SUNDIALS ON MARS ▪ AVIATION COMPOSITES ▪ SMALL WORLD EXHIBIT

NORTHWEST SCIENCE & TECHNOLOGY

Spring 2004

$5.95

Computer Animation

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ALSO INSIDE:
BALLAST WATER
SPARRING WITH SPARTINA
BAFFLING BOULDERS OF EASTERN WASH.

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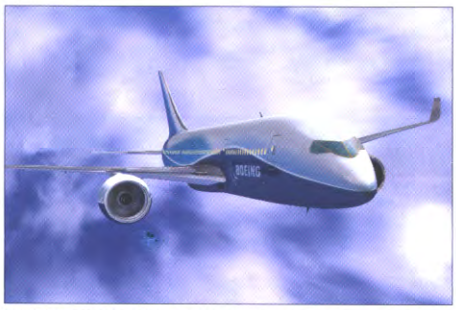
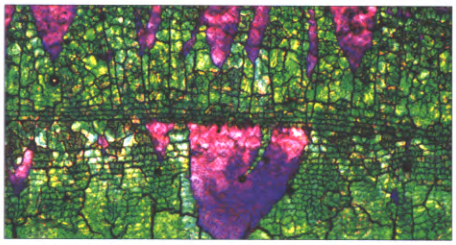
COVER STORY: The University of Washington's program in computer animation is a draw for students from departments across the campus. Student films are recognized for their quality around the world, as graduates find work in companies like DreamWorks and Pixar. **PAGE 14**



COMPOSITES TAKE FLIGHT: As polymer composites find more widespread use in aircraft, the FAA and airlines will need more information about how such materials wear over time and how to maintain and repair them—all part of the "to do" list at a new Northwest research consortium. Photo: The Boeing Company. **PAGE 6**

THOSE BAFFLING BOULDERS: Rocks carried to Eastern Washington on icebergs from as far away as Western Montana during cataclysmic floods of past glacial periods may hold clues to the nature of those floods, how large they were, and how often they occurred. Photo: Ben Raker. **PAGE 24**

A HEAVY SUBJECT: Ballast water is in the spotlight this spring, as federal and state legislators decide on regulations in an attempt to reduce the transit of invasive species. Photo: Russ Herwig. **PAGE 20**



SMALL IS BEAUTIFUL: An image captured by a Northwest student was one of the winners of the 2003 Nikon Small World Competition, honoring excellence in photography through the microscope. The exhibit visits the Northwest this spring and fall. Photo: Alice C. Kilgo. **PAGE 38**

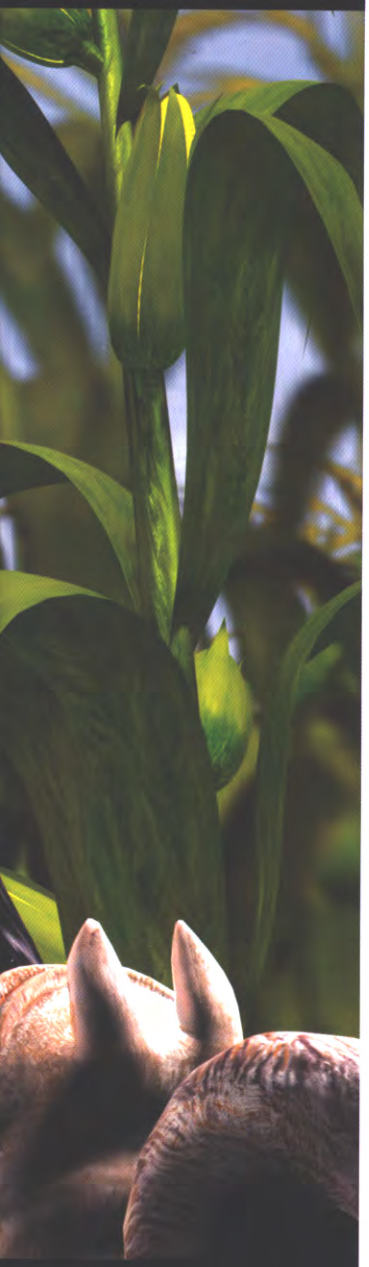
SPARRING WITH SPARTINA: Middle school students in Island County, Wash., confront this invasive grass, and increase community awareness in the process. Photo: Judy Feldman. **PAGE 44**

NORTHWEST SCIENCE & TECHNOLOGY

Computer Animation

UW's interdisciplinary program is a major draw

Computer animation students recently competed the short film Murder, *which is about a scarecrow finally standing up to a group of terrorizing crows.*



The participants seem so dissimilar that the following could easily be the setup to a joke: An artist, a computer scientist, and an architect find themselves in a classroom full of hand-drawn sketches, computer equipment, and clay models…

Although these University of Washington (UW) students may appear to have little in common at first glance, take some time to look at what they can create together, and you'll never forget the connection between each of them: a love for computer animation.

