

# Anjul Patney

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anjulpatney.com

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## Education

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- 2007–13 **Ph.D. in Electrical and Computer Engineering**  
University of California, Davis  
GPA: 4.0/4.0
- 2007–09 **MS in Electrical and Computer Engineering**  
University of California, Davis  
GPA: 4.0/4.0
- 2003–07 **Bachelor of Technology in Electrical Engineering**  
Indian Institute of Technology Delhi  
GPA: 9.3/10.0

## Experience

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- 2015– **Senior Research Scientist, NVIDIA Corporation, Redmond, WA**
- 2013–15 **Research Scientist, NVIDIA Corporation, Redmond, WA**  
Investigating algorithms and architectures to accelerate next-generation real-time computer graphics, with continued involvement in technology transfer to future NVIDIA products
- 2007–13 **Graduate Student Researcher, University of California, Davis, CA**  
Made fundamental contributions to techniques in the area of programmable graphics pipelines on modern GPUs, and proposed Piko, an abstraction to help design flexible, efficient and portable graphics systems
- 2010 **Summer Intern, NVIDIA Research, Santa Clara, CA**  
Designed, simulated and evaluated improved architectures for polygon rasterization in GPU architectures
- 2009 **Summer Intern, NVIDIA Research, Santa Clara, CA**  
Worked under Chief Scientist Bill Dally to devise compiler-assisted optimizations of large register files in manycore processors
- 2008 **Graduate Technical Intern, Intel Corporation, Santa Clara, CA**  
Worked towards performance modeling and evaluation of Intel Larrabee Architecture
- 2006 **Summer Intern, NVIDIA Corporation, Bangalore**  
Developed tools in Perl for verification and FPGA testing of a high-end Media and Communications Processor

## Publications

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- 2017 (**Best Paper award**) Rachel Albert, Joohwan Kim, Anjul Patney and David Luebke, “*Latency Requirements for Foveated Rendering in Virtual Reality*,” ACM Transactions on Applied Perception (Proceedings of Symposium on Applied Perception)
- 2017 (**Best Paper award**) Christoph Schied, Anton Kaplanyan, Chris Wyman, Anjul Patney, Chakravarty R. Alla Chaitanya, John Burgess, Shiqiu Liu, Carsten Dachsbacher, Aaron Lefohn, and Marco Salvi “*Spatiotemporal Variance-Guided Filtering: Real-Time Recon-*

- struction for Path-Traced Global Illumination*,” Proceedings of High-Performance Graphics
- 2016 Anjul Patney, Marco Salvi, JooHwan Kim, Anton Kaplanyan, Chris Wyman, Nir Benty, David Luebke, and Aaron Lefohn, “*Towards Foveated Rendering for Gaze-Tracked Virtual Reality*,” ACM Transactions on Graphics, 35(6) (Proceedings of SIGGRAPH Asia)
- 2016 (**Best Paper award**) Anton Kaplanyan, Stephen Hill, Anjul Patney, and Aaron Lefohn, “*Filtering Distributions of Normals for Shading Antialiasing*,” Proceedings of High-Performance Graphics
- 2015 Anjul Patney, Stanley Tzeng, Kerry A. Seitz, Jr., and John D. Owens, “*Piko: A Framework for Authoring Programmable Graphics Pipelines*,” ACM Transactions on Graphics, 34(4) (Proceedings of SIGGRAPH)
- 2014 (**Book Chapter**) Mohamed S. Ebeida, Scott A. Mitchell, Anjul Patney, Andrew A. Davidson, Stanley Tzeng, Muhammad A. Awad, Ahmed H. Mahmoud, and John D. Owens, “*Exercises in High-Dimensional Sampling: Maximal Poisson-disk Sampling and k-d Darts*,” Topological and Statistical Methods for Complex Data – Tackling Large-Scale, High-Dimensional, and Multivariate Data Sets
- 2014 Mohamed S. Ebeida, Anjul Patney, Scott A. Mitchell, Keith R. Dalbey, Andrew A. Davidson, and John D. Owens, “*k-d Darts: Sampling by k-Dimensional Flat Searches*,” ACM Transactions on Graphics
- 2013 Anjul Patney, “*Programmable Graphics Pipelines*,” Ph.D. Dissertation, University of California at Davis
- 2012 Stanley Tzeng, Anjul Patney, Andrew A. Davidson, Mohamed S. Ebeida, Scott A. Mitchell, and John D. Owens, “*High-Quality Parallel Depth-of-Field Using Line Samples*,” Proceedings of High-Performance Graphics
- 2012 Mohamed S. Ebeida, Scott A. Mitchell, Anjul Patney, Andrew Davidson, and John D. Owens, “*A Simple Algorithm for Maximal Poisson-Disk Sampling in High Dimensions*,” Computer Graphics Forum, (Proceedings of Eurographics)
- 2011 Mohamed S. Ebeida, Anjul Patney, Scott A. Mitchell, Andrew Davidson, Patrick M. Knupp and John D. Owens, “*Efficient Maximal Poisson-Disk Sampling*,” ACM Transactions on Graphics, (Proceedings of SIGGRAPH)
- 2010 Anjul Patney, Stanley Tzeng and John D. Owens, “*Fragment-Parallel Composite and Filter*,” Computer Graphics Forum, (Proceedings of Eurographics Symposium on Rendering)
- 2010 Stanley Tzeng, Anjul Patney, and John D. Owens, “*Task Management for Irregular-Parallel Workloads on the GPU*,” Proceedings of High Performance Graphics
- 2010 Mohamed S. Ebeida, Anjul Patney, John D. Owens, and Eric Mestreau, “*Isotropic Conforming Refinement of Quadrilateral and Hexahedral Meshes using Two-Refinement Templates*,” International Journal for Numerical Methods in Engineering
- 2009 Anjul Patney, Mohamed S. Ebeida and John D. Owens, “*Parallel View-Dependent Tessellation of Catmull-Clark Subdivision Surfaces*,” Proceedings of High Performance Graphics
- 2008 Anjul Patney and John D. Owens, “*Real-Time Reyes-Style Adaptive Surface Subdivision*,” ACM Transactions on Graphics (Proceedings of ACM SIGGRAPH Asia)
- 2008 B. V. N. Silpa, Anjul Patney, Tushar Krishna, Preeti Ranjan Panda, and G. S. Visweswaran, “*Texture Filter Memory – A Power-Efficient and Scalable Texture Memory Architecture for Mobile Graphics Processors*,” IEEE/ACM International Conference on Computer-Aided Design

