HIGH TECHNOLOGY RESEARCH AND ART

Computer Graphics Let Users Get the Picture

Lifelike electronic images, produced for complex scientific models or as art, are featured at SIGGRAPH conference

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IN a crowded Boston theater, a thunderstorm unfolds on the silver screen. As the storm grows, strong winds effortlessly toss objects from the ground into the air.

But this violent weather is a not part of a "Nature" TV program. It's a mathematical simulation, produced on a supercomputer and displayed with a state-of-the-art computer graphics system. As the storm develops, computer-simulated balloons and arrows trace the path and twists of the wind, making visible the storm's dangers. The film is a tool for a new generation of scientists – it's also a work of art.

"Previously, these [computer graphics] techniques have only been available for feature films and Madison Avenue," says Larry Smarr, director of the National Center for Supercomputing Applications, which produced the film. Recent plunges in costs, says Smarr, have made using such ...ns possible for the scientific ...mmunity at large.

Researchers want to use high-quality computer graphics because complicated scientific models are easier to understand and interpret when they are displayed in images that use realistic details like shadows and reflections.

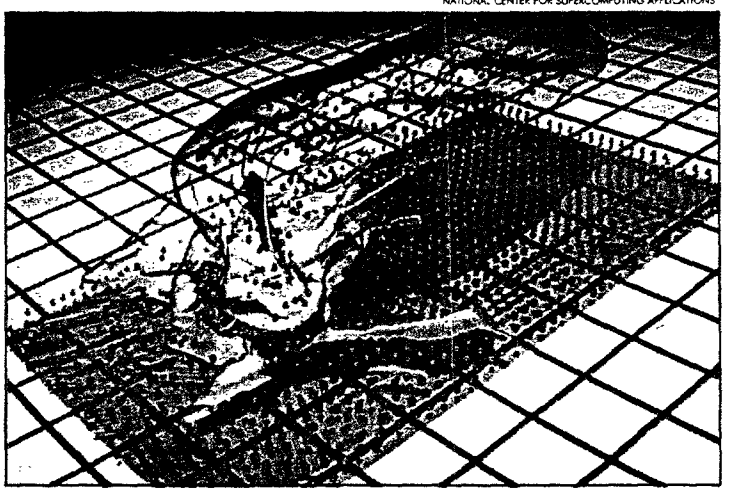
"Scientists deal with ideas and information that are extremely complex," explains Robert Haber, an associate professor of theoretical and applied mechanics at the University of Illinois. "We have information and data sets that we have had on hand for years that are just too difficult to understand. When you look at a picture, you get insights you just can't get any other way."

Both the art and the applications of computer graphics were explored earlier this month at SIGGRAPH, the weeklong, annual meeting of the Association for Computing Machinery's Special Interest Group on Computer Graphics.

Ten years ago SIGGRAPH was a small, academic conference attended by fewer than 1,000 people, who came to hear technical papers on topics like "Fong shading," says Dr. Haber. This year, more than 28,000 students, scientists, entrepreneurs, and artists from all over the world showed up. The technical papers, still an important part of the conference, have been joined by courses, panels, an art show, a floor with 238 exhibits from equipment manufacturers, and a 90-minute animation festival.

Using graphics systems to help scientists visualize the results of their calculations on supercomputers was one of the main themes of this year's show. With the aid of computer graphics, it is possible to change the viewpoint of a simulation in progress, freeze the action, and even step forward or backward through time. Physical properties such as stress and temperature, normally invisible, can be displayed and made comprehensible through color.

NATIONAL CENTER FOR SUPERCOMPUTING APPLICATIONS



SIMULATION: *A storm, 'cooked' up by a supercomputer, permits scientists to study natural forces.*

"It's the only way I can take a layman through my work," says Haber, whose research involves modeling the movement of cracks.

On the SIGGRAPH exhibition floor a computer displayed one of Haber's simulations, tracking a crack through a simulated block of aluminum. As the crack's velocity increases, its color changes from blue to red. "Nice graphics also help raise funding," he adds.

