Mridul Aanjaneya

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Research Statement

My research addresses problems that arise in digital modeling and simulation by integrating design choices and goals such as efficiency, scalability, parallelization, heterogeneity of hardware, and sparsity of data *directly into* the underlying data structures and algorithms, involving a healthy interplay between computer science, engineering, applied mathematics, and physics.

Research Interests

Computer Graphics, High Performance Computing, Physics-based Simulation, Computational Fluid Dynamics, Computational Geometry, Biomechanics, Computational Physics, Robotics.

Education

2008 – 2013 **Ph.D. in Computer Science**, *Stanford University*.
Dissertation: A Monolithic Mass Tracking Formulation for Bubbles in Incompressible Flow.
Advisor: Prof. Ronald Fedkiw
GPA: 3.97/4.0

2004 – 2008 **B.Tech. in Computer Science**, *Indian Institute of Technology Kharagpur*.
Thesis: Excursions in Neighborhood Geometry of Tessellations.
Advisors: Prof. S. P. Pal and Dr. Arijit Bishnu
GPA: 8.87/10.0

Publications

Journal Publications

- H. Liu, N. Mitchell, **M. Aanjaneya**, and E. Sifakis, "A scalable Schur-complement fluids solver for heterogeneous compute platforms", *ACM Transactions on Graphics* (proceedings of SIGGRAPH Asia), 35, 6, 201:1-12, 2016.
- S. Patkar, **M. Aanjaneya**, W. Lu, M. Lentine, and R. Fedkiw, "Towards Positivity Preservation for Monolithic Two-way Solid-Fluid Coupling", *Journal of Computational Physics*, 312, 82-114, 2016.
- N. Mitchell, **M. Aanjaneya**, R. Setaluri, and E. Sifakis, "Non-Manifold Level Sets: A multivalued implicit surface representation with applications to self-collision processing", *ACM Transactions on Graphics* (proceedings of SIGGRAPH Asia), 34, 6, 247:1-9, 2015.
- R. Setaluri, **M. Aanjaneya**, S. Bauer, and E. Sifakis, "SPGrid: A Sparse Paged Grid structure applied to adaptive smoke simulation", *ACM Transactions on Graphics* (proceedings of SIGGRAPH Asia), 33, 6, 205:1-12, 2014.
- **M. Aanjaneya**, S. Patkar, and R. Fedkiw, "A Monolithic Mass Tracking Formulation for Bubbles in Incompressible Flow", *Journal of Computational Physics*, 247, 17-61, 2013.
- A. Khan, S. P. Pal, **M. Aanjaneya**, A. Bishnu, and S. C. Nandy, "Diffuse Reflection Diameter and Radius for Convex Quadrilateralizable Polygons", *Discrete Applied Mathematics*, 161(10-11), 1496-1505, 2013.
- **M. Aanjaneya**, F. Chazal, D. Chen, M. Glisse, L. Guibas, and D. Morozov, "Metric Graph Reconstruction from Noisy Data", *International Journal of Computational Geometry and Applications*, 22, 4, 305-325, 2012.

- **M. Aanjaneya**, "Tromino tilings of domino-deficient rectangles", *Discrete Mathematics*, 309, 4, 937-944, 2009.

