

Digital Pyrotechnics: The Computer in Visual Arts

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ABSTRACT

Harmonic forces give shape to our experience of past and future. This is the dramatic essence of musical experience. It is why the composer, more or less intuitively, has manipulated the network of harmonic relationships of all musical scales for as long as music itself has existed. Evidence is accumulating to substantiate the need for much further study of harmonic phenomena. Because there is reason to believe—as I do—that the tensional charge and discharge—the expectations evoked and thence fulfilled by tonic structures in music—all this is a direct product of the mathematics of harmonic order. I further believe that the same possibilities exist in the skillful design of harmonic pattern for visual perception. Therefore, I am exploring harmonics designed for eye instead of ear. It is interesting to note that the very creation of harmonic pattern had been altogether inconceivable until a very recent time when computer graphics eventually and slowly became available to the visual artist.

I'd like to show how well computer graphics and harmonic pattern are suited for each other. And show how useful this compatibility can be for employing the computer to charm the eye.

To begin, let's consider the manner by which composers for centuries have used harmonic "force" to attract and hold the attention and otherwise charm the ear. Then we will examine a similar form of visual "force" which has been made possible by computer graphics.

At the outset we know the musician's aural spectrum to be an undifferentiated and continuous spread of frequencies, say from twenty to twenty thousand cycles. Yet this apparently homogeneous continuum is not continuous at all. Harmonic relationships interactively transfigure this spectrum. Harmonic phenomena create discontinuities, as nodules of tension, anticipation, and resolution deform this otherwise smooth continuum. Whole number, or harmonic nodes, scattered throughout the spectrum create order/disorder proclivities: centers of emotional focus which distort an otherwise smoothly ascending texture. In fact, sounding tones over the span of just one octave persuades the ear that we are nearer a return back to the start than we are advanced along any straight line of upward continuous ascension.

I want to suggest that it is this particular discontinuity, not really any other quality of the audio spectrum, that constitutes the raw material of the composer's art. Not pitch, texture, rhythm, and meter. Not frequency, intensity, and density, as most 20th-century modernists have wanted us

to believe.

That is to say, no matter how we divide the spectrum into steps we find a hierarchy of perceptual values that distinctly rank each step. It is the composer's cunning, or intuition, or even mindless exploitation of this hierarchy that is the primary source of rhythmic vitality and emotional content of music. The composer, however, must cooperate with these natural harmonic forces, or see his strategies defused by them. He cannot work his will against, nor exercise insensitivity to the charge and discharge. He cannot escape the dominion of the gravitational force of harmonic moment.

Furthermore, as a corollary to all the above, a visual domain of harmonic consequence has become accessible through computer graphics. With the graphical display rooted upon coordinate mathematics it is only natural that a great variety of periodic interference patterns can be produced. The motive now exists for the artist composer to discover his way into this diverse domain of dynamic visual form structured out of two and three-dimensional harmonic periodicity. This domain abounds with tonic centers of focus as in music. And this domain will render up an equivalent rhythmic and emotional content as in music. I think we will soon see the artist learn to cooperate anew with natural harmonic forces in hitherto unexplored visual territory.

In truth, harmonic forces give shape to our experience of past and future.

Yet harmonic force is not all that mysterious. We can speculate why the sound of "ti" urges us on to "do." Significantly a good diagram for the perceptual dynamics of harmonics is found in this picture (Figure 1).

It is characteristic of harmonic phenomena, visual, aural, or otherwise, to show this kind of pattern. As patterns go, the illustration is perhaps explicit in a way that is even more obvious than the aural, leading-tone effect of "ti" upon "do."

Eye and ear, each in its own unique manner, experiences the dynamics of this kind of pattern as an event in time—as punctuation. Especially as an event of arrival or departure. When we arrive at "do," the octave above the tonic "do," we hear that rudimentary relationship with a particular infallibility. If we sample ascending steps of the scale, the ear is bound to sense the final event of arrival just as the eye can see arrival and departure relationships in the illustration. I might add that these relationships are many times more explicit when seen as a motion picture sequence.

In terms of visual perception, vaguely a

corollary to aural responses, we have here a phenomena of hierarchical distribution and classification of elements into an array in which all are ranked according to some perceptual scale of complexity.

No need to argue which pattern is more "consonant" than another. For generating dynamic patterns here is an order/disorder principle, or a consonant/dissonant, principle to work with. It is a principle which can be exploited in more ways than one might expect to give meaningful order to temporal development. The principle becomes a composer's valid strategy—probably the first strategy to be so defined and applied in the brief history of the art of computer graphics.

