

CURRICULUM VITAE

MARC OLANO

Associate Professor
Computer Science and Electrical Engineering
University of Maryland, Baltimore County
1000 Hilltop Circle
Baltimore, MD 21250

olano@umbc.edu
<http://www.umbc.edu/~olano>
410-455-3094
410-455-3969 (fax)

EDUCATION

Ph.D.	1998	University of North Carolina, Computer Science Dissertation: <i>A Shading Language on Graphics Hardware</i> (Advisor: Anselmo Lastra)
B.S.	1990	University of Illinois, Electrical Engineering

EXPERIENCE IN HIGHER EDUCATION

2008–present	University of Maryland, Baltimore County, Associate Professor, Computer Science and Electrical Engineering
2002–2008	University of Maryland, Baltimore County, Assistant Professor, Computer Science and Electrical Engineering
2000	Stanford University, Adjunct Assistant Professor, Computer Science

EXPERIENCE IN OTHER THAN HIGHER EDUCATION

2016–2017	Epic Games, Visiting Faculty (sabbatical)
2014, 2015	Oxide Games, Graphics Consultant
2006–2015	NIST, Faculty Appointee, Scientific Applications and Visualization Group
2013	2K Games, Graphics Consultant
2011–2013	Activision, Visiting Faculty, Graphics Consultant
2009–2010	Firaxis Games, Visiting Faculty (sabbatical)
1998–2002	SGL, Member of Technical Staff / Technical Lead, OpenGL Shader
1988–1991	Eastman Kodak Company, Research Programmer, Visualization
1987–1988	Rhino Robotics, Inc, Programmer, CNC Lathe Simulator

HONORS RECEIVED

2009	DOE OASCR visualization award, W.L. George, N.S. Martys, S.G. Satterfield, J. Hagedorn, M. Olano and J. Terris, <i>Simulation of Non-Newtonian Suspensions: Shear Thinning Case</i> , SciDAC 2009 Electronic Visualizations and Posters
2008	DOE OASCR visualization award, W.L. George, N.S. Martys, J. Lancien, S.G. Satterfield, M. Olano, E. Garboczi and J. Terrill, <i>Simulation of a Dense Suspension with Interactive Controls</i> , SciDAC 2008 Electronic Visualizations and Posters.
2006–2008	Invited Expert, Khronos Group, OpenGL Steering Group

2003 Invited to write foreword for Randi Rost, *OpenGL Shading Language*, Addison-Wesley, 2004.

RESEARCH SUPPORT AND FELLOWSHIPS

Funded

2017 – 2020 *MRI: Acquisition of Cutting-Edge GPU and Phi Nodes for the Interdisciplinary UMBC High Performance Computing Facility* (\$605,850, NSF, Co-PI)

2018 *manyskin: a computer animation approach to photo-realistic image databases of human skin for training, testing, and evaluation of diagnostic devices* (\$45,683, FDA, PI)

2017 – 2018 *Real-Time Rendering Research in a Game Engine*, (\$50,000, Epic Games, PI)

2017 – 2018 *“Virtual Reality Design for Science”: Integrating Research, Communication, and Learning for Interdisciplinary Training* (\$24,598, UMBC Hrabowski Fund, PI)

2014 – 2016 *MRI: Acquisition of a 3D object and motion capture system* (\$175,195, NSF, PI)

2012 – 2018 *ABI Development: Ecosynth: An Advanced Open-Source 3D Toolkit for Forest Ecology* (\$879,800, NSF, Co-PI)

2015 – 2016 *Calibration of a Projection Virtual Reality System* (\$51,368, Howard Huges Medical Institute, PI)

2014 – 2015 *SimTheater: A Social Media Game for Audience Development* (\$10,000, NEA / Signature Theatre, PI)

2014 – 2015 *Re-Playing the Past: Building a Digital Game for the History Classroom* (\$23,931, UMBC Habrowski Fund, Co-PI)

2014 – 2015 *Supplemental Request: Teaching Information Assurance Concepts through a Multiplayer Computer Game* (\$152,078, NSF, Investigator)

2013 – 2014 *SecurityEmpire: Teaching Information Assurance Concepts through a New Social Media Game* (\$271,463, NSF, Co-PI)

2012 – 2015 *MRI: Acquisition of Hybrid CPU/GPU Nodes for the Interdisciplinary UMBC High Performance Computing Facility* (\$487,304, NSF, Co-PI)

2012 *UMBC CUDA Teaching Center* (\$5,500, NVIDIA, PI)

2011 – 2013 *Teaching Information Assurance Concepts to High School Students Through a New Social Media Game* (\$168,743, DoD IASP, Co-PI)

2009 – 2011 *Video Processor for Panoramic Head-Mounted Display, Phase II* (\$68,879, Maryland Industrial Partnerships / Sensics, PI)

2008 – 2011 *MRI: Acquisition of an Interdisciplinary Facility for High-Performance Computing* (\$200,000, NSF, Co-PI)

2009 *GPU Hybrid Rendering* (\$3500 Equipment Donation, NVIDIA Professor Partnership, PI)

2008 – 2009 *Video Processor for Panoramic Head-Mounted Display* (\$70,069, Maryland Industrial Partnerships / Sensics, PI)

2007 – 2008	<i>UMBC XNA GAIM Laboratory</i> (\$20,000 + \$10,000 UMBC match, Microsoft XNA Lab, PI)
2007	<i>UMBC Cell-Processor Virtual Computing Laboratory</i> (amount confidential, IBM VCL, Co-PI)
2006	<i>Websphere S/W Applications for Service Oriented Science, Engineering and Multi Core Cell Data Intensive Visualization</i> (\$72,133, IBM SUR, Co-PI)
2002–2008	Equipment donations, (\$3,000, ATI/AMD)
2005	<i>Programmable Layered Architecture with Artistic Rendering</i> (\$18,720, NIH, Lister Hill National Center for Biomedical Communications at the National Library of Medicine, Medical Informatics Visiting Faculty Fellowship).
2003–2004	<i>Visualization API Enablers for a High-End Fine-Grained Parallel Processor</i> (\$83,048, NSF STTR / XMTT Inc., Co-PI)
2002–2003	<i>Automatic Simplification of Procedural Shaders</i> (\$16,000, UMBC DRIF, PI)
2003	<i>Programmable Layered Architecture with Artistic Rendering</i> (\$20,000, NIH, Lister Hill National Center for Biomedical Communications at the National Library of Medicine, Medical Informatics Visiting Faculty Fellowship)

