

Aaron M. Knoll

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Education:

University of Utah, Salt Lake City, UT (October 2004-December 2008)

PhD in Computer Science. Advisor: Charles D. Hansen.

Dissertation: "Ray Tracing Implicit Surfaces for Interactive Visualization"

University of Essex, Colchester, United Kingdom (September 2001- July 2002)

MSc, Electronic Systems Engineering. Thesis: "Primates: an Interactive Agents Simulation."

Washington and Lee University, Lexington, VA, (1997-2001)

Bachelor of Science, Double-major in Mathematics and Computer Science.

Work Experience:

Scientific Computing and Imaging Institute, University of Utah, Salt Lake City, UT

Research Computer Scientist (April 2014 – current)

Member of Center for Extreme Data Management, Analysis and Visualization (CEDMAV), Valerio Pascucci.

Intel Parallel Computing Center for Data Analysis and Visualization (I4DAV) – PI

Guest Faculty Researcher, Argonne National Laboratory

Research areas: large-scale scientific visualization; ray-tracing and rendering for visualization; multifield and multidimensional data analysis; in situ visualization; molecular and materials visualization; visualization in high performance computing.

Current Projects: Intel IPCC (PI), Argonne Nanoview (co-PI), DOD PETTT (Neptune)

Texas Advanced Computing Center, the University of Texas at Austin, Austin, TX

Research Associate, Scalable Visualization Technologies (July 2012 – March 2014)

Projects: Large-scale remote and in transit visualization on the TACC Stampede supercomputer,

Ray tracing on Intel Xeon Phi (MIC) and Xeon CPUs with the IVL and ISPC SPMD languages.

bnsView: molecular and astrophysics visualization for CPU and MIC. Floor demos at SC12 and SC13.

OpenCL acceleration for operators in the VisIt visualization package, using VTK.

"Picowalls": portable multi-projector tiled displays from pico projector arrays.

User support and training for HPC facilities and the TACC visualization lab.

Argonne National Laboratory, Chicago, IL

Computational Postdoctoral Fellow, Mathematics and Computer Science (MCS), (July 2010 – July 2012)

Projects: Large-scale visualization in high performance computing environments with vl3.

Nanovol, an OpenGL GPU volume ray caster for large molecular data.

Support for computational chemists and materials scientists with visualization and analysis.

University of Kaiserslautern, Rheinland-Pfalz, Germany

Postdoctoral Fellow (January 2009 – July 2010)

Projects: Volume rendering, sampling and classification methods, OpenGL/GLSL and CUDA.

Instructor: Software Practice: Scientific Visualization (Fall 2009), Algebraic Geometry II (Spring 2010)

Intel Corporation, Santa Clara, CA

Intern, Graphics group, CTG/Intel Labs (September-December 2007)

Projects: Ray tracing methods for arbitrary higher-order surfaces, CPU volume rendering with SSE intrinsics

Scientific Computing and Imaging Institute, University of Utah, Salt Lake City, UT

Research Assistant. Advisor: Charles D. Hansen (2005-2008)

Projects: Interactive isosurface ray tracing of large structured volume data (2004-2005)

GPU-assisted visualization of large unstructured volumes (summer 2007)

Glyph and volume visualization of CSAFE data with the Manta CPU ray tracer (summer 2008)

Saffire Corporation, American Fork, UT

Game Software Engineer (2002 – 2004)

Credits: *Van Helsing* (PS2, Xbox), *The Hobbit* (GBA), *Around the World in 80 Days* (GBA)

Audio engine, localization, AI, and graphics for Xbox, PS2 and Gamecube platforms.

