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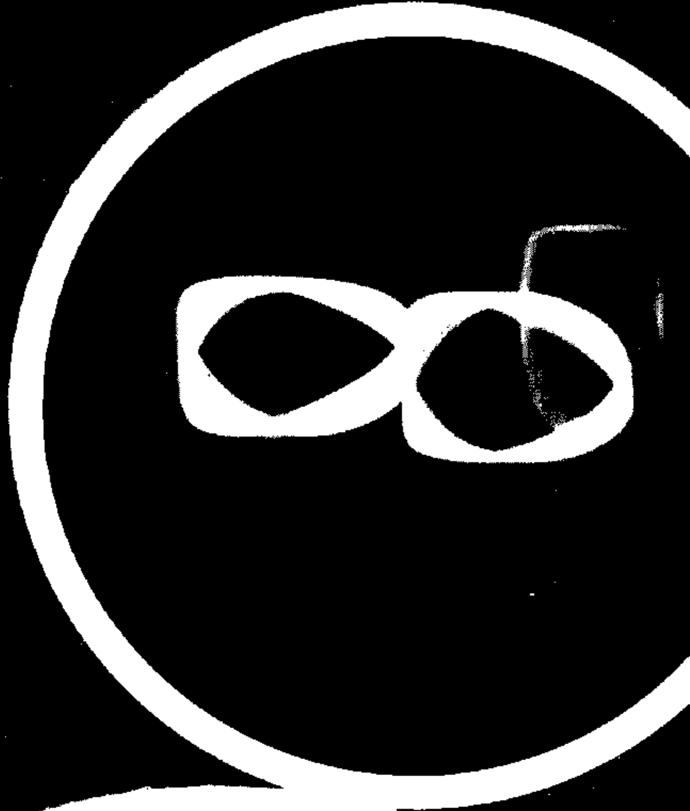