PH.D. STUDENTS

Yu Wang	2015	chair
<i>The Modeling Equation: Solving the Physically-Based Modeling and Animation Problem with a Unified Solution</i>		
Wesley Griffin	2016	chair
<i>Quality Guided Variable Bit Rate Texture Compression</i>		
Mark Bolstad	2017	chair
<i>Rendering Massive Models</i>		
Ari Blenkhorn	prelim 6/10/2015	chair
<i>Rendering Atmospheric Effects</i>		
Henan Zhao	prelim 1/30/2016	co-chair
<i>Accurate Spatial Data Visualization in Virtual Environments</i>		
Donna Thomas	pre-proposal	chair

Eleanor Chlan-Boyle	2005	committee member
<i>A Botanically Inspired Information Visualization of Hierarchical Data Sets</i>		
Alark Joshi	2007	committee member
<i>Effective Visualization of Time-varying Data Using Cognition-based Principles</i>		
Philippe Robert	2007	committee member
<i>Real-Time Rendering on a Stream Architecture using Hybrid Scalability Techniques</i>		
University of Bern, Switzerland		
Jesus Caban	2009	committee member
<i>Generation and Visualization of Hierarchical Statistical Volumes</i>		

- David Trimm 2012 committee member
Analyzing Path Populations and Associated Data Through Automation, Visualization and Interaction
- Christopher Morris 2014 reader
A Non-Photorealistic Rendering Framework for Integrating Separate Graphics Streams
- Dana Wortman 2014 committee member
Visualizing Sequential Patterns in Large Datasets Using Levels of Abstraction
- Fahad Zafar 2014 committee member
Medical Image Quality Assessment for Stereoscopic Display Devices Using Computational Observers
- Jonathan Dandois 2015 reader
Remote sensing of vegetation structure and composition using computer vision
- Xuan Huang 2015 committee member
An MPI-CUDA Implementation of a Model for Calcium Induced Calcium Release in a Three-Dimensional Heart Cell on a Hybrid CPU/GPU Cluster
- Samuel Khuvis 2016 reader
Porting and Tuning Numerical Kernels in Real-World Applications to Many-Core Intel Xeon Phi Accelerators
- Jonathan Graf 2017 committee member
Parallel Performance of Numerical Simulations for Applied Partial Differential Equation Models on the Intel Xeon Phi Knights Landing Processor

MASTER'S STUDENTS

- Daniel Hood 2003 MS project chair
Analogy Based Segmentation of Volumetric Data
- Joshua Barczak 2005 MS thesis chair
Interactive Illumination Using Large Sets of Point Lights
- Aimee Joshua 2005 MS thesis chair
Modeling and Rendering of Mold on Cut Wood
- Hanli Ni 2005 MS thesis chair
Hybrid 3D-model Representation Through Quadric Metrics and Hardware Accelerated Point-based Rendering
- Yi Wang 2005 MS thesis chair
GPU Based Cloth Simulation on Moving Avatars
- Pat Gillespie 2006 MS thesis chair
Perceptually Oriented Patch Based Texture Synthesis
- Kristian Kuhn 2006 MS project chair
Using RTP and RTSP for Real-time 3D Interaction
- Jonathan Decker 2007 MS thesis chair
System of Bound Particles for Interactive Flow Visualization
- Stephen Ingram 2007 MS thesis co-chair with Tamara Munzner
Glimmer: Multilevel MDS on the GPU
 (University of British Columbia, Canada)

Jeremy Shopf	2007	MS thesis chair
<i>Interactive Rendering of Heterogeneous Translucent Objects</i>		
John Kloetzli	2008	MS thesis chair
<i>Real-Time High Quality Volume Isosurface Rendering</i>		
Pankaj Chaudhari	2008	MS thesis chair
<i>Real-Time Multiple Refractions through Deformable Objects</i>		
Aaron Curtis	2009	MS thesis chair
<i>Real-Time Soft Shadows on the GPU via Monte-Carlo Sampling</i>		
Brian Strege	2009	MS project chair
<i>Using Tiled Head-Mounted Displays with a Single Video Source</i>		
Sean Dukehart	2009	MS thesis chair
<i>GPU Random Walkers for Image Segmentation</i>		
Wesley Griffin	2010	MS thesis chair
<i>Real-Time GPU Surface Curvature Estimation</i>		
Fahad Zafar	2010	MS thesis chair
<i>Tiny Encryption Algorithm for Cryptographic Gradient Noise</i>		
Yu Wang	2011	MS thesis chair
<i>A Framework for GPU 3D Model Reconstruction Using Structure-from-Motion</i>		
Ravikiran Dighade	2012	MS thesis chair
<i>Approach to Unwrap a 3D Fingerprint to a 2D Equivalent Fingerprint</i>		
Preeti Bindu	2012	MS thesis chair
<i>Numerical Integration Techniques for Volume Rendering</i>		
Taekyu Shin	2014	MS thesis chair
<i>Visualization of Smoke and Fire</i>		
Yuping Zhang	2015	MS thesis chair
<i>Real-time Realistic Rendering of Sunrise and Sunset</i>		
Elizabeth Baumel	2015	MS thesis chair
<i>Distance Adaptation of Diffuse Reflectance and Subsurface Scattering</i>		
Kyle Boyer	in progress	MS thesis chair
<i>Time Varying Volume Rendering in VR</i>		
Abhijeet Vhotkar	in progress	MS project chair
<i>Robust Lighthouse Tracking using Kalman Filtering</i>		
<hr/>		
Namita Parab	2003	MS thesis committee
<i>Refining Implicit Models</i>		
Jay Patel	2003	MS project committee
<i>Multivariate Data Visualization of Gait Ataxia</i>		
Utkarsch Ayachit	2004	MS thesis committee
<i>Flow Visualization: A Level-of-detail Approach</i>		
Srinivas Bhagavatula	2004	MS thesis committee
<i>Exploring the Volume Illustration Parameter Space</i>		
Poonam Shanbhag	2004	MS thesis committee
<i>Temporal Visualization of Planning Polygons for Efficient Partitioning of Geo-spatial Data</i>		
Simone Thomas	2005	MS thesis committee

