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Video: From Technology to Medium

Technologies of the Electronic Medium

In this article I propose to discuss video in two ways. First, I will examine video as an electronic technology of signal processing and transmission that shares these properties with other electronic media, notably television. Second, I understand video as a medium in its own right that—like any other medium—develops step by step from the emergence of a novel technology and through the articulation of a specific media language and semiotic system to successfully establish an aesthetic vocabulary, in this case specific to the videographic capacities of electronic signal processing. Once such a media-specific set of means of expression is achieved, video becomes a medium that can be distinguished from other, already existing media. The development from technology to medium also demonstrates that video has some features of analogue recording in common with film and shares processes of both signal-encoded information and transmission with television, but it also incorporates programmable functions in image processors that closely connect to digital programming in computers. I wish to focus on the matter of specificity from two angles: the first is the development from technology to medium, the second is the position of video in the context of analogue and digital media forms and the conceptual linkage among video, analogue processors, and digital computers.[1]

I propose to regard video historically, within the context of other media, and to emphasize technological requirements that are often neglected in debates from the art-historical perspective. The emergence of video needs to be better understood on the grounds of audiovisual processes. The media discussion of video has tended to abandon it as an exhausted, old medium that will be easily superseded by digital computers. In contrast, I will argue video has not become obsolete with the development of computers, but on the contrary has incorporated analogue computer applications since the early 1970s and has further enriched an electronic media culture increasingly oriented toward signal processing and digital imaging. At the end of the article, I will give the example of two video experiments—one by Dan Sandin in the early 1970s and another more recent one by David Stout—to emphasize further the overriding importance of the intersection of video and the computer as the common source for both analogue image processing (Sandin) and audiovisual feedback processes in the computer. In this respect, video and the computer are more closely connected media than film and video technologies.

To start with, we need to acknowledge that the introduction of a new technology interrelates in many ways with surrounding media and involves dynamic processes that shape the emergence of a new medium. As André Gaudreault and

1. See also Yvonne Spielmann, *Video: Das reflexive Medium* (Frankfurt: Suhrkamp Press, 2005). An edition in English, *Video: The Reflexive Medium*, is forthcoming from MIT Press, 2007.

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Philippe Marion explain: "When a medium appears, an intelligible media culture already exists. When a medium comes into the world, it must also come to grips with preestablished codes (genres, institutions, other media, etc.)."[2] What differentiates video from other media technologies lies in the expression of electronic signal processing, for example, in closed-circuit video feedback, delayed line processing, and other electromagnetic manipulations of the electronic flow of the video signal. These modulations of the signal lines take place inside the machine or are effected by a series of tools and may also occur through the exchange of video and audio signals. The flexible and transformative characteristics of video are highlighted by the specific possibility that the visible form of an image can arise from different machines in the electronic setting: from cameras, from monitors and screens, and in various effects devices such as synthesizers, keyers, and analogue computers. Video processing means that real-time visual effects can be directly presented within an external monitor (they do not need to be fixed on magnetic tape) or can arise in the integrated screen of a processor that shows the scanning of the video signals in horizontal lines.

This technical setting defines the open structure of video. The ability to process the electronic signal and the interchangeability of the audio and video signals manifest the transformative qualities of video. These are the technical conditions for the realization of video as a medium that employs specific forms of presentation that emerge directly from electronic signal processing.

To say that video is an electronic medium means that its emergence requires electronic signal transfer. Video signals are in constant motion. They are generated within the camera and can circulate inside the system of recording and transmission (the closed circuit). It is possible to modulate video signals through processors and keyers and to display the signal aurally, visually, or both simultaneously (you can "hear" what you "see" and vice versa). Conventional film comprises separate visual and audio elements, physically positioned next to each other on the material film strip. In the electronic medium, however, signals are output interchangeably as audio or video and can be fed back as video input, and so forth. This specific *audiovisual* capacity of video is expressed when signals generated by an audio synthesizer are transformed into visual signals, so that audio signals steer the appearance of video forms, and contrarily when information encoded in the video signal is displayed visually and aurally at the same time. Because of this generic interchangeability of audio and video in both directions, it is appropriate to call video the first *audiovisual medium*.[3]

The immediacy of video, the simultaneity of recording and playing, differs from photochemical media, like photography and film, even though video similarly has the optical mechanism of recording at its disposal. But the optical recording of light impulses is not the only way to produce video. Different from external input, the waveforms in a video signal can be created by oscillators in

2. André Gaudreault and Philippe Marion, "The Cinema as a Model for the Genealogy of Media," *Convergence* 8, no. 4 (2002): 12. This is a special issue on intermedia, edited by Jürgen Heinrich and the present author.

3. It is important to note that the use of terminology in this area is not coherent and mostly not very precise. To characterize video as audiovisual for the most part merges a technical and an aesthetic definition. Strictly speaking, "audio" and "video" refer to the status of the signal, whereas "aural" and "visual" would characterize the aesthetic processes (of using or working with audio and video signals) and would be used to describe the media properties of video in relationship to other media that also have aural and visual forms of presentation.

the machines. In fact, there are multiple ways to input a signal aside from the recording process (for example, the signal output of one device can be used as the input to another); more important, video can be realized through signal processes that are generated inside the devices and run through the machines—without any recording process at all. I emphasize these basic characteristics of video in order to demonstrate that there is no determinant place and also no fixed order required to generate, transmit, and represent electronic imagery.