Since the first class in computer animation was offered at the UW in the mid-1990s, the program has continued to expand and develop. While student films have improved with advancing technologies, one of the program's biggest assets has remained constant—its interdisciplinary and collaborative nature.

After arriving at the UW via Lucasfilm Animation Company and Pixar Animation Studios, David Salesin, professor of computer science and engineering (CSE), wanted to create a computer animation course that would mimic the work environment he had experienced in industry.

"What's so exciting about places like Pixar is they have computer scientists working side-by-side with people that have no computer science experience," says Salesin. "Computer scientists work directly with artists or individuals with training in story writing, drawing, animation, or lighting.

"Reproducing a situation like this in the university setting seemed like an ideal learning experience and a great opportunity for students to learn from each other," he says. "Students from different departments would get the chance to work together when they wouldn't have otherwise."

In the four years after its creation in 1996, Salesin co-taught the computer animation course with the help of former colleagues from the computer animation industry and other guest lecturers. Each year, in a single quarter, students learned the entire computer animation process, called the production pipeline, from story development to sound effects. Computer science students worked alongside art students, and by the end of each course, they had created a short computer-animated film in an environment much like one they would experience in industry.

by Jeff Wolfe

Pixar, Pacific Data Images (PDI), and other computer animation companies are organized into two houses, says Ed Lazowska, who holds the Bill and Melinda Gates Chair in Computer Science and Engineering at the UW. "There are the animators, who are the art people," he says, "and there are the technical directors, who come from more of a computer science background.

"Part of what we tried to do here was to bring artistic and technical people together as undergrads when they are more malleable," says Lazowska.

The short film *Fish Shtick* (1996) is the first animation completed by UW computer animation students and is just over a minute and a half long.

The nearly two-minute *Whose Hat is That?* was completed by computer animation students in 1997.

With an extra quarter to work on *The Art of Survival* (1998), UW computer animation students were able to concentrate on the finer details of the nearly three-minute film.

Students in the 2003 computer animation program have some fun with characters from their film *Murder*.

In 1998, the computer animation course was extended to span two quarters in order to allow the instructors to go much more in-depth about each aspect of the production pipeline. The value of the added time was apparent in the quality of the resulting film. *The Art of Survival* was one of 80 films selected from over 1,200 entries to be shown at the 1998 Ottawa International Animation Festival, and the film was also accepted for the 1998 Classical Festival of Animation. *The Art of Survival* and other films the students have created since 2002 can be viewed at http://www.cs.washington.edu/info/videos/.

In 1999, with funding from the Washington State Legislature's Advanced Technology Initiative (ATI), the UW was able to hire Barbara Mones to focus solely on directing the computer animation program. It was part of a suite of programs funded by the ATI for their potential to create new industries and transform existing industries to benefit Washington state's economy.

Mones has academic as well as industry credentials. She was a professor and founding director of the Visual Information Technologies program at George Mason University in Fairfax, Va. She was recruited to the UW from Industrial Light and Magic for her interdisciplinary strengths in art, graphics, and computing. Mones also spent time at DreamWorks and PDI.

Barbara Mones

"What Barbara has done with the program is dramatically expand it," says Lazowska. "There are now multiple courses where there was once a single course that had too much work in it. Now there are lots of courses each with too much work in them," he laughs.

"The first thing I did was try to adjust the production pipeline used in industry to fit within the quarter system," says Mones. "Our films are produced in a fraction of the time it would take in industry, and the work is done by students who are essentially novices," she says.

Early on, it was decided that students should apply for acceptance into the computer animation course, instead of being admitted on a first-come, first-served basis. A student's application, portfolio, and recommendation from a professor are all taken into account.

"I'm looking for people who are collaborative, smart, motivated and talented," says

Mones, "and I usually find a whole bunch of them."

Though most students accepted into the program are from the UW's art, computer science, and architecture departments, a wide range of students from other departments are accepted as well.

"The strangest background for someone applying to enroll in the courses was business, but he turned out to be a very gifted animator," says Mones. "I've had a drama student enrolled in the courses and an electrical engineer; I have a technical Japanese major in the course right now. Each person brings something unique to the table, and that's essential to the whole animation process," she says.

"The animations students have produced are just extraordinary," says Lazowska, "and the films have definitely evolved over the years. Students are now doing things that are more technically complex, and in many ways more complex in terms of storytelling."

Mones says students are now told that the computer animation course sequence is a three quarter commitment, which consists of four courses aimed at different parts of the production pipeline. However, many of the 16 to 22 students accepted into the program each year make a personal commitment to the program that can greatly exceed the course's three quarter duration, she notes. Nearly half of last year's 17 students worked months after the course ended in June of 2003 to fine-tune a film entitled *Murder*.

