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ABSTRACT

Included in this report are four short papers on television techniques which are used to produce images on a television screen. They are designed to enhance the use of television as an art form. (RH)

# INNOVATIONS IN TELEVISION.

National Center for Experiments in Television

1011 Bryant Street

San Francisco, California 94103

Supported by the Corporation for Public Broadcasting and the Rockefeller Foundation

VIDEO FEEDBACK: How to Make It; An Artist's Comments on its Use; A Systems Approach.

Feedback is the image configuration most video experimenters discover first. It is produced by the most simple complement of electronic tools, a camera and a display monitor. By manipulating these two objects the artist can conjure limitless variations of stunningly complex imagery. In the early days of discovery, feedback is magic: spirals, flowers, mandalas burst forth with the touch of a fingertip and regenerate themselves indefinitely on the screen. Later, for some, feedback's simplicity becomes deceptive and its ease occasions serious questions of composition.

What follows is a general description of the methods used to obtain feedback, an artist's comments on its use, and a systems approach to the phenomenon.

1. Feedback: How To

Video feedback is produced by aiming a camera at a monitor; the camera actually takes a picture of itself. The patterns thus engendered can be altered in several ways, by exerting various controls over the electronics, and by affecting the optical path of the picture/monitor loop.

The first time you set up a camera for feedback, get a wide shot of the monitor and make sure the f stop is open and the screen's brightness and contrast are turned up. Re-

peats of the outline of the monitor will appear. As you zoom into the spot of light on the monitor, the feedback will begin coming out in blobs toward the side. The precise nature of those blobs will vary depending upon the light sources, including the ambient light in the room. As you move closer and closer in with the zoom, you will begin to lose the definition of the blobs and will get a steady flow away from the center and toward the edges of the monitor.

Every slight movement affects the pattern. If the camera is moved haphazardly, it will flash by things that haven't had time to appear. Miniscule, gradual movements are absolutely necessary in order to begin to attain some kind of control over the pattern.

Changing the relationship between the camera and the monitor will alter the feedback. A camera standing upright will give a spiral pattern; when the camera is tilted slightly, a circle occurs; a camera placed at a 90° angle produces a rectangular shape. Work at the Center is done with small Sony cameras; broadcast studio cameras are obviously too heavy to juggle in this way, so under these circumstances tilt the monitor. After the camera/monitor relationship is set, the optical variables to manipulate are the f stop, zoom and focus of the camera's lens.

The monitor's brightness and contrast levels greatly affect the feedback pattern. Generally speaking, the lower these levels, the more intricate the design. It is sometimes

useful to start with both levels all the way down -- in black -- and begin slowly controlling each. In addition, it is almost impossible to make intricate patterns when the camera is moved from the center of the monitor. Perhaps the light level is most intense there.

Combining elements -- any kind of material -- with feedback means introducing other images into the light pattern of the feedback loop, thereby changing the original feedback pattern. Using two cameras, this can be done with any sort of object, a person, or with reflective surfaces such as pieces of mirror mylar. In the latter case, feedback becomes the fixed element, with the camera set and unattended, and the changes are produced by moving lights on the mylar pieces and by moving the camera which is picking up the mylar reflections.

Use of feedback becomes more sophisticated as electronic variables are introduced into the loop -- additional cameras, level control from a switching device, reversed polarity, color, "special effects" (particularly keying), and time delays.

Negative polarity allows the same possible variety of patterns that occur with positive feedback. The variables in making the images are identical. The major difference is that negative polarity achieves alternating unshaded black and white bands, or distorted bands. Instead of white images on a black field, black and white images occur on a black field. Negative feedback is more hard-edged than that produced by positive settings.

Feedback made with a color camera is heavier and more globular than the black and white variety; it is less intricate, harder to make and to control because color cameras require a higher level of light. But black and white feedbacks can be colorized though a switcher or mixer to produce very interesting image combinations. For example, record on videotape a solid feedback pattern like a flower which is rotating slowly and simply; play back that tape into a monitor and pick it up with two cameras so that you can take parts of the images and rearrange and combine them. By introducing flat solid colors into these combinations you find yourself in Matisse-like places.

2. Feedback: An Artist's Comments

Feedback is the most simple means of generating abstract video patterns that exists, and the forms it permits an artist are almost limitless. It has, in addition, two necessary elements for making art -- a reasonable amount of flexibility, and a reasonable amount of predictability. And with it, fairly complicated images can be produced with very simple tools.

Feedback's primary drawback for the artist is that, because of the ease with which one can produce lovely patterns, it is tempting to get caught up in the process of discovering it to the exclusion of anything else. Several years ago, a poet visiting the Center observed: "feedback is a whore." Its prettiness can be so enticing that time and en-

ergy are destroyed without leading to any serious expression or work. In this situation, it's been fun, but may be almost counterproductive to art.

