Selective Update

Computer graphics at AI 1986

Angela Reilly, IEEE CG&A Assistant Editor

Animating human motion, using color intelligently, and mapping routes over difficult terrain are three ways to integrate the concepts of artificial intelligence with computer graphics. These diverse applications were presented to an audience of 75 at AI 1986, in a session chaired by Christopher Schmandt of MIT.

Knowledge-based animation

Delle Maxwell, of Pacific Data Images, reported on a project at NHK-TV, the Japanese Broadcast Corp., that sought to animate realistic human motion. The result was Dr. Holon, a futuristic, Walter Cronkite-type emcee for the series, "Warnings from the 21st Century."

Although little more than a stick figure modeled with cloud dots, Dr. Holon nonetheless exhibited emotion and personality, mostly through hand motions.

The NHK-TV project combines motion data (walking) generated algorithmically with motion created by keyframing (hand movements), so Dr. Holon can make realistic hand gestures as he walks and turns. An attempt to provide facial expressions was abandoned because of time constraints.

Maxwell's work for NHK builds on research into human motion control at the MIT Media Laboratory, where she studied before going to Japan. The MIT research team seeks to go beyond animating human movement to explore knowledge-based

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Diverse crowd packs Computer Graphics 86

Angela Reilly, IEEE CG&A Assistant Editor

A record 35,000 people descended on Anaheim, California, for Computer Graphics 86, the huge conference and exhibition sponsored by the National Computer Graphics Assn., held May 11-13.

For one week 266 exhibitors demonstrated the wide range of applications for computer graphics, from the flash and polish of animation to the precision of CAD/CAM/CAE solid modeling to the hotly competitive world of business graphics. The same diversity was evidenced in the lineup of 141 tutorials and technical sessions.

The large turnout and the sophistication of the products left no doubt that the computer graphics industry has arrived. Indeed, the scope of the conference made one wonder if Computer Graphics 86 could continue to be all things to all applications.

"People keep predicting that graphics will just dissolve into everything else," incoming NCGA President Phil Mittleman said, "but it's not happening. What we want to do is attract the new user of computer graphics." To that end, a section of the floor at next year's exhibition will be devoted to the new user of PC CAD and computer-aided publishing, he said. Exhibition space for Computer Graphics 87 is already sold out, he added.

Broad user base

Judging from preliminary attendance figures, there is good reason to cater to the novice user.

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*animation*, a method of giving the animated character some information about its environment so it can move and react realistically in response to things or characters placed in that environment.

This type of animation requires *task level animation*, or the implicit description of behavior in terms of events and relationships. This is much more difficult than *guiding mode animation*, in which motions are specifically described, and *animator level animation*, in which actions are algorithmically described, according to Maxwell.

One technique to script the unique, nonrepetitive motion that makes animation look realistic is to directly track and digitize human motion. At the MIT Media Lab, this is done by dressing an actor in a suit covered with LEDs at strategic body points. As the actor moves around in a small (two meters square) space, four cameras pick up the light emitted by the LED arrays and the x,y,z coordinates are reconstructed for rendering.

This experimentation has led to the development of a new tree editor used to represent the human body as a hierarchy of linked nodes, Maxwell said.

Maxwell also reported that MIT has used voice and gesture input combined with speech recognition to animate a figure performing simple gestures. The goal of this research, Maxwell said, is to have the actions in the virtual 3D world be a direct consequence of motion, speech, or touch performed in the user's real world.

**Color it intelligently**

While more vendors are stressing the "user friendliness" of their systems, too often they ignore the role of color, according to Mark Versel of Intel, who spoke on intelligent use of color in designing user interfaces. Color is potentially one of the most important elements in the user interface, he said.

The situation could get worse, since software programmers now have thousands, even millions of colors at their disposal. But Versel warned that color can be a two-edge sword—the use of color for color's sake only confuses the user.

Intel's Engineering Design Environment (EDeN) project explored the correct use of color. It found that color can be used as a design attribute, but only if it is used consistently, not too many colors are used, and colors are chosen carefully.

**Color can be a two-edge sword—the use of color for color's sake only confuses the user.**

Vershel recommended the use of color for menus, status messages, and design data. When used in menus, colors should be used consistently across the product line, and should be consistent from one type of menu to another. He recommended the use of color to group concepts on a menu.

Green is the best color for "normal" status messages, Vershel said, yellow is best for "warnings," and red for "error" messages. The color of the message alone then conveys the relative importance of the message.

Color should be used to represent design data, but only when necessary, Vershel said. "If it doesn't add information, you shouldn't be using it," he said. Vershel recommended giving the user only 10 or so colors, then providing a way around this color range that forces the user to use color intelligently. Instead of different colors, he suggested providing the user with fill patterns and dashes.