Grants, Contracts and Gifts:

Intel Parallel Computing Center (“Applied Visualization, Computing and Analysis”)
\$300K gift, (10/2016 – 10/2018), PI

Intel Parallel Computing Center (“IPCC for Data Analysis and Visualization”)
\$300K gift, (10/2014 – 10/2016), PI

Nanoview Project with Argonne National Laboratory. \$240K subcontract, (5/2013 – 5/2016), co-PI.
(PI: Valerio Pascucci, University of Utah)

NSF ACI-1339863 “Collaborative Research: SI2-SSI: A Comprehensive Ray Tracing Framework for Visualization in Distributed-Memory Parallel Environments” \$1.2M (10/01/2013 to 09/30/2016), senior personnel.
(PI: Paul Navratil, TACC)

Publications (journal publications in blue):

2016 and later:

Kui Wu, **Aaron Knoll**, Ben Isaac, Hamish Carr, and Valerio Pascucci.
Direct Multifield Volume Ray Casting of Fiber Surfaces.
IEEE Visualization (SciVis) 2016.

Ingo Wald, Greg P. Johnson, Jefferson Amstutz, Carson Brownlee, **Aaron Knoll**, James Jeffers, Johannes Guenther, and Paul Navratil.
OSPRay: A CPU Ray Tracing Framework for Scientific Visualization.
IEEE Visualization (SciVis) 2016.

A.V. Pascal Grosset, Manasa Prasad, Cameron Christensen, **Aaron Knoll**, Charles D. Hansen.
TOD-Tree: Task-Overlapped Direct send Tree Image Compositing for Hybrid MPI Parallelism and GPUs.
IEEE Transactions on Visualization & Computer Graphics, 2016

Will Usher, Ingo Wald, **Aaron Knoll**, Michael E. Papka, Valerio Pascucci.
In Situ Exploration of Particle Systems with CPU Ray Tracing.
Supercomputing Frontiers and Foundations 2017 (accepted).

A.V. Pascal Grosset, **Aaron Knoll**, Charles D. Hansen.
Dynamically Scheduled Region-Based Image compositing.
Eurographics Symposium on Parallel Graphics and Visualization (EGPGV) 2016.

2015:

Ingo Wald, **Aaron Knoll**, Gregory P. Johnson, Will Usher, Valerio Pascucci and Michael E. Papka.
CPU Ray Tracing Large Particle Data with Balanced P-k-d Trees.
IEEE Visualization (SciVis) 2015.

Attila Gyulassy, **Aaron Knoll**, Kah Chun Lau, Bei Wang, Peer-Timo Bremer, Valerio Pasucci, Michael E. Papka and Larry Curtiss.
Interstitial and Interlayer Ion Diffusion Geometry Extraction in Graphitic Nanosphere Battery Materials.
IEEE Visualization (SciVis) 2015.

Hamish Carr, Zhao Geng, Julien Tierny, Amit Chattopadhyay, and **Aaron Knoll**.
Fiber Surfaces: Generalizing Isosurfaces to Bivariate Data.
Computer Graphics Forum 34(3), p 241–250, 2015. (Proceedings of Eurovis 2015)

O. Anatole von Lilienfeld, Raghunathan Ramakrishnan, Matthias Rupp, **Aaron Knoll**.
Fourier Series of Atomic Radial Distribution Functions: A Molecular Fingerprint for Machine Learning Models of Quantum Chemical Properties. *International Journal of Quantum Chemistry (Wiley Online Library), 2015*.

Attila Gyulassy, **Aaron Knoll**, Kah Chun Lau, Bei Wang, Peer-Timo Bremer, Valerio Pasucci, Michael E. Papka and Larry Curtiss.

Morse-Smale Analysis of Ion Diffusion in Ab Initio Battery Materials Simulations.

Symposium on Topology in Visualization (TopoInVis) 2015.

A.V. Pascal Grosset, Manasa Prasad, Cameron Christensen, **Aaron Knoll**, and Charles Hansen.

TOD-Tree: Task-Overlapped Direct Send Tree Image Compositing for Hybrid MPI Parallelism.

Eurographics Symposium on Parallel Graphics and Visualization (EGPGV) 2015.