Once one gets past a concentration on its flair and attractiveness, one discovers a movement about feedback that is, to me, its most distinctive characteristic. It is a kind of organic movement which is not reminiscent of any other. Feedback also has a remarkable ability to enrich other images or -- with more than one camera and monitor -- to multiply images and parts of images. Feedback can be combined with itself, or with entirely different sorts of video imagery.

Making with feedback is just like making with any other artistic tool: it takes patience to learn the use and control of it. This is time consuming, since there are so many variables involved in each feedback pattern. Often it is difficult -- or impossible -- to return later to a form once produced. It's advisable, therefore, to videotape an intricate kind of feedback; you may never find it again. These tapes can form an "image bank" of material to be used later by themselves, or to be fed into another combination of images.

The artist working with feedback should learn his tools well so that he can build up a vocabulary of patterns; when he needs a particular kind of form or movement he knows it is feedback that can give it to him, and he knows how to get it.

People often deal with feedback as an interesting "effect." As an effect, it's not very interesting. What's important is what's done with it. In my own experience, I prefer carefully using the same feedback as a different element in many tapes to concentrating on finding a new feedback form for each new work. The young state of video art tends to emphasize the new. So often with feedback it's just new, but compositionally rather uninteresting.

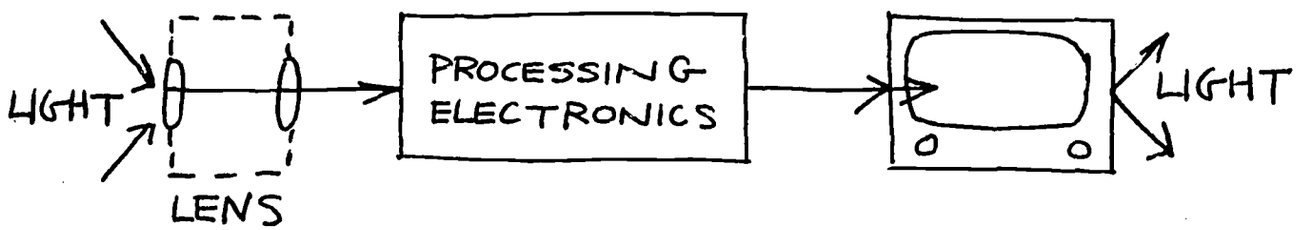
Is feedback a whore? I'd ask, "Are you an artist?" And, "Is feedback something you can use to make art?" It can be anything you make it.

William Gwin

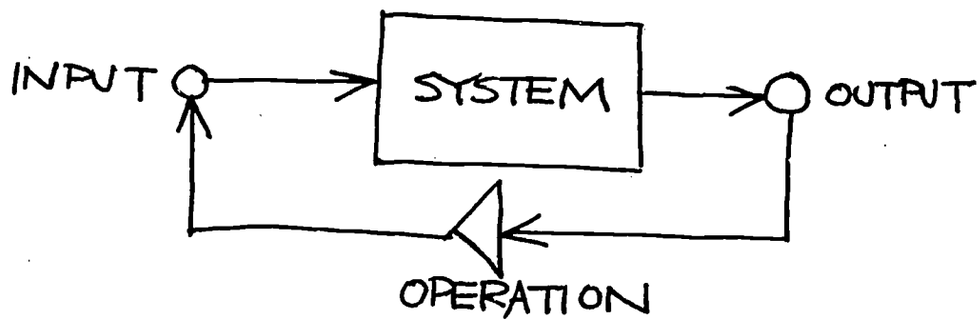
# 3. VIDEO FEEDBACK
## A SYSTEMS APPROACH
• NOTES •