Video's Position in the Media System

In the system of media, video appears with the introduction of a new technology that shares with television the technical characteristics of immediate presence and transmission. With the advent of satellite television (Nam June Paik introduced it into his work in 1977 at Documenta 6 in Kassel, Germany), the electronic medium came to hold a predominant position because its technology of immediate transmission set the stage for globally networked audiovisual information and communication transfer in real time.

Video builds upon these technical requirements and may express these principles in aesthetic ways through the use of processors, synthesizers, and analogue computers. Video-specific images differ from those produced in the electronic transmission of television. In conventional television, the goal is to stabilize signal processes and avoid the visibility of scanning lines that create a televisual impression of flow. Stabilization is necessary to achieve a recognizable image of the "world"—a representation of something that has been recorded. The constant flow of signals in electronic imagery takes stable form to represent the televisual image only when the video information that is written in lines (scan lines) from left to right and top to bottom (like writing on a page in Western culture) is adjusted according to the standardized broadcast formats of PAL (the common European standard) and NTSC (North America and Japan). So this standard form of stabilized "frames" adheres to the semiotic convention of Western culture.[4] The form as such gets disrupted and manipulated in all possible ways by video artists who experiment with the conventional technology. Among these practitioners have been Paik, Steina and Woody Vasulka, Dan Sandin, and Gary Hill, to name only a few prominent ones.

Video's immediacy and potential for processing generate a concept of the image that is different from other time-based media, namely photography and film. The status of the image changes in video: it is electronically recorded, transferred to another device, and finally transmitted to a monitor. In fact, it can be properly described as image only if we keep in mind that the electronic image is a constantly moving flow of signals. Due to its unstable and incoherent characteristics, it is more precise to emphasize the transformative capacities

4. These formal parameters of television are deliberately set and not specific to the technology, because if the signal flow were not adjusted to build the standard format, it would just run horizontally in time. Some readers will remember the white line of the horizontal running signal visible on early monitors that were not functioning properly (according to the broadcast norm).

of the video image, anchored in signal processes that differ from the spatial-temporal unity of a "tableau" or "frame" image. So video is best understood as "transformation image," that is, because of the line-signal process, video produces an image that is constantly undergoing transformation. In film and photography, the individual frame or a sequence of frames embodies the media-specific characteristics; in video, the passages *between* frames and frame positions are central. Moreover, these passages between images and half-images (since video images consist of half-images that are interlaced) can be constantly modulated, which allows video-still imaging, forward and reverse movements, and figurations that are reversible and can be endlessly repeated in feedback. The flexible, unstable, incoherent, and nonfixed forms of the video image I will refer to as *imagery*.

Video also differs from television and film due to the function of the apparatus specific to each medium. While television and film both maintain their specifically fixed setting of temporal-spatial relationships between the projection (film) or transmission (television) and the positioning of the viewer in the public space of the cinema or the private space of the living room, video differs in that it has no coherent apparatus structure. It has not developed a systematic model of viewing comparable to the orders of seeing in cinematography, which borrows its apparatus structure of the appearance of distance from Renaissance perspective. In contrast to this system of perspectival construction, video appears in modular presentations wherever the machines can be plugged together, so there is no systematic relationship between the placement of the apparatus and the medium's temporal-spatial model of addressing the viewer. Video's open-apparatus structure includes the multiple possibilities for the audiovisual exchange of electronic waveforms.

Due to its open apparatus—the processing and transformative characteristics of the electronic image—video, despite its status as an analogue medium, shares significant features of the digital. Both the electronic and the digital media forms of video have the potential to produce imagery in any direction and dimension in an open structure. In video, these operations result in the flexible and unstable appearance of electronic media images through changes of scale and the layering of image fields. As early as 1973, video developed almost generic connections to algorithmic forms of the digital with the introduction of a digital clock and priority keys that enabled the video artist to control the modular waveforms of video. The *multikeyer* constructed by George Brown had memory function and allowed up to six video sources to appear in *multiple layers* in one video output.[5] The multikeyer is a real-time processor and has a digital, programmable tool (the built-in clock) that controls the positioning and repositioning of keyed image elements in such ways that apparent relations between foreground and background elements are simulated. The tool combines analogue mixers and keyers

5. See Jeffrey Schier, "Description of the George Brown Multi-Level Keyer," April 21, 1992, unpublished document, Daniel Langlois Foundation, Steina and Woody Vasulka Fonds, VAS B37-C2-3.

with programmable sequencing and shows an early transition from plug-in tools to programmable devices.

