The infinite dimensions of future technology

Ware Myers, Contributing Editor

As innovations in computer and communications technology accumulate, Lynn Conway, a research fellow at the Xerox Palo Alto Research Center, told the Compon Spring 83 keynote audience, "we keep resetting the limits of the possible." On the other hand, she continued, cultural inertia restrains the processes of innovation, and to some extent that is a good thing as it provides a measure of societal stability.

But as technology makes it easier for people, independent of their locations, to do things in more complicated ways, the constraining effect of this inertia keeps declining. People in many different places can now observe the same things, interact with the same events, initiate ways of learning, try out new ideas, collaborate with other folks at a distance, and acquire new technical skills, and they can do all of this faster than ever before with the help of current technology.

Within the infinite dimensions of the future, Conway sketched out two areas of technology that are far enough apart to suggest the space of possibilities that lie before us. One aims at enhancing human visual interaction with remote events and phenomena; the other creates remote replicas of some part of the human thinking process.

Surrogate travel. The first new area lies where videodisk image generation and interactive computer technology meet. The Architecture Machine group at MIT has developed a demonstration that enables a person, seated before a display, to simulate moving at will through Aspen, Colorado. Every street scene in Aspen was prerecorded on a videodisk. As the observer turns his simulated vehicle one way or another, the corresponding scene is brought from the videodisk to the screen. This gives the observer the impression of driving or walking through Aspen under his own control. In a few places he can even go inside a store and look around.

So much is actual fact. Conway speculates further on the advantages of connecting a bicycle exerciser to such a simulator in order to make exercise a lot more interesting than it is now. As a next step, we could have games based on getting from one place to another quickly; then, with sufficient network capacity, we could have races between different participants. "All kinds of games—new ways of interacting with people—become possible," Conway observes.

Intelligent server. In the second new area, instead of bringing the world to the person, the person plants some of his intelligence as an expert system in a remote server. Conway's group has an operating prototype of one form of such a system, called "LOOPS," which was created by Mark Stefik, Dan Bobrow, and Sanjay Mittal. Their work began with the perception that the technology of building expert systems is presently in a "rather archaic form."

The intent was to design an environment that integrates some simple and easy-to-learn versions of major programming practices—object-oriented programming, data-oriented programming, and the rule-oriented programming methods used in artificial intelligence. Conway's group is trying to use information technology to boost the process of trying out this environment, simplifying it further, and propagating it.

The group has begun to offer some intensive three-day courses in which the participants study the environment and build a small expert system of their own. Instead of building a system from scratch, they modify an existing system—a system that deals with practical knowledge about the real world, information with which the participants are familiar. The real world knowledge is concerned with the buying and selling of commodities by truckers. "When the game is running," Conway says, "there are trucks going back and forth, zooming in and out of the places where the truckers buy and sell things, while trying to avoid bandits, hijackers, and, hopefully, rough roads."

So far the truckin' game sounds like a number of other video games, albeit with a more serious purpose—making money. But the students do not play the game directly. Rather they design an expert system that plays the game for them. The student designer has to embed in an expert system all the practical knowledge that he can find, knowledge that will help him survive and end up a winner. A procedural package is not good enough, because there is a game master who generates a completely different game board each time. Students have to devise rule sets that will function successfully in different circumstances, and the game introduces new difficulties each play, just as the real world does.

What the designers do is create a battery of dials and gauges that report the money spent, money remaining, available gas supply, and other facts. By watching these dials, the designer can keep track of how his rule set is functioning. He can see when his expert system is getting into trouble or is doing well, thus allowing him to think about how he is going to improve his rules for the next game.

Conway's effort appears to operate on multiple levels of sophistication. At the obvious level, we have a game that is fun. Beyond this, we have the keener motivation of challenge—the course ends in a series of play-off competitions between the gradually improving expert systems. The underlying purpose is to teach persons unfamiliar with artificial intelligence just what an expert system is and a little about how to build one. And at the deepest level, Conway is using interactive computer technology to amplify human learning abilities. "In the process we'll undoubtedly open up new forms of human experience," she concludes.