2014:

Sidharth Kumar, John Edwards, Peer-Timo Bremer, **Aaron Knoll**, Cameron Christensen, Venkatram Vishwanath, Phil Carns, John Schmidt, Valerio Pascucci. Efficient I/O and storage of adaptive-resolution data, *ACM Supercomputing 2014.*

Aaron Knoll, Ingo Wald, Paul Navratil, Anne Bowen, Khairi Reda, Michael E. Papka, Kelly Gaither.

RBF Volume Ray Casting on Multicore and Manycore CPUs.

Computer Graphics Forum (proc. Eurovis), 2014.

Nicolas Schunck, David Duke, Hamish Carr, **Aaron Knoll**.

Description of Induced Nuclear Fission with Skyrme Energy Functionals: I. Static Potential Energy Surfaces and Fission Fragment Properties.

Phys. Rev. C 90, 054305, 2014.

2013:

Khairi Reda, Alessandro Febretti, **Aaron Knoll**, Jillian Aurisano, Jason Leigh, Andrew E. Johnson, Michael E. Papka, Mark Hereld. Visualizing Large, Heterogeneous Data in Hybrid-Reality Environments. *IEEE Computer Graphics and Applications* 33(4), pp 38-48, 2013.

David Hughes, Ik-Soo Lim, Mark W. Jones, **Aaron Knoll**, and Benjamin Spencer. InK-Compact: In-Kernel Stream Compaction and Its Application to Multi-Kernel Data Visualization on General-Purpose GPUs. *Computer Graphics Forum*, 32(6), pp 178-188, 2013.

Natallia Kotava, **Aaron Knoll**, and Hans Hagen. Morse-Smale Decomposition of Multivariate Transfer Function Space for Separably-Sampled Volume Rendering. *Computer Aided Geometric Design*, 30(6), pp549-556, 2013.

Aaron Knoll, Kah Chun Lau, Bin Liu, Maria K.Y. Chan, Aslihan Sumer, Jeffrey Greeley, Larry Curtiss, Julius Jellinek, Mark Hereld and Michael E. Papka. Uncertainty Classification and Visualization of Molecular Interfaces. *International Journal of Uncertainty Quantification*, 3(2), 2013.

Khairi Reda, **Aaron Knoll**, Ken-ichi Nomura, Michael E. Papka, Andrew E. Johnson, and Jason Leigh. Visualizing Large-Scale Atomistic Simulations in Ultra-Resolution Immersive Environments. *IEEE LDIV*, 2013.

Aaron Knoll, Ingo Wald, Paul Navratil, Michael E. Papka, Kelly Gaither. Ray Tracing and Volume Rendering Large Molecular Data on Multi-core and Many-core Architectures. *SC Ultravis Workshop*, 2013.

Aaron Knoll, Cody Hammock, Jo Wozniak, Nathaniel Mendoza, Paul Navratil, and Brandt Westing. Picowalls: Portable Tiled Display Walls from Pico Projector Arrays.

Proc. Workshop on Visualization Infrastructure & Systems Technology at SC13 (Vistech), 2013.

2012:

David Duke, Hamish Carr, **Aaron Knoll**, Nicholas Schunck, Hai Ah Nam, and Andrzej Staszczak.

Visualizing Nuclear Scission Through a Multifield Extension of Topological Analysis.

IEEE TVCG (IEEE Visualization 2012)

Natallia Kotava, **Aaron Knoll**, Mathias Schott, Christoph Garth, Xavier Tricoche, Christoph Kessler, Elaine Cohen, Charles Hansen, Michael E. Papka, and Hans Hagen.

Volume Rendering with Multidimensional Peak Finding.

IEEE Pacific Vis Symposium, p 161-168, 2012.

2011:

Aaron Knoll, Tom Peterka, Mark Hereld, Michael E. Papka, Bin Liu, Maria K.Y. Chan and Jeffrey Greeley.
A Volumetric Framework for Registration, Analysis and Visualization of Nanostructured Materials.
SciDAC Online Proceedings, 2011.

