

HARI SUNDAR

CURRICULUM VITÆ

University of Utah
School of Computing

A BIOGRAPHICAL DATA

A.1 Education

Degree	Year	University	Field
Ph.D	2009	University of Pennsylvania	Bioengineering
B.Engg.	2000	University of Delhi	Control Systems

A.2 Employment History

Title	Organization	When
Associate Professor	University of Utah	Jul'20-present
Visiting Scholar	Flatiron Institute	Jan'22-present
Assistant Professor	University of Utah	Jul'14-Jun'20
Research Associate	University of Texas at Austin	Dec'11-Jun'14
Research Scientist	Siemens Corporate Research	Jan'08-Dec'11
Graduate Student	University of Pennsylvania	Jan'03-May-'09
Research Associate	Siemens Corporate Research	Jun'02-Dec'03
Graduate Student	Rutgers University	Sep'00-May'02

A.3 Research Focus

The central focus of my research is the development of computationally optimal *parallel, high-performance algorithms*, both discrete and continuous, that are efficient and scalable on state-of-the-art architectures. It is driven by applications in *computational relativity, computational fluid dynamics, geosciences* and *biophysics* such as cardiovascular mechanics, seismic wave propagation and the study of gravitational waves. My research has resulted in the development of state-of-the-art distributed algorithms for *adaptive mesh refinement, geometric multigrid, fast Gauss transform* and *sorting*.

The following are my current focus areas:

- Fast Elliptic Solvers
- Computational Relativity
- Parallel-in-time algorithms
- Scalable PDE Solvers & Preconditioners
- Adaptive Mesh Refinement

B TEACHING

B.1 Courses Taught

Course Number	Course Name	Semester
CS 4150	Algorithms	Spring 2024
CS 6958/5958	Parallel Algorithms	Fall 2023
CS 4150	Algorithms	Spring 2023
CS 6220	Scientific and Data Computing - II	Fall 2022

Course Number	Course Name	Semester
Honor 4471	Introduction to Computational Thinking	Spring 2021
CS 6220	Scientific and Data Computing - II	Spring 2020
CS 4150	Algorithms	Fall 2019
CS 4150	Algorithms	Fall 2018
CS 6230	Parallel Algorithms & High Performance Computing	Fall 2018
CS 6220	Advanced Scientific Computing II	Spring 2018
CS 4150	Algorithms	Fall 2017
CS 6230	Parallel Algorithms & High Performance Computing	Spring 2017
CS 3960	Parallel Programming (with Mary Hall)	Fall 2016
CS 6230	Parallel Algorithms & High Performance Computing	Spring 2016
CS 6965/5965	Big Data Computer Systems	Fall 2015
CS 6230	Parallel Algorithms & High Performance Computing	Spring 2015
CS 6965/5965	Big Data Computer Systems	Fall 2014

B.2 Seminars

Seminar	Theme	Semester
Intro to Computing	PhD Bootcamp	Fall 2022
Distributed Linear Algebra	Spectral Methods	Fall 2018
Distributed Linear Algebra	Graph Algorithms	Fall 2017
Distributed Linear Algebra	Hierarchical Matrices	Fall 2016
Parallel Algorithms	SC Best Papers	Spring 2016
Distributed Linear Algebra	Matrix & Tensor Factorization	Fall 2015

B.3 Individual Student Guidance

Students are from School of Computing, University of Utah unless otherwise noted. Students awards are listed under student.

Ph.D Students Supervised (as primary advisor)

1. Milinda Fernando - **Graduated** Spring 2021
 - ACM-IEEE CS George Michael Memorial HPC Fellowship 2019
 - University of Utah Graduate Research Fellowship 2019
2. Seyed Majid Rasouli-Pichahi - **Graduated** Spring 2021
3. Max Carlson - **Graduated** Summer 2022
4. Masado Ishii - **Graduated** Spring 2023
 - DOE High Energy Physics Graduate Fellowship 2019-2022
 - ACM-IEEE CS George Michael Memorial HPC Fellowship 2022
5. Eric Heisler - **Graduated** Spring 2023
6. Han Duc Tran (Fall 2018-present)
7. LeAnn Lindsey (Fall 2020-present)
 - ACM Student Research Competition 2022 - 3rd place
8. David van Komen (Spring 2021-present)
9. Gaurav Dhir (Fall 2022-present)
10. Budvin Edippuliarachchi (Fall 2023-present)

Ph.D Students Supervised (as co-advisor)

1. Vishal Sharma (with G. Gopalakrishnan), **Graduated** Jul 2016.

Post-Doc Mentoring

1. Songzhe Xu (Mechanical Engineering. Iowa State University) - Currently Asst. Prof. at Shanghai University

M.S. Students Supervised

1. Aadesh Deshmukh (Fall 2021-Spring 2023) MS Project
2. Liam Moynihan (Spring 2020-Spring 2022) MS Project
3. Shuvrajit Mukherjee (Fall 2018-Spring 2019) MS Project
4. Christopher Mertin (Fall 2015-Spring 2017) MS Project
5. Bryant Baird (Fall 2016-Spring 2017) MS Project
6. Matthias Schneider, University of Erlangen-Nuremberg, Germany (2010) *Thesis: Model-based respiratory motion compensation for image-guided cardiac interventions*

B.4 Ph.D Dissertation Committees

Students are from School of Computing, University of Utah unless otherwise noted. Advisors listed in parenthesis.