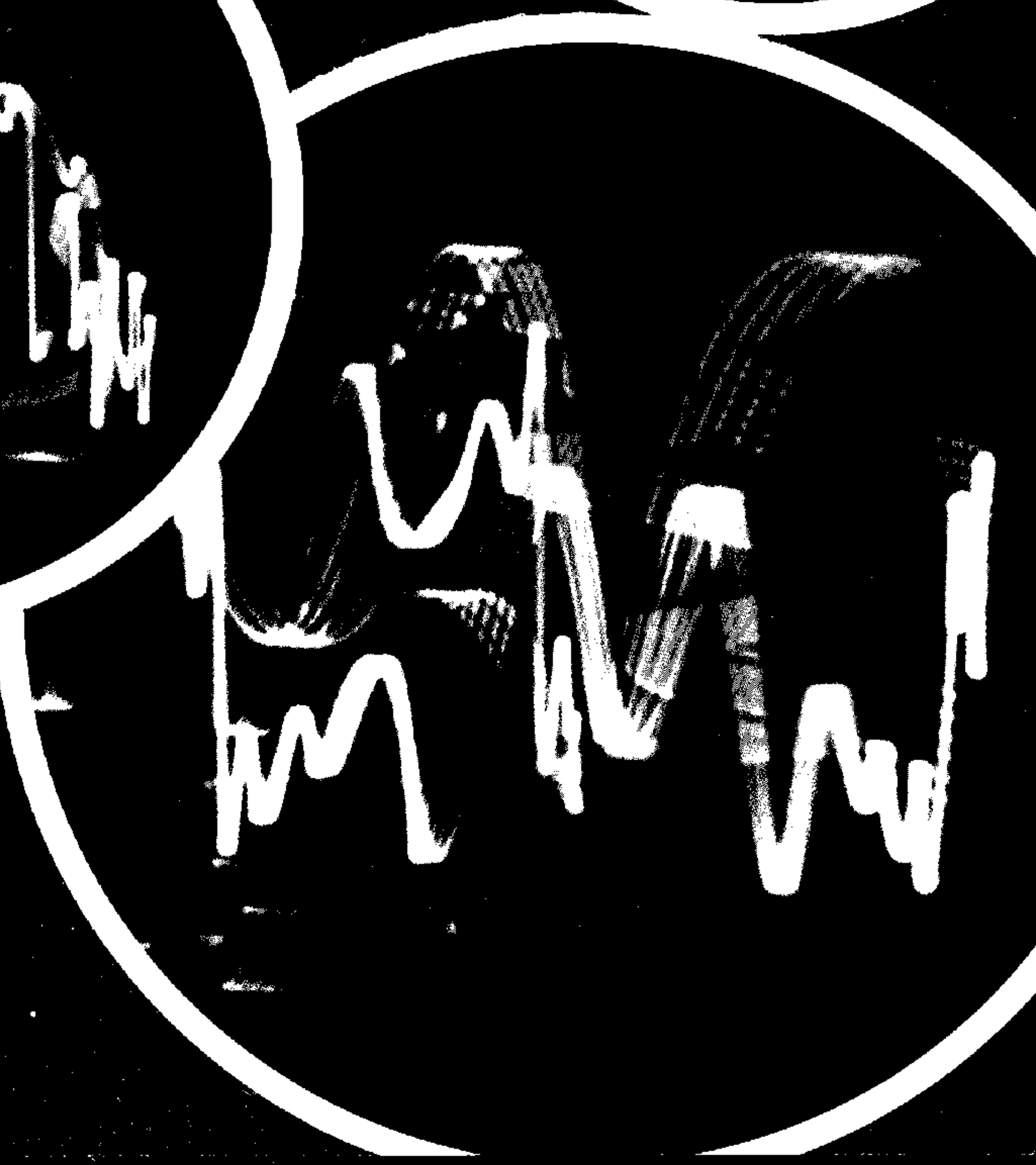

Kinetic images from sound

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American developments in a modern art form

by Thomas E. Mintner, *University of Iowa*

With the advent of certain technologies such as video, lasers and integrated electronic circuitry the contemporary artist or composer has resources available which allow forms of expression unheard of as little as fifteen years ago. One obvious example is the field of electronic music, where the proliferation of synthesizers and similar devices has resulted in a deluge of electronic music studios, compositions, live performances and commercial applications. A related area is concerned with devices and compositions designed to take advantage of simultaneous presentation of music with light and images.

Historically, this area ranges from essays on "colour music"[1] dating from the early part of this century to devices utilizing the latest technology. Now, as in the past, efforts in this area come not from any one discipline, but from composers, artists and sculptors, engineers, dancers and architects. Technologically, there is a wide span from simple colour light boxes to video or laser devices incorporating advanced combinations of electronic and electro-optical techniques. This article is not intended to be a comprehensive listing of all such aural/visual devices or works, but rather an overall view with detailed information on some projects with which the author has been associated.

If there can be one conclusion drawn from most of the artistic attempts at correlation of audible and visual information, it is that effective and natural co-ordination is difficult to achieve.

Although some early attempts were severely hampered by a lack of suitable technology, there is a still more basic problem. The fundamental differences in the two sensory systems involved are many. Since our senses of sight and hearing tend to complement each other in day-to-day activities, we may tend to overlook the many perceptual differences which must be confronted when we attempt to create a set of stimuli (a composition) that will utilize both senses together. Investigation of these two sensory systems is still at the level of basic research and modelling for even relatively simple stimuli. Complex signals such as music or visual arts can also be analysed in terms of their content, both from the point of view of their respective disciplines (e.g. music theory) and from the more general basis of information theory.

