



SIGGRAPH 2006:

Exploring the Art and Science of Computer Graphics

by *Justin Solomon*

For six days in the heat of a particularly miserable New England summer, the city of Boston became a hotbed of interaction, social networking, and knowledge exchange by some of the most prominent computer graphics researchers and designers worldwide. Better known as SIGGRAPH 2006 by programmers and artists alike, the 33rd International Conference and Exhibition on Computer Graphics and Interactive Techniques, held in the Boston Convention and Exhibition Center, boasted widely-varying displays of graphics excellence, from the more technical courses and paper sessions to an extensive animation festival complete with the world's largest Etch-A-Sketch.

Attended this year by almost 20,000 computer graphics enthusiasts ranging from students and hobbyists to animators and special effects experts from Pixar, Industrial Light and Magic, and other studios, SIGGRAPH is widely respected as the top conference bar none for computer graphics. The process for submitting a paper or other presentation to the conference is fiercely competitive, with rejection rate of about 82%, allowing conference organizers (not without some controversy) to choose a comprehensive program of top work in almost all subfields of graphics. Such hard work in planning and preparation pays off: from convincing video clips of synthetic water splashing through the most complex obstacles to scenes from computer games in which an amazingly realistic yet animated Tiger Woods prods the player to improve his or her game, even a quick inspection of the conference's offerings revealed a rich series of technologies designed to appeal to all the senses.

Still, despite the playful atmosphere and entertaining subject matter, SIGGRAPH is serious business. An extensive exhibition floor allowed representatives from hundreds

of companies, from small startups to large corporations like Disney and Google, to network among each other and advertise their latest products. Interested purchasers from industry and academia and other curious conference participants perused booths displaying the latest "render farm" software and hardware, monitors that allow observers to view and even interact with three-dimensional models, and other computer equipment that even a few years ago remained in the realm of science fiction.

The overwhelming size of the conference makes it impossible to give the reader a complete picture of the SIGGRAPH '06 experience. In the following sections, we'll take a look at the key parts of the conference and those that were most interesting to the college student with an interest in computer graphics from a technical or artistic standpoint.

At a Glance

Immediately upon arrival, one could observe the immense size of the conference. Having entered only fifteen minutes after the doors opened for the first full day, the lines for registration already winded throughout the conference center. Hundreds of men and women, many of whom wearing t-shirts and polo shirts from previous years' conferences, lined up to receive their conference credentials, a full program, and a bag of "freebies" distributed by some of the top conference sponsors. The most experienced attendees moved directly from the registration booth toward the exhibit hall once it opened; evidently the highest incidence of free t-shirts distributed on the exhibit floor generally occurs the morning of day one.

Adjacent to the registration area was a series of booths designed to appeal to all conference goers. On one side was the "Pathfinders" pavilion; due to the large size of SIGGRAPH, this pavilion was staffed every day with experienced attendees who could guide the overwhelmed first-timer. Across from that pavilion was a job fair, which featured booths from several companies seeking employees in the computer graphics field. In this area, some companies offered internship programs for students and were more than willing to accept resumes (note that most jobs were for artists and possibly "implementation experts" rather than researchers).

On the opposite side of the registration area was a series of historical, artistic, and informational displays. First was the Charles Csuri Retrospective, a collection of art spanning the lifetime of artist Charles Csuri, a pioneer of using computer tools to

generate or assist in the creation of art. This interactive exhibit featured not only Csuri's paintings but also biographical information and videos of his later work. The Retrospective was paired with a more general gallery of other computer-generated works of art.

Behind the Csuri Retrospective, in perhaps one of the less glamorous areas of the conference center, lay one of the most fascinating exhibits: the Emerging Technologies area. In this exhibit, researchers were invited to show off their latest work in an interactive display. For instance, developers from the University of British Columbia sported *Cubee*, a three-dimensional cube on which each side was a computerized display, designed for use in viewing objects from all sides and in all directions. The MIT Media Lab presented the *Huggable*, a robotic teddy bear designed for healthcare applications, making use of not only computer science research but also observations from pet therapy programs. *True 3D Display Using Laser Plasma in the Air*, from Burton Inc., Keio University, and the National Institute of Advanced Industrial Science and Technology, allowed users to display "true 3D images" in the air; this device could make points of light appear without using any special medium, spelling out words or drawing 3D shapes for the audience. Some technologies, however, were more artistic than practical. *Submerging Technologies*, from the Mitsubishi Electric Research Laboratories and the Courant Institute of Mathematical Sciences, presented several "interactive water displays," such as a "harp" whose strings were represented by columns of falling water the harp would sound when an object passed through the water.

