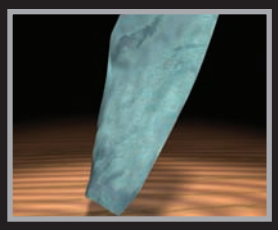
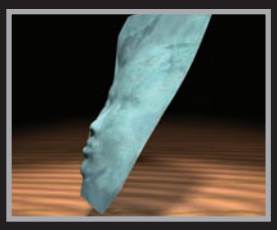
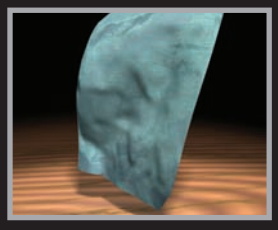
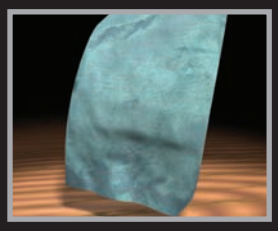
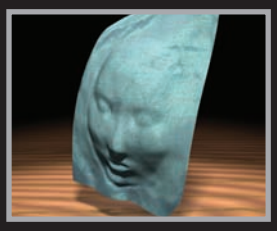
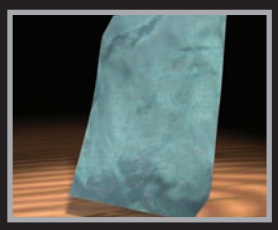
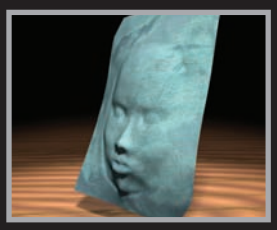
acm Transactions on Graphics July 2006 Volume 25 Number 3 465–1248





acm Transactions on Graphics

July 2006
Volume 25 Number 3

Proceedings of ACM SIGGRAPH 2006, Boston, MA

The Association for Computing Machinery, Inc.
1515 Broadway
New York, New York 10036

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ACM ISSN 0730-0301
ACM Order Number 428030

Printed in the USA

Additional copies may be ordered from ACM.

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New York, NY 10036
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+1-212-869-0481 (fax)

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8:30 – 10:15 **Image Collections**
Session Chair: Wojciech Matusik, Mitsubishi Electric Research Laboratories (MERL)

10:30 – 12:15 **Motion Capture**
Session Chair: Doug L. James, Carnegie Mellon University

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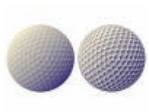
Paper Sessions – Thursday, 03 August 2006

3:45 – 5:30 **Non-Photorealistic Rendering**
Session Chair: Aaron Hertzmann, University of Toronto



Preface

Welcome to the SIGGRAPH 2006 Papers Program!

Here you will find a collection of ground-breaking and exciting papers that represent the best work in computer graphics from the past year. This year's program covers a wide range of topics, including the traditional core areas of computer graphics: animation, modeling and rendering. In addition this year's program spans a range of additional topics, notably, imaging, matting, and image manipulation; capture – of shape, appearance, and motion – and synthesis; and physically-based simulation of natural phenomena, such as fluids.

There were 474 submissions and 86 acceptances, for an acceptance rate of 18%. As has always been the case, papers were accepted based solely on their merit, and later arranged into thematic sessions. An additional 12 papers were accepted conditionally for publication in a regular issue of *ACM Transactions on Graphics*.

This year 99% of the papers were submitted electronically. In keeping with recent practice, authors were given access to their reviews and a three-day period to craft rebuttals to address factual errors raised by the reviews. Revision of accepted papers was again conducted in an electronic dialog between senior reviewers (members of the papers committee) and authors, enabling a journal-quality editorial process on a tight, conference schedule.

As a means of alleviating the large load on the electronic-submission server, this year we experimented with using MD5 checksum to electronically time-stamp documents and supplemental materials, such as images and videos. This experiment was a huge success in making the submission process smoother and, more important, ensuring that work completed before the deadline could be submitted and considered for review.

The papers program is the result of the dedication and hard work of many people. I am especially indebted to the following:

- The authors, SIGGRAPH's most valuable resource.