### 1 SYSTEM

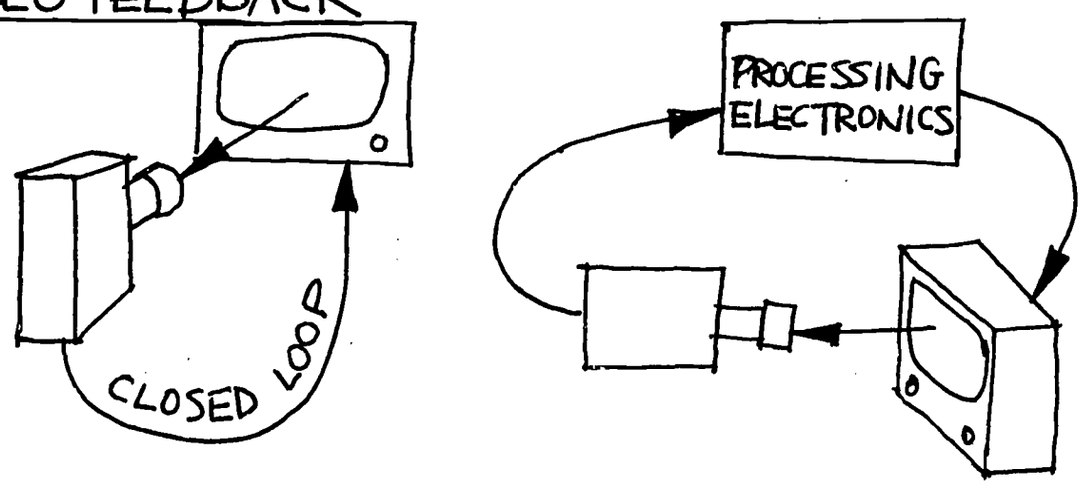

### 2 VIDEO SYSTEM




### 3 FEEDBACK SYSTEMS




### 4 VIDEO FEEDBACK



# OPERATIONAL FEEDBACK CONTROL ELEMENTS

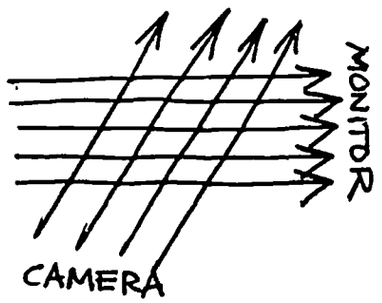
## A. OPTICAL PATH

1 LENS (FOCUS AND FRAMING)

2 CAMERA ⟷ MONITOR ORIENTATION

SCAN ANGLES

SCAN PLANE ANGLES




3 OPTICAL OBSTRUCTIONS AND REFLECTIONS

## B ELECTRONIC PATH

1 MONITOR ADJUSTMENT

BRITENESS AND CONTRAST

2 PROCESSING ELECTRONICS

PICTURE LEVEL

POLARITY

NON LINEAR EFFECTS

"KEY", EDGE OUTLINE

3 SIGNAL

PATH TIME

DELAYS

4 USE OF COLOR • (DIFFERENT COLORS HAVE DIFFERENT FREQUENCY RESPONSES)

# NATURE OF CLOSED-LOOP VIDEO FEEDBACK

CERTAIN CONDITIONS OF FEEDBACK

CONTROL ELEMENTS ⟶

SELF SUSTAINING OSCILLATIONS

LIGHT PATTERN OUTPUTS

DIFFERING CONDITIONS OF ELEMENTS

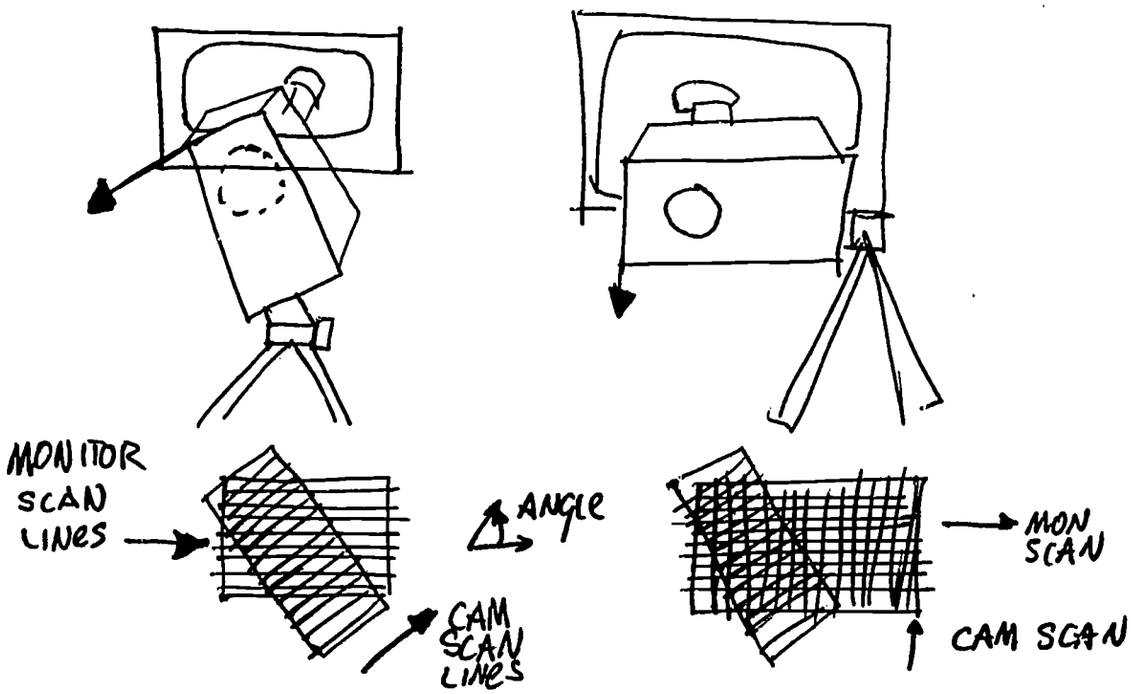
⟶ DIFFERENT MODES OF OSCILLATION (ACCOUNTING FOR DIFFERENT VARIETIES OF FEEDBACK)