Other recommendations from the EDeN project are

- Avoid the use of saturated colors.
- Never use blue for text.
- Avoid using red or green for messages on the periphery of the screen; they are hard to see.
- Avoid designating edges with color alone.
- Minimize background distractions by using, for example, a dark gray grid that can be turned on and off.

**Computer pathfinders**

A project at FMC Corp. is using computer graphics to help armies find their way over difficult terrain, according to James Zamiska of FMC.

The project seeks to bridge the gap between terrain databases and the military's mission planning systems. The ideal system, Zamiska said, would map a passable route based on information about elevation, vegetation, and visibility. He described an algorithm developed at BBN Labs that determines what areas can be seen from an arbitrary viewpoint so that enemy visibility can be determined.

The Decision Support System developed at FMC uses this terrain analysis database to reason about visible and covered regions, and notifies the user if the area is dangerous to enter. A path-planning system has also been connected to the terrain database, so passable routes can be mapped automatically.

AI 1986, Artificial Intelligence and Advanced Computer Technology Conference and Exhibition, held April 28 through May 1 in Long Beach, California, was sponsored by Digital Design magazine, the Society for Computer Simulation, and DM Data, Inc.
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The session on getting started in CADD drew more than 100 people, the majority indicating that their companies do not yet use CADD; sessions on computer graphics applications for corporate communications and evaluating and selecting graphics equipment also drew more than 100 people.

However, the presence of these novice users was complemented by many sophisticated users, especially in the CAD/CAM and business graphics areas. This was evidenced by the good attendance at sessions on getting more out of the computer graphics investment, planning for CIM, and the business graphics "shootouts."

The heavy traffic was good news to exhibitors coming off a slow year for the computer and computer graphics industries. Mittleman said the exhibitors at this year's conference were "the most enthusiastic I've seen." He said he visited a dozen booths, and said the vendors reported getting "more leads and better leads than before. They were very enthusiastic."

Keeping up

And there is plenty of room for growth, according to industry analyst Carl Machover, who attributed the slowdown last year to confusion, not saturation. Machover estimated that only 10 percent of those who could be using computer graphics with current technology are actually using it. CAE and CIM, he said, offer spectacular growth possibilities.

Machover's comments came at the NCGA Corporate Advisory breakfast, held for the corporate members whose task it is to keep up with this dynamic industry. Their challenge is perhaps best illustrated in a joke Machover told:

A man driving down a highway suddenly noticed a three-legged chicken running beside his car. The chicken raced the car down the road, finally passing it to speed off into the distance. The driver was so shocked he turned the car around and went back to the farm where the chicken appeared to have come from.

"Did you see that three-legged chicken?" he asked the farmer.

"Of course I saw it," the farmer answered. "I bred it."

"Why did you breed it?" asked the driver.

"Well," said the farmer. "There's only my wife, my son, and me living here and we all like drumsticks. It seemed too bad to kill two chickens just to get three drumsticks. So I bred a three-legged chicken."

"How does it taste?" asked the driver.

"Don't know," answered the farmer. "I've never been able to catch one."

So that was the challenge of the week: trying to get a handle on the state of the industry. Here's a capsulized summary of what conference attendees saw:

Videogala

The splashiest, most visible part of Computer Graphics 86 was the Videogala, a lavish Hollywood-type event hosted by NCGA President Thomas Cain and Roy Disney, vice president of Walt Disney. David Evans, of Evans & Sutherland, was presented with the NCGA Award for his pioneering work in computer graphics.

The focus of the evening was the awarding of prizes in the first International Computer Animation Competition. Despite the fact that animation accounts for only one percent of graphics applications, it is by far the most visible segment to the general public. This year's Oscar-like awards ceremony hinted at the beginnings of a computer graphics star system.

Mittleman, who chaired the animation competition, said that it would remain essentially the same next year, although some categories may change. "Videogala was definitely the high point for me," he said. "There was a real glow in the room," he said, a feeling of affinity that he attributed to the affability of Disney, who seemed genuinely bemused and impressed by the entries.

The trends

As expected, PCs and PC-based applications were a significant part of this year's new product announcements, with most established vendors offering a PC alternative of some kind to their high-end workstations and/or software packages.

While NCGA said 1400 "new" products were introduced this year, the emphasis was not on new technology, but on enhancements that integrated current hardware offerings, on unbundling of software, on the introduction of "friendlier" user interfaces, on the blurring of the fine
line that has separated computer-generated graphics from image processing and video technology, and on the importance of graphics standards.