Finally, it is worth remarking that the illustration for this article could not be created by conventional hand-drawing techniques. At least that would be quite difficult. Moreover, it would be impossible to hand-animate the film from which the illustration was derived. Many of these films required thousands of drawings while the computation for plotting is staggering. Thus the computer is the ultimate and the only tool for visualizing the dynamic world of harmonic functions. This may serve to illustrate the point that this new world of visual art cannot be confused with any previous traditional forms. (See *Art International*, Vol. XV/7, September 20, 1971.)

It should be of particular interest to realize that computer graphics—this 15-year-old infant—is patently capable of bringing forth a totally different kind of visual experience as unique and riotously enjoyable—much cheaper—more energy/materials intensive than the Chinese, pre-Christian invention of fireworks.

BIOGRAPHICAL SKETCH

John Whitney's growing reputation as a pioneer with applications of the computer in visual art was advanced another step with the completion of his film *Arabesque* last year. The film has received high honors in the U.S., and abroad; including Iran where its relation to the traditions of Islamic pattern was acknowledged. John's thirty-seven year "obsession" with the role of time and movement in visual art led to computer graphics long before that technology was accessible, or practical. What for years was only an obscure experimental study is just now evolving into an accepted and recognizable fine art attracting many young artists. It is a field which is of growing interest to the personal computing experimenter. John Whitney's part in bringing about these developments is well known.