1. Simone Atzeni, **Graduated** Aug 2017. (Ganesh Gopalakrishnan)
2. Wei-Fan Chiang, **Graduated** Aug 2016. (Ganesh Gopalakrishnan)
3. Arnab Das, **Graduated** Fall 2020 (Ganesh Gopalakrishnan)
4. Dimitar Dinev, **Graduated** Spring 2020 (Ladislav Kavan)
5. Mina Ghashami, **Graduated** May 2017. (Jeff Phillips)
6. John Holmen, **Graduated** Mar 2022. (Martin Berzins)
7. Ashok Babu Jallepalli, **Graduated** Spring 2020 (Mike Kirby)
8. Ouermi Timbwaoga Judicael, **Graduated** Fall 2022 (Martin Berzins)
9. Mojgan Khaledi, **Graduated** June 2017. (Sneha Kasera)
10. Mahesh Lakshminarasimhan, Fall 2020-present (Mary Hall)
11. Jing Li, **Graduated** Spring 2022. (Ladislav Kavan)
12. Joe Novak, **Graduated** Nov 2018 (Sneha Kasera)
13. Michael Penwarden, Fall 2021-present (Mike Kirby)
14. Brad Peterson, **Graduated** May 2019 (Martin Berzins)
15. Damodar Sahasrabudhe, **Graduated** Aug 2021 (Martin Berzins)
16. Saeed Taheri, **Graduated** Jul 2021 (Ganesh Gopalakrishnan)
17. Khalid Theeb, Fall 2016-present (Mary Hall)
18. Lizhi Xiang, Fall 2022-present (P. Sadayappan)
19. Tuowen Zhao, **Graduated** May 2022 (Mary Hall)

C RESEARCH

Web citation indexes:

- [Google Scholar](#) Citations: 3101, h-index 28, i10-index 48 (retrieved Dec 2023)

c.1 Theses

- Ph.D.: **Spatio-temporal deformation analysis of Cardiac MR Images** Completed: Jan 2009
Advisors: **George Biros, Christos Davatzikos**

c.2 Journal Articles (refereed)

1. Ling Shi, Jiang Wang, Songzhe Xu, Jingjing Li, Chaoyue Chen, Tao Hu, Hari Sundar, Zhongming Ren, **Modeling of epitaxial growth of single crystal superalloys fabricated by directed energy deposition**, **Materials Today Communications**, Vol 35, Jun 2023.
2. Eric Heisler, Aadesh Deshmukh, Sandip Mazumder, Ponnuswamy Sadayappan, Hari Sundar, **Multi-discretization domain specific language and code generation for differential equations**, **Journal of Computational Science**, Vol 68, Apr 2023.
3. Milinda Fernando, David Neilsen, Yosef Zlochower, Eric W Hirschmann, Hari Sundar, **Massively parallel simulations of binary black holes with adaptive wavelet multiresolution**, **Physical Review D**, Vol 107(6), 2023.
4. Makrand A Khanwale, Kumar Saurabh, Masado Ishii, Hari Sundar, James A Rossmanith, Baskar Ganapathysubramanian, **A projection-based, semi-implicit time-stepping approach for the Cahn-Hilliard Navier-Stokes equations on adaptive octree meshes**, **Journal of Computational Physics**, vol 475, Feb 2023.
5. Songzhe Xu, Qiming Zhu, Milinda Fernando, Hari Sundar, **A finite element level set method based on adaptive octree meshes for thermal free-surface flows**, **International Journal for Numerical Methods in Engineering**, Vol 123 (22) pp 5500-5516, Nov 2022.
6. Makrand A Khanwale, Kumar Saurabh, Milinda Fernando, Victor M Calo, Hari Sundar, James A Rossmanith, Baskar Ganapathysubramanian, **A fully-coupled framework for solving Cahn-Hilliard Navier-Stokes equations: Second-order, energy-stable numerical methods on adaptive octree based meshes**, **Computer Physics Communications**, Vol 280, Nov 2022.
7. Milinda Fernando and Hari Sundar, **Scalable Local Timestepping on Octree Grids**, **SIAM Journal on Scientific Computing**, 44 (2), C156-C183, Apr 2022
8. Kumar Saurabh, Boshun Gao, Milinda Fernando, Songzhe Xu, Makrand A Khanwale, Biswajit Khara, Ming-Chen Hsu, Adarsh Krishnamurthy, Hari Sundar, Baskar Ganapathysubramanian, **Industrial scale Large Eddy Simulations with adaptive octree meshes using immersogeometric analysis** **Computers & Mathematics with Applications**, Vol 97, Sep 2021.
9. Max Carlson, Xiaoning Zheng, Hari Sundar, George Em Karniadakis, Robert M Kirby, **An open-source parallel code for computing the spectral fractional Laplacian on 3D complex geometry domains** **Computer Physics Communications**, Vol 261, Apr 2021.
10. Songzhe Xu, Boshun Gao, Alec Lofquist, Milinda Fernando, Ming-Chen Hsu, Hari Sundar, Baskar Ganapathysubramanian, **An octree-based immersogeometric approach for modeling inertial migration of particles in channels** **Computers & Fluids**, Vol 214, Jan 2021.
11. Makrand A Khanwale, Alec D Lofquist, Hari Sundar, James A Rossmanith, Baskar Ganapathysubramanian, **Simulating two-phase flows with thermodynamically consistent energy stable Cahn-Hilliard Navier-Stokes equations on parallel adaptive octree based meshes**, **Journal of Computational Physics** Vol 419 Oct 2020.
12. Khalid Ahmad, Hari Sundar, Mary Hall **Data-driven mixed precision sparse matrix vector multiplication for GPUs**. **ACM Transactions on Architecture and Code Optimization**. Vol. 16. No. 4, Article 51, 2019.
13. Milinda Fernando, David Neilsen, Hyun Lim, Eric Hirschmann, Hari Sundar, **Massively Parallel Simulations of Binary Black Hole Intermediate-Mass-Ratio Inspirals**, **SIAM Journal on Scientific Computing**, 41(2), C97-C138. 2019
14. Janan Lake, Chao, Q., Hannah Eyre, Emerson Ford, Kevin Parker, Kincaid Savoie, Hari Sundar, Mary Hall. Student Cluster Competition 2017, Team University of Utah: Reproducing Vectorization