In the late 1960s, video pioneers like the Vasulkas, Hill, and Paik started to work with such tools as synthesizers, keyers, and image processors to manipulate, modulate, and control the flow of electronic signals and their waveforms in ways that deliberately departed from the coherent image and the usual televisual appearance of the electronic form, in which the video signal is "forced" to maintain a coherent form.[6] The structural openness of the electronic image determined its maneuverability and technically connected video to digital processing. This development at the same time departed from the cinematic form of the frame. Video effects such as closed-circuit feedback and delay transgressed and dissolved the concept of a coherent image, just as programming with digital computers would do. It was only when the visual appearance came to be driven by codes, numbers, and symbols, rather than by electrical energy (as in video), that real change occurred in the medium.

Although electronic imagery is not limited to the appearance of a frame, its modular and "flow" capacities nevertheless result from analogue plug-in operations and not from the programming of symbols and code, as with digital imagery. Modular elements like keyers were in fact building blocks toward the ability to process as a computer would, but they operated as plug-in connections (with as many as six different camera inputs) and not with mathematical functions. Analogue video tools and digital computers clearly share processing applications, and video also foreshadows modular media connections that in the digitally encoded, numeric simulation have now reached the limits of physicality. So the audiovisual structure of video demonstrates a technical stage of electronic applications at which the transformation techniques converge with the ability to process in the computer. Because of these media-specific characteristics, video largely differs from other analogue media and plays a major role in the intermedial processes of the emerging computer and the more complex hypermedia.

The experimentation in video techniques was largely carried out by artists who came from music, performance, film, and the fine arts with the intention of contributing to the formation of a new medium. The aesthetic language of video is grounded in the technical instruments of plug-in tools, but the structurally open nature of these tools allows them to be connected to computers. The difference starts with the departure from videographic forms of electric energy.

In an overview of video practices from the end of the 1960s to the present, we find three major directions of aesthetic-technical work. In the first we find videotapes and installations that contrast the institution and format of television and video with art; for the most part, these artists are interested in the visual critique of media and art institutions (for example, Vito Acconci, Dara Birnbaum, Joan Jonas, and Les Levine). Another direction is taken in video works that

6. See Yvonne Spielmann, "Video and Computer: The Aesthetics of Steina and Woody Vasulka," 2003, available online at www.fondation-langlois.org/flash/e/index.php?NumPage=461.

structurally explore the relationships of image, sound, text, and music and develop passages to hypermedia and interactive applications (for example, Robert Cahen, Peter Callas, and Bill Seaman). A third direction focuses on the modulation of electronic image-sound expressions and seeks to expand technological imagery to the limits of the possible (for example, the Vasulkas, Paik, and Hill). This third group of artists provides an ideal starting point for a discussion of the audio-visuality of video—the elements specific to the medium and its aesthetics.

Does Difference Matter?

From a historical perspective, relevant discourses of both media studies and art history commonly agree that photography and film will continue to play roles in emergent technological developments. The argument builds on the observation that the aesthetic and cultural achievements of these analogue techniques of recording and representation have turned out to be easily adaptable to digital technologies. In contrast, the same line of argument almost neglects video. Even where the electronic medium is included in the discussion, it is not seen as a problem to mix the vocabulary of "electronic" and "digital" and to use the technical terms synonymously so that differentiation between the two forms of media is effaced.

Historians generally see the new, computer-based technical tools as reduplicating and remediating previous artforms, which also means causing already existing media forms (for example, still and moving images) to cross and converge. This hybridization is possible through increasingly sophisticated simulation devices that perform extended transformation and transfiguration. For the most part, we are confronted with reworking, remodeling, and sampling various elements of differing media into newly converged forms of digital simulation. At the same time, the incorporation of digital effects into the technical means of photography and film enriches and expands the languages of these media. Much as the existing aesthetic vocabulary—among social, economic, and cultural factors—is shaped by newly conceived technical devices of computer-generated imagery, these media factors will set the tone and strongly determine the constraints for up-to-date experimentation.

There are two ways to understand video in this media picture. One is to say that video has entered a larger arena of media production and as a result is represented in many media applications, such as video-film, video installations, and video clips on Web sites; once video was successfully established as a proper medium, it then converged into mixed-media forms. And due to the wide range of interrelationships and the increase in technical development, in the end there is no need to distinguish video and film. This perspective overlooks historical factors that are responsible for the specificity of the medium and for the dynam-

ics within the media system where interrelationships with other media are not stable but shifting. Because of its flexible, nonfixed, and unstable structure, video is an easy tool to adapt to all different kinds of media. Therefore it cannot employ much specificity at all. And because it cannot have many features of its own, it does not constitute a real medium, but rather holds the position of an intermediary state, somewhere on the continuum between analogue and digital computers. The observation that video apparently is a multipurpose instrument would then be understood as an indication that historically it has spread into a variety of media practices and arts but has not created its own cultural forum. This view misunderstands the directions of media development and reverses the history of the use of video, reducing its status as a medium back to the level of a technology.