- Morphing Materials: Capturing Tangible Material Properties in Pen-and-Ink Style Rendering*
Mithila Patwardhan 2006 MS thesis committee
- Motion-based Visualization for Deep Exploration of Relational, Spatio-temporal Data*
Bryan Pass 2007 MS project committee
- A Virtual Security Coprocessor Design Using Hardware VMM Instructions*
Jason Pearlman 2007 MS thesis committee
- Visualizing Network Security Events Using Compound Glyphs from a Service-Oriented Perspective*
Alex Feldman 2008 MS thesis committee
- Swarm Robotics: Parallelized Line Formation*
Jonathan Bronson 2008 MS thesis committee
- Statistically Weighted Visualization Hierarchies*
Ryan Bergeron 2008 MS thesis committee
- Visualizing Team Performance Dynamics*
Guohao Zhang 2014 MS thesis committee
- Visual Marks for Functional Magnetic Resonance Imaging Visualization: A Ranking Study*
Ryan Day 2016 MS thesis committee
- Parallel Performance Studies for a Linear Parabolic Test Problem Using the Intel Xeon Phi*

UNDERGRADUATE STUDENTS

- Joshua Barczak 2002 Independent study advisor
Ray Tracing Using Programmable Fragment Shading Hardware
(published in UMBC Review)
- John Kloetzli 2005 Honors thesis advisor
Interactive Fur Rendering
- Tim Murray 2005 Independent study advisor
Source Code Visualization
- Bryan Pass 2005 Independent study advisor
Distributed Collision Detection
- Paul Oliver 2008 Independent study advisor
Graphical Design of Programmable Shaders
- Wallace Brown 2010 Independent study advisor
Cloth rendering
- Brendan Farrington 2010 Independent study advisor
GPU Path Finding
- Thomas Hervey, Aneep Bindra and Zachary Hullihen
2012-2013 Undergraduate research co-advisor
Lights, Camera, Motion, Action: The Dance Application of Microsoft's Kinect and Intelligent Stage Lighting
- Kevin Jones 2015 Independent study advisor
GPU Path Tracing with Optix

Brian Seipp 2018
Rendering Skin Lesions

Independent study advisor

PUBLICATIONS

Peer Reviewed Works

Books and Edited Proceedings

Marc Olano and Miguel Otuduy (editors), *Proceedings of I3D 2014: The 18th ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games* (San Francisco, CA, March 14–16, 2014). ACM Press 2014.

Marc Olano and Philipp Slusallek (editors), *Proceedings of Graphics Hardware 2006: The 21st ACM / Eurographics Symposium on Graphics Hardware* (Vienna, Austria, September 3–4, 2006). ACM Press 2006. 126 pages.

Carlo Séquin and Marc Olano (editors), *Proceedings of I3D 2006: The 10th ACM Symposium on Interactive 3D Graphics and Games* (Redwood City, CA, March 14–17, 2006). ACM Press 2006. 216 pages.

Marc Olano, John Hart, Wolfgang Heidrich, Michael McCool, *Real-time Shading*. AK Peters, 2002. 368 pages.

Edited Juried Course Notes

Marc Olano (editor), David Blythe, Larry Gritz, Mark Kilgard, Michael McCool, Fabio Pellacini and Thorsten Scheuermann. “GPU Shading and Rendering: Course 3.” ACM SIGGRAPH 2006 Courses, Proceedings of the International Conference on Computer Graphics and Interactive Techniques, ACM, July 2006. 285 pages.

Marc Olano (editor), Avi Bleiweiss, Larry Gritz, John C. Hart, Mark Kilgard, Michael McCool and Pedro Sander. “GPU Shading and Rendering: Course 37.” ACM SIGGRAPH 2005 Courses, Proceedings of the International Conference on Computer Graphics and Interactive Techniques, ACM, July 2005. 283 pages.

Marc Olano (editor), Kurt Akeley, John C. Hart, Wolfgang Heidrich, Micheal McCool, Jason L. Mitchell and Randi Rost. “Real-Time Shading: Course 1.” ACM SIGGRAPH 2004 Courses, Proceedings of the International Conference on Computer Graphics and Interactive Techniques, ACM, August 2004. 226 pages.

Marc Olano (editor), Kurt Akeley, John C. Hart, Wolfgang Heidrich, Bill Mark, Jason L. Mitchell and Randi Rost. “Real-Time Shading: Course 7.” ACM SIGGRAPH 2003 Courses, Proceedings of the International Conference on Computer Graphics and Interactive Techniques, ACM, July 2003. 243 pages.

Marc Olano (editor), Chas Boyd, Bill Mark, Michael McCool, Jason L. Mitchell and Randi Rost. “State of the Art in Hardware Shading: Course 17.” ACM SIGGRAPH 2002 Courses, Proceedings of the International Conference on Computer Graphics and Interactive Techniques, ACM, July 2002. 502 pages.

Marc Olano (editor), John C. Hart, Wolfgang Heidrich, Bill Mark and Ken Perlin. “Real-Time Shading Languages: Course 36.” ACM SIGGRAPH 2002 Courses, Proceedings of the International Conference on Computer Graphics and Interactive Techniques, ACM, July 2002. 379 pages.

Marc Olano (editor), John C. Hart, Wolfgang Heidrich, Erik Lindholm, Bill Mark, Michael McCool and Ken Perlin. "Real-Time Shading: Course 24." ACM SIGGRAPH 2001 Courses, Proceedings of the International Conference on Computer Graphics and Interactive Techniques, ACM, August 2001. 353 pages.

Marc Olano (editor), John C. Hart, Wolfgang Heidrich, Michael McCool, Bill Mark, Kekoa Proudfoot. "Approaches to Procedural Shading on Graphics Hardware: Course 27." ACM SIGGRAPH 2000 Courses, Proceedings of the International Conference on Computer Graphics and Interactive Techniques, ACM, July 2000. 139 pages.

Patents

Dan Baker and Marc Olano, "Method and System for Filtering of Visual Objects", US9684975 granted June 2017.

Brian Kieth Cabral, Marc Olano and Philip Nemec, "Reflection Space Image Based Rendering at an Interactive Frame Rate," US7268789 granted September 2007.

Brian Kieth Cabral, Marc Olano and Philip Nemec, "Reflection Space Image Based Rendering," US7123259 granted October 2006.

Marc Olano and Mark Peercy, "Method and System for Executing SIMD Instructions using Graphics Technology," US6943798 granted September 2005.