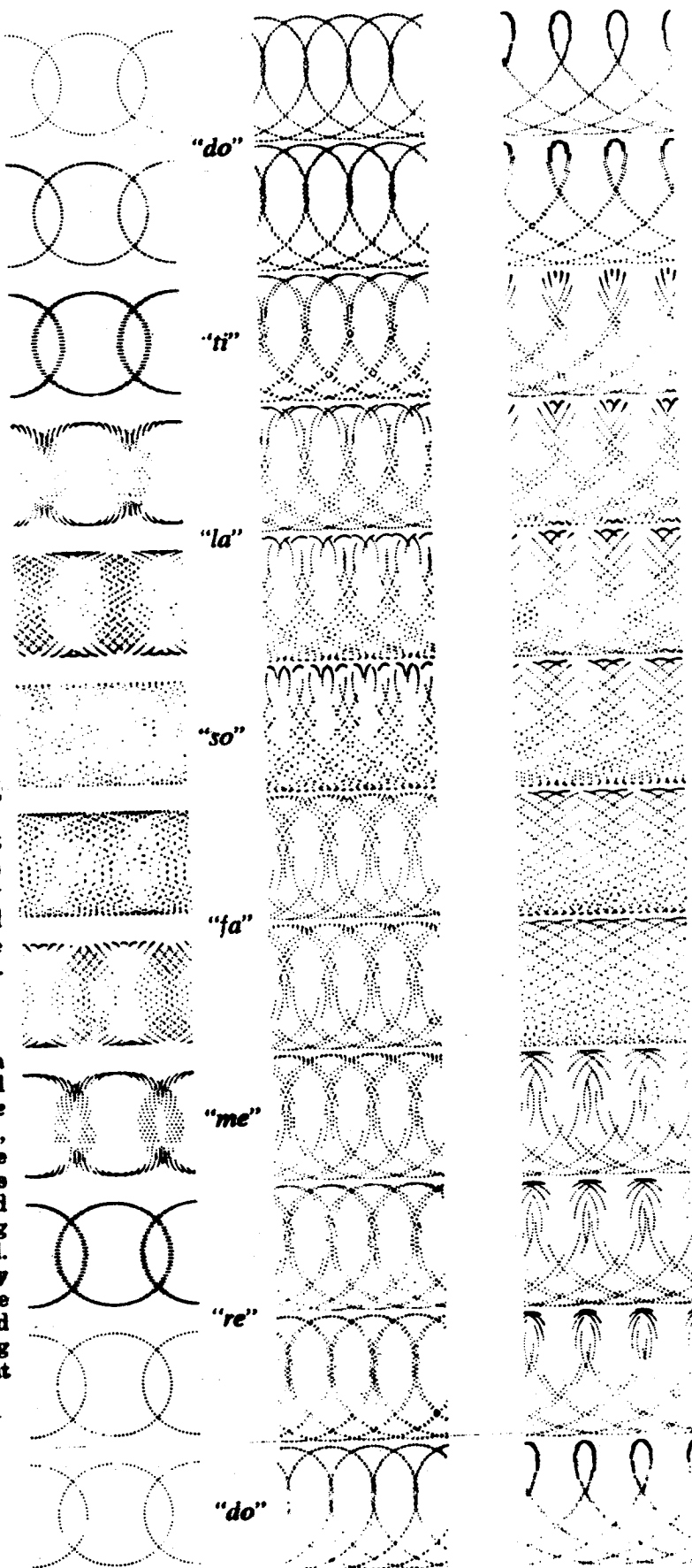
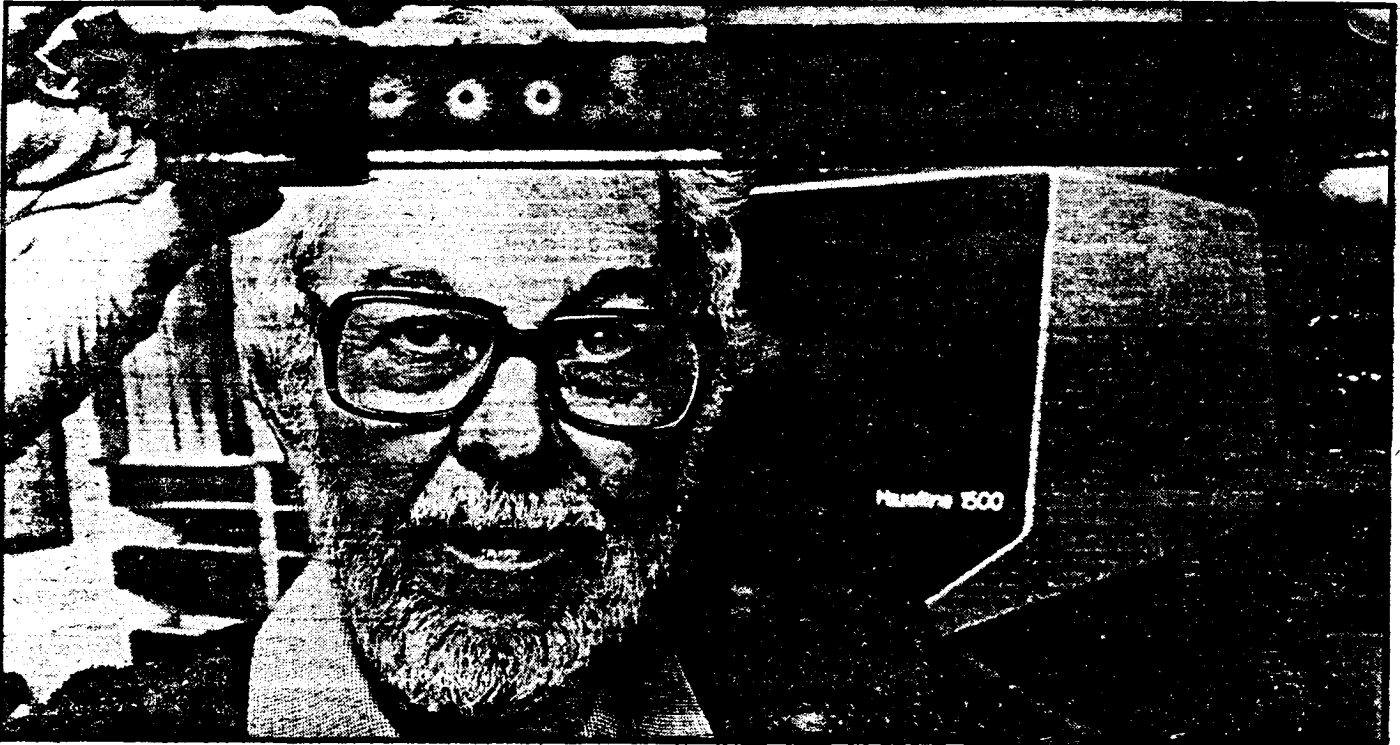


FIGURE 1.

Each of these frames might represent samples approximately one second apart out of a smooth continuous action sequence totaling twelve or more seconds in length. Read from bottom to top.



John Whitney examines film with geometric patterns which he constructed with Andromeda System high-powered minicomputer. Behind him is video screen.

Times photo by Tony Bernard

● John Whitney may have been born 30 years too soon.