QUESTION: HOW INTERESTING THAT THE TELEVISION SYSTEM HAS NATURAL, SELF-SUSTAINED OSCILLATIONS IN THE FORM THAT IT DOES, WHAT IS THE SIGNIFICANCE? (I.E. NATURAL RESPONSE OF PENDULUM, PERIODIC, (GRAVITY-MASS) USED FOR "TIME.")

# 5 CASE OF A PARTICULAR FEEDBACK

1 OPTICAL CAMERA — MONITOR ORIENTATED 90° TO ONE ANOTHER

2. FOCUSING AND FRAMING ESTABLISHES THE RELATIONSHIP BETWEEN THE CAMERA SCAN AREA AND THE MONITOR SCAN AREA IMAGED ON IT

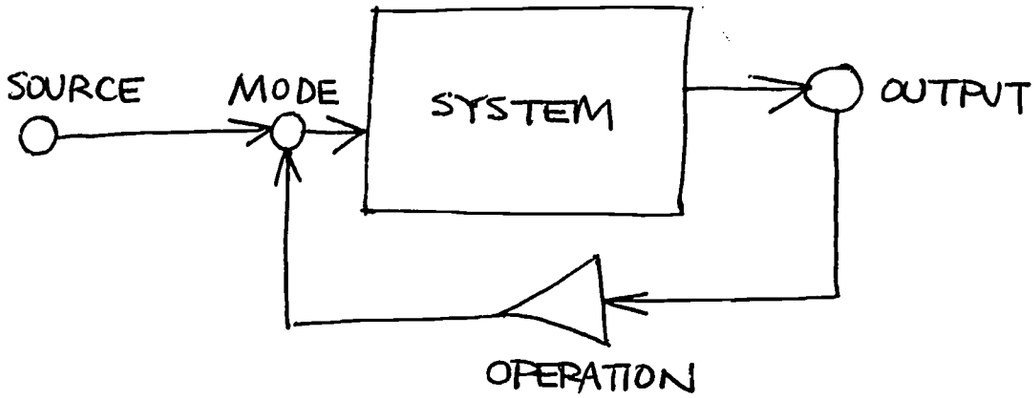


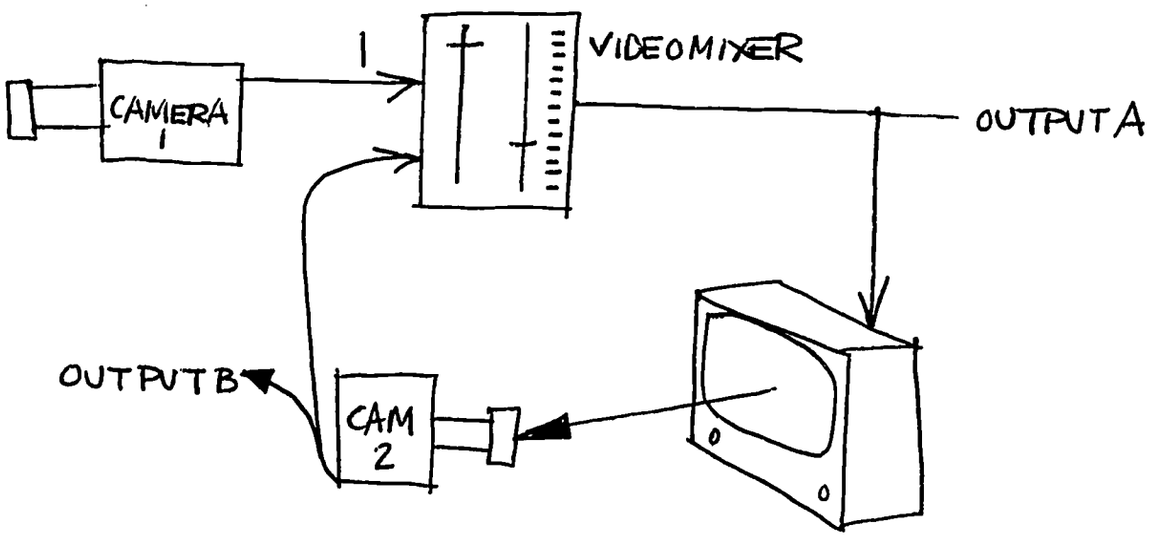

COMBINED EFFECTS OF DELAYS, BRIGHTNESS FOCUSING AND FRAMING ⟶ CAMERA PRODUCES AN OUTPUT WHEN MONITOR IS PRODUCING AN OUTPUT WITHIN A CERTAIN DISTANCE $\Delta X$ (WHICH DEPENDS) OF THE CAMERA SCANNING POINT.