Marc Olano and Mark Peercy, "Method and System for Accelerating Noise," US6747660 granted June 2004.

Marc Olano, "Method, System, and Computer Program Product for Implementing Derivative Operators with Graphics Hardware," US6717599 granted April 2004.

Mark Peercy, Marc Olano and John Airey, "Method and System for Implementing Graphics Control Constructs," US6707462 granted March 2004.

Brian Kieth Cabral, Marc Olano and Philip Nemec, "Reflection Space Image Based Rendering," US6697062 granted February 2004.

Marc Olano, "System, Method, and Computer Program Product for Real-time Shading of Computer Generated Images," US6657624 granted June 2003; WO03060638 granted July 2003.

Richard Ellson, Lawrence Ray and Marc Olano for Eastman Kodak Company, "Method and Apparatus for Performing Real-Time Computer Animation," US5455902 granted October 1995.

SIGGRAPH Publications

(ACM SIGGRAPH became a regular issue of ACM Transactions on Graphics in 2003)

Mark Peercy, Marc Olano, John Airey and P. Jeffery Ungar, "Interactive Multi-Pass Programmable Shading," Proceedings of ACM SIGGRAPH 2000 (New Orleans, Louisiana, July 23-28, 2000). In *Computer Graphics Proceedings, Annual Conference Series*, 2000. pp. 425–432 (acceptance rate: 19.4%).

Brian Cabral, Marc Olano and Philip Nemec, "Reflection Space Image Based Rendering," Proceedings of ACM SIGGRAPH 99 (Los Angeles, California, August 8-13, 1999). In *Computer Graphics Proceedings, Annual Conference Series*, 1999. pp. 165–170 (acceptance rate: 16.3%).

Marc Olano and Anselmo Lastra, "A Shading Language on Graphics Hardware: The PixelFlow Shading System," Proceedings of ACM SIGGRAPH 98 (Orlando, Florida, July 19-24, 1998). In

Computer Graphics Proceedings, Annual Conference Series, 1998. pp. 159–168 (acceptance rate: 14.9%).

Jon Cohen, Marc Olano and Dinesh Manocha, “Appearance Preserving Simplification,” Proceedings of ACM SIGGRAPH 98 (Orlando, Florida, July 19-24, 1998). In *Computer Graphics* Proceedings, Annual Conference Series, 1998. pp. 115–122 (acceptance rate: 14.9%).

Journal Articles and Book Chapters

Jonathan P Dandois, Matthew Baker, Marc Olano, Geoffrey G Parker, and Erle C Ellis, “What is the point? Evaluating the structure, color, and semantic traits of computer vision point clouds of vegetation”, *Remote Sensing*, vol 9(4), April 2017.

Kevin Jones, Advisor: Marc Olano, “Real-Time Path Tracing Using OptiX”, *UMBC Review*, 2016, v17. pp. 11–24.

Jonathan P Dandois, Marc Olano, and Erle C Ellis, “Optimal altitude, overlap, and weather conditions for computer vision UAV estimates of forest structure”, *Remote Sensing*, vol 7(10), October 2015.

Wesley Griffin and Marc Olano, “Evaluating Texture Compression Masking Effects using Objective Image Quality Assessment Metrics” *IEEE Transactions on Visualization and Computer Graphics*, vol 21(8), August 2015. pp 970–979.

Yu Wang, Marc Olano, Matthias Gobbert and *Wesley Griffin*, “Parallel Computing for Long-Time Simulations of Calcium Waves in a Heart Cell”, *PAMM*, vol 12(1). December 2012. Wiley-VCH Verlag, pp. 637–638.

Wesley Griffin, *Yu Wang*, *David Berrios* and Marc Olano, “Real-Time GPU Surface Curvature Estimation on Deforming Meshes and Volumetric Data Sets,” *IEEE Transactions on Graphics*, vol 18(10). October 2012. pp. 1603–1613.

Marc Olano, Dan Baker, *Wesley Griffin* and Joshua Barczak, “Variable bit rate GPU Texture Decompression,” *Computer Graphics Forum*, vol 30(4) (Proceedings of EGSR 2011). pp. 1299–1308.

Stephan Ingram, Tamara Munzner and Marc Olano, “Glimmer: Multilevel MDS on the GPU,” *IEEE Transactions on Visualization and Computer Graphics*, vol 15(2). March-April 2009. pp. 249–261.

James S. Sims, William L. George, Tere Griffin, John G. Hagedorn, Howard K. Hung, John T. Kelso, Marc Olano, Adele P. Peskin, Steven G. Satterfield, Judith Devaney Terrill, Garnett W. Bryant and Jose G. Diaz, “Accelerating Scientific Discovery through Computation and Visualization III. Tight-binding Wave Functions for Quantum Dots,” *Journal of Research of the National Institute of Standards*, vol 113(3). May-June 2008. (*cover image*).

Judith Terrill, William George, Terence Griffin, John Hagedorn, John Kelso, Marc Olano, Adele Peskin, Steve Saterfield, James Simms, Jeffery Bullard, Joy Dunkers and Nicos Martys, “Extending Measurement Science to Interactive Visualization Environments,” Book Chapter, *Trends in Interactive Visualization*, Elena Zudilova-Seinstra, Tony Adriaansen and Robert van Liere, Editors, Springer, 2009.

Joshua Barczak, Advisor: Marc Olano, “Ray Tracing Using Programmable Fragment Shading Hardware,” *UMBC Review*, 2004, v5. pp. 76–97.

Jonathan Cohen, Dinesh Manocha and Marc Olano, “Successive Mappings: An Approach to Polygonal Mesh Simplification with Guaranteed Error Bounds,” *International Journal of Computational Geometry & Applications*, vol. 13(1). February 2003. pp. 61–94.

Conference Proceedings (full paper refereed)

Wesley N Griffin, William L George, Terence J Griffin, John G Hagedorn, Marc Olano, Steven G Satterfield, James S Sims, Judith E Terrill, "Application creation for an immersive virtual measurement and analysis laboratory", Proceedings of SEARIS 2016: the IEEE Workshop on Software Engineering and Architectures for Realtime Interactive Systems (March 2016).

