

NYIT's Experimental Computer Graphics Extravaganza

PROJECTS: Inside "The Works"

by Suzan D. Prince



"Panzer" from NYIT's "The Works," by artist Dick Lundin.

Any year now, Lance Williams will be able to say he – and his cast of creative cohorts – have made a movie. Since 1978, Williams, senior research scientist for the Computer Graphics Lab at New York Institute of Technology in Old Westbury, LI, and a team of a dozen or so graphic artists, producers, students, programmers, and engineers have been sweating over a multimillion dollar motion picture project called "The Works." When

finished, the ongoing project will be a 90-minute, entirely computer generated feature. But don't expect pre-theater publicity and release date to be forthcoming. "The Works" is the research-oriented brainchild of Dr. Alexander Schure, a founder and former president of New York Institute and now college chancellor.

"Dr. Schure envisioned 'The Works' as a way for the Lab to focus r&d efforts on large-scale computer animation hardware and software development," Williams explained. "And he felt that the motion picture genre is particularly well-suited to this medium. It was not intended as an entertainment or commercially oriented production, although it does have implications in those areas for future applications using the technology we've developed."

Computer Pictures was privileged to tour the tight-security facility for an exclusive behind-the-scenes update on the film's progress. The visit included the presentation by Lab administrative director Louis Schure of brand new footage in a demonstration tape. Although dollar figures are not available, estimated development costs for "The Works:" including equipment, software and staff overhead, runs into millions of dollars since, according to the Lab, a significant percentage of the Institute's total funds, which are derived largely from private donations and government grants, is funneled to the graphics facility.

Much more complex than any computer generated feature to date, "The Works" has taken on something of a "stone soup" quality over the years, according to Williams.

" It just grew and grew and grew. No matter what came before, someone always had something more to add, there was always something more to do on the project," he said.

Which was exactly Dr Schure's intent, says the head designer. Unlike many computer-made features, which at least have the systems and software base in place for their conception and birth, "The Works" barely had theory going for it at the outset.

"We started absolutely from scratch. I wrote the screenplay, but we had to design all the programs and determine the hardware that would make the characters move and enable us to manipulate them," Williams recalled. It was literally a matter of building the technological wherewithal to produce a motion picture completely inside a machine."

As production designer Bill Maher succinctly put it, "We are creating a new art form from the ground up, but first we have to build the ground."

Maher, an artist whose background includes drawing for comic books, automobile design drafting, advertising and broadcasting, created many of "The Works" cast of 25 robots. The movie's title is itself derived from " robot," a Czech word meaning "work" and the film involves a "world-spanning computer complex that has been controlling Earth since the last World War," as Williams summarized. The designer chose the science fiction category for the Lab's research because of its flexibility and distinction from other literature.

"I'll admit it's hard to work on a project for this long without degenerating into cliches, especially when you talk about science fiction, a genre in which plots are frequently recycled. However, I think it's an interesting genre to work in; it's more playful than other forms. In some respects, it is the most modern literature."

The CGL team shares Williams' enthusiasm for sci-fi. More important, such fantasy settings provide a perfect backdrop for the technology behind "The Works," which combines several

powerful, staff-developed software systems with extremely fast hardware to draw, color and animate the film. The main characters, for example, were either created without any prior blueprint, or with just the artists' sketchpad renderings using the two-dimensional mathematical modeling "TWEEN" system, or a three-dimensional geometric solids modeling system. A Scan-and-Paint program was used to color them.

As in traditional animation, the first step in computer animation at NYIT begins in the artist's mind. But that's where the similarity ends. Dick Lundin's giant Ant, an adversary of the hero robot in the story and probably the most familiar CGI-released figure to date, was first conceived and pencil-sketched by the senior research scientist. Then, working with an electronic pen or "wand" wired to monitoring equipment and to computer storage or memory banks, Lundin drew directly (or traced from his prepared drawing) onto an electronic tablet. The Ant was digitized - converted to electronic impulses - on the tablet. In this method, while no marks appear on the tablet itself, the movement of the pen is transmitted and displayed on the video terminal. Significantly, to create a feeling of motion, the animator displayed the extreme stages of the Ant's movement - the starting and final positions. The computer filled in all the "in-betweens."

Added Williams, commenting on Lundin's ability to create within a computer environment, "The Ant was one of our most difficult designs. Dick studied mechanical engineering, and he took to computer graphics like a duck to water. He has designed some truly elaborate and beautiful complex mathematical models."

New software now being written at the Lab will enable characters to be even more easily manipulated, giving them smooth, flowing, near-human motion.

"Robots are a form of human instrumentality," observed Williams. "The new programs will only emphasize their relationship to man"

New hardware in the form of outboard computers using high-speed bit processors will double the present processing speed of the Lab's DEC PDP-11/34 and VAX 11/780 minicomputers.