- The SIGGRAPH 2006 Organizing Committee and Conference Chair, John Finnegan. The papers program is just one part of the conference, and I very much appreciate the support offered by my counterparts who are chairing the other venues.

- The SIGGRAPH 2006 Papers Committee. There were 49 members, half of whom were serving on the committee for the first or second time. Serving on the committee represents an incredible investment of time, and I am grateful to the committee for their expertise, dedication, and professionalism.

- The tertiary reviewers, whose reviews were, in many cases, the most informed and detailed of the lot, and therefore provided the most significant input to the decision process.

- Jim Blinn, Michael F. Cohen, David Thiel, and Marc Levoy who worked with me to produce and edit the promotional video for the papers program.

- Janet McAndless who, as a volunteer, provided the bulk of the administrative support for the papers program.

- Talley Management, which provided additional administrative and logistical support. Thanks especially to Laurie Schall, Francesca Regan, Angela Anderson, and Bob Niehaus. In addition, Karen Dickie of MERL helped support the sort and program committee meeting.

- John C. Hart, Editor-in-Chief of *ACM Transactions on Graphics*, both for allowing the committee to conditionally accept some papers for regular issues of *TOG* and for serving on the committee this year. He managed his dual roles extremely effectively and, as a result, a number of excellent papers will be published sooner.

Preface

- Stephen Spencer, ACM SIGGRAPH Director for Publications, whom I've long respected, for his role in producing the SIGGRAPH Proceedings.

- Leona Caffey of SmithBucklin Corporation, who ensures the correctness of the advanced program and other conference publications and who has, this year, spearheaded a number of improvements to the publication materials; Tom Rieke and Christine Golus of Q LTD for their superb design skills and communication expertise.

- Brian Ban, Marcia Daudelin, and Amy Goetz of SmithBucklin Corporation for their role in marketing and publicizing the papers program.

- Joe Munkeby for his help and patience implementing some major changes to the electronic-submission system.

- My advisory board, Michael F. Cohen, Marc Levoy, and particularly, Holly Rushmeier, for their sage advice and help with many difficult decisions; Steven Gortler of Harvard University and Joe Marks of MERL, who along with my advisory board, helped with the sort; Markus Gross, Jessica K. Hodgins, Joe Marks, all former papers chairs, provided advice and encouragement at critical times.

- Steven Gortler and Harvard University for planning and hosting the program committee meeting.

- The various institutions that provided support for the papers process, most especially the employers of the committee members. In addition, the following companies and universities have provided financial support: Microsoft Research, Mitsubishi Electric Research Laboratory (MERL), Pixar Animation Studios, and Harvard and Yale Universities.

- My assistant at Yale, Judi Paige, who helped with various SIGGRAPH-related tasks.

Next year the papers program will be in the very capable hands of Marc Levoy. He will need to draw on the help and expertise of many people; I urge you to help in any way you can.

Julie Dorsey
SIGGRAPH 2006 Papers Chair

Editorial: The Year in TOG

Want more?

Each year the SIGGRAPH proceedings provides us with a large number of new ideas in graphics and interactive techniques, but the SIGGRAPH proceedings is only one of four annual issues of ACM's *Transactions on Graphics*. The other three TOG issues contain yet more good ideas, including some SIGGRAPH submissions identified by the papers committee as ones that would obviously be accepted by the following year's SIGGRAPH (after the needed revisions were made) but were too exciting to defer for an entire year. Below please find papers from the past three issues of TOG organized into "imaginary sessions," offered as a guide to SIGGRAPH-quality papers you may have overlooked in the past year. And don't forget that your SIGGRAPH membership provides you free access to these papers through the ACM Digital Library.

