These are effected by calculation and are essentially ambivalent.

Nondirectionality also implies density and time compression, so that the digital is equally available in spatial and non-spatial forms. When, in digital processing, all possible forms of image can be realized, the electronic image approaches a translation or transfer to the digital matrix type of image. Couchot describes the incorporation of the analog into the digital: “Physiquement, sur l’écran de l’ordinateur, l’image numérique se présente comme une matrice à deux dimensions de points élémentaires: les *pixels*. À la différence de la télévision, la position des pixels ainsi que leurs caractéristiques chromatiques et lumineuses est définie automatiquement par calcul: la mosaïque télévisuelle est maintenant rigoureusement ordonnée... À l’inverse, il devient aussi possible de passer d’une image issue de procédés analogiques à une image numérique en la décomposant en nombres, à l’aide de caméras spéciales. L’image est devenue une image-matrice.”[49]

Because of its numeric basis (infinitely repeatable in endless combinations), the digital, as a matrix image, signifies the concept of “every image” in all possible ways: “Image-matrice, quand on la définit dans sa morphogenèse, image-réseau, quand on la définit dans son mode de distribution, elle contient une infinité potentielle d’autres images. C’est une image à la puissance image.”[50] Consequently, the spectator loses orientation because the temporal-spatial order of *dispositif* is dissolved: “il ne s’arrête plus à sa surface, il s’y plonge totalement.”[51]

A far-reaching example of the operational mode of video is given in the Vasulkas’ experimentation with “sound images” and the relatedness of video and audio “noise.” In other words, their demonstration of the interchangeability of electronic languages, aural and visual, further grounds media practices in the digital, which in more complex ways fuses multiple functions and produces multidimensional objects. Gene Youngblood clarifies: “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.”[52] Here, finally, a matrix image transcends the “frame-bound photographic image” (Youngblood) and counters the laws of physics. In this regard, the processed image (as prominently achieved through image synthesis and image modulation in the work of Steina and Woody Vasulka) marks a departure from surface image and entails a construction, deconstruction, and reconstruction of audio and video, analog and digital, automated and programmed. In view of this, the envelopment of programmable functions begins with the manipulation of the electronic signal in the Scan Processors and analog computers, such as the Image Processor, Video Sequencer, and Multikeyer. When incorporated into video experiments, these tools evidently contribute to the development of video from electronic technology to artistic medium. Needless to say, this approach requires insight into the matrix of any simulation image in order to perform the transformation of the electronic into a calculable *image-matrice*, as stated by Couchot.

The Matrix of Electronic Languages

Starting with his film experiments in the early seventies, Woody has been interested in exploring and developing machine processing functions into programming. In using the electronic signal as “raw material” from which to build up an electronic language system, he found a parallel in the investigation of digital image processing, where the search for the smallest programmable unit is seen as the "point zero" from which a "syntax of binary images" could emerge. Interestingly, this intervening approach toward video and computer took place at a time when each of the two media, analog and digital, were developing out of technological settings to form culturally semiotic expressions that define the level of media specificity. In this regard, I find that the Vasulkas were very aware of the state of media development, namely that a new medium was grasping for articulation and acknowledgement. This awareness guided the early use of image processors, mixers, and computers for modulating, keying, and switching. The concept of generating and organizing electronic signals directly via machine control is grounded in the idea of programmability as a way of interfering and radically transforming the status of an "image." In this view, electronic images when they develop complex layers and produce a spatial order through prioritizing image keys, clearly hold a position that foregrounds the matrix of digital space.

Experts in computer sciences maintain that the issue of representation in the computer refers solely to the *purpose* of using the computer and by no means indicates any characteristic that would be specific to any computer. "Neither in the design of the machine, nor during programming does anything indicate that the symbolic structures would induce representations of something else."[53] Algorithms are a conglomeration of commands needed to manipulate logic expressions in order to steer the computer and computer systems. One does not need to know how the program is transmitted into a series of instructions that are appropriate to the machine. Digital media forms arise from algorithms, numbers, and symbols and they build a media "language" that only the computer can "understand." These premises mean that, on the one hand, sharing creativity with the machine unavoidably produces unexpected effects, and on the other hand, the whole notion of creativity needs to be reconsidered in terms of a dialogue with the machine. The point is that we are not talking about smooth or invisible interfaces, but rather, incoherent semiotically diverse meanings of territory. In this regard, the computer system that "creates" numbers and symbols in epistemological ways is not part of our representational world. And it is precisely this machine level of technological simulation that Couchot has in mind when he characterizes the rupture in aesthetic articulation as a violent shift. This rupture indicates a kind of hybridity in reference to man-machine interfaces on the level of virtualization.

In thinking about a dialogue with hybrid media and the digital simulation machine, for Woody the stress rests on a reinforced conceptualization of "digital space" which, in abandoning formal organizing principles of art forms, departs from the use of the computer to "emulate" traditional forms in favor of environments. In a co-authored "research proposal," David Dunn and Woody Vasulka reflect on the expansion of the dialogic structure in constantly moving and transforming parameters of endless variations through immediate modifications. The proposal was written on the occasion of presenting the media installation, *The Theater of Hybrid Automata* (Ars Electronica, 1990, in collaboration with David Dunn), and it reflects the need to reconsider authorship (because of sharing creativity with the computer) and to understand the behavior of interactivity. Accordingly, it describes the development of "digital space": "Our interest and insight into this new perceptual environment results from our many years of creative use of digital technology as an aesthetic tool that has often brought us to a direct confrontation with traditional ways of composing images and sounds. This conflict has not only been initiated by our interest in new forms in general, but specifically, by the profound implications of organizing our materials through a computer code. What becomes apparent from the structural demands of this technology is that there is an ability and even an affinity for a discrete genre to interact through the binary code in ways which transcend linear cause and effect relationships, revealing new compositional concepts with regard to space, perspective, and morphology."[54] Furthermore, this new type of creativity strongly implements machine behavior on the grounds that interactivity and virtuality are the technologies that are specific to hybrid machines in the digital. As the proposal emphasizes the task of shared creativity lies in the digital space because this space opens up another, appropriate environment for the larger encounter between humans and increasingly complex machines. "What becomes evident is that a kind of digital synaesthesia could emerge from this perceptual environment that which provide an experience of the concept of nonlinear complexity which has become so profoundly significant to the sciences at large."[55]

One concern is to compare the constraints of the television frame and the presentational mode of pixelation in terms of their flexibility in time and space, especially regarding compressing and decompressing the temporal and spatial extensions of the "image object." Another interest is the positioning of oneself in the digital environment and exploring ways in which time and space can become enveloping, and also used to develop features that anticipate immersive media environments of virtualization. In two different experiments with representation of the artists' handcraft, Woody uses his own hand as a subjective and objective metaphor of a primary creative tool in order to achieve a visual presentation of the transformation process: one time in the analog (*Vocabulary,* 1973) and the other in the digital (*Artifacts,* 1980). In these experiments with multiple layers, the idea is to gradually shift the gestalt of the hand, so that the visual object is transformed from realistic recognition to abstract pattern, through the use of feedback tools. Viewed together, the two visual statements on "creativity" explain the shift from analog to digital in the work of the Vasulkas.