Refereed Conference Publications

- S. Patkar, **M. Aanjaneya**, A. Bartle, M. Lee, and R. Fedkiw, "Effficient Denting and Bending of Rigid Bodies", *Symposium on Computer Animation*, 2014.
- S. Patkar, **M. Aanjaneya**, D. Karpman, and R. Fedkiw, "A Hybrid Lagrangian-Eulerian Formulation for Bubble Generation and Dynamics", *Symposium on Computer Animation*, 2013.
- T. Pylvänäinen, J. Berclaz, T. Korah, V. Hedau, **M. Aanjaneya** and R. Grzeszczuk, "3D City Modeling from Street-Level Data for Augmented Reality Applications", *3DIMPVT*, 2012.
- M. Lentine, **M. Aanjaneya**, and R. Fedkiw, "Mass and Momentum Conservation for Fluid Simulation", *Symposium on Computer Animation*, 2011.
- **M. Aanjaneya**, F. Chazal, D. Chen, M. Glisse, L. Guibas, and D. Morozov, "Metric Graph Reconstruction from Noisy Data", *Symposium on Computational Geometry*, 2011.
- K. Heath, N. Gelfand, M. Ovsjanikov, **M. Aanjaneya**, and L. Guibas, "Computing and Exploiting Connectivity in Image Collections", *Computer Vision and Pattern Recognition*, 2010.
- **M. Aanjaneya** and M. Teillaud, "Triangulating the Real Projective Plane", *Mathematical Aspects of Computer and Information Sciences*, 2007.

Refereed Abstracts

- H. Mazhar, **M. Aanjaneya**, and D. Negrut, "Two Approaches to Simulating Large Multi-Scale Dynamics Problems Involving Soil Mechanics", *4th Joint International Conference on Multibody System Dynamics*, 2016.
- H. Mazhar, **M. Aanjaneya**, and D. Negrut, "Two Approaches to Simulating Large Multi-Scale Dynamics Problems Involving Soil Mechanics", *8th Asian Conference on Multibody Dynamics*, 2016.
- C. R. L. Anumolu, **M. Aanjaneya**, E. Sifakis, and M. Trujillo, "Simulating Phase-Change Phenomena Using Gradient Augmented Level Set Approach", *ILASS Americas 28th Annual Conference on Liquid Atomization and Spray Systems*, 2016.
- A. Pazouki, H. Mazhar, **M. Aanjaneya**, P. Jayakumar, E. Sifakis, and D. Negrut, "A Comparative Study of Four Fluid-Solid Coupling Methods for Applications in Ground Vehicle Mobility", *ECCOMAS Thematic Conference on Multibody Dynamics*, 2015.
- **M. Aanjaneya**, A. Bishnu, and S. P. Pal, "Directly Visible Pairs and Illumination by Reflections in Orthogonal Polygons", *European Workshop on Computational Geometry*, 2008.

Patents

- U. Velkavrh, **M. Aanjaneya**, T. Pylvänäinen, R. Grzeszczuk, R. Vedantham, "Method and Apparatus for Providing Perspective-Based Content Placement", US Patent# 20130162644, 2013.

Invited Talks

- Simulation-Enhanced Visual Computing for Real World Applications, *Computer Science Seminar*, Seoul National University, South Korea, December 2016.
- Scalable Continuum Solvers in Highly Irregular Domains on Heterogeneous Compute Platforms, *ARO Workshop on Characterizing the Dynamics of Geo-Surface Materials*, Chicago, August 2016.
- The interplay between Visual Computing and Engineering for High-Fidelity Computational Mechanics, *Mechanical Engineering Seminar*, University of Wisconsin-Madison, January 2016.
- Interfacing Chrono and PhysBAM, *Machine-Ground Interaction Consortium*, University of Wisconsin-Madison, May 2015.

Experience

Research

Mar 2014 – present **Research Associate**, *Department of Computer Sciences*, University of Wisconsin-Madison.
Conducting research in physics-based simulation with Prof. Eftychios Sifakis, with a focus on improving the scalability of numerical solvers for incompressible fluids and volumetric solids.

2008 – 2013 **Research Assistant**, *Department of Computer Science*, Stanford University.
Conducted research in physics-based simulation with Prof. Ronald Fedkiw, with a focus on designing efficient numerical solvers for underwater bubble simulation.

2007, 2008 **Research Intern**, *GEOMETRICA*, INRIA Sophia Antipolis, France.
Conducted research with Prof. Monique Teillaud, with a focus on designing geometric algorithms for triangulating the projective plane from an input point cloud.

Teaching

Spring 2016 **Guest Lecturer**, *Department of Computer Sciences*, University of Wisconsin-Madison.
Lectured in CS559 (Computer Graphics) on homogeneous coordinates and hierarchical modeling for articulated character animation.