Another way "The Works" robots were created was through three-dimensional geometric solids modeling. In this method, figures are produced completely by computer, without benefit of a photograph, a drawing or any other pre-existing graphic form. All manner of geometric shapes are stored in computer memory, then



"Saxabone" from NYIT's "The Works," by artist Dick Lundin.

recalled on-screen and manipulated much like fluid building blocks until proper form, order and distance are defined to the designer's satisfaction. This intricate technique depends on conceiving the entire surface of a form as a network of connected ellipses, polygons, or whatever shapes are being called up. Each of these small geometric divisions is then assigned a "light" value, depending on its relative location on the form. The differing light values of

adjacent shapes produce the illusion of advancing and receding planes as well as shadows, and in this way they describe the contours of a three-dimensional image. The location of each shape and its light value are digitized into the computer, and the information is then translated back as a graphic image, which appears on the monitor.

Thus, many of Maher's robots contain reflectivity, or shine, "because I like them to look shiny." But, he added, a matte, or flat-looking finish, is also easily achieved, Maher's creations are highly stylized, reflecting his own tastes in conjunction with the building blocks, light sourcing and shadow code of geometric solids modeling. For example "T-Square," the robot heroine of the story, boasts a metallic space suit – clear, but with a nice high sheen.

"It took us 12 design passes to design T-Square's suit," the artist revealed (much longer than the few days on the average that it takes to complete a portion of any character). "We were after a feeling of fully-articulated joints to express her full range of human emotions," he continued. "You see, in the film, she has human emotions even though she is a robot."

Maher admits that some of his own designs downright scare him. "After a while of using this technology they (the robots) seem so real. You live with them every day and night. They're in your mind constantly"

Indeed, if the movie's "actors" prey on producer's minds, so do the nitty-gritty manipulation and day-to-day design problems," Maher said. "T-Square's glove, for instance, was so complex as to be equal to creating a whole separate character. We wanted her hand and fingers to move like a human's, a very complex job," he noted, but one which should be made easier with the development of the latest software.

During the tour, *Computer Pictures* had a rare opportunity to view the latest demo tape the Lab plans to release for client viewing, trade shows and other public demonstrations. Among the most recent accomplishments from the Lab team, which include Rebecca Allen,

designer, Carter Burwell, computer scientist, Dick Lundin, and others, are digital sound synthesis and automatic digitization via laser-scan techniques. Digital Sound Lab, headed by Tracey Peterson, is currently experimenting with cross-synthesis, the ability to precisely synchronize sound and picture using array processors— important for finishing the sound track of "The Works."

Working in a separate laser laboratory located in nearby Glen Cove, some of the staff are learning to scan computer-generated, three-dimensional objects directly into the computer using a special scanning device. According to Williams, such a device is faster than drawing on an electronic tablet or keying in designs on a computer terminal. Also in the experimental stages are new algorithms for displaying work surfaces. Pat Hanrahan, a senior research scientist, is leading this particular project.

Page 18

The new tape appeared to be something of a "The Works" preview in its heavily robot-oriented theme. Evidence of Peterson's success with digital sound experiments was deftly demonstrated in the form of two "androids," one male and one female. The camera zoomed in on the mouths of each robot to show how closely male and female speech and lip movement coincided. A cute "commercial" for the futuristic "Helping Handroid" robot servant further enhanced the visually exciting man/ machine overtones of this new computer-generated exhibit.

While the finished "The Works" will be on film, CGL has done all the preliminaries on video tape. Williams explained that his staff is still building the capacity to create film on machine but that the technology isn't quite ready to make the big transition.

"With three-dimensional video, the turnaround time is much quicker and the costs are much lower than using film," he said. "This affords us greater opportunity to experiment. We aren't as limited in our trial-and error process."

"Also, video allows us to combine live action with computer animation which plays an important role in 'The Works'. But soon enough we will be ready to work with film."

Williams conceded that technology developed through experimentation for "The Works" could eventually filter down to NYIT's CGL Inc. marketing arm which sells complete animation systems to industrial users. "The R&D we're doing now will probably be applied at CGL Inc. at some point in the future," he remarked. "But commercially, there is a lag. We don't expect to revolutionize anything right now. That'll come later."

And although Williams sees inherent educational applications in a film such as "The Works," he says the Lab is primarily interested in its potential for the entertainment industry.

"Dr. Schure's primary objective from the start was to improve the motion picture medium as we know it," he recalled. "The map routines, the light sources, the image generation, the painting and work surfaces – all these elements could eventually be used to build exteriors,

such as simulated landscapes and even entire interiors inside the machine."

"Some examples of the potential of the latter have already been demonstrated in 'TRON,' " he continued. "But so far, the industry has acted very conservatively, considering that there have been maybe three or four major breakthroughs including color and sound in the whole history of film.

"Eventually, the computer will be a wonderful tool that will be able to correct mistakes and make backgrounds and sets that are otherwise impossible to create in the 'real world.' Think of the possibilities: models that don't break, that you don't have to dust or move around. Robots doubling for actors. It's incredible, really. At the very least," he concluded, "we hope our work will give the people who record visual information the same freedom that the audio people have enjoyed for 30 years."

Williams trailed off at the end of his sentence and looked longingly at the model robots – all lovingly hand built from assorted pieces of 'junk' – lining the top of a file cabinet in his office, and then at his design terminal.

"Sometimes the progress seems so slow. It just takes forever. But then I look back over the past few years and marvel at how far we've really come."

Page 19

Computer Pictures

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