A closer look reveals a second way to understand the medium. Because video was aesthetically different from film and television and despite its poor image quality and limited applications, video was welcomed by experimental practitioners of performance, Happenings, and Fluxus events, who were looking for new means of expression to transgress the vocabularies and territories of established institutions. Video was clearly seen as a new medium and not as an applicable technology. The waveforms of the electronic image, particularly feedback, and the immediacy of presentation were expressive means of an emerging video culture. As Woody Vasulka put it, "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 phenomenon that seduced users of video by its sheer beauty. . . . The acknowledged master of feedback was Skip Sweeney, organizer of the first video festivals and founder of Video Free America in San Francisco. To Sweeney feedback was 'a religion—a wave to ride.'"[7]

The critique that video is not a proper medium was also put forward in the early days of video. It was precisely because of the characteristics of video relating to the constant transformation of the waveform that filmmakers in the 1970s video found the medium unacceptable. In addition, the small-scale, black-and-white image had very low resolution and lacked depth of field. The rejection of video at first meant it would be neither accepted at film festivals nor discussed in relation to art. Later, in the 1980s, filmmakers started working with video equipment for economic reasons, but most were interested only in shooting in conventional feature-film format on video and not in producing for the medium. Furthermore, video for a long period was not acceptable to the art market: it did not enter collections and museums, and it was considered too poor-quality, fragile, and difficult to preserve. In this cultural environment, video developed in the experimental fields of art where there was strong concern with live art and the ephemeral. In addition video played an important role for political groups that had no media expertise but were dissatisfied with media coverage in institutionalized television. Many of these independent television groups, however, later moved into the television system.

7. Woody Vasulka, "Video Feedback with Audio Input Modulation and CVI Data Camera," in *Eigenwelt der Apparate-Welt: Pioneers of Electronic Art*, ed. David Dunn, Woody Vasulka, and Steina Vasulka (Linz: Ars Electronica, 1992), 148.

Some technicians, engineers, and computer pioneers engaged in the new technology and collaborated with the early experimental video artists to explore the aesthetic forms of abstract video. Artists and engineers worked together to build new devices that were not available on the market, generally for manipulation of the electronic image through feedback, delay, and layering: most prominently the Paik-Abe Synthesizer (used by Paik) and the Rutt/Etra-Scan Processor (used by the Vasulkas and Hill). Interestingly, such modulation and distortion effects were also applied to the existing televisual image. Paik especially was interested in defamilarizing the television frame, while the Vasulkas sought to create video imagery from scratch, from signals, and Hill explored similarities between the electronic and other language systems.

Because of the diversity of these activities and their focus on the immediacy of the live medium, video until recently was not prone to institutionalization, by comparison with the work in cinemas and museums. Even today, when there is a growing concern with the preservation of video art in archives and collections, video represents a much smaller secton than film. From this media-historical perspective, I would like to strengthen the argument that difference does matter: only on the grounds of media difference will it be possible to discuss specificity and determine the basic characteristics of video. As early experimentation with feedback demonstrates, specificity lies in the abstractness of transforming waveforms, which results from the susceptibility of electronic signals to processing. So both of the modes of understanding video discussed above are subject to critique, because they lack an appreciation of the dynamic development of video based on the specific nature of the medium. First, there is lack of concern with the articulation of an electronic vocabulary developed in interrelation with existing aesthetic forms. Second, a narrow perspective on the introduction of video technology fails to differentiate between applications that are specific (like feedback) and those nonspecific to video (e.g., the use of video for documentation).

When the understanding of media-specificity is not at the core of discussing video, the conversation can become purely academic. This occurs mainly in debates on the convergence of various technical media tools that have no body of video theory comparable to film theory to provide the necessary orientation. When the debates arrive at the actual materiality of a work, the issue of whether it is by technical definition film, video, video-film, film or video transferred to DVD, and so on is not addressed. Furthermore, when the processing aspect of video is not taken into account, video can easily be categorized as a technological step between film and computer, which not only undermines the existence of the medium, but downsizes video into a "little sister" of television. Video becomes nothing more than a tool that entered the market with the nonprofessional Portapak equipment in the mid-1960s and consequently disappeared with the development of digital video in the 1990s. Such a position gives video only

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limited historical significance and limits its influence to the sectors of alternative television and the performing and installation arts.

This happens because the discussion of video art is to a large degree poorly informed about dynamic technologies, but also because video—due to its open structure—has not built up institutions like cinemas and broadcast stations. Although the matter of media-specificity needs more attention in the video debates, nevertheless the recent adaptations of video techniques and aesthetics in multimedia installations and the implementations of video sequences in virtual and interactive media arts produce the side effect of finally helping video works enter museums and collections. One prerequisite of this move toward video, however, seems to be the categorization of the electronic as an "old" medium, something that has outlived its own era and has turned into an interesting tool for aesthetic productions in newer, more contemporary media. Again, the overriding concern is with video technology, not with media-specificity. This incorporation of video into art, exhibition, and museum practices may also explain to some extent why art historians and curators have recently demonstrated increasing interest in video. Video is welcomed as a visual technique of motion and immediacy. What is or was specific about video *as* video eludes discussion.