- of the Tersoff Multi-Body Potential on the Intel Broadwell and Intel Skylake Platforms. **Parallel computing**. 79, Nov. 2018.
15. Mark Baranowski, Brandon Caywood, Hannah Eyre, Janaan Lake, Kevin Parker, Kincaid Savoie, Hari Sundar and Mary Hall, Reproducing ParConnect for SC16. **Parallel computing**. 70, 2017.
 16. Amir Gholami, Dhairya Malhotra, Hari Sundar, George Biros, **FFT, FMM, or Multigrid? A comparative study of state-of-the-art Poisson solvers in the unit cube**, **SIAM Journal on Scientific Computing** 38(3), C280–C306. 2016
 17. Hari Sundar, Georg Stadler, George Biros, **Comparison of multigrid algorithms for high-order continuous finite element discretizations**, **Numerical Linear Algebra with Applications** 22 (4), 664-680. 2015
 18. David Rivest-Henault, Hari Sundar, Mohamed Cheriet, **Nonrigid 2D/3D registration of coronary artery models with live fluoroscopy for guidance of cardiac interventions**, **IEEE Transactions on Medical Imaging** 31 (8), 1557-1572. 2012
 19. Parmeshwar Khurd, Leo Grady, Rafiou Oketokoun, Hari Sundar, Tejas Gajera, S Gibbs-Strauss, **Global error minimization in image mosaicing using graph connectivity and its applications in microscopy**, **Journal of pathology informatics** 2 (2), 8. 2012
 20. Hari Sundar, Harold Litt, Dinggang Shen, **Estimating myocardial motion by 4D image warping**, **Pattern Recognition** 42 (11), 2514-2526. 2009
 21. Hari Sundar, RS Sampath, George Biros, **Bottom-up construction and 2: 1 balance refinement of linear octrees in parallel**, **SIAM Journal on Scientific Computing** 30 (5), 2675-2708. 2008
 22. Charles R Bridges, Kapil Gopal, David E Holt, Charles Yarnall, Steven Cole, Rochelle B Anderson, Xiaoqing Yin, Anthony Nelson, Benjamin W Kozyak, Zhonglin Wang, James Lesniewski, Leonard T Su, Danielle M Thesier, Hari Sundar, Hansell H Stedman, **Efficient myocyte gene delivery with complete cardiac surgical isolation in situ**, **The Journal of thoracic and cardiovascular surgery** 130 (5), 1364.e1-e8. 2005

c.3 Conference Publications (refereed)

1. Eric Heisler, Sandip Mazumder, Hari Sundar, Phonon Boltzman Transport Equation: Achieving GPU scalability for complex scientific models. *accepted* IEEE International Parallel and Distributed Processing Symposium (IPDPS), 2024
2. LeAnn Lindsey, Muhammad Haseeb, Hari Sundar, Muaaz Awan, **TANGO: A GPU optimized trace-back approach for sequence alignment algorithms** Proceedings of the SC'23 Workshops of The International Conference on High Performance Computing, Network, Storage, and Analysis (SC'23 Workshop).
3. Han Tran, Siddhath Saurav, Sandip Mazumder, Ponnuswamy Sadayappan, Hari Sundar, **Scalable parallelization for the solution of phonon Boltzmann Transport Equation**, Proceedings of the 37th ACM on International Conference on Supercomputing (ICS23), 2023.
4. Milinda Fernando, David Neilsen, Eric Hirschmann, Yosef Zlochower, Hari Sundar, Omar Ghattas, George Biros, **A GPU-accelerated AMR solver for gravitational wave propagation**, Proceedings of the ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis (SC22).
5. Han D. Tran, Milinda Fernando, Kumar Saurabh, Baskar Ganapathysubramanian, Robert M. Kirby, Hari Sundar, **A scalable adaptive-matrix SPMV for heterogeneous architectures**, Proceedings of the 2022 IEEE International Parallel and Distributed Processing Symposium (IPDPS), Lyon, France.
6. Eric Heisler, Aadesh Deshmukh, Hari Sundar, **Finch: Domain Specific Language and Code Generation for Finite Element and Finite Volume in Julia**, Proceedings of the International Conference on Computational Sciences (ICCS'22), London, UK.
7. Kumar Saurabh, Masado Ishii, Milinda Fernando, Boshun Gao, Kendrick Tan, Ming-Chen Hsu, Adarsh Krishnamurthy, Hari Sundar, Baskar Ganapathysubramanian, **Scalable adaptive PDE solvers in arbitrary domains**, Proceedings of the ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis (SC21).