"My aspiration to create abstract films in 1940 was like trying to build a flying machine in the 1840s," says Whitney, 60, a major influence in the use of specialized lettering in film titles, one of this country's leading abstract film-makers, a pioneer in the field of computer graphics as visual art and the inventor of the process by which the famous Star Gate sequence in "2001: A Space Odyssey" was produced.

"Until the proper kind of technology came along," he says, "it was like trying to fly with hand-powered wings."

Indeed, people in art and entertainment often have tried advanced techniques prematurely.

"During the great Golden Age of Hollywood movie musicals, Busby Berkeley made designs and patterns with his dance routines that became a half-serious attempt at 'visual music,'" explains Whitney. "This, too, was the same as trying to fly with feathers and wax."

But now technology finally has caught up with artistic aspirations and, according to Whitney, who uses a computer system in his Pacific Palisades studio to produce brilliant moving images, we're on the verge of a new era for the composer artist.

The Los Angeles Independent Film Oasis will present a talk and exhibition of films by Whitney at the L.A. Institute of Contemporary Art today at 8 p.m., 2020 S. Robertson Blvd. (Information: 559-5033.)

"I think the computer will be the ultimate instrument," he says, "and I see it thrust into the mainstream of visual arts and music in the early future. Although most culture in the 20th century has been inherited, the computer-generated visual experience of patterns in movement may evolve as our only indigenous cultural phenomenon with the exception of jazz."

Computer graphics are used occasionally in sci-fi and abstract films, rock concerts, TV commercials and stadium scoreboards. They're probably most widely viewed in the network identifications and Movie of the Week promotion spots. Whitney predicts that TV variety shows will be the next major area of entertainment to use computer graphics.

"Variety shows are best when they are musical and gorgeous," he says. "The producers tirelessly search for the best looking visual image their money will buy. Soon computer graphics will offer the most stunning flamboyance any money can buy."

Computer art may also lead to a direct relationship between TV and the record industry: "There has been a need to merchandise pop music on TV for a long, long time," says Whitney, who was influential in developing light shows in rock and classical concerts. "And with the success of computer graphics on variety shows will

music to something on TV."

Whitney, who was born in Pasadena, has supported his creative output over the years with a Guggenheim Fellowship (1947-49), a long-term academic research grant from IBM and a series of lecture tours to the Middle East and Europe sponsored by IBM and the U.S. Information Agency.

One of a growing group of independent artist/film-makers, he is currently on the faculty of the UCLA department of art and is completing a film with his most recent grant from the National Endowment for the Arts.

Most of his work is distributed through Pyramid Films, Santa Monica, to art museums, schools, universities and libraries.

Punching Out Visual Images With Computers

BY MATHEW TEKULSKY

The key to the proliferation of computer art is the videodisc, on which graphic designs, motion pictures and musical pieces can be stored and played back. Since the cost of a videodisc may only be \$10 to \$12, Whitney is optimistic that a large audience may be possible: "In commercial TV the monopoly of the mass audience has discouraged the kind of experimentation needed to advance new-video arts," he says, "but the videodisc may end centralization of production for that mass audience by the networks because people will be able to buy their own choice of programs directly from any producer. This would open the way for all kinds of new aesthetic approaches to packaging visual and musical art."

Does this mean that Whitney's works could be obtained for home viewing?

to happen," he says. "MCA-Universal says that a publication of only 10,000 issues of a videodisc could be sold profitably. That puts video art into business alongside the specialized record, novel or book of poetry, and there's an ample audience for all this."

"It's possible that by the end of the 1980s, works by innovative composers of the 20th century in the visual realm will be as much a household item as Stravinsky. I think half my creative career is still ahead. Who knows?"

Whitney postulates that the computer may become the most important artistic machine since the piano. "The whole story is not just about a few artists creating things for a passive audience," he says. "Art or music has never grown that way. In the period of Bach and Beethoven there was an enormous amateur enthusiasm. Among the fortunate elite of the Baroque era, everyone was performing."

"I can envision a renaissance of popular amateur art, visual as well as musical, that might become very common in any middle-class home. And if the composer can create vast and exciting color experiences, his computer is going to be just as acceptable and desirable in the home as the piano—and the computer may not be quite so difficult to perform on."

Computer technology may have additional ramifications in art and entertainment. The videodisc and other solid-state memory devices could wipe out the technical media of film and tape. Also, liquid crystals that are used in watches, or something comparable, may become a method by which videodisc images are made visible in daylight and on a surface of any size.

"That could mean the end of the dark theater as we know it," says Whitney. "It would eliminate the captive audience and the darkened environment and make it much more casual, with the ambience of an art gallery. You'd have to turn on the lights to view the show when the sun goes down."