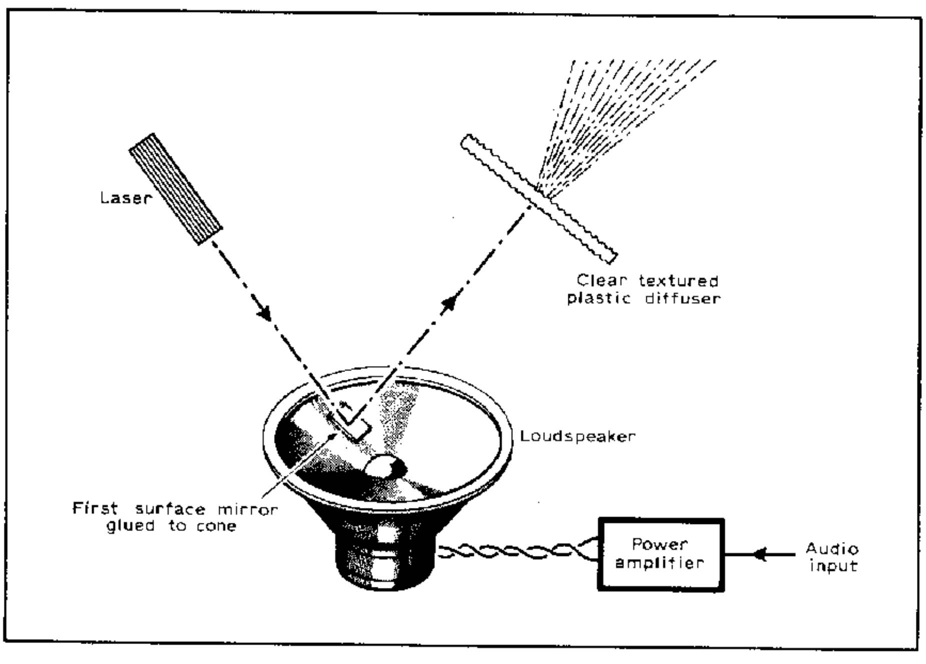

Fig. 1. One method of deflecting a laser beam by a sound source: a small mirror is attached to the loudspeaker cone. The laser beam is further modified by passing it through a clear diffuser.

Given these facts, it is not hard to understand the limited success of early "colour organ" type efforts at music-light correlation. Generally, it was assumed that there would be some sort of fixed relation between the colour spectrum and the musical scale (12 note), with perhaps differences in colour intensity used to represent octave displacement of pitches. There were also numerous other schemes, all with similar problems. However, it should be noted that at least one major composer wrote an orchestral work, still performed and recorded, with a notated part in the score for "tastiera per luce" or keyboard of light. This is A. N. Scriabin's *Prometheus, The Poem of Fire* (1909-10). Scriabin's correlation theories are somewhat more interesting than those above, and in fact a modern realization of his composition has been performed.

Colour organs, along with the pioneering work of artists such as Thomas Wilfred, who was the originator of the Lumia (or light box) in art, are part of a broad range of efforts relating more to colour than image. With the development of the cathode-ray tube it became relatively simple to generate visual image analogues to sound and music through the use of X-Y display techniques. This involves routing two sets of signal information or two similar components of the same information (e.g. left and right stereo channels of recorded music) to the vertical and horizontal inputs respectively of a cathode-ray tube. As early as 1953 an American artist exhibited his Oscillons – images created by photographing specially generated signals fed to a c.r.t.[2]

In the mid and late 1960s there was increased development of new techniques. Lowell Cross described his experiments and compositions with

X-Y display art as a kinetic form with music in articles for *Source* magazine.[3,4] The use of this type of display as an adjunct to electronic music allowed for another level of interest in a live or taped performance. Although the analogues produced with these methods are not necessarily the only way to interface the elements of sound and visual information, they are generally effective, and have been used in many works in recent years. Cross progressed from oscilloscopes to specially modified television sets and eventually to laser deflection systems, as we shall see later.