Using the Multikeyer, Scan Processor, and Dual Colorizer in *Vocabulary,* two three-dimensional "objects" are set in a new spatial relation to each other through processing their forms. Woody's hand is placed in the foreground of a sphere, and through replacing one luminance value with another, and through modulation of certain areas of the two-dimensional presentation of a three-dimensional form, the hand and sphere seem to loose their shape, and brighter parts reflect, like arrows, across the "image" field. The Dual Colorizer system feedback is used to create a new form of the transmitted electronic information that presents a different, unseen kind of spatial hierarchy, fundamentally different from the "real" spatial relationship between the two "objects." What happens is the keyer is used to take out areas of a certain luminance, replaced with a different mapping of electronic noise. While the Scan Processor in this video work is used for raster manipulation that causes the forward movement of the image, it functions as the keyer as well, because it can affect both dark and bright properties of the electronic image (normally the Scan Processor can only affect the brightness). The texture of an array of lines in triangle form is generated by system feedback, which, unlike optical feedback, generates a delay in the form of texture. System feedback is an electronic operation where the signal itself is fed back and needs to be distinguished from optical feedback, such as, in *Orbital Obsessions,* where the camera points at a monitor.

Conceptually, *Vocabulary* demonstrates the interplay of keying and feedback, because while the replacing of luminance makes visible the incoherence of the electronic "surface," system feedback at the same time disrupts and visually merges the otherwise distinctive shapes of the hand and the sphere. The disorder of object placement, first of all, results from the appearance of the electronic "raw material" on certain surface parts of the sphere and the hand, when both are subjected to processing and keying. Primarily, multiplication of the distorted shape is achieved through extended feedback where the presented hand as visual object gains a new spatial behavior that is independent from physicality and directionality of Woody's actual hand movement as it is presented. Clearly, an image of a body part becomes a spatial object, similar to the object of the sphere that is treated here in the same manner, because the visual field on the whole is "processed" by a system feedback operation. Not only does the presentation of the objects shift visualization from realism to an artificial look, more disturbing is the merging of parts of the objects with each other that creates a physically impossible situation.

While the expansion of the image field in *Vocabulary* trespasses the "borders" of a presented object, it signifies an early stage of control in the electronic image. In *Artifacts,* Woody experiments with constructing and deconstructing digital visual imagery. Moreover, he is interested in the possible ways of manipulating the electronic vocabulary on the basis of algorithms. The videotape visualizes this process-oriented restructuring of analog into digital images. Line composition and pixel structure are revealed as the visual effects of digital "scanning," where the modulation of x/y-signals causes horizontal and vertical expansion and the gradual deceleration and acceleration of image data ultimately generates morph effects. In constructing digital visual imagery, and, in particular through stripping the electronic vocabulary of its "material" algorithmic basis, *Artifacts* is, first of all, a dialogue between analog and digital image processing. It is also a dialogue with the machine, because again, Woody uses his own hand as a primary creative tool. However, in contrast to *Vocabulary,* the task is to visually present the transformation processes "layer by layer" and "number by number."

In *Artifacts,* Woody demonstrates the tools of the complex Digital Image Articulator that he found necessary to construct because the computers available on the market in the 1970s were not designed for real-time image processing. In the 1979 unpublished manual for the Digital Image Articulator, Woody Vasulka, Jeffrey Schier, and Tom Moxon describe at length the functioning of this system. In principle, the Digital Image Articulator processes encoded images. Once the image has been converted from analog to digital, the numeric content of the "image" gets scanned and stored by eight frame buffers according to the luminance value of each single section of the image; that is to say, each luminance value is assigned a numeric value. The range of numbers that can be assigned to each value in the dark/light scale determines the amount of discrete intensity changes that will be displayed on a 128-by-128 pixel grid. The frame buffers store single frames or sequences of frames. The microprocessor connects to two of the four busses that feed the image buffers. "By controlling the two busses, reading and writing may be done to different locations in two different buffers. This gives the capability of various picture transformations, such as picture inversion, compression, expansion, edge extraction, and outlining."[56]

While each buffer is connected to four busses that carry control signals, address, and data information, a sequencer and a 256-word-program stores, and gives instructions to the microprocessor. The address section (x/y-address-formation circuitry) is responsible for generating the horizontal and vertical timing signals to scan out, or to write, digitized video information for the image buffers. The modulation of the x/y-signals allows a continuous modulation of the buffer scanning to create scan processing effects, where the modulation of the deflection signal results in compression and expansion, in readjusting height and width of image forms, and even repositioning of the horizontal and vertical axes. As stated in the manual for the Digital Image Articulator, "In raster scan graphics two schools of thought are 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."[57]

The microcomputer interface connects a LSI-11 microprocessor to the video processor and allows it to request usage of a particular buffer. Once the buffer request sequence is successful, a block of data may be written in, or read, from the buffer. The LSI-11 is also responsible for setting the buffer priority registers on the eight image buffers.

In the light of the technical level of digital image processing that was available for *Artifacts* it seems ironic when Woody makes reference to the pictorial motif of the artist's hand (adapted from the classical tradition of handcraft). In response to the production methods of artists who maintain control over their own image, *Artifacts* allows a transformation to almost unstructured pixelation (stripping off, and in reverse, adding up layers) in the digital imaging process of this motif. Evidently, the production methods in electronic culture require that the artist acknowledge that he/she co-produces with the machine. As Woody explains in the voiceover to the videotape *Artifacts*: "By 'artifacts' I mean that I have to share the creative process with the machine. It is responsible for too many elements of this work. These images come to you as they came to me—in a spirit of exploration."[58]

Subsequently, in the off-commentary, Woody asks the viewer to use the videotape interactively by switching the VCR on and off several times while blinking the eyes—in order to experience interval effects. This, of course, is not meant to share the digital experience of real time with the viewer, but rather reminds the viewer of the technical difference between the tools used for creating video imagery and the media environment in which we view it. Significantly, when the viewer is asked to produce intervals using the VCR, there is another layer of media criticism involved, because the interval clearly belongs to film language where the interval is needed in order to, at the same time, separate *and* connect individual frames. Certainly, Woody's instruction "to interact" does not bridge the media difference between video machines and digital image machines, but is rather another statement about media specificity that is important on the technological level. Woody, particularly with *Artifacts,* describes the necessary precondition for thinking about another level of vocabulary. With the incorporation of the Digital Image Articulator, his applied research into visuality takes the "electronic vocabulary" one step further to the "syntax of binary images." However, as stated above, with digitization the interest in the audio/visual vocabulary (particularly in this early phase) focuses on the image, because, as Woody explains in his notes to *Binary Images,* therein lies the greater challenge.

In search of a connection between logic operations (algorithms) and a systematic of the visual, Woody analyzes with digitally organized image phenomena in the course of the Digital Image Articulator experiments. In contrast to analog processing, when the analog-digital-converter has translated the analog image information into binary codes, each discrete element, each pixel, can be controlled individually. The size of the pixel that defines the resolution of the image is dependent on the amount of memory capacity. And, in order to gain a high resolution image, a high density of binary codes is necessary, meaning a high amount of bits (the smallest unit of information in the binary mode). These need to be assembled to present values sufficient for presenting a digital image. To start such experiments, the Digital Image Articulator uses a standard computer tool, the Arithmetic Logic Unit (ALU) that is capable of real-time video.[59] While developing the tool, Woody found out that when performing the Boolean algebraic functions, the ALU usually deals with numerical input. And when these functions are applied to an encoded image (that is, an image already converted from analog to digital) the logic functions perform equally, because the notion of the referential is not a distinctive feature. Nonetheless, Woody realized that there was a relevance factor relating to a certain hierarchy that he describes as a "perceptual relationship."