(OF COURSE THE DISTANCE IS EQUIVALENT TO A TIME INTERVAL BETWEEN CAMERA AND MONITOR SCAN POINTS)

CIRCULAR MOTIFS OF FEEDBACK FORMS ACHEIVED WITH THIS TECHNIQUE

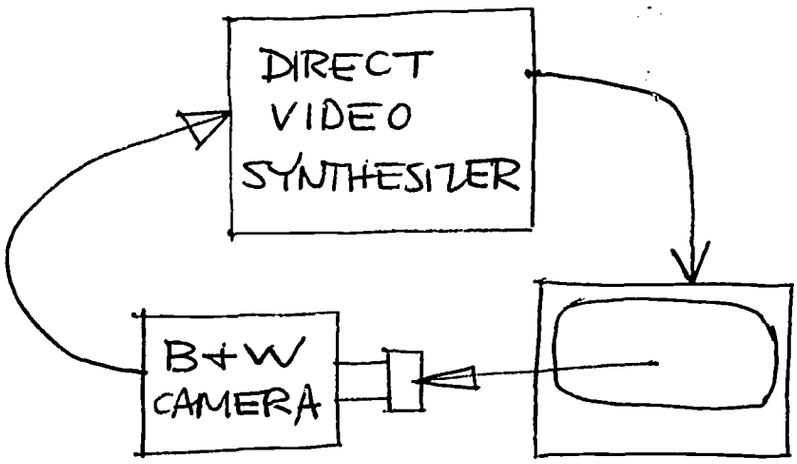
6 FEEDBACK SYSTEMS • seeding feedback WITH EXTERNAL INPUTS



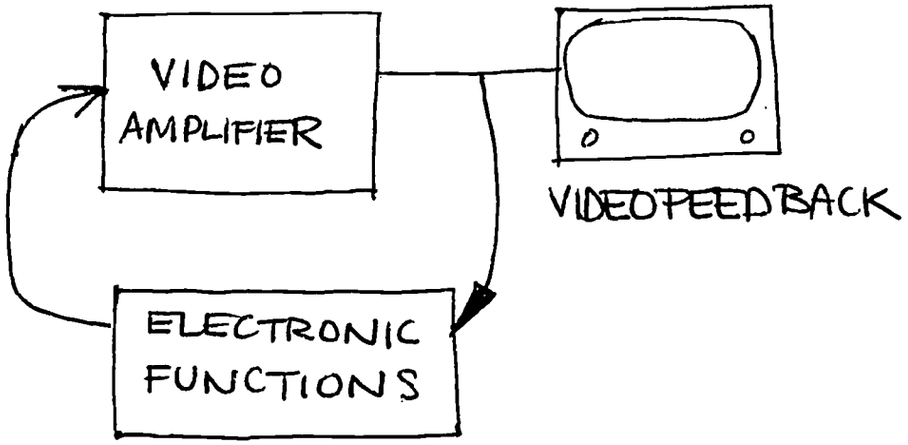

IMPUT FROM CAMERA 1 CAN ACT AS A TRIGGER TO THE FEEDBACK OBTAINED FROM CAMERA 2, THUS FEEDBACK FORMS MAY BE SELECTIVELY PLACED IN CERTAIN AREAS

7 FEEDBACK WITH ELECTRONIC SOURCE INPUT




ELABORATE NON LINEAR PROCESSING,
PRODUCTION OF FEEDBACK "MASKS"

8 FEEDBACK SYSTEMS WITHOUT CAMERAS




VIDEOFEEDBACK

INPUT CONTROLS SYNTHESIZE
DIFFERENT FUNCTIONS, →
VARIOUS MODES.

## ARCHITECTURAL SPACE, PSYCHOLOGY, AND VIDEO

(Within the past year, Center artists have begun to examine a variety of display modes for their video compositions. The increased recognition by museums of work from the Center and elsewhere necessitates a serious consideration of ways the television monitor, which is the video artist's display surface, can be integrated with the environment of the exhibition hall, originally designed for the plastic arts.

Many of the Center's current research questions are linked in some manner to an understanding of television and "architectural space." What follows are notes from psychologist George Kaplan to the Center staff on the subject of architectural space, psychology, and video.)

Academics always start with definitions. We don't need to, but, what is space?