During the same period, various artists and composers began experimenting with video imagery. One technique which was "discovered" for artistic purposes was video feedback. In its simplest form, a camera is pointed at the video monitor that it is feeding. As in the familiar situation in audio, oscillations are set up because of the relatively uncontrolled feedback path. By controlling this path, it is possible to use feedback as a versatile method of image generation. Various limiting and processing devices may be inserted into the feedback loop to modify and control the images. The author's introduction to this method was in 1969 in work with Glenn R. Sogge and Timothy Skelly, both composers and artists. At that time, considerable effort was sometimes necessary to convince studio supervisors that video feedback experimentation under controlled situations would not necessarily leave the video chain in flames! However, once this was done, it became possible to present a series of concerts/events with specially generated video imagery and electronic music.

Up to this point there was no actual electronic interface between the two domains. The initial attempt in this direction, which was moderately successful, was as follows. Oscillators being used in the generation of musical sounds were connected and mixed so that their outputs were fed to a balanced modulator as well as to their normal destinations. These oscillations were then modulated with a frequency high enough that the upper sidebands were in a video frequency range. The output of the modulator was then sent through an encoder to produce a composite video signal. In the intervening years various video processors and "synthesizers" have been developed using i.c. technology and methods borrowed from electronic music. Composers, film-makers, and video artists are continuing to experiment in this area.

One example of such experimentation from the Center for New Performing Arts of the University of Iowa is the Video Colour Quantizer System. The basic system is a modification of a standard unit manufactured by Colorado Video, Inc., an American firm. Franklin Miller, a film-maker at the university, started the experimentation

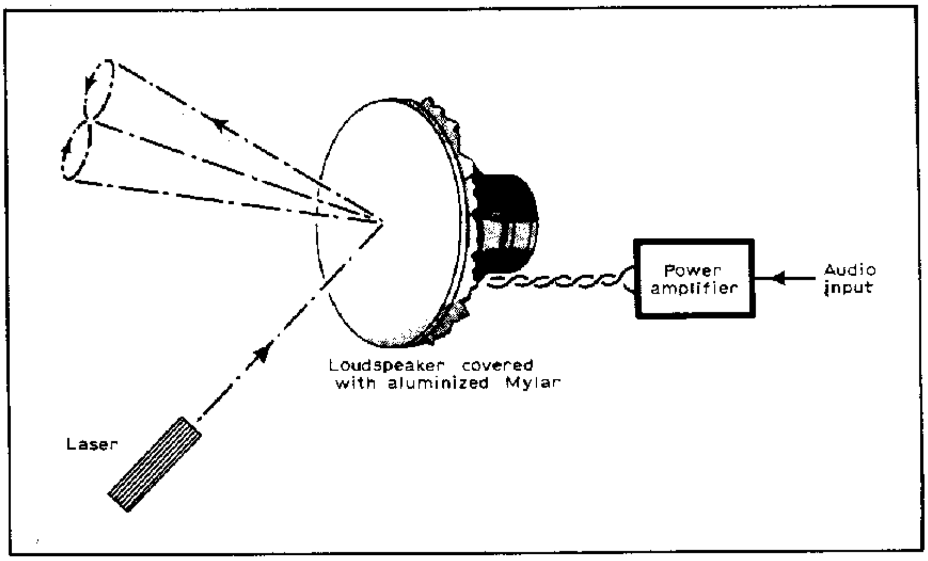

Fig. 2. Method of laser beam deflection used in the Sonovision system.

with this unit. Basically the quantizer is a device which accepts a monochrome video signal and has sixteen adjustable signal comparator thresholds relating to the amplitude of the video signal. At these various levels from black to white along the grey scale, sixteen points can be set to trigger production of sixteen different pre-assigned, synthetically generated colours. With the colour mixing unit incorporated in this version any combination of colours may be set to allow modifications such as synthetic colour generation, grey scale reversal and other effects.