John C. Hart
Editor-in-Chief, ACM *Transactions on Graphics* (www.acm.org/tog)

Rendering and Visualization

- **Physically-based simulation of twilight phenomena**, J. Haber, M. Magnor, H-P Seidel, TOG 24(4) Oct, 2005. An accurate atmospheric scattering model of the period just before sunrise or after sunset.
- **The Halfway Vector Disk for BRDF Modeling**, D. Edwards, S. Boulos, J. Johnson, P. Shirley, M. Ashikhmin, M. Stark, and C. Wyman, TOG 25(1) Jan, 2006. A new reflectance model parameterized by the tangent projection of the halfway vector that yields energy preserving BRDF's.
- **Rendering Biological Iridescences with RGB-based Renderers**, Y. Sun, TOG 25(1) Jan, 2006. How to render the surfaces of butterflies and beetles.
- **Low-complexity maximum intensity projection**, B. Mora, D.S. Ebert, TOG 24(4) Oct, 2005. Accelerates an X-ray-like projection of a large volume using an octree.
- **All-Frequency Relighting of Glossy Objects**, R. Wang, J. Tran, D. Luebke, TOG 25(2) Apr, 2006. Combines precomputed radiance transfer with factored BRDF's in a wavelet basis to sharpen illumination.

Multires Modeling

- **Hierarchical triangular splines**, A. Yvart, S. Hahmann, G-P Bonneau, TOG 24(4) Oct, 2005. A new parametric triangular patch that supports multiresolution control with tangent continuity.
- **Feature-based multiresolution modeling of solids**, S.H. Lee, TOG 24(4) Oct, 2005. The volume of components of a solid model are considered in its simplification into LODs.
- **Point-Based Multi-Scale Surface Representation**, M. Pauly, L. Kobbelt, M. Gross, TOG 25(2) Apr, 2006. A filter bank on dense point models that supports multires editing operations.

Surface Interface Tracking

- **A Semi-Lagrangian Contouring Method for Fluid Simulation**, A. Bargteil, T. Goktekin, J. O'Brien, J. Strain, TOG 25(1) Jan, 2006. Surface mesh front tracking that uses an octree to approximate a signed distance function, allowing e.g. texturing of interface surfaces.
- **Hierarchical RLE Level Set: A Compact and Versatile Deformable Surface Representation**, B. Houston, M. Nielsen, C. Batty, O. Nilsson, K. Museth, TOG 25(1) Jan, 2006. Reduces space requirements for level sets so they can operate on a 45G-voxel space using only 1GB of memory.

Mesh Processing

- **Salient Geometric Features for Partial Shape Matching and Similarity**, R. Gal and D. Cohen-Or, TOG 25(1) Jan, 2006. Large meshes efficiently compared via compound high-level features of local shapes.
- **Discrete Conformal Mappings via Circle Patterns**, L. Kharevych, B. Springborn, P. Schröder, TOG 25(2) Apr, 2006. Free-/fixed-boundary discrete conformal mesh parameterization found with circles on the faces whose radii are solved such that they intersect at given angles.
- **Algebraic analysis of high-pass quantization**, D. Chen, D. Cohen-Or, O. Sorkine, S. Toledo, TOG 24(4) Oct, 2005. Derives an algebraic error bound for the Laplacian-predictor high-pass mesh quantization method.
- **Accurate Detection of Symmetries in 3D Shapes**, A. Martinet, C. Soler, N. Holxschuch, F. X. Sillion, TOG 25(2) Apr, 2006. Spherical harmonics of generalized moments indicate symmetry.

Editorial: The Year in TOG

Reconstructing Models

- **Beta-connection: Generating a family of models from planar cross sections**, L.G. Nonato, A.J. Cuadros-Vargas, R. Minghim, M.C.F. De Oliveira, TOG 24(4) Oct, 2005. Uses 3-D Delauney triangulation to find correspondences between slices.
- **A Bayesian Method for Probable Surface Reconstruction and Decimation**, J. Diebel, S. Thrun, M. Bruenig, TOG 25(1) Jan, 2006. Uses training data to avoid simplifying articulated features in animated range scans.
- **Automatic restoration of polygon models**, S. Bischoff, D. Pavic, L. Kobbelt, TOG 24(4) Oct, 2005. Creates watertight manifolds using an octree that provides an effective 41K voxel resolution in only 2GB of memory.
- **Fitting B-Spline Curves to Point Clouds by Squared Distance Minimization**, W. Wang, H. Pottmann, Y. Liu, TOG 25(2) Apr, 2006. A quasi-Newton method for the nonlinear least-squares problem of fitting a B-spline curve to planar points that raises the bar on this well researched area.