Marc Olano, Alan T Sherman, Linda Oliva, Ryan Cox, Deborah Firestone, Oliver Kubik, Milind Patil, John Seymour, Isaac S Kohane, and Donna Thomas, "SecurityEmpire: Development and Evaluation of a Digital Game to Promote Cybersecurity Education", In 3GSE 2014: the USENIX Summit on Gaming, Games, and Gamification in Security Education (San Diego, CA, August 18, 2014).

Wesley Griffin and Marc Olano, "Objective Image Quality Assessment of Texture Compression." Proceedings of I3D 2014: The 18th ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games (San Francisco, CA, March 14-16, 2014). 8 pp (acceptance rate: 40.4%)

Wesley Griffin, Yu Wang, David Berrios and Marc Olano, "GPU curvature estimation on deformable meshes," Proceedings of I3D 2011: The 15th ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games (San Francisco, CA, February 18-20, 2011). pp. 159-166 (acceptance rate: 37.5%)

Fahad Zafar, Aaron Curtis and Marc Olano, "GPU Random Numbers via the Thin Encryption Algorithm," Proceedings of HPG 2010: The 2nd ACM SIGGRAPH/Eurographics Symposium on High Performance Graphics (Saarbrücken, Germany, June 25-27, 2010). pp. 133-142 (acceptance rate: 31.7%).

Marc Olano and Dan Baker, "LEAN Mapping," Proceedings of I3D 2010: The 14th ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games (Washington, DC, February 19-21, 2010). pp. 181-188 (acceptance rate: 32.4%).

Tom DuBois, Bryant Lee, Yi Wang, Marc Olano and Uzi Vishkin, "XMT-GPU: A PRAM Architecture for Graphics Computation," Proceedings of ICPP-08: the 37th IACC International Conference on Parallel Processing (Portland, Oregon, September 8-12, 2008). pp. 364-372 (acceptance rate: 30.8%).

Jonathan Bronson, Penny Rheingans and Marc Olano, "Semi-automatic Stencil Creation through Constrained Error Minimization," Proceedings of NPAR 2008: the 6th ACM SIGGRAPH Symposium on Non-Photorealistic Animation and Rendering (Annecy, France, June 9-11, 2008). pp. 31-38 + back cover image (acceptance rate: 40.7%).

John Kloetzli, Brian Strege, Johnathan Decker and Marc Olano, "Parallel Longest Common Subsequence using Graphics Hardware," Proceedings of EGPGV 2008: the 8th Eurographics Symposium on Parallel Graphics and Visualization (Crete, Greece, April 14-15, 2008). pp. 57-64 (acceptance rate: 55.7%).

John Kloetzli, Marc Olano and Penny Rheingans, "Interactive Volume Isosurface Rendering using BT Volumes," Proceedings of I3D 2008: the 12th ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games (Redwood City, CA, February 15-17, 2008). pp. 45-52 (acceptance rate: 42.1%).

Jeremy Shopf and Marc Olano, "Procedural Haptic Texture," Proceedings of UIST 2006: the 19th ACM Symposium on User Interface Software and Technology (Montreaux, Switzerland, October 2006). pp. 179-186 (acceptance rate: 23.0%).

Marc Olano, "Modified Noise for Evaluation on Graphics Hardware," Proceedings of Graphics Hardware 2005: the 20th ACM/Eurographics Symposium on Graphics Hardware (Los Angeles, CA, July 2005). pp. 105–110 (acceptance rate: 39.3%).

Marc Olano, Bob Kuehne and Maryann Simmons, "Automatic Shader Level of Detail," Proceedings of Graphics Hardware 2003: the 18th ACM/Eurographics Symposium on Graphics Hardware (Los Angeles, CA, July 2003). pp. 7–14 (acceptance rate: 33.3%)

Marc Olano, Shrijeet Mukherjee and Angus Dorbie, "Vertex-based Anisotropic Texturing," Proceedings of Graphics Hardware 2001: the 16th ACM/Eurographics Symposium on Graphics Hardware (Los Angeles, CA, August 12-13, 2001). pp. 95–98 + back cover image (acceptance rate: 48.3%).

Marc Olano and Trey Greer, "Triangle Scan Conversion Using 2D Homogeneous Coordinates," Proceedings of Graphics Hardware 1997: the 10th ACM/Eurographics Workshop on Graphics Hardware (Los Angeles, CA, August 2-4, 1997). pp. 89–95.

Jon Cohen, Dinesh Manocha and *Marc Olano*, "Simplifying Polygonal Models using Successive Mappings," Proceedings of IEEE Visualization '97: the 8th conference on Visualization (Phoenix, AZ, October 18-24, 1997). pp. 395–404 (acceptance rate: 25.9%).

Anselmo Lastra, Steve Molnar, *Marc Olano* and *Yulan Wang*, "Real-Time Programmable Shading," Proceedings of I3D 1995: the 4th ACM Symposium on Interactive 3D Graphics (Monterey, CA, April 9-12, 1995). pp. 59–67 (acceptance rate: 34.4%).

Marc Olano, *Jon Cohen*, *Mark Mine* and Gary Bishop, "Combating Rendering Latency," Proceedings of I3D 1995: the 4th ACM Symposium on Interactive 3D Graphics (Monterey, CA, April 9-12, 1995). pp. 19–24 (acceptance rate: 34.4%).

Conference Proceedings (abstract refereed)

Kishalay Kundu and Marc Olano, "Tissue Resection Using Delayed Updates in a Tetrahedral Mesh," *MMVR15: Medicine Meets Virtual Reality* (Long Beach, CA, February 6-9, 2007).

Jeff Butterworth, *Andrew Davidson*, *Stephen Hensch* and *Marc Olano*, "3DM: A Three Dimensional Modeler Using a Head-Mounted Display," Proceedings of I3D 1992: the 3rd ACM Symposium on Interactive 3D Graphics (Cambridge, MA, March 29 - April 1, 1992). pp. 135–138 (acceptance rate 43.5%).

Non-Peer-Reviewed Works

Yu Wang, Marc Olano, Matthias K. Gobbert, and *Wesley Griffin*. "A GPU memory system comparison for an elliptic test problem," Technical Report HPCF–2012–1, UMBC High Performance Computing Facility, University of Maryland, Baltimore County, 2012.

Dilip Banerjee, John Gross, William Hess, Marc Olano, and Judith Terrill, "Visualization of structural behavior under fire", NIST Interagency/Internal Report, NISTIR-7691, August 2009. 28 pages.