Another challenge arises when the larger media development seems to incorporate all media differences and notions of specificity under the umbrella of the digital. When film, video, and computer imagery are conflated technically, the distinctions among them cease to be a topic of interest in critical debates. A consideration of media-specificity in video seemingly becomes rather anachronistic. Following the logic of the digital as a universal medium, a new paradigm of sameness and loss of differentiation inevitably evolves, including a rather ahistorical understanding of the historically separate development of film, video, and computers; they are no longer seen as distinct. So once the rubric "digital" is introduced to video, there seems to be no need to talk about video and computer as distinct media. More important, the early intersection and the shared processing properties of video and computer are completely abandoned. We then exclude striking examples of the interplay of analogue and digital technologies in emerging media that are worth analyzing when we wish to understand how a technology becomes a medium.

Almost in parallel to the stated collapse of video into the digital is the seeming logic of the convergence of film and video under the new umbrella. "For instance, it is common for us to say that we are going to watch a film on video or a DVD when what we actually mean is that we intend to watch a *recording* of a film or movie (without recourse to celluloid). . . . It may be worth asking whether this matters and why in the process of convergence, video has been substituted, while film has been simulated by digital technologies. To answer the question, there is a need to re-examine the development of video as a medium

and its incorporation into digital form, while making some comparisons with film and, in turn, its simulation within the digital domain."[8]

Two aspects of the argument that video has become obsolete—because technological difference does not matter in the digital and because video was a technology, never a fully developed medium—converge in a new direction when we look at the sudden increase in video works since the 1990s. A close examination suggests that the artists newly involved in video regard it as an old technology and do not work with its media-specific language. The use of video in contemporary media arts is not necessarily driven by exploration and further development of video as an electronic form. Instead, the artists draw on video techniques in film (interactive cinema installations), in multiple-screen installations (mainly of narrative sequences), and in virtual-reality settings (which use video applications to convey the sense of movement).

The point I want to stress is that such contemporary "video installations" are less concerned with video than with other media forms: for instance, with painting in Bill Viola's recent works, with film and cinematic movement in Douglas Gordon's video-films, and with photography and film in Fiona Tan's work, to give examples of the variety. Evidently, in the context of new media, the older medium of video has become a means and a technique in the service of interactive installations in which video sequences are implemented to expand and enrich the "new" medium. For example, video and virtual-reality techniques are brought together in the new form of augmented reality. Clearly, when we discuss such elements of interactive and multimedia installations, we do not recognize video per se.

A different type of media art has been created by artists who exploit the interactive and performative capacities of video. These works demonstrate video's aptitude for processing in conjunction with and through the encounter with computer-generated forms of the visual. Striking examples are the works of Steina and of Bill Seaman since the late 1980s and the computer-noise performances of David Stout. Such practices of "performing" the video image live date to the early 1970s, when many artists presented video and live performances in parallel and created "live" effects with video processors. Works by both Sandin and Stout, discussed below, demonstrate that the processing and transformative capacities of the electronic medium continue to thrive in contemporary media art that uses digital computers.

The Electronic Medium

The emergence of a medium usually occurs through dynamic and interrelated processes and not in breaks and ruptures that would draw divisions in media history of the "before" and "after" kind (in painting, film, video, digital media,

8. Stephen Partridge, "Video: Incorporeal, Incorporated," in *Experimental Film and Video An Anthology*, ed. Jackie Hatfield (Eastleigh, UK: John Libbey Publishing, 2006), 180–81.

and so on). This suggests that both integration and differentiation come into play in the consideration of video as an electronic medium: "Various criteria interact when we paint the portrait of a medium or design its identity card: its relationship to an institution, its semiotic configurations, its means of transmission and the technological possibilities of this means, the ways it is disseminated, the communicative and relational devices that are put in place or induced, etc."[9]

To the extent that video departs from the frame-bound imagery that is essential to photography and film and transgresses the standardized format of the televisual image, an electronic language is put into place. The possibilities of electronic manipulation mean that the scale, form, directions, and dimensions of an image are all variable elements. These electronic properties, which in fact apply to television as well, exist in video apart from the standard broadcast formats (NTSC and PAL). The early video experiments of the 1970s with circulating video signals (feedback), temporal delays, and recursive loops (delayed feedback) had to be performed live. More elaborate forms of live-feedback developed, but it was only with the construction of processors with memory and programming functions that both the congruencies and the differences between plug-in and programming devices, between video and computer, became evident.

The connection of video and computer in the 1970s always entailed analogue computers, since the first digital computers used in electronic line processing were introduced around 1980. In significant ways, the video pioneer Dan Sandin took the first steps in video toward digital computers when he described the programmable functions of his analogue computer. The Analog Image Processor, which Sandin developed in 1972, could modulate the video signal in various ways and combine multiple operations:

> In brief, the Image Processor (I-P) is a patch programmable 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, video tape recorder, or similar device can be used to encode moving images into a form which the I-P accepts. A televison monitor decodes the signal and displays the modified image. The instrument is programmed by routing the image through various processing modules and then out to a monitor or video tape recorder. The modules are designed to maximize the possibility of inter-connection, thereby maximizing the number of possible modifications of the image. The I-P is designed to accept external signals from such devices as biological and environmental sensors."[10]