Other interactive exhibits were distributed throughout the conference center. The Guerrilla Studio contained several new computer and hardware systems, where researchers who presented papers at SIGGRAPH could give real-time demonstrations of their new products and software manufacturers could display their latest developments and upgrades. The Teapot Exhibit displayed artists' renditions of the Utah Teapot, a three-dimensional model used extensively as an example in computer graphics research papers.

The Research

It comes as no surprise that the same minds that created such a playground of technology and art would have a technical program to match. Even if the various booths and displays provided the sizzle, fundamental to the conference was the research presented in paper sessions and "Sketches" at regular intervals throughout

the program. These presentations, available only to those attendees who purchased the most comprehensive (and expensive) registration, single-handedly made the effort and cost of attending SIGGRAPH worthwhile.

Starting the first day, several courses were made available for attendees at all levels of technical expertise. Many of these courses return year after year, each time presenting an updated curriculum that covers the latest developments in theory and practice. A few of the courses available at SIGGRAPH 2006 included:

- *An Interactive Introduction to OpenGL Programming*

This course helped attendees move beyond the constraints of the console window, presenting the basics of the OpenGL graphics system. Even those in the audience who never had written a graphics program before could leave writing interactive programs using 3D graphics without a sweat.

- *The Art of "Open Season": Traditional 2D Styling With Today's Bells and Whistles*

In this "beginners" course, presenters from Sony Pictures Imageworks walked the audience through the art of digital storytelling. As artists and technicians collaborated to create the bucolic setting of "Open Season," they integrated state of the art technology with traditional storytelling seamlessly; after attending this course, it became clear that this was no trivial task.

- *Fluid Simulation*

In this more advanced course, attendees were introduced to the basics of the Navier-Stokes Equations and other laws that govern the dynamics of water, fire, and every fluid in between. Even for those who could not follow every algorithm or derivation presented, the compelling images and animations of fluids splashing, rolling over one another, and interacting with solids provided a compelling reason for anyone to become enthusiastic about fluid simulation research.

- *Discrete Differential Geometry: An Applied Introduction*

Researchers from the California Institute of Technology, Columbia University, and other schools came together to present this day-long course on discrete differential geometry, the mathematics and algorithms of 3D mesh geometry. After covering the basics of computing quantities and curves such as curvature and geodesics, this course went on to describe applications in simulating physical interactions between fluids, cloths, and other materials using meshes and even

parameterizing time and space at the same time.

Even more important than the courses presented at SIGGRAPH were the papers. These papers, gleaned from research labs, studios, and companies in the United States, Asia, Europe, and elsewhere, represented a breadth and depth of research uncommon even to other similarly-sized conferences. In all, 86 papers were presented at SIGGRAPH 2006, covering areas like ray tracing, image processing, appearance representation, motion capture, mesh processing, and animation. Because there's no way to attend all the paper sessions (not surprisingly, many are scheduled concurrently), SIGGRAPH sponsors a "Fast-Forward Papers Preview" event in which each paper presenter must summarize their work in the span of just a few minutes. This event provided an entertaining and informative summary of all the offerings of SIGGRAPH. Some of the more confident researchers even preferred simply to show short video clips of their work with minimal technical narration; fortunately, this work often spoke for itself ("here's a bald person; here's that person with straight hair; here's that person with curly hair; watch the hair blow in the wind. . .").

The paper presentations themselves were just as impressive. Consider only a few examples of the papers available for examination:

- *Analysis of Human Faces Using a Measurement-Based Skin Reflectance Model*
Tim Weyrich et al (Mitsubishi Electric Research Laboratories, other labs)
In this presentation, researchers explained a statistical and theoretical model developed for inputting, expressing, and computing the way that skin reflects light. This is a particularly tricky problem given such difficulties as "subsurface scattering," the relatively unexplored phenomenon of light scattering beneath the skin's surface. Possible applications range from photorealistic rendering to face recognition.
- *Photorealistic Rendering of Rain Streaks*
Kshitiz Garg and Shree Nayar (Columbia University)
Many of the rainiest scenes from the Matrix trilogy were filmed on sunny days using special effects. Now, using the models presented in this paper, this type of "rain streak simulation" can be made more accurate and more interesting. Using a database of rain streak videos, special effects can integrate rain into the most dry of video sequences, simulating its interaction with nearby lights and changes in viewing angle.
- *Drag-and-Drop Pasting*

Jiaya Jia et al (Chinese University of Hong Kong, other labs)

Using the Drag-and-Drop Pasting system presented in this paper, artists can combine two images of objects and scenery in totally different environments. Even if the pictures are under totally different lighting, the images are combined seamlessly. Disregarding ethical concerns about doctoring pictures, the methods in this paper make it possible to create highly realistic scenes that never happened.