With the computer animation course sequence lasting three quarters and including four courses, the student film *Mira and the Wind* (2000) is over 11 minutes long.

"These are students who are serious about having a career in animation," says Mones. "But in order to get their foot in the door at places like DreamWorks and Pixar, they need to be able to showcase their abilities. A high-quality, collaboratively produced student film, along with a strong individual demo reel, will allow them to do just that," she says.

While a number of the program's former students work in the animation industry with companies like DreamWorks and Pixar, others have stayed in the Northwest by working in Seattle's computer game industry or Vancouver, B.C.'s film industry.

"Because computer animation is such a collaborative process, I've found that students who make it in industry often find jobs for their classmates," says Mones. "When these classes work well, people become very close friends, so they're used to helping each other."

Two of the students who continued to work on *Murder* after the course ended were Brendan Condit and Nicholas Chen.

Graduating in December 2003 with degrees in zoology and interdisciplinary visual arts (IVA), Condit says he had always been interested in art as a career, but didn't think

Still Life Paintings Come Alive

As soon as a picture is taken or the last stroke of a painting is completed, the movement of life is confined to a single snapshot. The photographer or artist may be able to suggest subtle movement through the use of various techniques, but that movement is still only in the viewer's imagination.

However, a group of researchers in the University of Washington's (UW) Computer Science & Engineering (CSE) department have developed software that can put the movement back in artwork.

"The images created by the software can be used anywhere a picture would be used," says David Salesin, CSE professor and one of the collaborating researchers. "They could be used on Web sites or as computer screensavers and desktop wallpaper." Another application for the software could be adding movement to the painted backgrounds of computer animations, he says.

"The backgrounds in animations look much more lifelike if they are a little bit animated," says Salesin. "In order to get that effect now, little blinking lights are added to the background painting or computer animations are placed on top of it. Our software could give animators another way to go," he says.

The software only works with movements caused by wind force, says Salesin. After each object that would naturally move due to wind is isolated from the rest of the painting, a series of equations are applied to each object. "Basically," laughs Salesin, "there is a little math involved."

David Salesin

The equations are derived from research in the natural sciences about how certain kinds of objects behave in the wind. "We apply an equation to each object to simulate what the wind forces would have done to the tree or boat or whatever kind of object it is," he says.

The result is movement. By controlling the wind speed, direction, and roughness of the water, the software makes Monet's "The Bridge at Argenteuil" come alive. The three boats rock on the water, the 14 trees sway, the water ripples, and the clouds glide across the painting.

Collaborating with Salesin on the research were CSE Professor Brian Curless, graduate students Yung-Yu Chuang and Dan Goldman, and affiliate faculty member Richard Szeliski of Microsoft Research.

Production Pipeline

Pre-production

Story Development
The basic story behind the animation is developed.

Concept Art
The artwork that helps form the look and feel of the characters and setting.

Story Boards
Each story shift is sketched to give the animators a rough idea of camera layout, timing, and motion.

Story Reel
The storyboard is shown in real time to see if the timing of the story is correct.

Production

Animatics
The story reel is created in 3-D on the computer. This is the foundation on which the rest of the project is built.

Modeling
The characters envisioned in the concept art become 3-D objects in the computer.

Creating a New Kind of Storytelling

Zoran Popović

For millennia, stories have been passed from generation to generation from one century to the next both orally and through writing. Today, researchers in the University of Washington's (UW) Computer Science & Engineering (CSE) department are working on a new way for people to tell their stories: computer animation.

"Animation as a medium of expression is untapped," says Zoran Popović, UW assistant professor in CSE. "People don't use animation to tell their stories because it is extremely hard to create animations with current tools. It is our goal to make the process of animation easier."

To simplify the process, Popović and his colleagues are creating libraries of motion. With these collections at their disposal, Popović says people will be able to create computer animations the same way they use a computer's clip art to produce their own images.

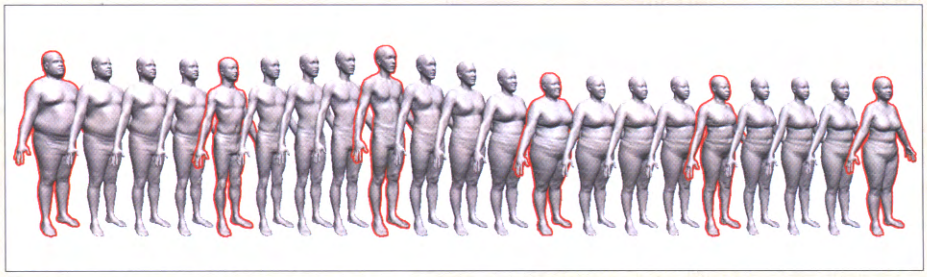
"You would first choose a kind of motion: walking, or running," he says. "Then you would choose the style of the motion: sad, happy, and so on. And finally, you would choose the type of character you wanted to carry out the motion: tall, thin, short, etc. In this way, a short animation could be created in 20 minutes instead of 3 or 4 hours."