8. Case study of SARS-CoV-2 transmission risk assessment in indoor environments using cloud computing resources, Kumar Saurabh, Santi Adavani, Kendrick Tan, Masado Ishii, Boshun Gao, Adarsh Krishnamurthy, Hari Sundar, Baskar Ganapathysubramanian, [SuperCompCloud: 5th Workshop on Interoperability of Supercomputing and Cloud Technologies](#) (SC21 Workshop).
9. Majid Rasouli, Robert M Kirby, Hari Sundar, [A Compressed, Divide and Conquer Algorithm for Scalable Distributed Matrix-Matrix Multiplication](#), The International Conference on High Performance Computing in Asia-Pacific Region, 2021.
10. Max Carlson, Robert M Kirby, Hari Sundar, [A scalable framework for solving fractional diffusion equations](#), Proceedings of the 34rd ACM on International Conference on Supercomputing (ICS20), 2020. Acceptance Rate 19%
11. Masado Ishii, Milinda Fernando, Kumar Saurabh, Biswajit Khara, Baskar Ganapathysubramanian, Hari Sundar, [Solving PDEs in space-time: 4D tree-based adaptivity, mesh-free and matrix-free approaches](#), Proceedings of the ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis (SC19) Acceptance Rate: 20%
12. Milinda Fernando, David Neilsen, Eric Hirschmann, Hari Sundar, [A scalable framework for Adaptive Computational General Relativity on Heterogeneous Clusters](#), Proceedings of the 33rd ACM on International Conference on Supercomputing (ICS19), 2019. Acceptance Rate: 21%
13. Majid Rasouli, [Scalable Lazy-update Multigrid Preconditioners](#), 2019 IEEE High Performance Extreme Computing Conference (HPEC '19)
14. Nishith Tirpankar, Hari Sundar, [Towards Triangle Counting on GPU using Stable Radix binning](#), 2018 IEEE High Performance Extreme Computing Conference (HPEC '18)
15. Max Carlson, Hari Sundar, [Utilizing GPU Parallelism to Improve Fast Spherical Harmonic Transforms](#), 2018 IEEE High Performance Extreme Computing Conference (HPEC '18)
16. Majid Rasouli, Vidhi Zala, Robert Kirby, Hari Sundar, [Improving Performance and Scalability of Algebraic Multigrid through a Specialized MATVEC](#), 2018 IEEE High Performance Extreme Computing Conference (HPEC '18)
17. Isuru Fernando, Sanath Jayasena, Milinda Fernando, Hari Sundar, [A Scalable Hierarchical Semi-Separable Library for Heterogeneous Clusters](#), Parallel Processing (ICPP), 46th International Conference on, 513-522, 2017. Acceptance Rate: 28%.
18. Parmeshwar Khurd, Hari Sundar, [Parallel Algorithm for the Computation of Cycles in Relative Neighborhood Graphs](#), Parallel Processing (ICPP), 46th International Conference on, 191-200, 2017. Acceptance Rate: 28%.
19. Hari Sundar, [Efficient Parallel Streaming Algorithms for large-scale Inverse Problems](#), 2017 IEEE High Performance Extreme Computing Conference (HPEC '17), 2017.
20. Milinda Fernando, Dmitry Duplyakin, Hari Sundar, [Machine and Application Aware Partitioning for Adaptive Mesh Refinement Applications](#), Proceedings of the 26th International Symposium on High-Performance Parallel and Distributed Computing (HPDC'17), 2017. Acceptance Rate: 19%
21. Hari Sundar, Omar Ghattas, [A Nested Partitioning Algorithm for Adaptive Meshes on Heterogeneous Clusters](#), Proceedings of the 29th ACM on International Conference on Supercomputing (ICS15), 2015. Acceptance Rate: 25%
22. Jithin Jose, Sreeram Potluri, Hari Subramoni, Xiaoyi Lu, Khaled Hamidouche, Karl Schulz, Hari Sundar, Dhabaleswar K Panda, [Designing scalable out-of-core sorting with hybrid MPI+ PGAS programming models](#), Proceedings of the 8th International Conference on Partitioned Global Address Space Programming Models, 2014.
23. Hari Sundar, Dhairya Malhotra, Karl W Schulz, [Algorithms for high-throughput disk-to-disk sorting](#), Proceedings of the ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis (SC13), 2013. Acceptance Rate: 20%
24. Hari Sundar, Dhairya Malhotra, George Biros, [HykSort: a new variant of hypercube quicksort on distributed memory architectures](#), Proceedings of the 27th international ACM conference on international conference on supercomputing (ICS13), 2013. Acceptance Rate: 21%
25. Hari Sundar, George Biros, Carsten Burstedde, Johann Rudi, Omar Ghattas, Georg Stadler, [Parallel geometric-algebraic multigrid on unstructured forests of octrees](#), Proceedings of the ACM/IEEE