Stephen Ingram, Tamara Munzner and Marc Olano, "Glimmer: Multilevel MDS on the GPU," *UBC CS TR-2007-15*, Department of Computer Science, University of British Columbia, Vancouver, Canada, 2007. 8 pages.

Josh Barczak and Marc Olano, "Interactive Shadowed Caustics Using Hierarchical Light Volumes," *UMBC Department of Computer Science and Electrical Engineering Technical Report*, 2005. 8 pages.

Marc Olano, Invited foreword for Randi Rost, *OpenGL Shading Language*, Addison-Wesley, 2004.

Marc Olano and Bob Kuehne, "SGI OpenGL Shader™ Level-of-Detail White Paper," *SGI Document 007-4555-001*, SGI, 2002. 22 pages.

Olano, Marc and Michael North, "Normal Distribution Mapping," *UNC Computer Science Technical Report 97-041*, 1997. 7 pages.

Marc Olano, Anselmo Lastra and Jon Leech, "Procedural Primitives in a High Performance, Hardware Accelerated, Z-Buffer Renderer," *UNC Computer Science Technical Report 97-040*, 1997. 10 pages.

Jon Cohen, Dinesh Manocha and Marc Olano, "Simplifying Polygonal Models using Successive Mappings," *UNC Computer Science Technical Report 97-011*, 1997. 19 pages.

Jon Cohen and Marc Olano, "Low Latency Rendering on Pixel-Planes 5," *UNC Computer Science Technical Report 94-028*, 1994. 24 pages.

Terry S. Yoo and T. Marc Olano, "Instant Hole (Windows onto Reality)," *UNC Computer Science Technical Report 93-027*, 1993. 13 pages.

Marc Olano and Terry S. Yoo, "Precision Normals (Beyond Phong)," *UNC Computer Science Technical Report 93-021*, 1993. 4 pages.

Richard Ellson and *T. Marc Olano*, "Injection Molding: Supercomputing and Supergraphics," *Cray Channels*, v11n3, Fall 1989, Cray Research, 1989. pp. 2–5.

PRESENTATIONS

Conference Papers (Juried/Refereed)

"Modified Noise for Evaluation on Graphics Hardware," Proceedings of Graphics Hardware 2005: the 20th ACM/Eurographics Symposium on Graphics Hardware (Los Angeles, CA, July 2005). Full paper peer review.

"Automatic Shader Level of Detail," Proceedings of Graphics Hardware 2003: the 18th ACM/Eurographics Symposium on Graphics Hardware (Los Angeles, CA, July 2003). Full paper peer review.

"Vertex-based Anisotropic Texturing," Proceedings of Graphics Hardware 2001: the 16th ACM/Eurographics Symposium on Graphics Hardware (Los Angeles, CA, August 12-13, 2001). Full paper peer review.

"Interactive Multi-Pass Programmable Shading," Proceedings of ACM SIGGRAPH 2000 (New Orleans, Louisiana, July 23-28, 2000). Full paper peer review.

"Reflection Space Image Based Rendering," Proceedings of ACM SIGGRAPH 99 (Los Angeles, California, August 8-13, 1999). Full paper peer review.

"A Shading Language on Graphics Hardware: The PixelFlow Shading System," Proceedings of ACM SIGGRAPH 98 (Orlando, Florida, July 19-24, 1998). Full paper peer review.

"Triangle Scan Conversion Using 2D Homogeneous Coordinates," Proceedings of Graphics Hardware 1997: the 10th ACM/Eurographics Workshop on Graphics Hardware (Los Angeles, CA, August 2-4, 1997). Full paper peer review.

"Real-Time Programmable Shading," Proceedings of I3D 1995: the 4th ACM Symposium on Interactive 3D Graphics (Monterey, CA, April 9-12, 1995). Full paper peer review.

Other Professional Presentations

Conference Courses and Tutorials

Marc Olano (organizer/lecturer), David Blythe, Larry Gritz, Mark Kilgard, Michael McCool, Fabio Pellacini, Pedro Sander (lecturers), *GPU Shading and Rendering*, Full-day course, SIGGRAPH 2006, Boston, MA, August 2006. Juried: Proposal selection by course committee.

Marc Olano (organizer/lecturer), Avi Bleiweiss, Larry Gritz, John C. Hart, Mark Kilgard, Michael McCool, Pedro Sander (lecturers), *GPU Shading and Rendering*, Full-day course, SIGGRAPH 2005, Los Angeles, CA, August 2005. Juried: Proposal selection by course committee.

Marc Olano (organizer/lecturer), Kurt Akeley, John C. Hart, Wolfgang Heidrich, Michael McCool, Jason L. Mitchell and Randi Rost (lecturers), *Real-Time Shading*, Full-day course, SIGGRAPH 2004, Los Angeles, CA, August 2004. Juried: Proposal selection by course committee.

Marc Olano (organizer/lecturer), Kurt Akeley, John C. Hart, Wolfgang Heidrich, Bill Mark, Jason L. Mitchell and Randi Rost (lecturers), *Real-Time Shading*, Full-day course, SIGGRAPH 2003, San Diego, CA, July 2003. Juried: Proposal selection by course committee.

Marc Olano (organizer/lecturer), John C. Hart, Wolfgang Heidrich, Bill Mark and Ken Perlin (lecturers), *Real-Time Shading Languages*, Full-day course, SIGGRAPH 2002, San Antonio, TX, July 2002. Juried: Proposal selection by course committee.

Marc Olano (organizer/lecturer), Chas Boyd, Bill Mark, Michael McCool, Jason L. Mitchell and Randi Rost (lecturers), *State of the Art in Shading Hardware*, Full-day course, SIGGRAPH 2002, San Antonio, TX, July 2002. Juried: Proposal selection by course committee.

Marc Olano (organizer/lecturer), John C. Hart, Wolfgang Heidrich, Erik Lindholm, Michael McCool, Bill Mark and Ken Perlin (lecturers), *Real-Time Shading*, Full-day course, SIGGRAPH 2001, Los Angeles, CA, August 2001. Juried: Proposal selection by course committee.

Marc Olano (organizer/lecturer), John C. Hart, Wolfgang Heidrich, Michael McCool, Bill Mark and Kekoa Proudfoot (lecturers), *Approaches for Procedural Shading on Graphics Hardware*, Full-day course, SIGGRAPH 2000, New Orleans, LA, July 2000. Juried: Proposal selection by course committee.