The discovery that the logic steps made "syntactic image sense" (though based on a table of logic functions) led to further examination of a possible "syntax" that expresses specific properties of the code: "What was surprising was to find that the table of logic functions can be interpreted as a table of syntaxes—syntactical relationships between two images—visual or spatial relationships which are not normally thought of as being related to abstract logical functions. Because the logic functions are abstract, they can be applied to anything. That means they become a unified language, outside of any discipline. They are cross-disciplinary."[60] This characteristic applies as well to sound/speech processes, but as Woody emphasizes, he was not particularly interested in imaging as such, "but imaging has the highest time demand—requires the system work at the greatest speed. That is why I am fascinated by it."[61]

In *Cantaloup* (1980), Steina documents the steps involved in image programming with the Digital Image Articulator, and she reveals her fascination with the growing complexity that can be achieved through adding density. It becomes evident that in working with "digitally organized imaging" the Vasulkas are interested in maneuvering the smallest amount and the highest density of image clusters, but they are also interested in creating logically impossible situations and relations—using the medium to go "against the grain." One such approach lies in the construction of machines that are not available on the market and another in the parallel experiments with the perceptual "environment" and the paradoxical behavior of an image in "digital space."

Image Becomes Object

The concept of a synthetic image is by definition transformative, dynamic, multilayered, and not bound to the constraints of a "frame." In short, the electronically simulated image characterizes not only the transition from film to video and from video to computer but, particularly in the work of the Vasulkas, expresses an "instantly moving image" that is multidirectional, multidimensional, and "open-ended" in a number of ways. In Steina's work, since she was trained in music, her interest in process and synthesis underlie the creative principles for rendering and interrelating audio *and* video in spatially condensed, flowing motion. That is most clear when "the frame" (as known in photography and film) is scrutinized and seen to be quite irrelevant in video: the image "field" can be treated as an object that has behavior of its own. "I recognize video as frame-bound and frame-unbound," states Woody. "In frame-bound video, you're basically following the cinematic reliance on the frame. Cinema can't leave the frame unless it makes a special effort. But with the new generation of tools in digital video, it is possible to remove the image from the frame and treat it as object."[62] Equally, the idea of an "image object" is a driving force in electronic processing, because the notion of "building" an image from scratch in real time has an architectural component and treats the image as a visual object that must not necessarily follow the model of a frame. Therefore, the image has spatial appearance and behavior.

In various explorations of how video and space can be interrelated, Steina departs from the common treatment of space as being "what is in front of the camera," as it is mainly realized in performance video. To a certain extent, she engages the concept of extending visual perspective through an apparatus that derives from film, but her video-specific interest manifests in modifying and modulating images, equally with external input or internal generation. In these kinds of works—where performance, videotape, and installation are intermingled—Steina closely deals with the ability to control and repeat, such as waveforms for instance. Again, the question of authorship becomes a critical issue in her concept of "machine vision," since Steina determines her own view of the medium. A departure from Woody's experiments with man and machine co-creating (where he uses the metaphor of hand to signify "handcraft") Steina has, since her early demonstrations "on how to play video on the violin" (*Violin Power*), involved her bodily appearance in the modulation of audio and video signals, so that, in a way, she shifts Woody's "dialogue" with the machine into a wedding of body and machine.

Where Steina approaches the technological setting of video, variable as it is, with an encompassing perspective, we may conclude that her early concept of "machine vision" renders aspects of virtuality visible. In more recent years of media development, such aspects have been extensively carried out in the field of immersive environments, beginning with DataGloves and Virtual Reality headsets. However, Steina's work is crucially different: where most Virtual Reality environments demand the interactive encounter of a viewer/user, Steina's approach is more subtle in that it demonstrates an already immersed aural/visual surrounding where she is, for the time of the performance, fully spatially immersed in the machines arranged around her, observing and manipulating her own image. "All my installation pieces have involved rotating cameras, explorations of space/time... My pieces are an analysis of space, or even a surveillance of a space."[63] Through such processes, it is possible to also create "immersion" for the viewer of a performance, videotape, or installation. In other words, the spatial relationship is part of the video itself and not something that video imparts in relation to an exterior. Thus, Steina is able to demonstrate that space is an internal category of video. And, as result of her creating an experience of immersion or embedding, we may rethink the kind of interactivity that the artist/author maintains with the machine.

There are different stages of spatial immersion in Steina's work: *Orbital Obsessions* (1977), and *Warp* and *Mynd* (both 2000), are all "enveloping" video objects that indicate the interactivity between body-and-machine, and machine-and-machine is not an activity with external features but an internal process. However, in experiments with "machine vision," Steina also explores the collision of shape and frame *(Violin Power, Orbital Obsessions*), and the spatial exchange and reversibility of perspective and imagery generates a paradoxical and open system of external machine-based language.

Other explorations of space can be seen in the five sections of Steina's *Summer Salt* (1982), where each part engages a unique way of using the optical means of viewing. The camera is not used as an extension of human vision but as a tool of independently functioning machine vision. In her description of the experiments, Marita Sturken stresses Steina's systematic approach to reaching the limits of the physical. In self-reflexive ways the constraints of the electronic medium are exposed, mostly by rather violent, disorienting encounters between recording technology and the spatial environment. Here again, we find the notion of exhausting the medium with enhanced devices. Sturken says: "Each section of the videotape builds upon the previous one to create an increasingly multifaceted sense of spatial dimensions. In *Sky High*, the camera is attached to the roof of a moving car with a mirrored lens that creates a 360-degree 'distortion' of the New Mexico sky, curved into a spherical merging of landscape and horizon. *Low Ride* takes the camera to the opposite extreme, with it strapped to the front bumper of the car as it drives through desert bush... In *Somersault*, Steina playfully does gymnastics with her camera and its mirrored lens attachment as a means of producing a 360-degree image of a torso wrapped around the camera lens... *Rest* allows the camera to rest in a hammock, exhausted, in effect, from its physical exertions, as Steina digitally refigures the surrounding trees. Finally, in *Photographic Memory*, seasonal landscapes are interwoven, shifted, and layered in sequences that insist on the tension between moving and still image."[64]

In the section *Somersault,* as Steina explains in the videotape *The Making of Summer Salt* (1982), she added to her camera lens a glass tube containing a convex mirror, so that the camera perspective envelopes the surrounding space. She presents two ways of dissociating spatial recognition for the viewer: she jumps around in front of her camera embedded with the viewing prosthesis; or, she stands still, leaning against a tree, and moves the camera from side to side. In each, as the perspective is distorted, it is difficult for the viewer to decide what is mobile and what is stationary. In this regard, the exercise in mirrored, multiplied, and bent camera-views foregrounds experiments with treating single segments of the image differently, such as with parallel events (*Orka* and *Warp*) and metamorphosis (*Lilith*). At the same time, *Summer Salt* is an exercise in an immersive space that can both envelop the calculated presence of Steina herself (*Somersault*) and invite the random presence of viewers, who are also "enveloped" in the installation space.

In the installation *Allvision* (1975), the interplay of observing a system of cameras as they observe each other has been altered from that of *Orbital Obsessions*. No longer does Steina hold the central position in the space between focusing cameras: In *Allvision,* two cameras "face" each other, adjusted in a stable position in relation to each other on a horizontally turning axis. However, the two cameras pick up their own "images" instead, because their viewing of each other is "blocked" by a centrally positioned mirror sphere placed between them. The cameras aiming to "see" each other instead see their *own* images reflected in the mirror sphere. Distinct from a comparable self-reflection in a flat-surface mirror, the reflection "screen" has been replaced by a curved convex mirroring object (the sphere), which also reflects the surrounding environment in a wide but distorted angle. At the same time, the mirrored sphere presents to each recording camera the space in front of and behind the camera. This process also randomly catches the image of any visitor near the installation—a process that is doubled because the views of the two opposing cameras are displayed on two large monitors, which are also included in the encompassing space as the axis turns.