- International Conference for High Performance Computing, Networking, Storage and Analysis (SC12), 2012. Acceptance Rate: 22%
26. Rahul S Sampath, Hari Sundar, Shravan K Veerapaneni, **Parallel fast gauss transform**, Proceedings of the ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis (SC10), 2010. **Best Paper Finalist**. Acceptance Rate: 20%
 27. Ying Zhu, Y. Tsin, Hari Sundar, Frank Sauer, **Image-based respiratory motion compensation for fluoroscopic coronary roadmapping**, Medical Image Computing and Computer Assisted Intervention (MICCAI), 2010. Acceptance Rate: 32%
 28. Matthias Schneider, Hari Sundar, Rui Liao, Joachim Hornegger, Chenyang Xu, **Model-based respiratory motion compensation for image-guided cardiac interventions**, IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2010. Acceptance Rate: 22%
 29. Matthias Schneider, Hari Sundar, **Automatic global vessel segmentation and catheter removal using local geometry information and vector field integration**, IEEE International Symposium on Biomedical Imaging: From Nano to Macro (ISBI), 2010. Acceptance Rate: 15%
 30. Hari Sundar, Christos Davatzikos, George Biros, **Biomechanically constrained 4D estimation of myocardial motion**, Medical Image Computing and Computer-Assisted Intervention (MICCAI) 2009. Acceptance Rate: 27%
 31. Hari Sundar, Ali Khamene, Liron Yatziv, Chenyang Xu, **Automatic image-based cardiac and respiratory cycle synchronization and gating of image sequences**, Medical Image Computing and Computer-Assisted Intervention (MICCAI) 2009. Acceptance Rate: 27%
 32. Rahul S Sampath, Santi S Adavani, Hari Sundar, Ilya Lashuk, George Biros, **Dendro: parallel algorithms for multigrid and AMR methods on 2: 1 balanced octrees**, Proceedings of the ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis (SC08), 2008. Acceptance Rate: 21%
 33. Hari Sundar, Rahul S Sampath, Santi S Adavani, Christos Davatzikos, George Biros, **Low-constant parallel algorithms for finite element simulations using linear octrees**, Proceedings of the ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis (SC07), 2007. **Best Student Paper Finalist**. Acceptance Rate: 20%
 34. Hari Sundar, Dinggang Shen, George Biros, Chenyang Xu, Christos Davatzikos, **Robust computation of mutual information using spatially adaptive meshes**, Medical Image Computing and Computer-Assisted Intervention (MICCAI) 2007. Acceptance Rate: 31%
 35. Hari Sundar, Dinggang Shen, George Biros, Harold Litt, Christos Davatzikos, **Estimating myocardial fiber orientations by template warping**, IEEE International Symposium on Biomedical Imaging: From Nano to Macro (ISBI), 2006. Acceptance Rate: 35%
 36. Dinggang Shen, Hari Sundar, Zhong Xue, Yong Fan, Harold Litt, **Consistent Estimation of Cardiac Motions by 4D Image Registration**, Medical Image Computing and Computer-Assisted Intervention (MICCAI) 2005. Acceptance Rate: 28%
 37. Hari Sundar, Deborah Silver, Nikhil Gagvani, Sven Dickinson, **Skeleton based shape matching and retrieval**, IEEE Shape Modeling International, 2003.

c.4 Other Publications

1. Yang Gao, Hari Sundar, **Coronary arteries motion modeling on 2D x-ray images**, Proc. SPIE 8316, Medical Imaging 2012.
2. Vipin Gupta, Amit Kale, Hari Sundar, **A robust and accurate approach to automatic blood vessel detection and segmentation from angiography x-ray images using multistage random forests**, Proc. SPIE 8315, Medical Imaging 2012.
3. Rui Liao, Yunhao Tan, Hari Sundar, Marcus Pfister, Ali Kamen, **An efficient graph-based deformable 2D/3D registration algorithm with applications for abdominal aortic aneurysm interventions**, Medical Imaging and Augmented Reality, 2010.

4. Luc Duong, Rui Liao, Hari Sundar, Benoit Tailhades, Andreas Meyer, Chenyang Xu, [Curve-based 2D-3D registration of coronary vessels for image guided procedure](#), Proc. SPIE 7261, Medical Imaging 2009.
5. Hari Sundar, Ali Khamene, Chenyang Xu, Frank Sauer, Christos Davatzikos, [A novel 2D-3D registration algorithm for aligning fluoro images with 3D pre-op CT/MR images](#), Proc. SPIE 6141, Medical Imaging 2006.
6. Deborah Silver, Hari Sundar, Nikhil Gagvani, Shape Based Culling for Volume Graphics, Proc. 13th Eurographics Workshop on Rendering, 2002.

c.5 Invited Talks

1. Finch: Extensible and Scalable DSL for Scientific Computing, Mar 1, 2023, From Math to Code: Domain-Specific Programming Abstractions, Languages, and Frameworks Minisymposium, SIAM CSE 2023, Amsterdam, The Netherlands.
2. Data-Sparse Formats for Improving the Scalability of Seismic Imaging, Feb 27, 2023, Computational Challenges in Wave Theory: Methods and Applications Minisymposium, SIAM CSE 2023, Amsterdam, The Netherlands.
3. Scalable multi-phase flows in complex domains using adaptive octree meshes, May 4, 2022, Center for Computational Mathematics, Flatiron Institute, New York, NY.
4. Scalable two-phase flows in complex domains, Apr 25, 2022, Imperial College, London.
5. Local timestepping and 4D tree-based adaptivity: Enabling spacetime adaptivity for scalable numerical simulations, Apr 5, 2022, Applied Physics Applied Mathematics Colloquium, Columbia University.
6. [Solving PDEs in space-time: 4D tree-based adaptivity, mesh-free and matrix-free approaches](#), Feb 18 2022, Numerical Analysis and Scientific Computing Seminar, Courant Institute of Mathematical Sciences, NYU.
7. Scalable adaptive PDE solvers in arbitrary domains, Oct 20 2021, Department of Scientific Computing, Florida State University.
8. [Scalable Space-time adaptivity for Simulations of Binary Black Hole Intermediate-Mass-Ratio-Inspirals](#), Sep 16 2020, Advances and Challenges in Computational Relativity, ICERM, Brown University.
9. [Scalable Space-Time Adaptivity for Simulations of Binary Black Hole Intermediate-Mass-Ratio-Inspirals](#), Feb 13 2020 SIAM PP'20.
10. [Scalable Space-time adaptivity for Simulations of Binary Black Hole Intermediate-Mass-Ratio-Inspirals](#), Oct 09 2019, CS Colloquium, University of Illinois at Urbana-Champaign, IL.
11. [Scalable Space-time adaptivity for Simulations of Binary Black Hole Intermediate-Mass-Ratio-Inspirals](#), Jun 5, 2019. Center for Relativistic Astrophysics, Georgia Institute of Technology, Atlanta, GA.
12. [A Scalable Framework for Adaptive Computational General Relativity on Heterogeneous Clusters](#), Apr 25, 2019. Oden Institute, University of Texas at Austin, Austin, TX.
13. Scalability & Adaptivity: Achieving Conflicting Goals in a Heterogeneous Computing Era, Apr 09, 2019. Mechanical Engineering, Iowa State University, Ames, IA.
14. [dendro-GR: Enabling Adaptivity & Parallelism for Computational Relativity, Computational Challenges in Gravitational Wave Astronomy](#), Feb 1, 2019. IPAM, UCLA, Los Angeles, CA
15. [Parallel Fast Gauss Transform, SIAM PP'18](#), Mar 7, 2018, Waseda University, Tokyo, Japan.
16. Efficient Parallel Streaming Algorithms for large-scale Inverse Problems - September 13, 2017 - IEEE High Performance Extreme Computing Conference, Waltham, MA
17. Parallel Algorithms for the Computation of Cycles in Relative Neighborhood Graphs - August 16, 2017 - 46th International Conference on Parallel Processing, Bristol, UK
18. Challenges in Parallelizing Adaptive High-order Geometric Multigrid, 17th Copper Mountain Conference on Multigrid Methods, Copper Mountain, CO Mar 2015.
19. Parallel hp-Multigrid for HDG, SIAM Conference on Computational Science and Engineering, Salt Lake City, UT Feb 2015.