- *Reassembling Fractured Objects by Geometric Matching*

Qi-Xing Huang et al (Tsinghua University, other labs)

Computer graphics techniques can be used for more than creating the next Toy Story. In this paper, a pipeline is presented for reassembling 3D figures from the shapes of their pieces. Potential applications outside of graphics include fields like archaeology; after scanning in the three-dimensional pieces of an artifact, the computer can be used to put them together.

As if 86 paper presentations were not enough, several sessions of "Sketches" presented work completed after the SIGGRAPH submission deadline. This provides an anticipation factor as attendees can look forward to next year's SIGGRAPH for full paper presentations of some of the emerging technologies presented in the Sketches this year.

Other Events

Whereas the papers and courses appealed primarily to SIGGRAPH's technical audience, there was something for everybody on the exhibit floor. Strolling through a single aisle, one could hardly absorb the vast variety of technologies available. From modeling software to textbooks to 3D printers, almost every vendor on display had its own unique graphics product to distribute. Rendering software companies proudly displayed clips from Titanic, Shrek, and other films that their programs helped create. Other companies tried more creative strategies: Sony Pictures Imageworks offered a drawing class in which artists and programmers sat side-to-side creating their own renditions of live models standing proudly on the conference floor. Even Google sent representatives, demonstrating their new 3D SketchUp program.

Most entertaining was the annual SIGGRAPH Computer Animation Festival. In this over two hour show, almost 40 different animations screened by a committee of technical and creative experts in the field were shown to the exclusive audience of conference

attendees. The Best of Show prizewinner was the film "One Rat Short," by Bryan Godwin of Charlex, a heartrending and realistic animation about - surprisingly - rats. Other highlights included Foster's Australia "Big Ad," a beer commercial featuring hundreds of actors frivolously singing, "It's a big ad!," and Pixar's "One Man Band," a more lighthearted short film about a pair of competing street musicians.

The list of SIGGRAPH '06 events goes on. A keynote address by Disney's Joe Rohde accompanied the distribution of the annual SIGGRAPH awards to kick off the conference program. For teachers, a special Educators Program featured tips for teaching computer science and computer graphics courses with the latest in graphics technologies. Birds of a Feather sessions allowed attendees with common interests in fields like molecular graphics and CAD to network and meet one another. A boutique and store offered conference materials and gear, including t-shirts and DVD's from the Animation Festival.

Get Involved

SIGGRAPH annually makes opportunities available for students at all levels to participate in the organization, presentation, and even contents of the conference. In case you are interested in participating in future conferences, consider a few of these options:

- A battalion of student volunteers is needed to monitor the entrances to official events and the needs of vendors on the exhibit floor. As additional incentive to volunteer, past student volunteers are eligible for the XSV, or Ex-Student Volunteer, Mentoring Program, in which they are paired up with a computer graphics researcher for support as they start their career.
- The ACM sponsors several student research competitions for undergraduate and graduate students. One such competition is held annually at the SIGGRAPH conference. Beware - the competition is tough; this year, the SIGGRAPH Student Research Competition hosted projects as diverse and complex as a system for projecting video onto textured or colored surfaces to a program that colors and displays the 3D structure of the brain for medical applications.
- If you have been working on research related to computer graphics or visualization, consider submitting a paper, poster, or Sketch. Although admission rates are somewhat daunting, work accepted to SIGGRAPH conferences generally represents some of the most outstanding in the field.

Regardless of how you choose to participate, the experience is sure to prove more entertaining than strenuous. Whether your interest lies in graphics programming, research, or artwork, a ticket to SIGGRAPH will serve as a valuable source of creative inspiration and innovational ideas to last for the year.

For Additional Information

To read more about the SIGGRAPH 2006 conference or about any of the research described in this article, be sure to check the official SIGGRAPH '06 website, at <http://www.siggraph.org/s2006>. The full text of any research paper presented at the conference can be found on the ACM Digital Library, at <http://www.acm.org/dl>, as part of the proceedings in Transactions on Graphics (TOG). To find out how you can participate in the SIGGRAPH 2007 conference in San Diego, go to <http://www.siggraph.org/s2007>.

Biography

Justin Solomon is a freshman at Stanford University majoring in Computer Science. His ongoing research interests, which he has pursued at the Naval Research Labs, MIT, the Mitsubishi Electric Research Labs, and other research organizations, include graphics and three-dimensional computer vision.