- 2008 Mark Silberstein, Assaf Schuster, Dan Geiger, Anjul Patney, and John D. Owens, “*Efficient Computation of Sum-Products on GPUs Through Software-Managed Cache*,” ACM International Conference on Supercomputing

## Fellowships and Awards

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- 2017 Best Paper Award, Symposium on Applied Perception  
2017 Wolfgang Straßer Best Paper Award, High-Performance Graphics  
2016 Laval Virtual Award, SIGGRAPH 2016 Emerging Technologies  
2016 Wolfgang Straßer Best Paper Award, High-Performance Graphics  
2014 Honorable mention, Zuhair A. Munir Award for best doctoral dissertation, *UC Davis*  
2011 **Intel Ph.D. Fellowship**  
2011, 2012 Summer Graduate Student Research Award, *UC Davis*  
2011 CITRIS Davis Research Award  
2010 **NVIDIA Research Fellowship**  
2010 ECE Winter Block Grant Fellowship, *UC Davis*  
2009 **NVIDIA Research Fellowship**  
2009 ECE Winter and Spring Block Grant Fellowship, *UC Davis*  
2008 Graduate Student Travel Award, *UC Davis*  
2007 ICIM Stay Ahead Award, *IIT Delhi*  
2003–07 Four Merit Prizes for Academic Excellence, *IIT Delhi*  
2002 Finalist, Indian National Mathematics and Physics Olympiads

## Patents

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### Granted

- 2015 *System, method, and computer program product for shading using a dynamic object-space grid*  
Anjul Patney, Eric B. Enderton, Eric B. Lum, Marco Salvi, Christopher Ryan Wyman, Yubo Zhang, Yong He, G. Evan Hart JR., Kayvon Fatahalian, Yury Uralsky, Henry Packard Moreton, and Aaron Eliot Lefohn  
United States Patent 9,754,407
- 2015 *System, method, and computer program product for performing object-space shading*  
Anjul Patney, Eric B. Enderton, Eric B. Lum, Marco Salvi, Christopher Ryan Wyman, Yubo Zhang, Yong He, G. Evan Hart JR., Kayvon Fatahalian, Yury Uralsky, Henry Packard Moreton, and Aaron Eliot Lefohn  
United States Patent 9,747,718
- 2014 *Coverage Caching*  
Michael C. Shebanow and Anjul Patney  
United States Patent 8,860,742
- 2014 *Conflict-Free Register Allocation*  
Anjul Patney and William J. Dally  
United States Patent 8,832,671
- 2013 *Conflict-free register allocation using a multi-bank register file with input operand alignment*