Aaron Knoll, Sebastian Thelen, Ingo Wald, Charles Hansen, Hans Hagen, Michael Papka.
Full-Resolution Interactive CPU Volume Rendering with Coherent BVH Traversal.
IEEE Pacific Vis 2011

2010:

Younis Hijazi, **Aaron Knoll**, Mathias Schott, Andrew Kensler, Charles Hansen, and Hans Hagen.
CSG Operations of Arbitrary Primitives with Interval Arithmetic and Real-Time Ray Casting.
Advanced Topics in Visualization, Schloss Dagstuhl Online Proceedings, 2010.

2009:

Aaron Knoll, Younis Hijazi, Rolf Westerteiger, Mathias Schott, Charles Hansen, and Hans Hagen.
Volume Ray Casting with Peak Finding and Differential Sampling.
IEEE TVCG (proc. IEEE Visualization 2009)

Aaron Knoll, Younis Hijazi, Andrew Kensler, Mathias Schott, Charles Hansen and Hans Hagen.
Fast Ray Tracing of Implicit Surfaces with Interval and Affine Arithmetic.
Computer Graphics Forum, 2009.

Aaron Knoll, Charles Hansen, and Ingo Wald
Coherent Multiresolution Isosurface Ray Tracing.
The Visual Computer, 25(6), pp 209-225, 2009

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Ray Tracing Implicit Surfaces for Interactive Visualization.
PhD Thesis, University of Utah, May 2009

Aaron Knoll, Rolf Westerteiger and Hans Hagen.

An Evaluation of Peak Finding for DVR Classification of Biological Data. *Proceedings of Visualization in Medicine and Life Sciences (VMLS) II, Springer, 2009.*

Mario Hlawitschka, Younis Hijazi, **Aaron Knoll**, and Bernd Hamann.

[Towards a High-quality Visualization of Higher-order Reynold's Glyphs for Diffusion Tensor Imaging.](#)
Proceedings of Visualization in Medicine and Life Sciences (VMLS) II, Springer, 2009.

2007:

Ingo Wald, Heiko Friedrich, **Aaron Knoll**, and Charles D. Hansen
Interactive Isosurface Ray Tracing of Time-Varying Tetrahedral Volumes
IEEE TVCG (IEEE Vis 2007), 13(6), pp 1727-1734, 2007

Aaron Knoll, Younis Hijazi, Charles Hansen, Ingo Wald, and Hans Hagen
Interactive Ray Tracing of Arbitrary Implicits with SIMD Interval Arithmetic
Proceedings of the 2nd IEEE/EG Symposium on Interactive Ray Tracing, Ulm, Germany, 2007

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A Survey of Implicit Surface Rendering Methods, and a Proposal for a Common Sampling Framework
GI Lecture Notes in Informatics, Proceedings of the 2nd IRTG Workshop, Kaiserslautern, Germany, 2007

2006:

Aaron Knoll, Ingo Wald, Steven Parker, and Charles Hansen.
Interactive Isosurface Ray Tracing of Large Octree Volumes. In *Proc. IEEE Symposium on Interactive Ray Tracing, 2006.*

Aaron Knoll

A Short Survey of Octree Volume Rendering Techniques

Ingo Wald, Thiago Ize, Andrew Kensler, **Aaron Knoll**, and Steven G. Parker.

Ray Tracing Animated Scenes with Coherent Grid Traversal. *'ACM TOG, (proc. SIGGRAPH 2006.)*

Service:

PC member:

Eurovis 2013, 2014, 2015, 2016

IEEE Large Scale Data Analysis and Visualization (LDAV) 2014, 2015, 2016

Eurographics Symposium on Parallel Graphics and Visualization 2015, 2016

Reviewer:

IEEE Visualization (Visweek)

IEEE Pacific Visualization

IEEE Transactions on Visualization and Computer Graphics (TVCG)

The Visual Computer

Computer Graphics Forum

IEEE Transactions on Medical Imaging (TMI)

Teaching:

CS5630/CS6630: Data Visualization, Fall 2016, University of Utah, Alexander Lex – guest lectures in Scientific Visualization.