As this early experimentation demonstrates, video could incorporate analogue computer functions. Artists could treat the visual information of the image

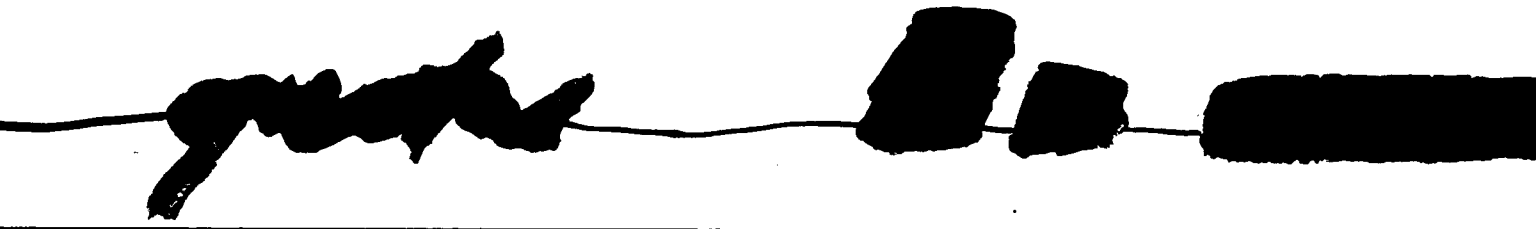
9. Gaudreault and Marion, 15.
10. Dan Sandin, quoted in Phil Morton, Dan Sandin, and Jim Wiseman, "In Consecration of a New Space: A Color Video Process," January 26, 1973, unpublished notes, Daniel Langlois Foundation, Steina and Woody Vasulka Fonds, VAS B41-C16.

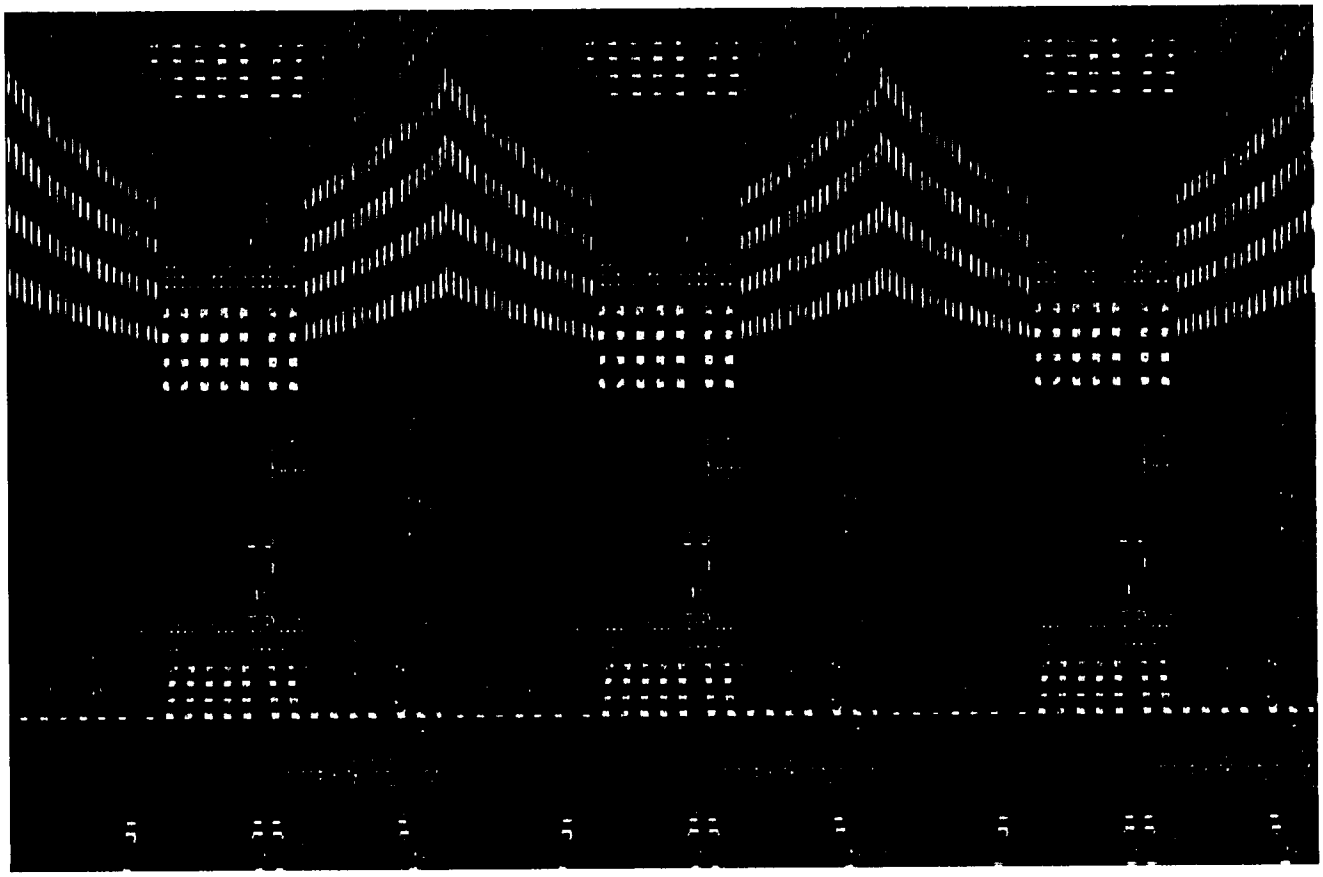
Dan Sandin, Analog Image Processor, USA, 1972 (photograph by Dan Sandin)