In the installation *Machine Vision* (1978), the set up of *Allvision* is incorporated as one of seven parts: *Allvision, Rotation, Zoom, Pan, Tilt, Double Rotation,* and *Bird's Eye*. Here, the mixing of fields of vision becomes even more complex because the monitors combine spatially distorted images of *Allvision* with other camera images: for example, the optical device used in *Somersault.* In visual terms, the sphere installation creates the impression of an *image en creux* that I understand to be an intentional deviation from the common assumption of perspectival continuity in spatial perception, which, according to cognitive perception theory, is an operation of inner schema in human perception. However, it is possible to demonstrate this internal mechanism through a deviation that is meant to create awareness of the construction of the perceptual environment. The image of the viewer entering the installation is transposed via the mirrored sphere into the abstract virtual space of the video monitors. *Allvision* redefines space so that concepts such as inner/outer, left/right, forward/backward, and up/down have no meaning. Steina explains: "The cameras alone scan the whole room. The idea was of course that the whole room can never be perceived or understood by human vision. Inserting the sphere in between emphasized the absurdity. When I mount the camera on the car, I define it as machine vision, but when I use the sphere, it is the concept of allvision."[65]

Regarding the two cameras installed on the horizontal revolving axis (*Allvision*), the insertion of exterior space into the field of vision of a recording device is a way of multiplying the visibility of space. But the construction also presents the enlarged space in a continuous horizontal drift, causing instability and disorientation with the *image en creux,* because the two cameras circulate around each other on a horizontal axis. In this installation, visual representation of space is no longer bound to horizontal-vertical categories following the Cartesian grid but instead, enlarged spatial categories transgress the surface image limitations. Such expansion clearly means a multiplication of possible spatial forms that a camera installation in motion, but more likely a computer through algorithms, can intersect, converge, and constantly reshape.

It is especially clear in *Allvision* that Steina is experimenting with mirrored sphere devices in order to transcend the limited spatial perception of the human eye's perspective. Nevertheless, machine's "vision" is not an issue in itself, but the encounter between machine vision and human vision is part of the idea of enveloping and immersing the viewer in a perceptual space that is disorienting and incoherent—a departure from Cartesian coordinates. This multi-perspectival view also revolts against the current concept of a "picture plane" in electronic arts, which is bound to the notion of a surface image. In contrast, Steina subtly and playfully demonstrates that not only is the image in video no longer an image because of its drifting, but it is also an image that potentially employs virtual space.

One way to immerse herself (*Somersault, Warp*) and the viewer (*Allvision*) in the virtual space of her/his own surrounding is to construct the impression of an *image en creux*, by which I mean an intentional deviation from the common assumption of perspectival continuity in spatial perception. A second way is to multiply facets of image fields in image synthesis, where parallel streams of segments, multiple layers, and metamorphosis together stress the multidimensionality of the image as object (such as in *Lilith*). A third way relates to image processing and reversibility where, again, incompatible visual events occur, events that de-familiarize the scale and pace of the image while expanding its directionality and maneuverability (as in *Orka, Mynd,* and *Bad*).

In referring to an understanding of the matrix beyond the level of visibility—"that works entirely underground, out of sight" as Krauss defines it—the potential of *l'image matrice* is prominently exemplified by the *image en creux*. That is because it encapsulates "properties of invisibility and synchrony" (Krauss), which means that it realizes paradoxical situations. In saying that the matrix image is basically the property of the digital, as Couchot suggests, it can be added here that aspects of "invisibility and "synchrony" are already carried out conceptually in image operations on the borders of what is realizable by electronic media. In these experiments of "machine vision," some of the most important characteristics of the digital matrix image are foregrounded, where difference does not operate as "difference" but appears as a variation of the same scheme. I refer to a concept in radical Modernism that doesn't just break from the tradition of varying the scheme in contained surface structure (such as with the painterly experiments of Cubism, Futurism, and Constructivism), but instead, is in principle endlessly variable on the scheme. Umberto Eco in his study on innovation in seriality has linked the radical practice in early Modernism with contemporary Conceptualism, without explicitly referring to digital visual culture. The "variability of the scheme" is no longer the point of interest, but the "fact that we can vary upon it 'endlessly.'"[66] This practice creates a "new infinity" and, as such, surpasses existing modes of repetition, reproduction, and seriality. In applying the conceptual approach to radical practices in electronic and digital media, it becomes clear that the concept of the matrix image entails this "new infinity." Concurrently, the examples that the Vasulkas offer expose the material basis of the new electronic medium with its digital binary syntax as it carries out the potential of the matrix, in varying upon the scheme. And, as earlier stated, because only the computer can understand the algorithmic machine code, this matrix level is realized in the digital articulation of image potentials that are not bound to representation but offer paradoxical situations.

Another kind of machine performance, such as in *Bad* (1979), presents an early programmed self-portrait of Steina where the memory command in the buffer of the Digital Image Articulator is used to carry out varied functions with preprogrammed speed that manifest in image resolution—such as stretching or squeezing the image, and reversing up/down and left/right. This work also provides another example of sound-image inversion, in which the digital differs from the analog modulation of wave forms that either become video or audio noise because audible noise output in the digital uses bits as input: "The tape starts with the register at Zero and adds One at a preprogrammed speed. For sound, the most active bits are selected, translated through a digital/analog converter to voltage controlled oscillators... *Bad* is a play on a computer performance. By a simple command: 'add one', the machine scrambles for its pictorial and tonal expressions, succeeding at random."[67] This videotape demonstrates, for its time, a highly complex image calculation, which by today's standards looks simple. Nevertheless, it offers another example, from the early works of the Vasulkas, of how they creatively forced the medium, exhausted the tools, and attempted to exceed the limitations of the machine. Certainly, with the addition of digital tools and algorithms, the dimensional expansion more easily allows transfigurations and reversibility, such as metamorphosis, parallel stream of events in one image field, and image synthesis.

When discussing the transformative image in the work of the Vasulkas, Gene Youngblood considers the difference between frame-bound media and digital image synthesis (where the image expresses a database encompassing infinite possibilities) leading him to the conclusive statement: "A cut is a cut, but a transforming or metamorphosing operation is open-ended."[68] The operations that are possible specifically in digital video are further categorized as figurations, where the image becomes object through image processing, image synthesis, and 3-D operations—entirely escaping the assigned properties of any frame. According to Youngblood, "This is another aspect of parallel event-streams... When image becomes object in a stream of parallel events, the realm of psychological realism or photographic truth is abandoned."[69] Given the premise of the image being "non-referential" in the digital, at the same time there is also a mix of properties of photographic images and digital imagery available that can be converged through metamorphosis to express a specific digital property of transfiguration, which is not possible in photography-bound visual representation. That is because the digital equally encompasses analog and digital properties, but it does so on the level of digital options, meaning that it can incorporate and "present" other media properties in simulation. Youngblood: "Metamorphosis is not unique to digital imaging; it is a familiar strategy in hand-drawn animation. What is unique is the special case of photo-real *metamorphosis*... It is possible digitally, because the code allows us to combine the subjectivity of painting, the objectivity of photography, and the gravity-free motion of hand-drawn animation... With the code, a part of the frame can metamorphose."[70] This signifies another manifestation of the technological possibility that the digital medium offers for realizing "simultaneity of logically incompatible situations" (Krauss).