"around-type spaces"
"between-type spaces"
"in-between-type spaces" (that which is "in" the inbetween)

These are all spatial/extensive/three-dimensional. There is also two-dimensional space which we usually call surface. The television monitor is a 2-D surface, but an array of monitors could be experienced as a surface or as a space, depending on us.

Aside: Koffka (a pretty together Gestalt perceptionist) said that the space between the tip of our nose and the back of our head is the ego. Perls said that it expands and contracts with our center, and others have also talked in these ways about ego-space. The point to remember is that we-are-part-of-the-space-we're-talking-about.

This also leads to an interesting question: what's the difference between "personal space" and "architectural space"? Maybe the answer is that personal space is about spaces between people and architectural space is about spaces between people and institutions.

focal vs. ambient spaces. The difference here is between what spaces are (identification) and where spaces are (location). In terms of the biology/neurology/wiring of perception, these two spaces are dealt with by anatomically distinct parts of the brain. A display surface could generate spaces which localize oneself or lead one to get further into the structure of the display.

fixed vs. movable spaces. The spaces which man has evolved to deal with range from large, extended, immovable surfaces, such as the crust of the earth, to small, local, movable objects, and everywhere in between.

contingent vs. non-contingent spaces. The issue here is the relationship between doing and doing-spaces; our behavior rarely influences the image or the environment (unless we're an institution in which case we influence, if not control, both). Thus, much of our ordinary experience with images and spaces has a passive, one-way flow to it. The main source of control which man has over most of the images and spaces which he encounters

is that which is mediated by his feet -- he can walk away from them. So at every level we need to explore contingent images and spaces which allow the space-image-person loop to feed back upon itself in an organic way.

At the same time we can ask how the image experience fits into this contingent/non-contingent dimension. For example, is the image space in a place, or is it the place? This may be the clue to talking about architectural space: we need to understand the relationship between the place-as-experienced, the image-as-experienced, and the two put together. Keep in mind that our normal experience of space is as we purposefully move about it and manipulate it; every perceptual system that I know of is "designed" to respond to change. So if we're to experience "seeing" rather than "watching" video, we need to take this into account.

nested structure. Image structure "out there" exists everywhere and the relationship between structures is seldom arbitrary. The texture of a stone is contained within the form of the stone which is contained within the field, etc.; all the way to the sky-earth distinction. That is, forms and textures are very often related in an hierarchical or nested fashion. We need to be aware of this as we start experimenting with multiple image spaces within architectural spaces. Otherwise it's like trying to study perception with a single point of light in an otherwise dark room.

size and scale. If we are to really deal with some of these questions we will have to reach some understanding of the ways in which size and scale influence our experience, and the ways in which we can architecturally manipulate them.

-to be continued-

George Kaplan

## DIRECT VIDEO: Electronic Artform for Color Television

(Television has been employed for most of its history as a vehicle for images which originate outside of itself. Direct video synthesis is an electronic means of evoking images from within the television system. The Beck Direct Video Synthesizer was designed and built by Stephen Beck last year with a grant from the National Endowment for the Arts. It provides video artists with a wholly new tool for expressive composition, with images never before produced on a television monitor. The following is a statement by Stephen Beck on the origin and configuration of his instrument; it will be followed in the second series of "Reports" by a longer and more detailed paper.)

### Genesis of the Direct Video Synthesizer

Within many of mankind's tools are latent properties unobserved even by those whose intuition has led to the design of the tool. Television is no exception. As an electronic system its range and complexity is astonishing; unfortunately, far more so than its usual content indicates. Let us go one step further than television might seem to permit and remove the TV camera, replacing it with electronic circuits which can be manipulated to effect the formation of an image on a video monitor. This is direct video synthesis. It presents the artist, or videographer, with a new potential for using television as a medium of personal expression.

I was led to color television in the search for a precise means of expressively controlling light. Conventional computer graphics displays seemed costly and neglected a common

piece of hardware -- the color television set -- as a display terminal; hence, the notion of a visual synthesizer as intermediary between control and display of an image.

It remained, however, to assess and understand the aesthetic properties of the television medium, and to formulate an aesthetic model upon which to base the construction of electronic image-forming modules which would constitute a synthesizer. With a voltage-controlled parameter approach the computer could be used to direct the image-producing modules. But more important, the videographer would have intimate control of the image through various physical -- and possibly biologically controlled -- transducers which would develop control voltages.

Sense impressions of both my inner and outer world and their subsequent intellectualization led to the formation of an aesthetic model comprised of elements of form, motion, texture and color. (A mathematical development of form as points, lines, planes and perspective illusions serves as a preconditioner for electronically realizing these elements.) The temporal changing of geometrical relationships between elements of form gives rise to motion. Texture arises as brightness gradients over the elements of form, or a macroscopic aggregate of microforms, while the spectral distribution of reflected and radiant energy of forms evokes color from our senses.

