The images presented in this silver-anniversary issue were generated primarily from software programs created by Dr James F Blinn and adapted to my own fine-arts use. The programs were originally developed as fundamental research in the field of computer graphics and have been applied to motion-picture simulations of deep-space phenomena for NASA.

Programs I have employed involving 2-dimensional transformations were generated primarily by Alvy Ray Smith of Lucas Film. The hardware with which the images were created includes a Digital Equipment Corp PDP-11/55, an Evans and Sutherland Picture System 2 and frame buffer and various peripherals such as disk and magnetic-tape storage.

Documentation has been handled by shooting directly from the display-tube face with a 35-mm still camera; by a Dunn Instruments recording device which handles 35-mm still film, 8 3 10-in. Polaroids and 16-mm motion-picture film; or by recording directly on to videotape.

My work in computer graphics is based in art and not on technology. My formal training is in the fine arts. I come to this electronic medium via a strong traditional background in painting and sculpture, not in computer technology. My work in computer graphics is firmly rooted in the classical concerns of form, color, light and composition. However, I have had to radically reorient my attitude toward these concerns in terms of this new technology. I do not use the computer as a more efficient paintbrush; I use it to develop a new form or art, related to and yet unlike all other forms of art—just as painting is related to and yet unlike sculpture.

The greatest nontraditional problem I have encountered in this medium is the need to deal with high technology's continually evolving state of the art. I have also had to collaborate with many people in order to create an effective working procedure.

**Dealing well with abstractions**

My introduction to the interfacing of man and machinery began with my work in plastics sculpture, which necessitated the use of heavy industrial equipment. A long-term interest in time as a dimension of art led me to work in analog video techniques, which required greater interaction with more highly sophisticated machinery and an even larger number of support personnel, both in creative and technical capacities. Digital computer graphics became the logical extension of this video work because of its greater flexibility and control, which extend down to an image’s smallest picture element.

Just as the brush was an advance over cave-painting techniques, so the vocabulary of the artist is similarly expanded by computer technology. The computer is particularly well suited to deal with the abstract symbols and representations that constitute the purely formal elements of composition.
Because of the facility with which the computer can manipulate various elements of an image, modifications of those elements are possible with unprecedented speed and with extraordinary accuracy. Using rapidly accessible computer memory, an artist is able to create, restore and retrieve vast amounts of picture information from a single terminal.

As an example, a graphic artist using a pen might produce in 20 min a line drawing with a sketchy layout of lettering and other information. A graphic artist working with a computer system, however, could in the same time produce a full-color poster with final-form lettering as well as many related alternative images. With production time so reduced, the only time limitation is therefore the actual work of creation.

My own approach to the medium is highly intuitive. Rather than sit down with a series of predetermined equations, I prefer to interact directly with the machine. This process if facilitated by the capabilities of software programs designed to allow the user to range across a gamut of picture-making possibilities in near real time. These possibilities range from painting directly on the display monitor with an electronic stylus to creating completely synthesized colored and textured objects that possess all the surface qualities of actual 3-dimensional objects.

**Problems that limit creativity**

There are limitations inherent in the medium, however. As with any state-of-the-art technology, computer systems tend to be hybrids; no two systems are alike. Hardware breakdowns are frequent. The software employed—development software—is subject to breakdowns and is frequently not documented. Thus, the image of briskly efficient machinery eliminating production problems is far from the actual reality of working with the equipment.

Additionally, because the cost of the necessary equipment is prohibitive to an individual, the technology is available only in large corporate or governmental installations.

Creating art in an institutional environment, though, is a radically different experience from creating it in a studio. Because time on the machine is so valuable, most work can only be done when access to the machine is free. Thus, a certain undue pressure results from knowing that there is no time for a creative block if the machine is (a) accessible and (b) actually on line and not down for any one of a myriad of reasons. These factors all inhibit the instincts of curiosity and play that are so necessary to the artistic process.

An additional problem is that the artist has very little artistic control over the specific direction in which the system is developed. I adapt myself to software as it becomes available for other purposes unless someone is available to write programs specifically for me.

These problems are not insoluble, though. With corporate cooperation, what are currently major artistic problems could be solved relatively easily to everyone’s mutual gain—and in particular to the benefit of the nontechnical user.

The potential audience for this work is enormous. But audiences still need education in the medium to appreciate its sophistication. A typical member of the public is mystified by the use of computers to generate art, let alone the function of the artist in the process. Two conclusions frequently reached are first, that the images are created by the machine and that I merely photograph and document its creations, and second, that the images are somehow hidden inside the machine and are pounced upon by me with some sort of electronic butterfly net.

The avenues for display of computer-assisted art are many. In the last year, my computer-graphics
work has been displayed in fine-arts galleries, photo galleries, multimedia productions, video shows, theater productions (projected as sets), magazines, animation conventions and computer-technology conferences.

Furthermore, computer prices are plummeting so rapidly that price is no longer a constraint, and the day is rapidly approaching when artists will own their own systems.

The operational complexity of the user/machine interface will also see marked improvement. The most important improvements will be in interactive design. Being able to use a potentiometer or a joystick like a brush is a totally different experience for the user from typing numbers into a terminal. Likewise, we can expect to see process-oriented software programs.

Computer art is not better than any other art form. It is different. It is more capable. It also gives the artist several possibilities not found in any other medium. In the future, awareness by engineers and artists of each other's work promises mutual benefits as inexhaustible as the technology they share.

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David Em is an independent artist who frequently works with high-technology media. The portfolio of images presented in this issue of *EDN* is representative of a large body of work he has created using state-of-the-art computer-graphics programs developed by Jet Propulsion Laboratory scientist Dr James F Blinn. (Photo titled “SX70 Self-Portrait” copyright © 1980 by David Em)