COMPUTER GRAPHICS AS ARTISTIC EXPRESSION

Herbert W. Franke
(translated from the German)

Computer graphics has been in existence for more than twenty years. From the beginning, people experimented on ways to use the new medium — in addition to scientific, technical and commercial application — for artistic goals. Around 1965, Germans Frieder Nake and Georg Nees and the American, A. Michael Noll, strove for that goal; they were followed by individuals such as Kenneth Knowlton, the team of Charles Csuri and James Shaffer in America, and the Japanese Computer-Technique Group. All of them were represented in the large exhibition "Cybernetic Serendipity" in 1968 in London.

In the following years, in addition to mathematicians and programmers, more and more professional artists adopted the methods of computer graphics. This became an international activity, but was little known to the general public. The situation changed a few years ago, not so much because of a breakthrough in the field of art, but as a result of the production of spectacular computer-produced special effects for science fiction films and advertising commercials.

As a technical method, computer graphics no more is involved with art than pencil and color. It becomes interesting only after it is applied to creative goals, and even then it needs the creative human being to achieve high quality, aesthetic results. In view of the short time that computer graphics tools have been at our disposal, each computer graphics work of art should be looked upon as an experiment to test the medium for its suitability as a means of artistic expression. We have here the unique case of an art "in statu nascendi," the extraordinarily interesting initial state of an art which eludes all classical fields of observation, to be observed in its emergence. This is a special opportunity which, strangely enough, scarcely has been exploited up to now by relevant scientists.

One noteworthy observation in the evolution of computer art is its development from playful experiments to commercialization. Another is the formation of different styles and criteria of valuation, a phase not yet concluded so far. This article will concentrate on yet another aspect of this discipline — the interaction between technical instrumentation and artistic expression.

In the fifties, the mechanical "plotter" was the only drawing apparatus in use. According to a program, the plotter controlled the movement of ink, pen and pencil, over flat paper or paper stretched over a roll. This method limited artistic experiments with computer graphics to line drawings, initial production of block diagrams, wiring diagrams, maps, etc.

Software, as well as hardware, affected these artistic experiments in design. The first programming languages were particularly well-suited to describe mathematical and logical associations. The first computer artists used these existing routines, so it is not surprising that many of the things produced then originated from the rich store of forms in technique and science.

From the view of artistic trends, these works are formally related to constructivism, especially concerning the precision of presentation and the limitation to simple form elements, which were then still necessary. While representatives of classical constructivism had to make do with a ruler and compass, thus being limited to straight lines and circles, it is easy for the computer user to insert precise and complicated curves. This is possible either by the process of interpolation or by the program evaluating mathematical formulas and transforming the resulting numbers into graphic presentation.

Another expansion of form and style, accessible with programming languages, concerns the transfer from order to chaos. With the help of a random number generator, one can get essentially orderless rows of numbers which can be used as reference numbers for graphics presentations. The use of the chance effect, common in the early days of computer graphics, also found expression in manually produced constructivist works, such as those by Herman de Vries. Some constructivists, like Peter Struycken, Zdenek Sykora and Gerhard von Graevenitz, used the computer to realize their picture ideas.

Different effects were achieved by using methods of image processing, that is, the graphic processing of data. Originally this technology was used by scientists to enhance pictures obtained photographically. With digital electronics, a considerable widening of this field of activity was possible, such as being able to correct distortions of pictures or eliminate "noise." Distinguished from computer graphics, image processing works with pictures of real objects and scenes, which are thus open to artistic treatment. Again, already written computer programs are available to artists, who use them to distort pictures rather than to improve them. This can lead to attractive graphic effects.

The beginnings of image processing go back to the time of printers and plotters, but the real impetus is connected with television. This technical innovation, with the appearance of the picture tube as a presentation tool for computer graphics, initiates a significant change. With color screen limits of more than one hundred million hues, the number of available colors is greater than the number of colors the human eye can distinguish.

Contrary to the plotter presentations, the construction of which often took more than an hour, a picture is now created within fractions of a second. This permits interactive work — there is essentially no waiting time — and the producer immediately can see the results of his graphics applications and improve upon them until the effects are optimal. This also eases the capture of movements over time. With bigger systems, sequences of thirty pictures per second can be created in real time. For the first time, the visual artist has a means to create graphics sequences freely.