Technical Outline of the Synthesizer

Mapping from the aesthetic model into real electronic control of video images occurs in the following way:

i. sequences of pulse-width modulated signals are developed which define contours of form over the monitor surface;

ii. waveshaping and amplitude modulation of these signals allows control of the brightness gradient, thus yielding texture;

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

I constructed a prototype video synthesizer employing this process, consisting of circuit and control modules which function directly with the scanned video raster. Some modules serve to generate and manipulate forms, while other modules impart differing textures to forms, or independently control their colors. Camera-originated video may also be introduced into the synthesis process. By patching desired modules together and supplying the appropriate control voltages, a given passage of images may be produced.

The synthesizer accepts video sync and drive pulses as "backside" inputs and delivers parallel RGBY (red, green, blue, luminance) outputs to an encoder, making it possible to use the system with any television format (PAL or SECAM, for

instance), an important element of flexibility. The present version produces NTSC color video.

The Direct Video Synthesizer, to be sure, is not the final word in image-making tools. It does, however, open new vistas in the use of television as a solo medium of expression, places which remain to be explored by the new video artists.

Stephen Beck

## A VIDEO PROCESSING FACILITY FOR ARTISTIC USE: Design Philosophy and a Description of Components

In the organization of a standard television facility, a switcher functions roughly like the system's brain. It receives information in the form of incoming electronic signals, processes them, then sends them out again to monitors, videotape recorders, or to a transmitter for broadcast over the air. The evolution of television technology has produced a common two bus switcher which enables an operator to fade between two signals. It is used conventionally for making transitions between various picture sources, and is limited to two signals at any one time.

Artists at the National Center are pressing out upon the parameters of broadcast technology. Images traditionally considered aberrative are used as aesthetic components. The receiving monitor has become a canvas for subtly layered images mixed simultaneously from many sources. For these artists and their work, the conventional system's brain seemed to restrain, rather than coordinate and liberate. As a result, Lawrence W. Templeton, when he began design and construction of a switcher for the Center, found he must create an instrument which had no precedent in video, one which required a new design philosophy as well as new circuitry, one which could not properly be called a "switcher" at all.

DESIGN PHILOSOPHY

At the outset, the artists' work obviated purchasing a standard two bus-plus preview switcher. This instrument is designed to fade between two signals simultaneously; the Center artists wished to fade and mix among at least eight. An eight input/eight output switcher is not manufactured commercially; it could be custom-built, at great cost, but it would be basically an inflexible instrument, particularly for an experimental operation. This is due to the design philosophy of the broadcast switcher itself, which reflects wholly different production needs: there are certain situations in broadcasting which are normals; they are repeatable day after day in a television studio; there are normal paths for certain kinds of flow -- three cameras into a switcher, that switcher into a master control switcher and to videotape recorders -- and it is nearly impossible to reverse this flow, recombine signals, or loop them back through the switching apparatus. The working mode of Center artists seemed much more analogous to an audio mixing situation than to this conventional video scheme. The standard switching design, therefore, was rejected, and a highly flexible arrangement of patch cords and experimental plug-in modules instituted.

As the Center "Mixer" evolved, its pliability became apparent. Its six distribution amplifiers -- only one of many types of modules in the Mixer -- with four inputs and three out-

puts each, permit simultaneous mixing of nineteen signals to become one new, complex image. Rather than using the lighted pushbuttons of the broadcast instrument, signals are connected among modules with patch cords. An artist makes these connections directly, by plugging and unplugging cords of various colors, and, as his work becomes complex, can see clearly all the elements of his signal flow. The Mixer's normal mode is open-ended and disconnected, with compatibility both-endwise on each module. This means that instead of a "male" plug coming in and a "female" going out, anything can be plugged into anything. Outputs can even be patched to outputs by mistake, without damage. The artist can connect pieces of equipment together in strings, parallels or multiples -- in any configuration he wishes -- to the point of controlling what are normally considered technical aberrations and utilizing them aesthetically.

Design of the Mixer took three areas into account: the generation of signals, their processing and their control. Presently, signals are generated at the Center by two Sony DXC-2000A black and white cameras, a Sony DXC-5000 color camera, or they can be originated by the Beck Direct Video Synthesizer. In this report, it is the processing and control of signals which is emphasized; a description of the Beck Synthesizer appears as another paper in this bundle.

All inputs, levels and outputs in the Center Mixer are standard. Any external video signal can be patched in, processed in a number of ways, and then become a standard output signal.