Whitney needs hours now to produce what took him weeks in the past, but his principal purpose is still the same as it was 30 years ago:

"Icarus, with his feathers, was no dilettante," Whitney says. "He put his life on the line. I think you can find again and again in history that people do have mad, impractical ideas and visions and try to realize them at a premature time and at a great cost to themselves."

"But for me the times have changed and the ideas that I aspired to realize have become possible at this rather late date. I don't begrudge this, nor do I consider myself unique. Right now I'm more enthusiastic and more confident than I've been in my whole adult life. I could use some kind of certificate, however, that guarantees me an extra 30 years." ●

When I first went to Paris, I did so instead of returning to Pomona College for my Junior year. Looking around, it was Gothic architecture that impressed me most. And of that architecture I preferred the flamboyant style of the fifteenth century. In this style my interest was attracted by balustrades. These I studied for six weeks in the Bibliotheque Mazarin, getting to the library when the doors were opened and not leaving until they were closed. Professor Pijoan, whom I had known at Pomona, arrived in Paris and asked me what I was doing. (We were standing in one of the railway stations there.) I told him. He gave me literally a swift kick in the pants and then said, "Go tomorrow to Goldfinger. I'll arrange for you to work with him. He's a modern architect." After a month of working with Goldfinger, measuring the dimensions of rooms which he was to modernize, answering the telephone, and drawing Greek columns, I overheard Goldfinger saying, "To be an architect, one must devote one's life solely to architecture." I then left him, for, as I explained, there were other things that interested me, music and painting for instance. Five years later, when Schoenberg asked me whether I would devote my life to music, I said, "Of course." After I had been studying with him for two years, Schoenberg said, "In order to write music, you must have a feeling for harmony." I then explained to him that I had no feeling for harmony. He then said that I would always encounter an obstacle, that it would be as though I came to a wall through which I could not pass. I said, "In that case I will devote my life to beating my head against that wall."

John Cage—A Year From Monday

When I first went to Paris, I did so instead of returning to Pomona College for my junior year. Looking around, it was Gothic architecture that impressed me most. And of that architecture I preferred the modest style of the eleventh century. And in this style it was Chartres, the Royal Portal where I sat on the steps reading Henry Adams. Professor Ray Kendal who conducted singing sessions at the Pasadena YMCA when I was in junior high school appeared on the seat in front of me on my train to Italy. He was by then a professor of music at USC on sabbatical in Europe and touring Italy. I saw him again and again on this tour and observed that he had no taste for Giotto. In Paris my best friend, a native of Paris, claimed to be the principle Schoenberg authority in Paris whether he was or not. Certainly he was the only one teaching twelve-tone music composition in Paris in 1939 and I was his pupil despite the painful fact I had failed first year harmony my last semester at Pomona. Two years later I explained to Arnold Schoenberg at UCLA that my friend, who was Jewish and who still lived in Paris, needed help to get out of Europe. But already Paris was an occupied city. No one could be helped who lived there. I too had a mind that harmony was an appendage though my feelings for Beethoven and Schoenberg quartets were a contradiction to those ideas. Many years later I learned how important Pythagoras was to Islamic ideas of design. And later still I learned how to deal with Pythagorean principles of harmony on the computer in a visual way. Now I understand what Arnold Schoenberg said to John Cage.

COUNTRY NOISES



Phone rings



Phone rings in TV drama



Phone rings in house across the road



Furnace



Refrigerator



Lawnmower



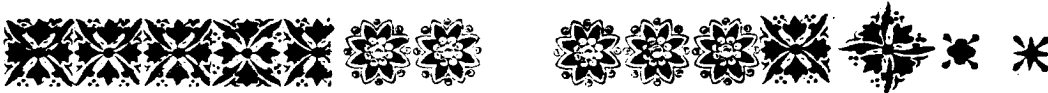
Small plane



T.W.A. from Paris to Kennedy



Dishwasher



Cricket



Electric clock



Car



Truck



Dead leaves cross the road



Mosquito



Paper uncrumples in wastebasket



Willow



Raccoon?



Chest of drawers creaks



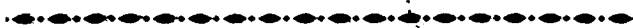
Frog



Woodpecker



Rain on roof



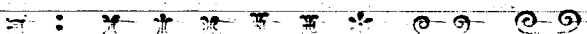
Rain on deck



Blue jay



Catbird



Unidentified