Spring 2015 **Associate Lecturer**, *Department of Computer Sciences*, University of Wisconsin-Madison.
Taught CS412 (Introduction to Numerical Methods) to a class of 70 students.

Spring 2014 **Guest Lecturer**, *Department of Computer Sciences*, University of Wisconsin-Madison.
Lectured in CS838 (Topics in Computing: Introduction to Physics-Based Modeling and Simulation) on level set methods and numerical solvers for underwater bubble simulation.

Spring 2013 **Course Assistant**, *Department of Computer Science*, Stanford University.
Head course assistant for CS205a (Mathematical Methods for Computer Graphics, Vision and Robotics). Lead weekly hour-long review sessions and also lectured on behalf of the instructor.

Fall 2012 **Course Assistant**, *Department of Computer Science*, Stanford University.
Course assistant for CS148 (Introduction to Computer Graphics). Assisted students with fundamental concepts, OpenGL programming and writing customized rendering software.

Summer 2012 **Instructor**, *Department of Computer Science*, Stanford University.
Taught CS154 (Introduction to Automata Theory) to a class of 17 students.

Spring 2010 **Course Assistant**, *Department of Computer Science*, Stanford University.
Course assistant for CS103 (Mathematical Foundations of Computing). Delivered a guest lecture and assisted students with using concepts from class to solve problems.

Industry

Aug 2013 – Feb 2014 **Staff Software Engineer**, *@WalmartLabs*, San Bruno, CA.
Member of the Algorithmic Business Optimization (ABO) team. Designed and implemented an automatic and scalable system for computing margin from financial data.

June 2010 – June 2012 **Research Consultant**, *Nokia Research Center*, Palo Alto, CA.
Designed and implemented algorithms for 3D reconstruction from point clouds, geometry optimization, and visual recognition of large planar facades for mobile applications.

Professional Activities & Service

Outreach

Oct 2013 **Guest Lecturer**, *Junior Achievement Program, CA.*
Taught elementary school kids (4th grade) for a day about entrepreneurship.

Summer 2011 **Mentor**, *Department of Computer Science*, Stanford University.
Supervised four undergraduate students (three from University of Texas at El Paso, and one from Morgan State University) on physics-based simulation on Android tablets, under the Army High Performance Computing and Research Center (AHPCRC) Summer Institute.

Service

2016 **Reviewer**, ACM Transactions on Spatial Algorithms and Systems.

2015-present **Reviewer**, IEEE Transactions on Visualization and Computer Graphics.

2013, 2015 **Reviewer**, Pacific Graphics.

2015-present **Reviewer**, SIGGRAPH.

2014-present **Reviewer**, Communications in Mathematical Sciences.

2014-present **Reviewer**, Journal of Computational Physics.

2011-present **Reviewer**, Discrete Mathematics.

2009 **Reviewer**, Workshop on Algorithms and Computation.

Honors & Awards

Jul 2013 **Best Paper Award (honorable mention)**, *Symposium on Computer Animation*.
For the paper *A Hybrid Lagrangian-Eulerian Formulation for Bubble Generation and Dynamics*.

Aug 2011 **Best Paper Award (honorable mention)**, *Symposium on Computer Animation*.
For the paper *Mass and Momentum Conservation for Fluid Simulation*.

Dec 2008 **Innovative Student Project Award**, *Indian National Academy of Engineering*, Government of India.
Best undergraduate thesis award (given only to *five* undergraduate theses all over India).

May 2008 **Best B. Tech. Thesis Award**, *Department of Computer Science*, Indian Institute of Technology Kharagpur.

Feb 2007 **Outstanding Inventor Award**, *International Exhibition for Young Inventors*.

Dec 2006 **Best Project Award**, *IRIS National Fair*.
Awarded for the project "Tromino tilings of rectangles". Organized by Intel, Confederation of Indian Industry (CII) and Government of India.