SCI Visualization seminar, Fall 2016.

CS5630/CS6630: Data Visualization, Fall 2015, University of Utah, Alexander Lex – guest lectures in Scientific Visualization.

SCI Visualization seminar, Spring 2015.

Visualization in Practice course, Spring 2010, University of Kaiserslautern.

Algorithmic Geometry, Fall 2009. University of Kaiserslautern.

Patents:

Ray Tracing a Three Dimensional Scene Using a Grid. US 20100194751 A1

PhD Students mentored:

Will Usher, Pavol Klacansky, Duong Thai Hoang (Valerio Pascucci, University of Utah).

Kui Wu (Cem Yuksel, University of Utah)

Qi Wu, Pascal Grosset (Chuck Hansen, University of Utah)

John Holmen (Martin Berzins, University of Utah)

Graduated PhD students mentored:

Khairi Reda – Indiana University Indianapolis (Jason Leigh, University of Illinois Chicago)

Natallia Kotava, Rolf Westerteiger, Sebastian Thelen (Hans Hagen, University of Kaiserslautern)

Selected Collaborators:

Michael E. Papka (Argonne National Laboratory); Ingo Wald (Intel Corporation); Hamish Carr (University of Leeds); Khairi Reda (Indiana University Indianapolis); Valerio Pascucci (University of Utah); Charles D. Hansen (University of Utah); Martin Berzins (University of Utah).

Invited Talks:

“Toward Scalable Visualization for Materials Science.” University of Stuttgart, CECAM, October 13, 2016.

"IVL: Independent Vector Layer", Kitware, Albany NY, March 10, 2015.

“Large SPH Molecular Visualization on CPU, GPU and MIC.” Argonne National Laboratory, July 2013.

“Nanovol: Visualization for Computational Materials Science”. National Renewable Energy Laboratory, July 2012.

“Volume Rendering with Peak Finding and Differential Sampling”. Université Louis Pasteur, Strasbourg, May 2009

“Fast and Robust Ray Tracing of Arbitrary Implicit”, Brown University, November 2007

“Various Methods for Ray Tracing Implicit”, University of Texas at Austin, March 2007

Contributed Talks:

- “Visualization Performance on CPU, GPU and Xeon Phi.” Intel booth panel talk at ACM Supercomputing, 2016
- “Toward Direct Visualization on CPU and Xeon Phi.” Intel HPC Developers Conference (HPCDC), 2016
- “Research and Production in OSPRay.” SCI Visualization Seminar, October 2016.
- “Visualization with vl3: Now on CPUs”, with Silvio Rizzi. IXPUG, Argonne National Laboratory, September 22, 2016
- “Visualization with OSPRay: Research and Production.” IXPUG, Argonne National Laboratory, September 22, 2016
- "Scientific Visualization for HPC". University of Utah CHPC, December 1, 2015
- “Code Modernization on Xeon Phi.” Intel booth panel talk at ACM Supercomputing, 2015
- "Large-Scale Scientific Visualization". Rocky Mountain Advanced Computing Consortium (RMACC), August 2015
- “Introduction to Scientific Visualization,” Florida International University, April 2013.
- “Molecular In Transit Visualization on the Xeon Phi.” TACC booth talk, Supercomputing 2012.
- “Efficient Volume Rendering on CPU”. 3rd IRTG Workshop, Bodega Bay, 2010

Honors and Awards:

- International Game Developers Association (IGDA) Scholarship, Game Developers Conference 2006
- Pi Mu Epsilon*, National Mathematical Honors Society, 2001