Animation

- **Animation Planning for Virtual Characters Cooperation**, C. Esteves, G. Arechavaleta, J. Pettré, and J-P Laumaond, TOG 25(2) Apr, 2006. Motion planning has studied how to move a piano into an apartment, but this paper shows how to animate the two people actually doing the moving.
- **Expressive speech-driven facial animation**, Y. Cao, W.C. Tien, P. Faloutsos, F. Pighin, TOG 24(4) Oct, 2005. Adds expression controls to facial animation, extracting emotion automatically from the audio stream.
- **Learning silhouette features for control of human motion**, L. Ren, G. Shakhnarovich, J.K. Hodgins, H. Pfister, P. Viola, TOG 24(4) Oct, 2005. Combines multiple view silhouettes with motion datasets to allow an unencumbered user's movements to control a character.

Hardware

- **The irregular Z-buffer: Hardware acceleration for irregular data structures**, G.S. Johnson, J. Lee, C.A. Burns, W.R. Mark, TOG 24(4) Oct, 2005. Z-buffer hardware optimized for random scenes sampling.
- **Forward Rasterization**, V. Popescu, P. Rosen, TOG 25(2) Apr, 2006. Depth image reprojection causes temporal aliasing on existing rasterizers, fixed here by a better small-polygon rasterization method.
- **Glift: Generic, Efficient, Random-Access GPU Data Structures**, A. Lefohn, J. Kniss, R. Strzodka, S. Sengupta, and J. Owens, TOG 25(1) Jan, 2006. GPU data structures for efficient stacks, quadtrees and octrees, demonstrated with adaptive shadow maps and octree surface painting.

Subdivision Surfaces

- **Extended subdivision Surfaces: Building a Bridge between NURBS and Catmull-Clark Surfaces**, K. Mueller, L. Reusche, D. Fellner, TOG 25(2) Apr, 2006. Provides an alternative to NURSS that keeps coarse-level vertices on the limit surface to provide a more accurate shape estimation during modeling.
- **Intrinsic Subdivision with Smooth Limits for Graphics and Animation**, J. Wallner, H. Pottmann, TOG 25(2) Apr, 2006. Modifies subdivision rules based on the shape of the embedding space.
- **A Tangent Subdivision Scheme**, E. Vanraes, A. Bultheel, TOG 25(2) Apr, 2006. New subdivision surface where per-vertex surface normals can be specified on the coarse-level mesh.

Painting, Texturing and Navigating

- **Animating Chinese Paintings through Stroke-Based Decomposition**, S. Xu, Y. Xu, S.B. Kang, D. Salesin, Y. Pan, H-Y Shum, TOG 25(2) Apr, 2006. Reverse engineers simple paintings; repaints them in different poses.
- **A procedural object distribution function**, A. Lagae, P. Dutré, TOG 24(4) Oct, 2005. Wang-like tiles of Poisson disk samples are used to distribute procedural texture elements.
- **Solution Space Navigation for Geometric Constraint Systems**, M. Sitharam, A. Arbree, Y. Zhou, N. Kohareswaran, TOG 25(2) Apr, 2006. If you describe the tinkertoy construction of an object by which pieces are connected, you get an exponential number of possible shapes. This paper offers a scalable system to automatically or interactively search through these possibilities.

2006 ACM SIGGRAPH Awards

Computer Graphics Achievement Award

Thomas W. Sederberg

ACM SIGGRAPH is pleased to recognize Thomas W. Sederberg with the 2006 Computer Graphics Achievement Award for his pioneering work on free-form deformations and the use of algebraic geometry in geometric modeling.

Tom received his Ph.D. in 1983 in Mechanical Engineering from Purdue University. That same year he joined the faculty of Brigham Young University in the Department of Civil Engineering. He is currently a professor in the Department of Computer Science at BYU, as well as Associate Dean of BYU's College of Physical and Mathematical Sciences.