Whereas the limited possibilities of the plotter favored a trend toward mathematical constructive presentations, the monitor picture gives the artist relative freedom. Today, computer graphics is not bound to a certain style but depends on the views of the artist. If he wants to use the so-called paint systems, which allow for simulation of hand-drawn objects, he achieves a flexibility hardly imagined before: he can mix and change paints at will, turn parts of the picture, move, manipulate or erase; he can withdraw objects and enlarge details which are then zoomed back into the picture, etc. Pictures produced in this way do not differ significantly from those achieved with conventional methods.

Some artists have discovered the wider possibilities in style and expression that can be realized with computer graphics, unknown in classical painting. Mathematical formulas, used since the early days of computer graphics, have been applied more rigorously to current work. A significant difference results. With conservative working methods you go point-by-point, meaning that in a picture, the exact spot you touch is changed. Computer graphics also permits changing the picture in its entirety.

In this field of mathematical techniques belong transformations. When applied to images, these transformations yield manifold changes. In simple cases, a transformation can cause an exchange of colors, a physical structure, or the accentuation of contours. With more complicated transformations, new picture structures can emerge that do not resemble the original. A picture can be formed by applying different transformations, or by modifying form and color manually. A mathematical law says that, in this way, any picture may emerge. Both methods are also complementary.

An even more remarkable computer technique available to artists is the ability to create three-dimensional perspective presentations. Just as line-drawings of plans and maps influenced computer art in the beginning, today's computer-aided design applications are influencing 3-D art. In place of physical models of machine parts or buildings, there are pictures that can be observed from all sides; a change of the viewing angle can be achieved from the control panel. A 3-D representation of the object is stored in the computer. Software computes the desired views and displays them on the screen.

With the help of special programs, 3-D objects and scenes can be made to look real. Once the user specifies the number and locations of light sources, software removes hidden lines and hidden surfaces, and adds shadowing and highlights according to the laws of optics. Last, computer graphics programmers developed algorithms for realistic generation of mountains, clouds, water, living beings, etc. Some of the effects are so astonishing that they are taken for works of art in themselves. At previous exhibitions of the annual SIGGRAPH conference, artistic works were displayed alongside images showcasing technical achievements and creative programming.

And yet, it would be a mistake to deny this medium's artistic potential. The development of programs has proven to be the necessary basis without which no artistic achievement in this field is possible. It is the realm of photorealism, the style dominant in art circles some time ago, which demanded the rendering of scenes from everyday life as realistically as a photograph. Although the results of this style are not distinguishable from painted works, there still is a considerable difference. In the application of 3-D routines, the artist is concerned with more than the surface of things — quite another approach from the reproduction of perspective projection. It is evident that we have here a real expansion in presentation, as the objects presented in this way can be observed from all sides, as well as through time. If we deal with moving things, e.g. an animal, then the dialogue between the artist and his object goes further still. He may think about the interplay of skeleton and muscles, the degrees of freedom of movement, and finally, create a film of the creature in motion. Here again, the effect alone is not sufficient to make the presentation into a work of art, but the availability of the method presents an enormous challenge to the artist who now has means of expression hitherto unavailable to him.

The experiences with the first picture sequences created this way show that realism is relatively uninteresting. As has been confirmed in other fields of art, an exact copy of reality is not what counts. An entirely new dimension opens for the artist when he moves from realism to surrealism, just as with image processing, which serves not only to "improve" pictures, but also to make them abstract and interesting. For the first time, he has the possibility of building scenes of his fantasy in three-dimensional form, to give shape to worlds that do not exist in reality and, perhaps, cannot exist.

The hardware and software needed to create real and surreal pictures are still extremely expensive and limited in number. For the artist who wants to use these systems, it is difficult to find and gain access. But at those rare happenings where highly developed technique and artistic talent come together, there originate examples of surreal forms with the potential to initiate a new epoch.

Among the few pioneers of this trend are David Em, an American, and Yoichiro Kawaguchi from Japan. Today, their art might still appear exclusive, just because the method applied is at the disposal of only a few. But we can see already that hardware and software for computer graphics presentations are developing and spreading quickly. What is still a pioneer achievement may, in ten or twenty years, belong to the ordinary fields of artistic activity.