A recent grant has allowed the design and construction by the author of a voltage control interface for the quantizer system. With this interface the sixteen threshold points, or "slice levels," can be determined by the application of a d.c. or a.c. control voltage. This means that a colour assigned to a given grey level range may be made to change with the applied voltage, or that a threshold can be shifted electrically to alter (by colour addition) several other colour areas in the image. In addition, the master outputs of red, green, and blue can each be gated with a control trigger. Signals routed to this total of nineteen control inputs may be used directly, as in the case of electronic music, or may be generated from other music through the use of an amplitude detector or a pitch-to-voltage converter. Another performance possibility is to use control signals derived from other than musical sources, or to split the allocation of control inputs, with some control voltages coming from musical material, and some from other sources, such as devices sampling video signals or sensors attached to dancers. As a part of the grant programme, two colour films are to be produced, one by the author, and one by Peter Tod Lewis, composer and director of electronic music at the University of Iowa. These films will have specially composed sound tracks to control the video colour quantizer interface.

Another interface project is a work realized by West Coast US artists and engineers Bob Watts, Bob Diamond and David Behrman. The work, called the *Cloud Music*, uses a video camera trained on the sky during daytime periods. As clouds pass into the field, the changing video signal, sampled at various cursor points on the screen, controls a system by composer David Behrman which produces electronic music "on the spot." The piece functions as a kind of performing sound sculpture (depending, of course, on the weather).

Shortly after small lasers became commercially available, artists began experimenting with them in a variety of ways. The laser light itself is the object of some of these investigations. The highly collimated beams lend themselves to a variety of illumination tasks, including large outdoor geometric constructs using the stationary beams of high power lasers. On the question of light and sound correlation, however, we find that most uses of lasers involve methods of scanning the beam. Various approaches have been tried, and the most sophisticated systems in use today use galvanometer mirror scanners to produce X-Y scanning. Thus we find that principles of music-light correlation applicable to oscilloscope type displays find a new and much larger scale medium in X-Y laser scanning.

In addition to this simple X-Y scanning there are other techniques which are sometimes combined with X-Y systems. By passing a laser beam through an uneven glass or plastic surface, for example, one can generate patterns of a "cellular" nature which results from the interference of the laser light with itself as it passes through the material. If the beam is deflected slightly as it passes through the material, kinetic images related to the deflection signal (e.g. music) may be generated. One of the deflection methods which

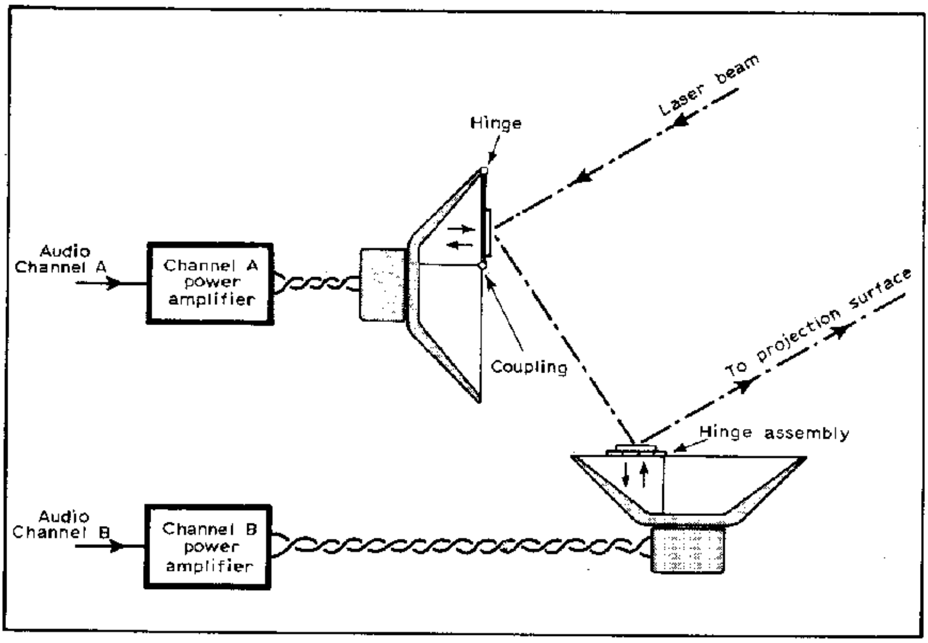

Fig. 3. Beam deflection system using two loudspeakers, each with a hinged mirror moved by a connecting member attached to the cone.