Conference Presentations (Invited)

Marc Olano (keynote), *Bridging the gap between academic research and game development*, ACM SIGGRAPH Symposium on Interactive 3D graphics and Games, February 2017.

Marc Olano (moderator), Mike Acton, Mark DeLoura, Stephen Hill, Naty Hoffman, Peter-Pike Sloan, Natalya Tatarchuk, *Panel: Sharing technical ideas in the games industry*, ACM SIGGRAPH Symposium on Interactive 3D graphics and Games, March 2012.

Mark Segal (moderator), Marc Olano, Dave Luebke, Mike Doggett, Bill Mark, *Panel: whither graphics hardware and Graphics Hardware*, ACM SIGGRAPH/Eurographics Symposium on Graphics Hardware, August 2007.

Marc Olano, *Programming Graphics Hardware*, UMBC CSEE Research Review, May 2007.

Marc Olano, *Interactive Realism with Multi-Pass Rendering*, NIST Workshop on Metrology and Modeling of Color and Appearance, National Institute of Standards and Technology, Gaithersburg, MD, March 2000.

Other Invited Presentations

Marc Olano, *Our 3D World*, TedX, Towson University, May 2016

Marc Olano, *LEAN Mapping: Research experience at a game company*, Bowie State University, Bowie, MD, June 2014.

Marc Olano, *LEAN Mapping and Related Techniques*, Blizzard Entertainment, Irvine, CA, October 2013.

Marc Olano, *LEAN Mapping: research experience at a game company*, IMPA – Instituto Nacional de Matemática Pura e Aplicada, Rio de Janeiro, Brazil, July 2012.

Marc Olano, *LEAN Mapping: research experience at a game company*, University of Iowa, November, 2010.

Marc Olano, *UMBC Games, Animation and Interactive Media*, International Game Developers Association, Washington DC Chapter, September 2007.

Marc Olano, *Real-Time Shading*, NIST, Gaithersburg, MD, June 2006.

Marc Olano, *The Future of Shading Language Compilation*, NYU, New York, NY, October 2004.

Marc Olano, *The Future of Shading Language Compilation*, ATI, Santa Clara, CA, August 2003.

Marc Olano, *Interactive Procedural Shading*, University of Maryland, College Park, MD, November 2002.

PRESS

Daniel Leaderman, "Immersive, 3D scanner comes to UMBC," The Daily Record, 12/23/2015.

Stephen Babcock, "A crazy 3D-scanning room was recently delivered to UMBC," Technical.ly Baltimore, 12/14/2015.

Daniel Leaderman, "Full Steam ahead: UMBC students take video game to market," The Daily Record, 9/14/2015.

Stephen Babcock, "HueBots, a video game created by UMBC students, is now on Steam," Technical.ly Baltimore, 9/12/2015.

Stephen Babcock, "This UMBC class just launched 2 new games (and presented them to clients)," Technical.ly Baltimore, 5/20/2015.

Daniel Leaderman, "At UMBC, a taste of professional life for game designers," The Daily Record, 5/19/2015.

Stephanie Botelho, "Gaming: Serious Business at University of Maryland, Baltimore County," University Business, 5/2015.

Freeman Hrabowski, III, "Commentary: Video Games in the Classroom? Welcome to the future of learning," CNBC, 3/31/2015.

BMore Media, "Video: Gaming at UMBC", 5/26/2011.

Gus Sentementes, "The new frontier: online social games," Baltimore Sun, 9/26/2010

Terri Hogan, "Sherwood students pit gaming skills against international teams," Maryland Business Gazette, 3/17/2010.

Kevin Rector, "Global Game Jam features a packed weekend at UMBC," Catonsville Times, 2/4/2009.

Matt Vensel, "Weird 101: Baltimore's unusual college courses," B Daily, 10/1/2008.

Tricia Bishop, "Gamer Making a Career of it: Student develops games, gets Microsoft's attention," Baltimore Sun, 7/24/2008 (Lead article, Business section).

Chris Emery, "Serious About Games," ACM Tech News, 4/23/2008.

Chris Emery, "Video Games, from Scratch," Baltimore Sun, 4/20/2008 (Front page article, Sunday paper).

Staff, "Concrete Flow Researchers to use Argonne Supercomputer," Science Daily, 1/24/2008.

Michael E. Newman, "Concrete Flow Researchers to use Argonne Supercomputer," NIST Tech Beat, 1/23/2008 (appeared on www.nist.gov front page).

Steve Berberich, "Video Games Starting to get Serious: Producers Target Military, Medical, Education Clients," Maryland Business Gazette, 8/31/2007

SERVICE TO THE DEPARTMENT, UNIVERSITY, COMMUNITY AND PROFESSION

Department

Curriculum Development

2007–present	Director, UMBC CMSC BS Game Development Track
2007	Lead design and creation of UMBC CMSC Game Development Track

Committees

2017–2018	Chair, CS Graduate Admissions Committee
2011–2014	Computer Science Undergraduate Program Director
2002–2011	Member, Graduate Committee, Computer Science
2004–2006, 2011	Chair, Graduate Admissions Committee, Computer Science
2004–2005	Member, Publicity Committee
2003–2004	Member, Equipment Committee
2002–2004	Member, CS Graduate Admissions Subcommittee
2003	Chair, Departmental Image Working Group

University

2015–present	Member, IT Steering Committee
2007–present	Member, High Performance Computing Facility Governance Committee
2007–present	Faculty advisor, UMBC Game Development Club

Community

2006–2008	Treasurer, Hill East Community Garden
-----------	---------------------------------------