Initially, Steina's concept of the "constantly moving image" (which began with electronic imaging and is developing through computer generation) expands the "vocabulary" of operations for image simulation. In *Lilith* (1987), Steina intersects vibrating layers to render the presented imagery multidimensional. *Lilith* (with analog processing) shows the mobile face of painter Doris Cross, talking and shifting in a natural background. Her voice has been processed through a Vocoder, so that her words are no longer understandable. Concurrently, with a luminance keyer, darker parts of her face are removed, reversed, and reinserted in slight delay, so that the parts do not exactly match. This delayed image is set against the background of an initially half-minute-long segment of in-and-out-of-focus trees bending in the wind, which are manipulated back-and-forth in real and slowed-down time. The visible transformation of image into object is reflected on the audio level as well, demonstrating the phases of the kind of transfiguration that result in an image synthesis. Steina, in *Lilith,* presents the process rather than the results of transfiguration, because the constantly changing image fields perform, in real time, a smooth shifting from temporal to spatial organization—similar to digital articulation. The alterations and manipulations of the face of Doris Cross subsume the painter into a traditional object of painting: that is, a portrait in a natural landscape. In an ironic comment on visual media, the painter is portrayed at the crossroads of a submerged natural and technological landscape. The flexible quality of the visual imagery emphasizes the spatial dimension, so that the image-as-object is overtaken by the medium of presentation. The result is an "almost sculptural fusion of human figure and landscape."[71]

In *Orka* (1997), Steina combines both techniques—processable imaging and synthesis—to render visual imagery in spatially condensed, flowing motion based on principles of musical composition. *Orka* expresses motion, a motion that runs counter to the laws of physics and the "frame-bound image." The overriding formal orchestration of image events and their relatedness resembles the composition of a visual symphony. Steina describes the roots of her visual thinking, expressed in paradoxical events and free-floating imagery: "Since my art schooling was in music, I do not think of images as stills, but always in motion. My video images primarily hinge upon an undefined sense of time with no earth gravity. It is like a duty to show what can not be seen except with the eye of media: water flowing uphill or sideways, upsidedown rolling seas or a weather-beaten drop of a glacier melt."[72] This approach to expanding perceptual expectations also has an immersive dimension: when the single-channel videotape, *Orka,* is set up in a three-channel video environment, the visual material is shown on translucent screens that are equally intense on both sides. "The idea is that perhaps the audience could feel a part of this creative trance, living for a moment in a mental world where they have never been."[73]

In a reverse process to create immersive experience through dissociating and synthesizing visual perspectives generated from events of the "logically incompatible," Steina's "digital spaces" also investigate the notion of parallel events that can be mapped in high density to create the impression of being immersed, and, for example, of being squeezed by accumulating picture zones. In *Warp* (2000), Steina uses her own body in motion, when compressing and stretching segments of her body in digital real-time computer processing so that multi-perspectival "objects" are built up—sculptural forms of the traces of movement. The effects in *Warp* are produced with the software Image/ine and consist of twisting segments that are "time-warps" and endless multiplication through "slit-scan" processing. What happens in the twisting is an inversion of time into space, because the temporal course of the movements performed are presented spatially, so that we can say time is enveloped, immersed in space. The visual result of slit-scan presents an endlessly multiplied view of Steina that builds up to a multi-perspectival view, not unlike Futurist painting. However, here the sculptural form results from real motion in real time that in slight delay is fed into the digital system and transfigured into a freely moving object in space. It becomes evident that the digital computer emulates the analog. Needless to say, the spatial presentation in itself multiplies when the image sculpture travels through a series of screens. The non-fixity of the digital matrix potential, in a sense, gets frozen and fixed, because the sculptural image form encompasses time and linearity, but does not act it out. It only exhibits the potential of temporal expansion, and it does so in another dimension, which is space. In this regard, the theoretical concept of the digital—to optimally present in simulation any direction and multiple dimensions—has been turned into an aesthetic "perceptual environment."

Similar to the videotape *Warp*, the installation *Mynd* (2000) uses the "time-warp" and "slit-scan" mode of the software Image/ine to create real-time processing of the frame: reading the incoming image, line-by-line from top, bottom, or either side. The video material selected for this process is Icelandic landscapes, horses grazing, images of the Atlantic Ocean. *Mynd* uses identical images for both processes, the moving of "warp" type images and the freezing of "slit-scan" images, in order to comparatively explore and unfold the multiplicity of digital manipulation. In the "time-warps," the optional direction becomes particularly apparent when, in reprocessing, the initial edits of the source material become visible as lines traveling horizontally or vertically up and down and side to side through the frame. The "slit-scan" operation differs in that a single line once captured remains frozen, creating an endlessly scrolling still image that is multiplied over the entire frame. The resultant frozen image presents itself as a continuous stream of running images, similar to an uninterrupted pan. These processes then build the content of a new frame. This inversion of a moving image into still-image appearance—where always the edge line of any incoming streaming image is processed—nevertheless presents the characteristics of movement in such a way that the image seems to be scrolling through the frame.

In the six-channel video installation of *Mynd,* these different kinds of processing (of the same imagery) are set next to each other on adjacent large screens, spanning the room. The resultant paradoxical visual experience, of parallel moving images and frozen images of movement, surrounds the viewer immersively. Here the two processes, warp and slit scan, are not only combined, as in *Warp,* but have been applied to an already existing analog video. *Mynd* exhibits the interaction of video and computer as another step in multidirectional processing of the visual. Similar to the two available options for scan processing in the 1970s, where the electronic signal could be manipulated through either raster or line modulation, here we see that digital processing of video also affects line and raster.

The Art of Intervention

Avant-garde video art is characterized by synthesized imagery, the manipulation of existing tools and devices (construction equals deconstruction), and artists working together with engineers and programmers to develop new tools. In the sense that the avant-garde always involves a double—that is, technological and cultural intervention at the same time—the early video avant-garde foregrounded and pre-shaped what decades later would be called "electronic culture" and "new media." In retrospect, Paik managed to be the first: the first to use a Portapak camera for video art, the first to succeed in "exhibiting" electronic media as an object (i.e., his early magnetic manipulations and critique of television). Hill approached the articulation of electronic language by contextualizing and comparing visual and spoken languages. For Steina and Woody Vasulka, electronic imagery is essentially different from culturally dominant concepts of the "image" as entity. Their "images" make visible the specific capacities of video in terms of multidimensional and omnidirectional characteristics, including forms that express variable formats where images appear as objects. The Vasulkas radicalize the theoretical statement by truly exploring the dimensions and directions of electronic imaging and its immersive potential by starting with the manipulation of the electronic signal with its aural/visual ambivalence. Needless to say, their video work transgresses the surface level of presentation towards sculptural dimensions. The artists' statement can be viewed as a counter-argument to theories that video lacks "depth of space/*profondeur*."

Not only experimental in terms of the unusual use of hand-built tools (which has its conceptual parallel in the approaches of structuralist/materialist films of the 1960s and 1970s), the work of the Vasulkas moves farther because of their intermedial thinking in regard to the complexity of experiments pursued. On the level of patching together machines and attempting to exhaust the capacities of whatever technology is at hand, the challenges are viewed as a necessary means for finding out what articulates video. Notably, this work was done from scratch because in the early 1970s the medium was just emerging and had yet to develop a semiotic-cultural level of media reference, and, eventually, a specificity of its own. In its emerging phase, video was a void medium in a dual sense, technically and technologically, which the Vasulkas wanted to engage in ways that differed from film and television.