**PC workstations**

In a session on future trends, Alan Paller of ISSCO predicted PCs will be used as both workstations and terminals. PC users can expect improved resolution, with the 350 × 640 resolution of the Extended Graphics Adapter and 100 dpi becoming standard, he said.

Paller said he also sees cooperative processing between PCs and mainframes and a great upsurge in PC power. The Intel 80/386, predicts Paller, will put the mainframe on the user's desk; MS DOS Version 5.0, which may be released as early as the first quarter of 1987, will expand PC memory limits to 1M to 2M bytes.

More memory at the PC level will fuel advancements in paint, drawing, and animation programs. Paint programs for artists are growing in sophistication, and were some of the more popular booths on the floor.

The impact of PCs was also covered in Eric Teicholz' presentation on PC CADD. "Nobody anticipated the growth of PC CADD," Teicholz said, but now the installation rate is between 3000 to 4000 systems a month. Vendors that offer total functionality from the mainframe down to the PC, he said, will have the market edge.

Other companies may wait for the price of 32-bit workstations to drop, he said. But even those companies will offer some integration to PC-based systems, whether as an interface to DOS or as a PC-like icon-based interface.

**Integration and modularity**

Several speakers and vendors were taking a holistic view of graphics, emphasizing the importance of integrating the technology into the office and into the process of serving the client.

"Nobody argues that the technology isn't cost effective anymore," Teicholz said, "but you have to integrate it into the process, or you'll turn off designers." An important trend, he said, was the use and reuse of the database generated by CADD. Many clients are now asking for tapes of the design as built to use in facility management. He cited a survey that said 15 percent of clients now want these tapes; and of that 15 percent, half of them want a particular system.

This argument was echoed by James Meadlock of Intergraph in an address to the corporate advisory board. The same database used to do the earthwork for a building should be used for doing the foundation and then to design, construct, and do the finishing work on the same building, he said. Finally, it should be used to maintain the building, Meadlock said.

Paller also cited a trend in software that will offer integrated solutions on mainframes, and the importance of the database in this trend. The database should "know" what various charts look like so the computer can draw the most appropriate chart based on supplied data.

Taking that database to the manufacturing process is the basis of CIM. The session on CIM technology drew 50 people; one on CIM implementation drew 70 people, and the one on management perspectives on integrating CAD/CAM/CAE into the organization drew 85 people.

One case study of how to use and reuse the database was given by Robert Abel, whose firm walked away with the best of show prize for the "Gold" series of commercials for Benson and Hedges. For advertising purposes, the compass, pocket watch, and fountain pen had to be intricate and beautiful. But Abel stressed that the real significance of the commercials was that the modeling data used to do the rendering was then used to generate the manufactured items, which are for sale in selected markets.

The Abel Image Research software is being sold "unbundled," spotlighting another trend. Auto-trol and SDRC also announced the unbundling of their software.

**Human factors and user interfaces**

The fact that computer graphics is now more accessible than ever is changing the way user interfaces are being designed, and raising concerns in some circles about the "responsible" use of graphics.

The manufacturers of sophisticated systems have begun to adopt some of the tricks that make PCs seem so easy to learn. Computer vision was showing a new icon-based interface to its CADDs 4X software. Silicon Graphics, while stressing its position in the high end of the workstation market, acknowledged that the PC standards for easy user interfaces will have to be matched by manufacturers of more sophisticated systems.

Aaron Marcus, among other speakers, raised the question of design standards for the use of computer graphics. Desktop publishing, Marcus said in his tutorial on information design, "will turn almost every user into a graphics designer."

Unfortunately, Marcus said, many users of graphics packages do not have a background in design, and so may produce a "vast amount of visual garbage." In particular, Marcus noted that the advent of 3D software for PCs has meant a large increase in the number of business graphs done in 3D despite the fact that, in most cases, the third dimension doesn't add information and may even introduce error.

**Business graphics**

Based on the reaction of attendees to the two business graphics "shootouts," however, many firms are ready to upgrade to a graphics package that gives them 3D and combines chart making with database access, drawing packages, and more typefaces.

This was the second year for the shootouts, which pit products against each other in live demonstrations, and attendance was very good (200 in the first session). Zengraphics, the winner of the shootout for best business package (Mirage), emphasized its use in tandem with a drafting package to create more sophisticated charts. Graphic Communications' Freelance won the drawing package title.

That this segment of the market is rapidly maturing was evidenced by the emphasis on USA Today- and Newsweek-style graphics.

**Image processing and video effects**

The trend that is blurring the distinction between image processing, video effects, and computer graphics

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July 1986
was best demonstrated by the debut of the Pixar Image Computer.