COURSES

Spring 2016	UMBC CMSC 611, <i>Advanced Computer Architecture</i>
Spring 2016	UMBC CMSC 491/691, <i>Data Oriented Computing</i>
Fall 2015	UMBC CMSC 411, <i>Computer Architecture</i>
Spring 2015	UMBC CMSC 493/ART 488, <i>Game Development Group Project</i>
Fall 2014	UMBC CMSC 435/634, <i>Introduction to Computer Graphics</i>
Spring 2014	UMBC CMSC 435/634, <i>Introduction to Computer Graphics</i>
Spring 2014	UMBC CMSC 491, <i>Graphics for Games</i>
Fall 2013	UMBC CMSC 411, <i>Computer Architecture</i>
Spring 2013	UMBC CMSC 493/ART 488, <i>Game Development Group Project</i>
Fall 2012	UMBC CMSC 435/634, <i>Introduction to Computer Graphics</i>
Fall 2012	UMBC CMSC 611, <i>Advanced Computer Architecture</i>
Spring 2012	UMBC CMSC 411, <i>Computer Architecture</i>
Spring 2012	UMBC CMSC 491/691, <i>Computer Graphics for Games</i>
Fall 2011	UMBC CMSC 435/634, <i>Introduction to Computer Graphics</i>
Spring 2011	UMBC CMSC 491/635, <i>Advanced Computer Graphics</i>
Spring 2011	UMBC CMSC 493/ART 488, <i>Game Development Group Project</i>
Fall 2010	UMBC CMSC 611, <i>Advanced Computer Architecture</i>
Spring 2009	UMBC CMSC 491/635, <i>Advanced Computer Graphics</i>
Spring 2009	UMBC CMSC 493/ART 488, <i>Game Development Group Project</i>
Fall 2008	UMBC CMSC 611, <i>Advanced Computer Architecture</i>
Spring 2008	UMBC CMSC 435/634, <i>Introduction to Computer Graphics</i>
Spring 2008	UMBC CMSC 635, <i>Advanced Computer Graphics</i>
Fall 2007	UMBC CMSC 491G/691G, <i>Computer Graphics for Games</i>
Spring 2007	UMBC CMSC 635, <i>Advanced Computer Graphics</i>
Fall 2006	UMBC CMSC 435/634, <i>Introduction to Computer Graphics</i>
Spring 2006	UMBC CMSC 611, <i>Advanced Computer Architecture</i>
Fall 2005	UMBC CMSC 635, <i>Advanced Computer Graphics</i>
Spring 2005	UMBC CMSC 491G/691G, <i>Real-Time Shading</i>
Fall 2004	UMBC CMSC 435/634, <i>Introduction to Computer Graphics</i>
Spring 2004	UMBC CMSC 491E/691E, <i>Computer Graphics for Games</i>
Spring 2004	UMBC CMSC 435/634, <i>Introduction to Computer Graphics</i>
Fall 2003	UMBC CMSC 611, <i>Advanced Computer Architecture</i>
Spring 2003	UMBC CMSC 635, <i>Advanced Computer Graphics</i>
Fall 2002	UMBC CMSC 435/634, <i>Introduction to Computer Graphics</i>
Spring 2000	Stanford CS 448, <i>Real-Time Programmable Shading</i> (with Bill Mark)
Fall 1994	UNC CS 136, <i>Introduction to Computer Graphics</i>

Profession**Standards Organizations**

2002–2009	Participant	OpenGL Shading Language Working Group
		Active participant defining OpenGL's Shading Language
2006–2009	Invited Expert	Khronos Group
		OpenGL Architecture Review Board Steering Group

2002–2006 Individual Member OpenGL Architecture Review Board
Graphics Standards Organization, merged with Khronos Group

Conference Organization

2014 Student Research Competition Chair, ACM SIGGRAPH 2014, Vancouver, Canada, August 2014

2014 Papers Co-Chair, I3D 2014: ACM SIGGRAPH 2014 Symposium on Interactive 3D Graphics and Games, San Francisco, CA, March 2014.

2013 Student Research Competition Chair, ACM SIGGRAPH 2013, Anaheim, CA, July 2013

2013 General Co-Chair, I3D 2013: ACM SIGGRAPH 2013 Symposium on Interactive 3D Graphics and Games, Orlando, FL, March 2013.

2011 Industry Co-Chair, I3D 2011: ACM SIGGRAPH 2011 Symposium on Interactive 3D Graphics and Games, San Francisco, CA, February 2011

2006 Papers Co-Chair, Eurographics/ACM SIGGRAPH 2006 Symposium on Graphics Hardware, Vienna, Austria, September 2006.

2006 Papers Co-Chair, I3D 2006: ACM SIGGRAPH 2006 Symposium on Interactive 3D Graphics and Games, Redwood City, CA, April 2006.

2005 General Co-Chair, I3D 2005: ACM SIGGRAPH 2005 Symposium on Interactive 3D Graphics and Games, Washington, DC, April 2005.

Program Committees and Editorial Boards

2015–present Editor in Chief, Journal of Computer Graphics Techniques

2013–2015 Editorial Board, Journal of Computer Graphics Techniques

2013, 2014 General Submission Jury, ACM SIGGRAPH

2014 Program Committee, ACM SIGGRAPH/Eurographics High Performance Graphics

2008 – 2009 Papers Program Committee, ACM SIGGRAPH

2008 Editorial Board, Journal of Scientific Programming, Special Issue on High Performance Computing on the Cell BE Processor.

2005 – 2013 Program Committee, I3D: ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games (includes years as chair)

2006 – 2012 Program Committee, SIBGRAPI: The Brazilian Symposium on Computer Graphics and Image Processing

2005 – 2012 Program Committee, GRAPP: International Conference on Computer Graphics Theory and Applications

2009 – 2012 Program Committee, ACM SIGGRAPH/Eurographics High Performance Graphics

2000 – 2008 Program Committee, ACM SIGGRAPH/Eurographics Graphics Hardware (includes year as chair)

Reviews

Books Addison-Wesley, AK Peters, CRC Press, Elsevier.

Journals	Computers and Graphics, ACM Transactions on Graphics, IEEE Transactions on Visualization and Computer Graphics, IEEE Computer Graphics and Applications, Visual Computer, ACM Journal of Graphics Tools, International Journal of Computers and Applications, Optical Engineering, Progress in Electromagnetics Research
Conferences	ACM SIGGRAPH papers, courses and sketches, ACM SIGGRAPH Asia, Eurographics, Eurographics Workshop on Rendering, IEEE Visualization, IEEE InfoVis, ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games, SIGGRAPH/Eurographics Graphics Hardware, Pacific Graphics, ACM SIGGRAPH Symposium on Real-time Ray Tracing, VINCI.
Funding	NSF CPA, NSF ITR, NSF VEC, Maryland Industrial Partnerships

Memberships

2008–present	IGDA (International Game Developers Association)
2006–present	Eurographics (European Association for Graphics)
1989–present	ACM (Association for Computing Machinery) ACM SIGGRAPH (Special Interest Group for Graphics)
1987–present	IEEE (Institute of Electrical and Electronics Engineers) IEEE Computer Society