In line with other avant-garde artists, whose radical modernist approaches have opposed the dominant aesthetics of representation, the Vasulkas see their explorations of video and computer within a larger cultural context, deliberately opposing the predominance of a camera-obscura determined, and thereby limited, view of visual culture. Their idea is to abandon the dominant modes of representation in visual media culture and instead reveal a parallel visual world of aesthetic beauty.

Woody summarizes their critique of the one-dimensional, pinhole-bound principle of visualization: "This tradition has shaped our visual perception, not only through the camera obscura, but it has been reinforced, especially through the cinema and through television. It's a dictatorship of the pinhole effect, as ironic and stupid as it sounds to call it that. But it has been reinforced, and eventually we came to accept that as the most real. In painting, where the surface can be controlled to a much greater degree, people have rationally broken down this notion of Renaissance space, into no image—eventually the camera was empty. In electronic imaging, we have discovered that there is an inner model of imaging, which is not related to traditional camera-obscura imaging... 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."[74]

It can be added here, that seemingly each new medium is subject to competing developments that, on one hand, import and sustain borrowed elements from previous media and favor traditional aesthetics, while, on the other, struggle for a media specific language necessarily beginning with the concept of the tabula rasa. However, the video void is not an empty form in the sense of no information, but, on the contrary, it provides the potential for building up truly electronic imagery.

In conclusion, from the historical-systematic point of view and in light of a broader context of other video experiments over the past decades, I find that Steina and Woody Vasulka, in many ways, were ahead of their time. One reason is that they understood video as another kind of visualization, as a true audiovisual medium not limited to a surface expression. What Steina describes as her interest in "machine vision" signifies a qualitative difference from other media, such as photography and film, which are also grounded in an apparatus function. However, saying that video offered a chance to abandon pinhole perspective means a structural departure from other recording media, bridging the way to an algorithmic generation of "images." In this regard, video works by the Vasulkas are reflexive practices that force the media machines to self-reflexively strip off their components and lay bare the smallest element recognizable in visual/aural output. Starting from this "point zero" of electronic language, Woody is interested in systematically building up vocabulary and syntax so that effects could be controlled, repeatedly maneuvered, and finally stored. This task, together with extreme aberrations of the video image, encapsulates an artist-scientist attitude toward the medium that logically employs the computer and explains the interest in digital spatialization.

From the beginning video was seen as a potential rather than a prefigured medium. The Vasulkas, together with few other similarly interested video experimenters, regarded video as a technology that was not structured but had a potential to appear in multiple structures. As I have tried to elucidate, the video artists' interest in forcing the matrix image to express scale, pace, and pattern is embedded in comparable encounters in abstract film and connects video to non-cinematic media, namely the computer. And the matrix-experiments need to be recognized as an exploration of the vocabulary from inside–analyzing the specificity of video as a matrix phenomenon. The Vasulkas in numerous ways over several decades have demonstrated that the electronic and the digital share transformative characteristics in exploring process-oriented, multidimensional, and open-ended imagery in creating the "beauty of the artificial."

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[1] Robert A. Haller, "An Interview with Steina" (Manuscript to be published in the periodical *Video Art Review*, date on document: October 28, 1980) 3p. *The Daniel Langlois Foundation for Art, Science, and Technology*, *Steina and Woody Vasulka fonds,* VAS B4-C81

[2] Transcription by the author of Dan Sandin's commentary from his videotape, *How TV Works* (New York: Electronic Arts Intermix, 1977).

[3] William J. Mitchell, *The Reconfigured Eye, Visual Truth in the Post-Photographic Era*, (Cambridge: MIT Press, 1992) p.2.

[4] A helpful definition of analog computers is provided by the Computer Museum at University of Amsterdam: "Analog computers are based on principles completely different from digital computers. Problem variables are represented by electrical 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. This makes it possible to solve a system of ordinary linear differential equations by properly combining a number of adders, integrators, amplifiers, and potentiometers using flexible chords and a patch panel... The results of the computation can be shown graphically, in real time, on an oscilloscope or plotter, or be digitized for being stored or further processed by a digital computer in a hybrid system. Also the results can be used directly for he control of some physical process." "Analog Computers" in *Computer Museum* (Amsterdam, University of Netherlands, 2003) Date of reference: (October 7, 2003):
http://www.science.uva.nl/faculteit/museum/AnalogComputers.html.

[5] Dan Sandin, "Image Processor" in Phil Morton, Dan Sandin, Jim Wiseman, *In Consecration of New Space: A Color Video Process, 1-26-73* (Program Notes, c. 1973) n.p. The Daniel Langlois Foundation, *Steina and Woody Vasulka fonds*, VAS B41–C16.

[6] John Minkowsky gives a close description of the tool: "The scan processor displays a video camera image on a small monitor, built into its console and specifically prepared to reorganize the television raster, or the 525 scan lines which make up the screen. This raster reorganization or manipulation is done by a process of *deflection modulation*. In an unaltered television, deflection circuitry regulates electromagnets (the yoke) which in turn guide the movement of the electron beam in a precise, a regular scanning pattern of 525 lines, top to bottom, every 1/30th of a second. The television screen of the Rutt-Etra Scan Processor contains a system of electromagnets and deflection coils into which the user can input signals which alter the scanning pattern of the electron beam across the face of the display in unusual, but predictable ways." John Minkowsky, "Five Tapes–Woody and Steina Vasulka" in Program Notes for "The Moving Image State-Wide: 13 Tapes by 8 Videomakers." Programmed and distributed by Media Study/Buffalo (September 1978) n.p. The Daniel Langlois Foundation, *Steina and Woody Vasulka fonds*, VAS B33–C9. See also: "Rutt/Etra Scan Processor" in the Daniel Langlois Foundation web site (Montreal: The Daniel Langlois Foundation for Art, Science and Technology):
http://www.fondation-langlois.org/flash/e/index.php?NumPage=456

[7] In the following I refer to the Vasulkas when describing commonly conceived concepts and works, and will separately address works that are individually carried out by Steina or Woody.