20. A Nested Partitioning Scheme for Adaptive Meshes on Parallel Heterogeneous Clusters, SIAM Conference on Parallel Processing for Scientific Computing, Portland, OR Feb 2014.
21. Geometric Multigrid for high-order discretizations, 16th Copper Mountain Conference on Multigrid Methods, Copper Mountain, CO Mar 2013.
22. Parallelization Strategies for High-order Discretized Hyperbolic PDEs, SIAM Conference on Computational Science and Engineering, Boston, MA Feb 2013.
23. Applications of projective registration for peripheral CTO, Interventional Radiology, University of Virginia Medical Center, Charlottesville, VA 2010.
24. Image-based guidance for the crossing of Chronic Total Occlusions, Thoraxcentrum, Erasmus Medical Center, Rotterdam, Netherlands Aug 2009.
25. A biomechanical model of the human heart incorporating myocardial fiber orientations, NSF ERC, Computer-Integrated Surgical Systems and Technology, Johns Hopkins University, Baltimore, MD Oct 2008.

c.6 Patents

Full list, including pending applications can be [found here](#).

1. Medical imaging system, **US 8422754 B2**, Issued Apr 16, 2013.
2. Medical imaging system for segmenting blood vessel, **US 8488852 B2**, Issued Jul 16, 2013.
3. Method and system of affine registration of inter-operative two dimensional images and pre-operative three dimensional images, **US 7450743 B2**, Issued Nov 11, 2008
4. Hierarchical atlas-based segmentation, **US 8861891 B2**, Issued Oct 14, 2014.
5. Global error minimization in image mosaicking using graph laplacians and its applications in microscopy, **US 8983230 B2**, Issued Mar 17, 2015.
6. System and method for robust 2D-3D image registration, **US 8457373 B2**, Issued Jun 4, 2013.
7. Deformable 2D-3D registration of structure, **US 8494243 B2**, Issued Jul 23, 2013.
8. Coronary artery motion modeling, **US 8849005 B2**, Issued Sep 30, 2014.
9. Network cycle features in relative neighborhood graphs, **US 9047660 B2**, Issued Jun 2, 2015.
10. System and method for image-based respiratory motion compensation for fluoroscopic coronary roadmapping, **US 8798347 B2**, Issued Aug 5, 2014.
11. Non-rigid 2D/3D registration of coronary artery models with live fluoroscopy images, **US 8948487 B2**, Issued Feb 3, 2015.

c.7 Grants - Approved & Funded

1. Sponsor: *Air Force Research Laboratory (AFRL)*
 Role: **Co-PI**
 Mathematical Contributions to AFRL Simulation Tools (MCAST)
 Award Amount: \$91,000
 Project Period: 12/01/2023-11/30/2024 (with annual renewal for 5 years)
 with Varun Shankar (PI) and Mike Kirby
2. Sponsor: *NSF*
 Role: **Co-PI**
REU Site: Trust and Reproducibility of Intelligent Computation
 Grant Number: 2244492
 Award Amount: \$405,000
 Project Period: 3/15/2023-02/28/2026
 with Ganesh Goopalakrishnan (PI) and others
3. Sponsor: *NSF*
 Role: **Co-PI**
URoL:EN: Understanding the rule of life facilitating the proliferation of toxic cyanobacterial benthic