field differently from the standard frame-format of television, setting video aesthetically apart from television. Through abstraction and because video can abandon a photographic function of the visual, the electronic medium could present audio and visual characteristics in transformations—a sign of later developments in digital computer graphics. Sandin himself led the way from analogue to digital when he described how video signals encode information. At the end of each individual scan line and especially at the end of the bottom line, the signal needs to return to the starting position. To adjust the image, video needs *horizonal synchronization pulses* at the end of each line and also *vertical synchronization pulses* at the end of the bottom line. The camera itself creates the information that it needs to perform this synchronization, which Sandin refers to technically as "encoded information": "The actual video information is encoded only in the scanning lines from left to right."[11]

While in principle video effects are not systematic but live-processed and unpredictable—the reason early pioneers developed devices to better control the manipulation and modulation of the signal— digital effects, by contrast, result from numeric operations and are structurally systematic. They are controlled by the program and the programmer, who might admit that uncontrollable, chaotic

11. Dan Sandin *How TV Works*, 1972, color videotape, sound, 27 min. 48 sec., transcribed by the present author. See also Daniel J. Sandin, Tom DeFanti, Lou Kauffman, and Yvonne Spielmann, "The Artist and the Scientific Research Environment," *Leonardo* 39, no. 3 (June 2006): 219.





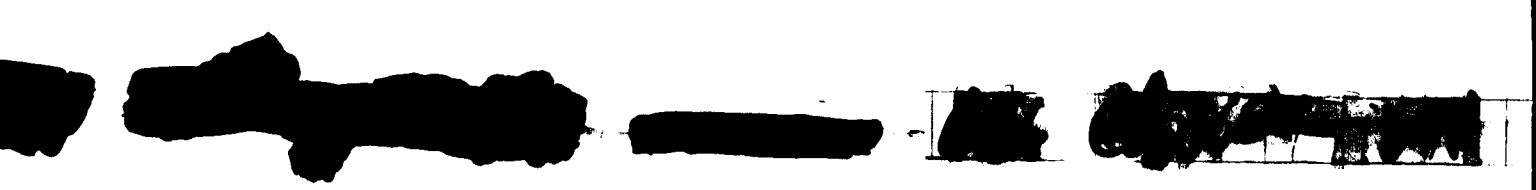
David Stout, *Transit*, 2003, video (artwork © David Stout)

phenomena sometimes occur. The major difference is that video modulation depends on line processing and is therefore temporal, since video is a linear, time-based medium. In the digital domain, development has no spatial or temporal extensions, modifications can happen from any direction and in multiple dimensions, and operations can be reversed (as in morphing techniques). The computer is a nonlinear medium, and the concern is with access and storage. It is evident that line-processing effects in the linear medium of video differ aesthetically from those accomplished by mathematical programming, although it is worth noting that it is in principle possible to simulate those electronic effects digitally. This comes as no surprise, since we have already seen that in digital processes all previous media forms, such as painting, photography, film, and others, can be simulated.

The passage from the linear processing of electronic signals to nonlinear computer programming is especially clear in the interactive video-noise performances by David Stout. He seeks to synthesize dynamic visual, audio, and musical elements with machine performances. In his interactive performances with live audio and plugged-together computers, Stout uses feedback and closed-circuit structures and draws on the early videographic concepts of noise and the audio-visual interchangeability of signals at the level of digital manipulation of raw material in the computer. "My recent work in interactive installation and chaotic video performance shares a common origin in the use of video noise as the primary visual element. A simple definition of video noise is 'a random grouping of black and white pixels changing position every 25–30 times a second.' I have subjected this *visual noisefield* to a range of digital image processes to produce an array of images and sounds. One process common to all the works shown here is the use of feedback. Those familiar with this technique will remember the early video experiments of the late 60s and early 70s which produced a rich body of recursive visual phenomena that has been subsequently dismissed for its cheap hallucinatory allusions; nonetheless, feedback circuits have proven an important means of illustrating the dynamic principles of theoretical chaos and suggest the potential power of artificially intelligent sound-image engines."[12]

As in audiovisual transformation in video, the feedback processes in the computer generate sound directly from visual synthesis, and the visual output is fed back as input. This work develops variations on graphic patterns through feedback and digitally modulated waveforms, and through changes in scale, velocity, and the multiplication of the information that result in infinite new formations of the image. The work reveals the processes of abstraction in video, fosters the audiovisual structure of the electronic medium, and also exemplifies the essentially chaotic behavior of the elements characteristic of the medium. In contrast to analogue video, processing in the digital realm represents just one

12. David Stout, "Introductory Notes on the Work of David Stout," unpublished notes provided to the present author.



option for performing a computer-generated image; there is a multitude of ways to create visuals from numbers and symbols.