Tom's doctoral research demonstrated for the first time that classical methods of algebraic geometry could be used to answer important and difficult questions in geometric design. For example, Tom used elimination theory to give an exact algorithm for implicitization, which is the conversion of parametric curves and surfaces into implicit polynomial form. Moreover, he used implicitization to answer one of the key questions of the day: Does the intersection curve between two bicubic surfaces have a rational polynomial parametrization? Tom's answer, quite surprising at the time, was that such a curve could be of degree 324 and cannot be parameterized.

In 1984 he published a paper that introduced the idea of piecewise algebraic curves. Whereas algebraic geometry was classically concerned with analysis of existing shapes, this work represented a constructive method that married ideas from parametric splines with those of algebraic geometry. Tom's interest in constructive methods eventually led him and others to develop powerful and elegant techniques for representing surfaces using low-degree piecewise algebraic surface patches.

In the graphics community, Tom is best known for his groundbreaking SIGGRAPH 86 paper that introduced the concept of free-form deformation (FFD) as an effective means for modeling and animation. FFD was quickly established as an essential technique in every major geometric modeling system, animation package, and production company. The work also inspired considerable follow-on research that continues to this day.

Tom's work in graphics is by no means limited to FFD. He has done significant work on a wide range of topics, including scan-line rendering of algebraic surfaces (SIGGRAPH 89), ray-tracing parametric surfaces (SIGGRAPH 90), polygonal morphing (SIGGRAPH 92 and 93), non-uniform subdivision surfaces (SIGGRAPH 98), and more recently, locally refinable tensor product B-splines and subdivision surfaces (SIGGRAPH 03 and 04).

Tom is one of a rare breed of scholars: he is thoroughly steeped in the knowledge and methods of the past but is also extraordinarily creative and forward thinking. His consistent and long-lasting contributions, together with his clarity of thought, personal integrity, and compassion, make him an ideal recipient of the Computer Graphics Achievement Award.

Previous Award Recipients
2005 Jos Stam
2004 Hugues Hoppe
2003 Peter Schröder
2002 David Kirk
2001 Andrew Witkin
2000 David H. Salesin
1999 Tony DeRose
1998 Michael F. Cohen
1997 Przemyslaw Prusinkiewicz
1996 Marc Levoy
1995 Kurt Akeley
1994 Kenneth E. Torrance
1993 Pat Hanrahan
1992 Henry Fuchs
1991 James T. Kajiya
1990 Richard Shoup and Alvy Ray Smith
1989 John Warnock
1988 Alan H. Barr
1987 Robert Cook
1986 Turner Whitted
1985 Loren Carpenter
1984 James H. Clark
1983 James F. Blinn

2006 ACM SIGGRAPH Awards

Significant New Researcher Award

Takeo Igarashi

Takeo Igarashi earned a Bachelor's degree in Mathematical Engineering at the University of Tokyo in 1995, and his Ph.D. from the Department of Information Engineering at the University of Tokyo in 2000. From his earliest papers in the mid-1990s, his sense of fluidity in interaction design was apparent.

His early work was on 2D interfaces, including systems that not only beautified drawings using "snapping" techniques, but which added a new kind of interaction in which the system offered the user multiple suggestions for further drawing strokes based on what was already present in the drawing. This made it easy to draw parallel lines, reflected shapes, and repeated patterns.

By 1997, the "visual programming" metaphor had made programming via spreadsheets a model success story for computer science. As a summer intern at Xerox PARC, he and his colleagues attacked the problem of making it even easier to do spreadsheet programming by providing visualizations of the underlying dataflow structure and, more importantly, allowing a kind of inductive copying of dataflow structure as part of the interface. During his internship the following year at PARC, he developed a collection of interaction techniques for large-scale, whiteboard-like displays, including a remarkably intuitive street-map drawing application in which strokes were automatically widened into two-sided roads, and intersections appeared like magic.