[8] Woody Vasulka, quoted from the videotape *Matrix* (1969-1972). The tape is part of the series *Six Programs for Television*, by Steina and Woody Vasulka, produced for WNED, Buffalo and broadcast November 1979, consisting of: *Steina* (1975–1977), *Objects* (1975–1977), *Digital Images* (1977–1978), *Transformations* (1974–1975), *Vocabulary* (1973–1974), and *Matrix* (1969–1972). In the videotape *Matrix* Woody demonstrates the results of audio and visual experiments and their function in the earlier installation entitled *Matrix* (1970-1972) and in other related works, such as *Evolution* (1970), *Elements* (1971), and *Distant Activities* (1972).
[9] Marita Sturken cited from *Matrix 1970-72 (six loops of horizontal movement) Steina and Woody Vasulka* (Description and technical data sheet of the video installation *Matrix*, January 9, 1995) n.p. The Daniel Langlois Foundation, *Steina and Woody Vasulka fonds*, VAS B4-C10.
[10] Woody Vasulka, see footnote 8.
[11] In his essay for the catalog of the exhibition *Video / Sonority: Video Born of Noise*, held at the National Gallery of Canada (Ottawa, Canada) in 1994, Jean Gagnon states that the "formless entity known as noise" is the "raw material" for video artists and signifies a new media condition that video shares with music, but not with other visual media. "For the first time in art history, visual forms were being created by methods closer to those employed in music than in painting, sculpture, or even cinema. From this point on, technology would have the capacity to generate visual forms, bringing about a relationship between image and image-maker characterized by instrumentation and the directness of instrumental creation." Jean Gagnon, *Video / Sonority: Video Born of Noise* (Ottawa: National Gallery of Canada, 1994) p.4-5.
[12] Jean-François Lyotard, *Discours, Figure* (Paris: Klincksieck, 1985).
[13] Rosalind E. Krauss, *The Optical Unconscious* (Cambridge: MIT Press, 1993) p.217.
[14] Krauss, ibid., p.220-221.
[15] John Whitney, *Digital Harmony. On the Complementarity of Music and Visual Art* (New Hampshire: McGraw-Hill, 1980) p.42.
[16] For a close discussion of the tools and effects of image processing see: Lucinda Furlong, "Notes Toward a History of Image Processed Video: Steina and Woody Vasulka" *Afterimage*, vol. 11, no. 5 (December 1983) p.12 - 17.
[17] Chrissie Iles, *Dream Reels, Videofilms and Environments by Jud Yalkut* (New York: Whitney Museum of American Art, 2000, program notes) n.p.
[18] "Video feedback is a dynamic flow of imagery created by the camera looking at its own monitor. It was often (and still is) the first phenomena that seduced users of video by its sheer beauty. Although everyone who discovered feedback was transfixed by it, feedback seemed an uncontrollable, roiling effluent byproduct of technology—one of those natural mysteries, appreciated but untamable." Woody Vasulka, "Video Feedback. With Audio Input Modulation and CVI Data Camera" in David Dunn, Woody Vasulka, *Eigenwelt der Apparatewelt / Pioneers of Electronic Art* (Santa Fe, The Vasulkas, Linz, Ars Electronica Center, 1992) p.148.
[19] Jeff [Jeffrey] Schier, [Description of the George Brown Multi-Level Keyer] (April 21, 1992) n.p., The Daniel Langlois Foundation, *Steina and Woody Vasulka fonds*, VAS B37–C2-3.
[20] Ibid.
[21] In his cultural-historical survey of the concept of sound in the arts Douglas Kahn describes the significance of noise with the emergence of the European avant-garde that deliberately introduces machine noises as counterpoint to the reigning cultures of European societies. Noise is defined as follows: "Noise is the forest of everything. The existence of noise implies a mutable world through an unruly intrusion of an other, an other that attracts difference, heterogeneity, and productive confusion; moreover, it implies a genesis of mutability itself. Noise is a world where anything can happen, including and especially itself." Douglas Kahn, *Noise, Water, Meat, A History of Sound in the Arts*, (Cambridge: MIT Press, 1999) p.22.
[22] The performances of 1970-1978 use switcher, keyer (since 1977 including a computer interface) and analog computers, while the latter performances of the 1990's use MIDI protocol for real time manipulation of stored images on a videodisc.
[23] Robert A. Haller, op. cit.

[24] Steina Vasulka, *Violin Power: an interactive performance* (Description and technical data sheet of the performance *Violin Power*, c. 1992) n.p. The Daniel Langlois Foundation, *Steina and Woody Vasulka fonds*, VAS B5—C2.

[25] "A colorizer is an instrument with which 'artificial' electronic color can be added to a black-and-white picture. Through internal circuitry, a chrominance signal, or signal subcarrier containing color information, is electronically generated and integrated with the monochrome luminance signal. In real time, the user can select colors of specific identities as well as the areas of the monochrome picture in which each color is to be intersected... For example, one could decide that all areas of the lowest luminance—dark grey to black—will be colorized blue, while areas of white, or the highest luminance turn orange... By comparison with the colorizing techniques of other artists, the Vasulkas' use of Eric Siegel's Dual Colorizer is controlled, almost subdued in effect." John Minkowsky, op. cit., p.[3].

[26] Woody Vasulka, "Statement" in Woody Vasulka and Scott Nygren, "Didactic Video: Organizational Models of the Electronic Image" *Afterimage*, vol. 3, no. 4 (October 1975) p. 9.

[27] Bill Etra, Steve Rutt, *Second draft of text for section one (of 3 sections) of the "R/E video synthesizer-operating manual"* (Unpublished manuscript, New York: Rutt Electrophysics, [s.d.]) [7] p. The Daniel Langlois Foundation, *Steina and Woody Vasulka fonds*, VAS B44-C3.

[28] John Minkowsky, op. cit., p.[3].

[29] Notes from a conversation between Woody Vasulka and the author in Santa Fe, March 2001.

[30] Steina and Woody Vasulka, "Raw Tapes" in *Vasulka, Steina: Machine Vision, Woody: Descriptions* (Buffalo: Albright-Knox Art Gallery, 1978) p.35.

[31] For a survey of alternative television in the U.S. see: Deirdre Boyle, *Subject to Change: Guerrilla Television Revisited* (New York and Oxford: Oxford University Press, 1997).

[32] Although it is widely agreed that the term "video art" in the early phase of late sixties and early seventies equally applies to political activism and art works, the term "video art" in the general discourse has since then been attributed to this second group that acts within the expanded reference frame of "art." A more general definition is provided by Johanna Branson Gill: "Consequently, the term 'video art' does not describe any single unified style; it indicates a shared medium." Johanna Branson Gill, *Video, State of Art* (New York: The Rockefeller Foundation, Working papers, 1976) p.1.

[33] Steina Vasulka points out the problem of naming in video, because on the one hand the term "video artist" does apply to the self-definition of this group, but on the other hand the term is occupied by representatives of conceptual art that belong to a world of art where, as Steina stresses, interest in experimental video has not developed. Furthermore, a term like "videomaker" is inappropriate because there are no connections to the referential term "filmmaker." Both terms, "filmmaker" and "artist" mean something else (connoting a specific genre and auteur approach) and rather signify the difference to video. (Notes from a conversation between Steina Vasulka and the author at Santa Fe, March 2001).

[34] Gary Hill, "Inter-view" in *Gary Hill* (Vienna, Kunsthalle Wien, Amsterdam, Stedelijk Museum,1993) p.13.

[35] It can be argued that the introduction of Sony's Portapak camera in 1965 marks the "birth" of video, but it is around 1968/69 that video technology with separate recording and playing devices supersedes earlier television experiments without videotape and constitutes the emergence of a medium. Notably, before Paik in October 1965 purchased one of the first portable Sony cameras and recorders and played his tape to the public, Andy Warhol in August 1965 was able to make his first videotape with the Norelco video equipment that was used in his first double-screen film, *Outer and Inner Space,* 1965. Warhol makes the transition from film to video and back to film—differently from Paik's approach—in using a professional video system. Warhol incorporates video as the inner image in a frame-within-frame structure of a double-screen film. The resultant effect is a double portrait in which Edie Sedgwick on film is seen in "communication" with herself previously recorded on video, so that the film installation shows her in the same frame with her video image. Callie Angell describes the context in which this work emerged: "The summer of 1965 was the time when portable, affordable video equipment designed for the home market first

became available to the general public; a number of different companies, including Sony and Matsushida, were developing their home video recording systems and beginning to market them at prices ranging from $500 to $1000 each. The Norelco equipment was a rather high-end system costing about $10,000, and it was loaned to Warhol as a kind of promotional gimmick. ... The Norelco equipment was delivered to Warhol's studio, The Factory, on July 30, 1965; in fact, the arrival of the video camera and the ensuing conversations about it between Warhol and his colleagues are some of the events documented in the early chapters of Warhol's tape-recorded novel, *a novel*. During the month that Warhol had this video access, he shot approximately 11 half-hour tapes (at least that's how many Norelco videotapes have been found in the Warhol Video Collection). One of the interesting things about *Outer and Inner Space* is that it contains, in effect, the only retrievable footage from these 1965 videotapes. The Norelco system utilized an unusual video format, called 'slant scan video,' which differed from the helical scan format developed by Sony and other video companies, and which very quickly became obsolete. There are now no working slant scan tape players anywhere in the world, the other videotapes which Warhol shot in 1965 cannot be played back, and the only accessible footage from these early videos exists in this film, which Warhol, in effect, preserved by reshooting them in 16mm film." Callie Angell, "Doubling the Screen: Andy Warhol's *Outer and Inner Space*", *Millennium Film Journal*, no. 38 (Spring 2002) p.24.