Just as the medium of film generates the image form of the frame, video as a medium is by its nature inclined to processing, while the digitally encoded image that results from programming can theoretically generate all possible image forms. In a comparative examination of media forms, the predisposition of the electronic to processing and the interchangeability of its audio and video streams together characterize the technical conditions that ground the realization of the aesthetic forms specific to video. Once these specific presentational forms were established, video developed into a medium. This brief history of the audio-visual medium of video also demonstrates that the articulation of an electronic language must be discussed in the context of a larger dynamic development from technology to medium. The first steps, however, toward the articulation of a media language distinct from preexisting media reflect the struggles of each medium to realize its singularity and specificity.

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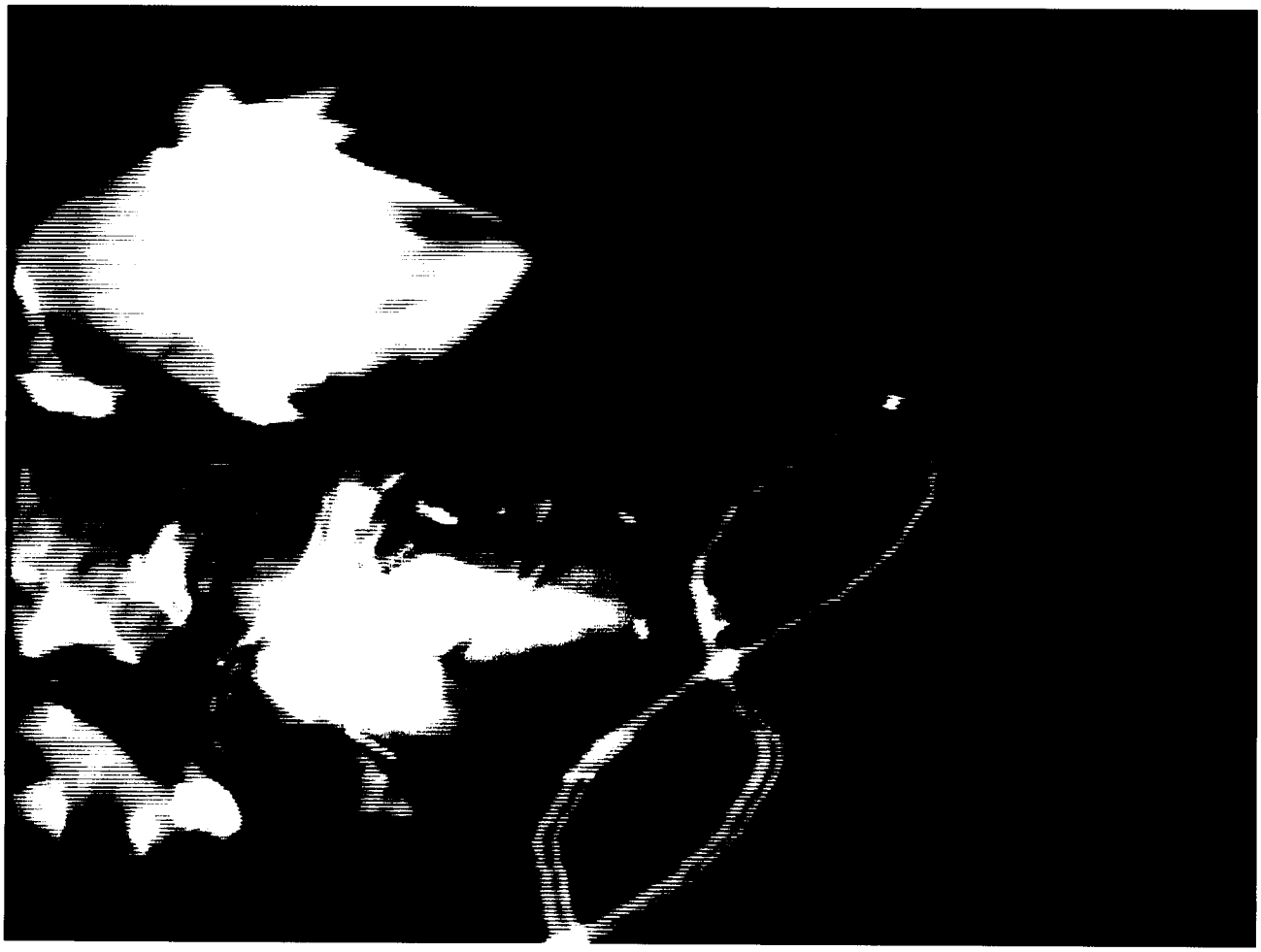

Steina, still from *Violin Power*, 1969–78, black-and-white videotape, 10 min. (artwork © Steina Vasulka; photograph provided by the Daniel Langlois Foundation)