The Pixar machine demonstrated an impressive ability to interactively enhance medical images and stereoscopic images for geophysical analysis. On a PC level, AT&T was drawing crowds with its Image Director, which can scan images into MS-DOS-compatible PCs for manipulation and overlay with a paint program.

Those who attended a session on the optical disk given by Peter Black of XIPHIAS got a hint of the awesome potential of this technology, especially in electronic publishing and education. Black compared the storage capacity of the optical disk (550MB bytes) to 380,000 typed pages, 1400 PC floppy discs, a good typist working full time for nine and a half years, or 5000 to 7000 images.

Standards

New and old technology aside, the past year has seen no lessening of the confusion surrounding graphics standards. Throughout the conference there were constant references to the importance of standards: what they are, why they are, and who decides what and why they are.

"Standards are kind of like orphans," Mittleman said, "no one quite knows what to do with them."

Several well-attended sessions were devoted to defining terms and explaining the standards process, an effort, Mittleman said, to make corporate members aware of standards. He cited the lack of communication and information in the past as the impetus for NCGA's recent push in the standards area. "These things are so complicated," he said, "yet they can have a large economic impact. We're trying to give our top corporate members a feeling as to what these standards mean to them."

NCGA's new standards committee is headed by Don Millers of Megatek. Its mission, he said, is to educate top corporate management about standards and their importance to companies in this field. Technical sessions and tutorials covered GKS, PHIGS, CGI (formerly VDI), IGES, the new PDES (Product Data Exchange Specification), MAP, and TOP.

MAP and TOP

Automated manufacturing will more than likely be made possible by MAP, the Manufacturing Automation Protocol being used by General Motors. TOP, the Technical and Office Protocol, is to office and technical people what MAP is to the people on the factory floor. The Corporation for Open Systems, or COS, is a group of manufacturers who are preparing to certify that products comply with the standards they claim to support.

CGI

A presentation by Peter Bono explained the Computer Graphics Interface, formerly called the Virtual Device Interface. Bono stressed that the CGI specifies an interface and communication across that interface, not what's done on either side. CGI manages only one virtual device, while GKS and Core manage several.

Only the functional description and semantic definitions have been developed. The procedural language bindings and data stream bindings have not been developed, he said.

Exchange standards

ANSI representative Paul Smith tried to clear up the confusion about IGES versus PDES in a technical session on CAD/CAM exchange standards. IGES covers the exchange of data, but PDES will standardize the exchange of complete project models. PDES was made necessary when the limitations of IGES in handling large data sets were fully realized, he said.

ANSI approached the development of PDES with a "clean slate," he said, and a rough draft is expected by the end of the year. PDES is the US version of STEP, the exchange standard that has been proposed on the international level.

In the meantime, Version 3 of IGES has just been distributed. This version extends connectivity, architecture, and piping. Version 4, due next spring, will account for solid models. "IGES works," Smith said, "but it has not been without a lot of problems." Currently, the bulk of the problems are caused by incomplete or imprecise translators, he said.

The IGES certification program will be administered by the Society of Automotive Engineers, and the Department of Defense has volunteered to use the standard in practice to guarantee that it is complete.

Forecasts

So what's next for the industry? Naturally, most analysts were predicting growth and a maturing of products and buyers. Machover provided some numbers, estimating a $10 billion market this year and a $35 billion market by 1991, but a slower growth rate overall.

The CAD/CAM slice of the market, now 60 percent, will shrink to 48 percent as other applications mature, he said.

On the database front, Meadlock predicted that the current network databases will give way to relational databases, which can be small enough to run on PCs. The dilemma that faces users of relational databases, he said, is their inability to handle high geometry: How can a geometry-oriented environment live with relational databases? The answer to that question, Meadlock said, will have much to do with the future of the industry.

Meadlock also predicted the optical disk (CD-ROM) will gain in importance because of its enormous capacity, a prediction echoed by Ken Anderson of the Anderson Report.

Anderson also reported on the consumer side of the industry, saying that buying decisions are moving to higher corporate levels, but that tax uncertainty has put many capital expenditure budgets on hold. One statistic from Anderson, however, indicates that the stage is set for explosive growth: 40 percent of solid modelers being used today were installed in 1985.

Computer Graphics 86 proceedings are in three volumes, two for tutorials and one for technical sessions. They are $35 each for members, $55 each for nonmembers. The theme of Computer Graphics 87, to be held March 22-26 in Philadelphia, is "Applications for Excellence." For more information contact NCGA, 2722 Merrilee Dr., Suite 200, Fairfax, VA 22031; (703) 698-9600.