EDITORIAL COMMENT

This is a great article. It's a pleasure to read. The author does a great job of explaining the technology and its implications. I especially like the way she describes the surrogate travel and the intelligent server. It's clear and easy to understand. The article is well-written and well-structured. I recommend it to anyone interested in the future of computer and communications technology.
Caltech premieres "algebraic ballet"

Ware Myers, Contributing Editor

The algebra of falling bodies becomes "dancing equations" as part of The Mechanical Universe, a college-level television course being developed by the California Institute of Technology in cooperation with the Corporation for Community College Television. Funding of $2.1 million has been put forward for the project by the Corporation for Public Broadcasting and the Annenberg School of Communications. The dancing equations—a computer graphics application—are being created for the series by James Blinn of Caltech's Jet Propulsion Laboratory. Blinn's animated films for the Voyager planetary encounters and the Cosmos television series were widely seen on public television.

In the premier episode, first viewed by the public at Caltech on February 23, physics professor David I. Goodstein derives the three equations of falling bodies—distance, speed, and acceleration. As he starts to do the derivation on his classroom blackboard, the film cuts to the animated equations. As Goodstein talks over the film, the equations are manipulated in accordance with the rules of algebra and calculus. Terms are moved from one side of the equation to the other; terms common to both sides drop out; or the same operation is performed on both sides. These operations take place to the dancing lil of a tinpan alley piano. The dancing maneuvers are probably too fast for most students to follow, but they give an enchanting illustration of the power of algebra. In the actual classroom, the instructor and accompanying book will provide the students with more detail about what is going on, at a somewhat slower pace.

Another part of the episode is devoted to deriving the equation for the Free Fall ride at Magic Mountain entertainment park in California. First we follow an attractive young woman, who seems a bit dubious about free fall as an upcoming experience, as she gets on the ride. The ride begins, and from time to time the sliding vehicle dissolves into animated graphics that show the distance the car moves in various lengths of time.

The videotape presentation at Caltech was preceded by some introductory remarks by Goodstein. Caltech has always attached great importance to freshman physics. Former Caltech president Robert Millikan once taught the course, and Nobel prize winner Richard Feynman taught it, too, about 20 years ago. In fact, president Marvin Goldberger is teaching it this year. Nevertheless, about five years ago freshman physics was the focus of student complaints—complaints that eventually led to its assignment to Goodstein. His course was so well received that he was asked to create a special physics lecture as an evening program for The Associates, a Caltech support group. That show was videotaped and became the inspiration for The Mechanical Universe.

Goodstein emphasizes that the series will "probe the history, spirit, and methods of science, and the application of the basic laws of mechanics." For instance, he delves into the notebooks of another Nobel prize winner, Robert Millikan, to show how Millikan treated (or perhaps mistreated) data on his classic oil-drop experiment that revealed the charge on the electron.

"We'll discuss how the laws of conservation of angular momentum help us understand hurricanes, fire storms, and the shape of galaxies and solar systems. We'll show how basic laws are applied to navigation in space, to black holes, and to understanding how sound can break wine glasses and why the Tacoma Narrows Bridge collapsed."

Two textbooks are being prepared to go along with the visual material, one for engineering and science majors and the other for students in nontechnical disciplines.

The entire series of 26 half-hour programs is expected to be ready in 1985.

Correction

In the January/February issue of IEEE CG&A, an incorrect entry was inadvertently included in Carl Machover's "An Updated Guide to Sources of Information about Computer Graphics." The correct address for Computer-Aided Design, a publication of Butterworth Scientific Ltd.— Journals Division, is PO Box 63, Westbury House, Bury St., Guildford, Surrey GU2 5BH, England.

As a further update, Butterworth has announced the publication of two new graphics-oriented quarterlies: Image and Vision Computing and the Journal of Molecular Graphics. Author and subscription information can be obtained by writing to Butterworth at the address given above.