could be used in this application involves attaching a small first surface mirror to a loudspeaker (Fig 1). A signal fed into the speaker will cause the mirror to move and deflect the beam. An early experimenter in this area was Lloyd Cross (not to be confused with Lowell Cross), who developed a system called Sonovision[5] using a loudspeaker covered with a reflective membrane (Fig. 2). In addition, the system, which was intended to be commercially available, had a rotating prism assembly for generating more complex multiple images. A slightly more useful version of this idea uses two loudspeakers (Fig. 3), each of which has a hinged mirror assembly connected to the cone. The hinges restrict the movement of each mirror to one axis. Thus a simple X-Y scanning system is formed. The deflection is limited to relatively low frequencies and the system response is not at all linear because of the many mechanical resonances.

More sophisticated X-Y scanning systems use commercially available galvanometer mirror scanners. The first such system assembled for the artistic purpose of exploring kinetic inter-relationships between light and sound was Video/Laser I, an experimental laser deflection system initiated by Lowell Cross, Carson Jeffries and David Tudor at Mills College, USA. This was in May 1969. Soon after, another such system was commissioned for use in the Pepsi-Cola Art and Technology Pavilion at the 1970 World Exhibition in Osaka, Japan. Both of these early systems have been dismantled. However, Video/Laser III, the latest system constructed by Cross and Jeffries for the Center for New Performing Arts at the University of Iowa had its premiere in a concert with orchestra on November 29, 1972.[5] Improvements and additional electronic control devices are being added on a continual basis by Lowell Cross and the author.

The system used is as follows. The output beam of a 2-watt krypton-argon laser is split into its component beams. This is achieved by passing the initial greenish-white output beam through a direct vision prism. Any four of the approximately sixteen available colours may then be selected and routed to the four beam deflection systems. Each system contains a beam chopper/interrupter and two mirror scanners for deflection (X and Y). Each deflection component of each channel has its own direct coupled amplifier, and any audio signal may be fed to the systems. The devices used have certain frequency response limitations because of necessary compromises between maximum scanning angle and frequency response.

The maker of the scanners, General Scanning, Inc., through a subsidiary, is now involved in X-Y scanning systems for artistic purposes also. One such system, called Skywriter, is designed with X-Y inputs and an accompanying vector generator system to produce a variety of line images, including a kind of animation.

Multi-colour laser systems using large lasers are capable of creating extremely large images on any suitable projection surface, indoors or out, though generally the area must be in relative darkness for best results. The Video/Laser III system mentioned above is used in a variety of performance situations, often with electronic music as a sound source. It is conceived of as an experimental performance and research instrument.

One fairly recent performance with the Video/Laser III system may demonstrate how the original art of "colour music" has progressed to its current position. A performance of A. N. Scriabin's *Prometheus* was given on

September 24, 1975, with the laser system functioning to realize fully, perhaps for the first time, Scriabin's wishes for the keyboard of light. A specially constructed keyboard interface was used, with a performer playing the written part as indicated in the orchestral score. The keyboard controlled the gating of the various colours, while the images were generated both directly from the orchestral sound and also by electronic means with auxiliary equipment. In addition to the lighting effects, fog and various scents were present in the hall at appropriate points in the performance.

This unusual meeting between the latest technology for realization of one type of kinetic music/light performance and the ideas of one of the earliest and most interesting proponents of this art form may serve as an appropriate point to conclude this brief survey. However, work involving video, lasers, and other systems for the realization of this very old dream of "music light" will undoubtedly be continuing for years to come.

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The front cover of this issue shows examples of projected multi-coloured images produced by the Video/Laser III equipment described by the author.