At SIGGRAPH in 1999, Takeo presented his Ph.D. work, "Teddy," a system for drawing smooth 3D shapes with a minimal gesture set. In many ways, this work represents the essence of Takeo's approach: he wasn't improving the interface to standard CAD modeling; instead, he was bringing a new kind of simple but powerful 3D shape modeling to computer graphics. Teddy's success can be measured in part by its user base: it is now being used in a variety of commercial products, including PC applications and home video games. And the insight was that with the right goal and sufficiently well-designed interface, new things were possible for new users. One of the really beautiful things about Takeo's work is that he takes a problem that is, in general, very difficult or even unsolvable, and finds an important special case where there is a simple and elegant solution.

Takeo continues to surprise us with this vision of the possible, from interactive clothing manipulation and design to the description and illustration of volume data through a sketching interface, to handmade animation of shapes through multi-touch interaction that lets the human "feel" of a motion be captured in an easily-created animation.

Takeo's work serves as a model for what the "Interactive Techniques" portion of SIGGRAPH's charter can be. ACM SIGGRAPH is pleased to recognize Takeo Igarashi with the 2006 Significant New Researcher Award both for his research contributions and for the inspiration and new directions he brings to the SIGGRAPH community.

Previous Award Recipients
2005 Ron Fedkiw
2004 Zoran Popović
2003 Mathieu Desbrun
2002 Steven J. Gortler
2001 Paul Debevec

2006 ACM SIGGRAPH Awards

Outstanding Service Award

John Fujii

For his creativity, dedication, and leadership, ACM SIGGRAPH recognizes John M. Fujii's commitment to our community with its 2006 Outstanding Service Award.

Since 1986, John has repeatedly shared his enthusiasm with SIGGRAPH in many forms such as conference contributor, organizer, reviewer, facilitator, scribe, mentor, leader, and even cheerleader. His personal values of volunteerism and keen awareness of SIGGRAPH's needs drove him to help pioneer new roles such as SIGGRAPH's first Siggraph.Org Information Director in 1992 and co-founding the Pathfinder program in 1998. His capacity for organization, management, and strategic thinking has supported invaluable contributions to the conference and organization as they navigated SIGGRAPH through the perilously dynamic economy of the past two decades.

John Fujii chaired the first New Orleans SIGGRAPH in 1996 where his attention to detail served us all well. His expert management of conference resources set an unsurpassed record for budget performance. SIGGRAPH 96 enabled many new initiatives, including the Applications program, the "Get Involved" meetings, the exhibition "Startup Park," a professional conference website, local school outreach programs, new conference planning paradigms, and the first-ever remote presentation of a technical paper. John accomplished this for us through countless hours of personal time and generous (sometimes full-time) support of his employer, Hewlett-Packard. John continues to serve on many SIGGRAPH committees for the conference and organization, providing valuable insight, ideas, wisdom, and fun in their operational management and strategic directions.

More recently, based upon his own experience and empathy for the first-time SIGGRAPH conference attendee, John created Pathfinders, a program where experienced SIGGRAPH mentors help ensure that new attendees get the most from their SIGGRAPH experience. He has also mentored hundreds of new students and attendees since 1993 in a variety of fashions, including his writing of "The 5-Minute Career Mentor." John takes to heart his concern for SIGGRAPH's role and responsibility in growing the greater graphics community. John considers "the spirit of sharing a collective best is one of SIGGRAPH's greatest assets and gifts" and is "most proud of the people of SIGGRAPH." With this award, ACM SIGGRAPH shows its pride in John Fujii and his exemplary contributions to its collective best.

John is a graphics software engineer for the Hewlett-Packard Workstation Global Business Unit in Fort Collins, Colorado. He holds a B.S. in Computer Science from Yale University and a M.A. in Computer Graphics and Animation from the Advanced Computing Center for the Arts and Design (ACCAD) at the Ohio State University.

Previous Award Recipients
2004 Judith R. Brown and Steve Cunningham
2002 Bertram Herzog
2000 Thomas A. DeFanti and Copper Frances Giloth
1998 Maxine D. Brown