- mats in flowing freshwaters**
 Grant Number: 2222322
 Award Amount: \$2,997,766
 Project Period: 1/1/2023-12/31/2027
 with Ramesh Goel (PI) and others
4. Sponsor: *NSF*
 Role: **Co-PI**
Collaborative Research: PPOSS: Large: A comprehensive framework for efficient, scalable, and performance-portable tensor applications
 Grant Number: 2217154
 Award Amount: \$3,649,636
 Project Period: 9/1/2022-8/31/2027
 with Ponnuswamy Sadayappan (PI) and others
5. Sponsor: *NSF*
 Role: **PI**
Collaborative Research: Accelerating the Pace of Discovery in Numerical Relativity by Improving Computational Efficiency and Scalability
 Grant Number: 2207616
 Award Amount: \$180,000
 Project Period: 9/1/2022-8/30/2025
 with David Neilsen, Eric Hirschmann (BYU)
6. Sponsor: *Air Force Research Laboratory (AFRL)*
 Role: **Co-PI**
 Composite Repair and Modeling.
 Grant Number:
 Award Amount: \$250,000
 Project Period: 09/01/2022-8/31/2024
 with Michale Czabaj (PI), Varun Shankar and Mike Kirby
7. Sponsor: *NSF*
 Role: **PI**
Collaborative Research: Engineering Fractional Photon Transfer for Random Laser Devices
 Grant Number: 2110215
 Award Amount: \$99,723
 Project Period: 9/15/2021-8/31/2024 with Luca Dal Negro (BU)
8. Sponsor: *NSF*
 Role: **Co-PI**
CICI: SIVD: Context-Aware Vulnerability Detection in Configurable Scientific Computing Environments
 Grant Number: 2115167
 Award Amount: \$499,834
 Project Period: 7/1/2021-6/30/2024 with Mu Zhang(PI) and Sneha Kasera
9. Sponsor: *NSF*
 Role: **PI**
OAC Core: Small: Architecture and Network-aware Partitioning Algorithms for Scalable PDE Solvers
 Grant Number: 2008772
 Award Amount: \$499,317
 Project Period: 10/1/2020-9/30/2023
10. Sponsor: University of Utah
 Role: **Co-PI**
 Rules of Resilience: Modeling impacts of host-microbe interactions during perturbations

- Award Amount: \$35,000
with Denise Dearing (PI), June Round, Aditya Bhaskara
11. Sponsor: *NSF*
Role: **PI**
Collaborative Research: CDS&E: A framework for solution of coupled partial differential equations on heterogeneous parallel systems
Grant Number: 2004236
Award Amount: \$367,000 (for Utah)
Project Period: 9/1/2020-8/31/2023
with Ponnuswamy Sadayappan, Sandip Mazumder (OSU)
 12. Sponsor: *NASA*
Role: **PI**
Binary Black Hole Waveforms for LISA using Numerical Relativity
Grant Number: 80NSSC20K0528
Award Amount: \$150,000 (for Utah)
Project Period: 1/23/2020-1/22/2023
with David Neilsen (BYU), Eric Hirschmann (BYU), Yosef Zlochower (RIT)
 13. Sponsor: *NSF*
Role: **PI**
Collaborative Research: Massively Parallel Simulations of Compact Objects
Grant Number : 1912930 Award amount: \$150,000
Project Period: 9/1/2019-8/31/2022
with David Neilsen, Eric Hirschmann (BYU)
 14. Sponsor: *NSF*
Role: **PI**
CDS&E: Collaborative Research: Strategies for Managing Data in Uncertainty Quantification at Extreme Scales
Grant Number : 1808652 Award amount: \$396,066
Project Period: 9/1/2018-8/31/2022
with Tan Bui-Thanh (UT Austin)
 15. Sponsor: *NSF*
Role: **co-PI**
SHF: Medium: Hierarchical Tuning of Floating-point Computations
Grant# : 1704715 Award amount: \$1,200,000 (Utah)
Project Period: 8/1/2017-7/31/2020
with Ganesh Gopalakrishnan (PI), Mary Hall, Zvonimir Rakamaric
 16. Sponsor: *NSF*
Role: **co-PI**
EAGER: Application-driven Data Precision Selection Methods
Grant# : 1643056 Award amount: \$299,970
Project Period: 8/1/2016 - 07/31/2018
with Ganesh Gopalakrishnan (PI), Mary Hall, Zvonimir Rakamaric, John Regehr, Vivek Srikumar
 17. Sponsor: *NSF*
Role: **PI**
Scalable Multigrid Algorithms for solving elliptic PDEs on power-efficient Clusters
Grant# : 1464244
Award amount: \$175,000
Project Period: 8/1/2015 - 07/31/2017
 18. Sponsor: *DOE MMICCs*
Role: Senior Investigator
DiaMonD: An Integrated Multifaceted Approach to Mathematics at the Interfaces of Data, Models, and Decisions

Award amount: \$5,425,000 (total for UT Austin)

Grant# : 11145687

Project Period: 1/1/2013 - 12/31/2017

19. Sponsor: *NSF*

Role: Senior Investigator

Algorithms and Architectures for Multiresolution Applications

Grant# : 1337393

Award amount: \$749,801

Project Period: 10/1/2013 - 09/30/2016

c.8 Gifts

1. Gift of two **Jetson Tegra-K1** development boards from NVIDIA Corporation.
2. Gift of one **Jetson Tegra-TX2** development board from NVIDIA Corporation.

c.9 Research Honors & Awards

- NSF CRII Award - 2015.
- Best Poster Award, ACM/IEEE SuperComputing 2014.
- Best Paper finalist, ACM/IEEE SuperComputing 2010. Best paper in Math Library Parallelization.
- Best Student Paper finalist, ACM/IEEE SuperComputing 2007. Best paper in PDE Applications.
- Siemens-Penn Fellowship for Ph.D. studies

c.10 Software Development

The below codes build on MPI for distributed memory parallelism and are written in C/C++. Most implementations were started from a clean sheet of paper to ensure optimal parallel scalability of each component, and few external libraries are used. Currently, some codes are modified towards OpenMP and SIMD.