The signals within the processing system are non-composite -- sync and color burst are stripped off the signal before it enters the processing module so that the signal can be easily transformed, and they are added again as the video leaves the Mixer for external destinations such as monitors and videotape recorders.

The processing modules -- keyers, colorizers, color modulator, edge generator, feedback delay lines and multi-keyer -- were designed as experimental plug-in modules. As they were used and refined, they became regular tools built into fixed panels on the Mixer. Liberal space was provided, moreover, for the continued addition of experimental modules to give the Mixer new functions and the artist new capabilities.

## PROCESSING OF SIGNALS

Keyers. The Center's four keyers deviate only slightly from those standard in the broadcast industry. A keyer is basically a switch controlled by a video signal which enables an operator to switch between any other two video signals with the switching decision made by a third video signal, or one of the two he is switching between. It is used most often in broadcasting for show titles or for creating the illusion that a newscaster is sitting in the corner of his news footage. Center artists generally use keyers to remove parts of images and insert new material inside. Portions of a face, for example, will seem to disintegrate and new colors or imagery replace them. Into the

Center's keyers was built the ability to invert signals so that those reversed signals could be added together -- black as white, white as black, or colors in their negatives.

Colorizers. The four colorizers generate a color signal of arbitrary amplitude (brightness), hue and saturation, so that an artist can create any color at any brightness or intensity he wishes. The basic color signals out of which he forms the color are generated digitally and will not drift after being set. Colorizers can be used through straight addition to other video signals, either monochrome or color, or with the keyer to insert arbitrary colors into a signal. They are controlled by "joysticks," as if the color spectrum were laid out in a circle; the artist creates his color by moving and twisting the joystick: it is twistable for brightness; the saturation is deviation from center and the hue position-relative to center.

Color Modulator. With this module an artist takes a basic color signal from the color camera or from a colorizer and controls the hue and saturation of the color in that signal using another signal, either audio or video. Instead of moving his hand around with a joystick, he can electronically create or change colors of previously existing signals. Brightness is literally translated into color. In a picture of a man's face, for example, the bright spots on the face might appear to be red, the dim spots blue, green, or whatever else the artist chose to make them.

Edge Generator. The edge generator outlines solid forms, so that the human body, for example, becomes a moving line drawing. This module separates out the high frequency components of the video waveform, i.e., wherever there is a sharp transition from black to white or white to black, and puts them through a squaring circuit so that all transitions, positive or negative, come out all positive or all negative.

Delay Lines. The Center artists utilize two variable delay lines to create new images. These delay lines are used during "feedback" production, i.e., when a camera is being trained on a monitor which is displaying the signal the camera is creating. The delay lines permit the artist to vary the time required for a complete trip around the circuit -- from camera through cables to the monitor, through space, to the camera lens. This causes changes in the feedback-created patterns, with the most profound effect on colors.

Multi-Keyer. This module enables an artist to simultaneously key eight different signals -- colors or separate picture information -- into a video display. The multi-keyer switches are driven by another external video source, a ninth source, or any one of the eight that are being introduced into the switches. The decision to switch is based on the amplitude of this input control signal, i.e., if the input control signal is higher than a certain level, it opens up one switch; if it is higher than the threshold level for the second switch, it opens the second and the first one is closed. Through any

of these switch-inputs an artist can put in a colorizer, another picture, or a processed signal of any kind.

Remote Control Switcher. This is an addition to the Center Mixer designed and built by circuit engineer Richard Stephens. An adaptation of broadcast switching design, it is a hand-held unit that enables one artist on the studio floor to make an entire work without ever leaving that small area. In addition to switching between one or more cameras, the artist can switch between images combined or processed by the Mixer. The hand-held unit is an encoding box which sends control voltages to circuits built into the Mixer where the switching actually occurs.

CONTROL OF SIGNALS

In designing an experimental video facility, it is important that each piece of equipment be compatible with the others by means of standardized signals. Artists at the Center, for example, have begun modulating video in the multi-keyer via control voltages from a Buchla Electric Music Box. At present, control of signals is effected by the human being manipulating knobs, buttons and joysticks. There is no reason, however, why this cannot occur with touch-sensitive plastic "keyboards," or biological feedback devices. Experiments have begun at the Center where polygraph and skin response measurement devices have been interfaced with the Buchla synthesizer to modify video displays. Ultimately the

human being may be able to "make" video with his own, natural biological signals.

In both audio and video art, many of the electronic processing techniques are the same: the difference lies in the bandwidths involved. With commonality of control voltages, each element in an experimental system could be plugged into all the others. With audio and video processors, entire video compositions could be stored as audio control tones on an audiotape, and artists would be making audiotapes to play back on audiotape machines which control video processors.

Lawrence W. Templeton
Don Hallock
Richard Stephens
Ann Turner