But it isn't technology alone that has drawn so much interest to this fledgling field: "I like computer graphics because . . . it combines art and technology," says O. Gordon Wait, an electronics designer at Cubicomp, a Canadian graphics company.

Other attendees came primarily for the art. Lynn Pocock-Williams will teach computer art at the University of Vermont this fall. "The newest works of art are out and some of the pieces are extraordinary," she says, adding that SIGGRAPH is one of the few places where such collections can be seen.

The high point of the multimedia extravaganza was an evening of 44 state-of-the-art animations from around the world. One film, submitted by the University of North Carolina, took the audience on a tour through a realistically illuminated "virtual lobby"; the eventual goal of the project is to give architects a picture of what their buildings will look like before they are built.

Thirty minutes of this year's 90-minute show was recorded by using a stereoscopic technique that made the films appear three-dimensional when viewed through special glasses.

Such films use sophisticated computer-modeling techniques to produce scenes that can be virtually indistinguishable from reality: Lights cast shadows, reflections are seen in glass or metal, and objects blur when they move too fast.

One film producer, California-based Pixar, Inc., won an academy award for the animated film it debuted at last year's SIGGRAPH. Making a short film can require dozens of people and thousands of hours of computer time. Still, the results are dramatic.

"I was really blown away by the 3-D stuff at the end," says Joel Gluck, a Boston actor who went to the showing. Most impressive, he says, was Pixar's "Knicknack," a five-minute film about a snowman trapped inside a kitsch souvenir from Alaska. "It was professionally done, and it had a great spirit of fun to it," says Mr. Gluck.

Close Encounter With 'Virtual Reality'

IF I turn my head to the left, I can see the Cheshire Cat. If I extend my hand and reach in front of me, I can touch the Mad Hatter. I am in Alice's Wonderland.

Neither dreaming nor hallucinating, I am really sitting on a stool in a booth at a computer graphics show in Boston.

The cause of my fantastic view is the helmet on my head. In front of each eye is a tiny television, each connected to a computer that is displaying a scene from its memory bank. A device on top of the helmet reports changes in my head's position to a controlling computer, which instantly updates the pictures. A special glove on my hand tells the computer the position of each of my fingers, so when I raise my hand, the computer can draw it.

Inventor Jaron Lanier calls the system "virtual reality," and his company, VPL Research Inc., in Redwood City, Calif., is ...ng a lot of heads turn. Not limited to ...derland, the computer can be programmed to display any "world" imaginable. Wearing the headset, an architect can literally walk through a computer simulation of a building under construction and observe first-hand how things will look. The National Aeronautics and Space Administration is exploring ways of using the system to control robots in space.

To the person wearing the helmet, the virtual world appears "completely real," says Mr. Lanier. "It's like being in a dream. You can hold up your hand and wriggle your fingers, and there is another version of your hand" in the computer screen, doing the same thing.

What's more, when two people don the helmets and gloves, the computer can be programmed to let them see each other.

VPL may soon install a system in a hospital for children with disabilities, "so they can leave their disabilities behind and interact with others on the same level," says Chuck Blanchard, a programmer for VPL.

Beyond the headset and gloves, the company makes a full-body suit, although at $92,000, none of them have been purchased yet.

Indeed, high cost is one of the real remaining barriers to virtual reality. Together, the helmet and a single glove cost $17,800; add in the two computers required to control the two TV screens, and the cost jumps to over $200,000.

And the system still has problems: The virtual world lags behind a person's head movements by a quarter of a second or so, and the images displayed inside the headset currently look more like pages out of a child's coloring book than high-quality computer graphics. Nevertheless, as the graphic systems get faster and more realistic, these problems should, like the Cheshire cat's grin, disappear.

And, with the cost of systems tumbling, the day may soon arrive when people take vacations to other planets simply by donning full-body suits and helmets.

– S.G.

ROBERT HARRISON – STAFF

COPYCAT: *With computer-imaging helmet, wearer can have his movements re-created by small television set held in front of each eye.*