- **Dendro**: A C++ library for constructing and balancing octrees in parallel. It also generates hexahedral meshes from the octrees and extends PETSc's distributed array framework to support octree-based meshing. Basic routines for solving PDEs on such meshes using the finite element method are also provided. Currently major changes are underway to support efficient orderings using Hilbert Curves.
- **Dendro-GR** A scalable framework for highly-adaptive computational relativity on modern heterogeneous cluster. Supports high-order finite differencing schemes on curved spacetime. The code is written in C++ and MPI, with support for OpenMP and CUDA. The application interface is at a high-level using SymPy and Python, enabling rapid development by domain scientists. This has enabled simulations of intermediate mass ratio inspirals for extracting gravitational waves that are not possible with existing codes.
- **Saena** A highly-scalable algebraic multigrid package that provides computationally optimal solvers and preconditioners for elliptic operators in a black-box fashion. The package uses specialized sparse matrix data-structures with scalable methods for performing SpMV and SpMM that enable excellent scalability on modern supercomputers.
- **aMat** A generic sparse matrix class targeting matrices obtained from high-order finite elements, targeting different modes of refinement. Different modes of refinement—including h and p refinement—add additional degrees of freedom requiring frequent reordering and partitioning of data. **aMat** implements a sparse matrix class in a pseudo matrix-free way enabling efficient operations without requiring reordering.

- **homg** High-order finite-element package using hexahedral elements in Matlab. The code is a testbed for geometric multigrid approaches for high order discretizations. The current implementation supports setting up a combination of h and p heirarchy.
- **hykSort**: Highly scalable distributed sorting and selection library. The package implements Bitonic-Sort, MergeSort, SampleSort and HykSort. The code is highly tuned and provides parallelism using MPI, OpenMP and SIMD vectorization.
- **pfgt**: Fast adaptive parallel algorithms to compute the sum of N Gaussians at M points using the fast Gauss Transform. We use parallel octrees and a new scheme for translating the plane-waves to efficiently handle non-uniform distributions.

D SERVICE

D.1 Department, College and University Service

- Associate Chair, School of Computing Retention, Promotion and Tenure (Fall 2023-present)
- Director, College of Engineering Fellowship Office (Fall 2022-current)
- Departmental grant writing workshop and mock panel for junior faculty. Spring 2019-current
- Member, Faculty Hiring Committee (multiple years)
- Member, College of Engineering and School of Computing Curriculum Committee (Spring 2019-Spring 2021)
- Member, University Interdisciplinary Teaching Programs Committee (Fall 2017-Summer 2020)
- Track Director, Scientific Computing, School of Computing (Fall 2014-current)
- Poster Session Organizer, Grad Visit 2015, 2015 (Department)
- **CES** Steering Committee member (University-level) Fall 2014-Fall 2016
- Member, Graduate Admissions Committee, 2015, 2016 (Department)
- Member, Faculty Hiring Committee, Architecture 2016 (Department)
- Member, Faculty Hiring Committee, Robotics 2015 (Department)
- Coordinating cluster purchase via CHPC for the School of Computing faculty. This has required coordinating with different faculty on their computing needs and managing the usage by SoC faculty and students. Fall 2016-current

D.2 Professional External Service

- Member of XSEDE/ACCESS Resource Allocation Committee (XRAC) Aug 2017-
- **Editorial Board** Associate Editor for the following Journals
 - Journal of Computational Science (2014-present),
 - Journal of Parallel and Distributed Computing (2019-present),
 - Concurrency and Computation: Practice and Experience (2021-present)
- **Area-Chair** - IPDPS 2023 - Applications Area Chair (with Sivasankaran Rajamanickam)
- **Co-Chair** - LCPC 2018
- **Program Committee** member for the following Conferences:

- ACM/IEEE Supercomputing (SC) 2016, 2017, 2019, 2020, 2022, 2023
- IEEE Cluster 2016, 2017, 2019
- ACM International Conference on Supercomputing (ICS) 2015, 2019
- IEEE International Parallel & Distributed Processing Symposium (IPDPS) 2015, 2017, 2019, 2020, 2022, 2023
- **Reviewer** for the following journals: ACM Transactions on Parallel Computing, ACM Transactions on Mathematical Software, SIAM Journal of Scientific Computing, IEEE Transactions on Medical Imaging, IEEE Transactions on Biomedical Engineering, IEEE Transactions on Image Processing, Medical Image Analysis, The Visual Computer, Signal, Image & Video Processing.
- **Reviewer** for the following Conferences: Supercomputing, ICCV, CVPR, IPDPS, MICCAI, ISBI.
- Member on the Stampede User Advisory Committee at the Texas Advanced Computing Center (TACC), 2013-.

D.3 Mentoring of Faculty and Students other than Advisees

- **Faculty Mentoring:**
 - Faculty mentor of Shireen Elhabian - Associate Professor, School of Computing, University of Utah 2022-present
- Grant writing workshop for junior faculty. Every fall since 2019-present. Over 20 faculty have attended these workshops. Also organize a mock-NSF panel for junior faculty to introduce them to the review process. every spring since 2019-present.
- Mentoring of students for NSF Graduate Research fellowship. Organized 4 workshops focused on different aspects of applying for graduate fellowships, including proofreading and feedback to students
 - Fall 2022 - for students in the School of Computing, University of Utah
 - Fall 2023 - for students in the College of Engineering, University of Utah
- Mentor for Utah Cluster Competition team, Supercomputing 2016, 2017.
- Mentor, Mentor-Protege program at Supercomputing 2015, Austin, TX
- Mentor, Student Mentorship program at SIAM Computational Science & Engineering 2015, Salt Lake City, UT.