In addition to creating the motion library, the researchers have developed ways to produce realistic human characters and simulate the movement of smoke, water, and cloth. The smoke research was used to create the title of the 2003 student computer animation film *Murder.*

"We try to find instances where research can be integrated into the student production animations whenever we can," says Popović. "The animations are a great way for us to showcase our work."

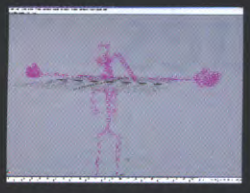
Much of the group's research is now conducted in the motion capture laboratory of the recently completed Paul G. Allen Center for Computer Science & Engineering. One of the largest motion capture labs in the country, it has 12 cameras that allow researchers to process the three-dimensional movements of actors for use in computer animations.

"Anybody with a PC should be able to tell their stories using animation," says Popović. "It shouldn't be only for highly skilled animators at Pixar and Industrial Light & Magic."



Using the 3-D scans of 250 volunteers, the researchers developed an algorithm that allows them to morph between individuals. The individuals outlined in red were randomly generated. Image: UWCSE

Post-production



Rigging
A "skeleton" is added to each model, which allows the models to animate realistically.

Character Animation & Motion Capture
The characters are brought to life when specific movements are assigned to each model's rigging. Realistic motion is often captured from actors in a motion capture studio.

Shading/Lighting
Shading adds color and texture to the environment while lighting adds depth and provides the composition for each individual shot.

Rendering
The computer takes 2-D snapshots of the 3-D environment. When frames are shown in sequence, the viewer perceives movement.

Special Effects
Aesthetically and technically challenging objects and motions are custom-designed to further support the story. Sound effects, titles, credits, and the musical soundtrack are added to the animation and any flaws are fixed, e.g. color correction.

he could make a living at it. However, after taking an animation production seminar taught by Mones, he says he knew computer animation was the career for him.

"During the course, Barbara brought in professionals from industry that specialized in sound, special effects, and character design and development," says Condit, "and they really got me interested in computer animation. I never thought there would be a program like this at the UW," he says. "I always thought you had to go to a technical school that specialized in animation."

What sets this program apart compared to programs elsewhere is that "it gives you a feel for the entire production pipeline," says Chen, a June 2003 graduate in IVA. Other schools concentrate on individual student projects where students are exposed to just a single aspect of the pipeline, he says. At the UW, students work in teams and are involved in each step of the production.

One of the industry professionals Mones has brought to the UW to talk with students is Joyce Miller, the former vice president of production for Walt Disney Television Animation.

Miller says one of the things that impressed her most about UW's computer animation program was the combination of practical technical knowledge with the creative aspect that is essential to storytelling.

"Because the University of Washington is so strong in the field of computer science," says Miller, "it would be very easy for its computer animation program to overlook the creative aspect of filmmaking."

However, Miller says that Mones has structured her courses in a way that keeps them well balanced, and she believes that the mix of students from different departments has only strengthened that balance.

"Some of the students may go on to do computer animation research instead of becoming active filmmakers," says Miller, "But by being part of a team that creates a short movie, those students gain practical knowledge that will help them in their research."

"There is a lot of talk about the strength of interdisciplinary programs, but Barbara actually does it," says Kenneth O'Connell, professor emeritus and former chair of the University of Oregon's (UO) Fine Arts Department in Eugene. "There aren't many classes that you could go into at major universities across the country and find half computer science students and half art students.

"With animation, you never know the story you're going to have to tell," says O'Connell, "and you never know what subject you're going to have to learn more about. And that's why an interdisciplinary approach to animation is so important," he says.

Currently teaching classes at the UO in studio animation, computer animation, and clay animation, O'Connell says the films of UW students will continue to be recognized for their quality as they are given the opportunity to be shown and presented around the world. "I've seen work from all over the country," he says, "and their films are some of the strongest."

Finished in February of 2004, *Murder* was screened for the first time at the Smithsonian American Art Museum during a lecture by Mones entitled "Animation as an American Artform." The film will be shown at numerous events and festivals across the country during the rest of 2004. The next student film is currently in production and has a working title of *Armonia.*

"You can't teach a course like this at an art school because they don't have anybody that's doing the technology," says Lazowska, "and you can't do this at an engineering school because you don't have anybody that's doing the art. One of the great things about being at a university like this is you have a diversity of strong programs, which makes a program like this possible."

For more information about the program, including public lectures, visit www.cs.washington.edu/research/ap ■

Jeff Wolfe received a B.A. in communication from Washington State University in May 2003. Currently, he is pursuing a master's degree in technical communication at the University of Washington.