[36] Sean Cubitt, *Time Shift. On Video Culture* (London and New York: Routledge, 1991) p.30.

[37] Strictly speaking, the Beck Direct Video Synthesizer (Stephen Beck) and the Electronic Video Synthesizer (Eric Siegel) were real synthesizers meaning that they generated the signal, whereas in contrast, the tools by Paik/Abe, Dan Sandin, and Rutt/Etra were image processors and not signal generators, and were dependent on an incoming signal, an external image source.

[38] Segments of the footage are re-edited in Nam June Paik's *Global Groove*, produced 1973 for WNET-TV (Buffalo, U.S.).

[39] Because, according to Paik, McLuhan is not aware that video is an electronic audio-visual medium, Paik performs the electronic signal processing on the media image representing McLuhan, and comments: "But even McLuhan misuses and mixes up the words 'electric' and 'electronic,' which have as much difference as tonal and atonal." Cited after: Jud Yalkut, "Art and Technology of Nam June Paik: Interview" in Judson Rosebush (ed.) *Videa 'n' videology: Nam June Paik: 1959-1973* (Syracuse: Everson Museum of Art, 1974) p.51.

[40] Woody Vasulka, notes from a conversation between Woody Vasulka and the author in Santa Fe, March 2001.

[41] According to McLuhan, the new medium changed capacity, operationality, and velocity. Following, the *message* of the medium is the *massage* of "scale," "pace," and "pattern." In this view the statement "*the message is the massage*" describes intermedial relations between historically different media in terms of structural transformation. See: Marshall McLuhan, *Understanding Media: The Extensions of Man* (Cambridge: MIT Press, 1994).

[42] Woody Vasulka, notes from a conversation between Woody Vasulka and the author in Santa Fe, March 2001.

[43] Steina Vasulka, notes from a conversation between Steina Vasulka and the author in Santa Fe, March 2001.

[44] Woody Vasulka, "An Interview with Woody Vasulka," *Afterimage*, vol. 6, no. 1 & 2, (Summer, 1978) p.20.

[45] In order to talk about digital media it is necessary to distinguish the machine level of the digital computer and the broader frame of a computer medium that, following Grahame Weinbren, can be described by four leading categories: "digitization, interactivity, random access to data, and programmability." Grahame Weinbren, "The PC is a Penguin" in Yvonne Spielmann and Gundolf Winter (eds.), *Bild–Medium–Kunst* (Munich: Wilhelm Fink Publishers, 1999) p.274.

[46] The frame in video is made up of two fields that are interlaced and achieve twice the vertical resolution of the system. The technical need of scanning two fields in one frame (odd lines from top to bottom and then even lines from top to bottom) was to avoid flicker. With two interlaced

lines the image appears constant. While in the US system (NTSC) the vertical field is composed of 262 half lines, in the European PAL system the vertical field consists of 256 half lines.

[47] Edmond Couchot, "La mosaïque ordonnée ou l'écran saisi par le calcul" in *Communications*, n° 48 (1988) p.81.

[48] Gilles Deleuze, *Cinéma 2. l'Image–temps* (Paris: Editions de Minuit, 1985).

[49] Emond Couchot, *La technologie dans l'art: de la photographie à la réalité virtuelle*, (Nîmes: Editions Jacqueline Chambon, 1998) p.134.

[50] Ibid., p.223.

[51] Ibid., p.224.

[52] Gene Youngblood, "Cinema and the Code" in *Computer Art in Context: ACM SIGGRAPH '89 Art Show Catalog: Special Issue of "Leonardo"* (San Francisco: Leonardo, 1989) p.28.

[53] Terry Winograd and Fernando Flores, *Erkenntnis, Maschinen, Verstehen. Zur Neugestaltung von Computersystemen* (Berlin: Rotbuch Publishers, 1989) p.145.

[54] David Dunn, Woody Vasulka, "Digital Space: a Research Proposal" in *Virtuelle Welten* (Linz: Ars Electronica, 1990) p.270.

[55] Ibid., p.272.

[56] [Woody Vasulka, Jeffrey Schier, Tom Moxon] The articulator manual (unpublished technical manual for the *Digital Image Articulator*, c.1979) [74] p. The Daniel Langlois Foundation, *Steina and Woody Vasulka fonds*, VAS B63 - C1.

[57] Cited after [Woody Vasulka, Jeffrey Schier, Tom Moxon] The articulator manual, ibid.

[58] Woody Vasulka, cited in *Steina & Woody Vasulka. Video Works* (Tokyo: NTT InterCommunicationCenter (ICC), 1998) p.44.

[59] "The arithmetic logic unit (ALU) is not an image-producing device by its concept. It is a basic component of a digital computer, and performs a set of functions based on Boolean logic primitives and their arithmetic combinations." Woody Vasulka, "A Syntax of Binary Images" in *Afterimage*, vol. 6, nos. 1 & 2 (Summer 1978) p.20.

[60] Ibid., p.21.

[61] Ibid., p.23.

[62] Woody Vasulka, cited in Marita Sturken (ed.) *Steina and Woody Vasulka: Machine Media* (San Francisco, San Francisco Museum of Modern Art, 1996) p.38.

[63] Robert A. Haller, op. cit.

[64] Marita Sturken "Summer Salt," in *Steina and Woody Vasulka: Machine Media*, op. cit., p.29.

[65] Steina Vasulka, cited after: Marita Sturken, "Steina and Woody Vasulka: In Dialogue with the Machine" in *Steina and Woody Vasulka: Machine Media*, op. cit., p.44.

[66] Umberto Eco "Die Innovation im Seriellen" in *Über Spiegel und andere Phänomene* (München, Wien: Hanser, 1988) p.174. Originally published in 1985 under the title *Sugli Specchi*.

[67] [Vasulkas Master Tapes: Tools and Technology] (Printed lists of records from a FileMaker Pro database, c. 1999) The Daniel Langlois Foundation, *Steina and Woody Vasulka fonds*, VAS B1—C4.

[68] Gene Youngblood, op. cit., p.28.

[69] Ibid., p.29.

[70] Ibid., p.28.

[71] Work description, in *Steina & Woody Vasulka. Video Works*, op. cit., p.23.

[72] Ibid., p.27.

[73] [Steina Vasulka], *Orka, 1997* (Description and technical data sheet of the videotape *Orka,* [s.d.]) [6] p. The Daniel Langlois Foundation, *Steina and Woody Vasulka Fonds*; VAS B4—C13. Steina is also describing other video installation works, such as *Germania* and *Borealis* that with regard to a musical understanding of spatial development where in the creation of enveloping spaces the viewer is always thought of being immersed. See: Steina Vasulka, "My Love Affair with Art: Video and Installation Work," *Leonardo*, vol. 28, no. 1 (1995) p.15—18.

[74] Woody Vasulka, "A Syntax of Binary Images," op. cit., p.23.