Anjul Patney and William J. Dally  
United States Patent 8,555,035

### **Pending**

- 2016 *Frustum tests for sub-pixel shadows*  
Christopher Ryan Wyman, Aaron Eliot Lefohn, Anjul Patney  
United States Patent Application 14/989,585
- 2013 *System, method, and computer program product for reduced-rate calculation of low-frequency pixel shader intermediate values*  
Jaakko T. Lehtinen, Samuli Matias Laine, Kayvon Fatahalian, Yong He, and Anjul Patney  
United States Patent Application 14/137,888
- 2012 *Grid Walk Sampling*  
Michael C. Shebanow and Anjul Patney  
United States Patent Application 13/461,666

### **Talks, Courses & Demos**

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- 2017 *Applications of Visual Perception to Virtual Reality Rendering*  
Anjul Patney, Marina Zannoli, George-Alex Koulieris, Joochwan Kim, Gordon Wetzstein, Frank Steinicke  
ACM SIGGRAPH 2017 Course, Los Angeles, CA
- 2017 *Foveated Reconstruction*  
Demo at GTC 2017, San Jose, CA
- 2017 *Perceptual Insights into Foveated Virtual Reality*  
Talk at GTC 2017, San Jose, CA  
Recap at SIGGRAPH 2017, Los Angeles, CA
- 2017 *Perceptually-Based Foveated Virtual Reality*  
Anjul Patney, Joochwan Kim, Marco Salvi, Anton Kaplanyan, Chris Wyman, Nir Benty, Aaron Lefohn, and David Luebke  
Demo at Laval Virtual 2017, Laval, France
- 2016 *New Insights into Foveated Rendering*  
Joochwan Kim, Anjul Patney, Marco Salvi, Anton Kaplanyan, Chris Wyman, Nir Benty, Aaron Lefohn, and David Luebke  
Invited talk and demo at IMID 2016, Jeju, Korea
- 2016 *Perceptually-Based Foveated Virtual Reality*  
Anjul Patney, Joochwan Kim, Marco Salvi, Anton Kaplanyan, Chris Wyman, Nir Benty, Aaron Lefohn, and David Luebke  
Demo at ACM SIGGRAPH 2016 Emerging Technologies, Anaheim, CA
- 2009 *Real-Time Reyes: Analysis of a Programmable Rendering Pipeline*  
Invited talk at Crytek Academy, Frankfurt, Germany
- 2008 *Real-Time Reyes: Programmable Pipelines and Research Challenges*  
Course Talk at SIGGRAPH Asia 2008, Singapore
- 2008 *Real-Time Reyes-Style Adaptive Surface Subdivision*  
Microsoft Research, Redmond, WA  
Invited talk at Berkeley Graphics Lunch, UC Berkeley, CA

### **Activities**

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## Program / Paper Committee Membership

- 2018 Paper Co-Chair, ACM/Eurographics High Performance Graphics
- 2017 General Co-Chair, ACM/Eurographics High Performance Graphics
- 2017 Paper Committee Member, ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games
- 2016 Publicity Chair, *Simulation* Session Chair and Paper Committee Member, ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games
- 2015–16 Publicity Chair, ACM/Eurographics High Performance Graphics

## Dissertation Committee Memberships

- 2015 Srinath R., M.S. in CSE, IIIT, Hyderabad, India

## Technical Paper Reviewing

- 2018 CHI
- 2017 SIGGRAPH, SIGGRAPH Asia, I3D Symposium
- 2016 SIGGRAPH, Computer Graphics Forum, Eurographics, I3D Symposium
- 2015 Journal of Parallel and Distributed Computing (JPDC), High Performance Graphics
- 2014 SIGGRAPH, High Performance Graphics, Pacific Graphics
- 2013 ACM Transactions on Graphics
- 2012 SIGGRAPH, SIGGRAPH Asia, and IEEE Transactions on Visualization and Computer Graphics
- 2011 SIGGRAPH Asia, and Eurographics Parallel Graphics and Visualization
- 2010 High Performance Graphics, SIGGRAPH Asia, and ACM Transaction on Graphics
- 2009 SIGGRAPH and Eurographics

## Personal Projects

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- 2014 **Ahkoncha** [tinyurl.com/ahkoncha](http://tinyurl.com/ahkoncha)

An independent video game built to use the Microsoft Kinect for Windows controller; Awarded 2nd prize at the Microsoft Kinect v2 hackathon (Seattle), and first prize in the Microsoft “Ready, Set, NUI” contest

## Teaching

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- 2008 **EEC70: Assembly Language**  
Teaching Assistant under Prof. Kent Wilken  
University of California, Davis

## Computer Skills

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### Languages

*Fluency* C, C++,  $\LaTeX$ , CUDA, GLSL, Python  
*Familiarity* C#, HTML, CSS, JavaScript, Verilog, Perl

### Programming Systems

SSE, DirectX, OpenGL, WebGL, Unity3D