Grey Ballard

ballard@wfu.edu

www.wfu.edu/~ballard

PO Box 7311 • Computer Science Department • Wake Forest University • Winston Salem, NC 27106

Professional

Associate Professor 2022 – present

Wake Forest University Department of Computer Science, Winston Salem NC

Assistant Professor 2016 – 2022

Wake Forest University Department of Computer Science, Winston Salem NC

Harry S. Truman Postdoctoral Fellow 2013 – 2016

Sandia National Laboratories, Livermore CA

Education

Ph.D. in Computer Science Fall 2008 – Spring 2013

University of California Berkeley, with a Designated Emphasis in Computational Science and Engineering

Advisor: James Demmel, Thesis: Avoiding Communication in Dense Linear Algebra

M.A. in Mathematics Fall 2006 – Spring 2008

Wake Forest University, Advisor: John Baxley

B.S. in Mathematics and Computer Science Fall 2002 – Spring 2006

Wake Forest University, *summa cum laude* with honors in mathematics and honors in computer science

Honors and Awards

WFU Award for Excellence in Research 2021

Awarded to early-career faculty member for significant research, creative activity, or scholarly activity

NSF CAREER Award 2020-2024

National Science Foundation Faculty Early Career Development Program

Dunn-Riley Faculty Fellowship 2020-2022

Wake Forest Faculty Fellowship Program

ACM Senior Member 2021

Recognizes those ACM members with at least 10 years of professional experience who have demonstrated performance through technical leadership, and technical or professional contributions

ICDM Best Paper Award 2015

Awarded by the program committee, with coauthors Tamara Kolda, Ali Pinar, and C. Seshadri

ACM Doctoral Dissertation Award - Honorable Mention 2014

Presented annually to the authors of the best doctoral dissertations in computer science and engineering

Harry S. Truman Fellowship in National Security Science and Engineering 2013

Three year fellowship at Sandia National Laboratories providing the opportunity for recipients to pursue independent research in the national interest

IPDPS Best Paper Award in Algorithms Track 2013

Awarded by the program committee, with coauthors Dulceneia Becker, James Demmel, Jack Dongarra, Alex Druinsky, Inon Peled, Oded Schwartz, Sivan Toledo, and Ichitaro Yamazaki

C.V. Ramamoorthy Distinguished Research Award 2012

Awarded by the UC Berkeley EECS Student Awards Committee, based on outstanding contributions by a computer science graduate student to a new research area in computer science and engineering

SIAM SIAG/Linear Algebra Prize 2012

Awarded triennially by prize committee, with co-authors James Demmel, Olga Holtz, and Oded Schwartz

SPAA Best Paper Award 2011

Awarded by program committee, with co-authors James Demmel, Olga Holtz, and Oded Schwartz

William C. and Ruth N. Archie Award 2006

Awarded to outstanding senior demonstrating commitment to liberal learning, scholarship, and ideals of WFU

John Y. Phillips Prize in Mathematics 2006

Awarded by WFU mathematics department to the outstanding graduating senior

Walt Chyzowych Award 2006

Awarded by the WFU men's soccer coaching staff to the player who most embodies the ideals of the program

Edwin G. Wilson Male Student Athlete of the Year 2006

Awarded by WFU athletic department to the athlete who displays excellence in both academics and athletics

Nancy Susan Reynolds Scholar 2002

Full academic scholarship for Wake Forest University

Publications

Journal Papers

1. Parallel Algorithms for Tensor Train Arithmetic. Hussam Al-Daas, Grey Ballard, and Peter Benner. *SIAM Journal on Scientific Computing*. Volume 44, Issue 1, pp. C25-C53. 2022.
2. PLANC: Parallel Low Rank Approximation with Non-negativity Constraints. Srinivas Eswar, Koby Hayashi, Grey Ballard, Ramakrishnan Kannan, Michael A. Matheson, and Haesun Park. *ACM Transactions on Mathematical Software*. Volume 47, Number 3, Article 20. 2021.
3. TuckerMPI: A Parallel C++/MPI Software Package for Large-scale Data Compression via the Tucker Tensor Decomposition. Grey Ballard and Alicia Klinvex and Tamara G. Kolda. *ACM Transactions on Mathematical Software*. Volume 46, Number 2, Article 13. 2020. *Impact factor: 1.7*
4. Joint 3D Localization and Classification of Space Debris Using a Multispectral Rotating Point Spread Function. Chao Wang, Grey Ballard, Robert Plemmons, and Sudhakar Prasad. *Applied Optics*. Volume 58, Number 31, pp. 8598–8611. 2019. *Impact factor: 2.0*
5. The Geometry of Rank Decompositions of Matrix Multiplication II: 3x3 Matrices. Grey Ballard, Christian Ikenmeyer, J.M. Landsberg, and Nick Ryder. *Journal of Pure and Applied Algebra*. Volume 223, Number 8, pp. 3205–3224. 2019. *Impact factor: 0.8*
6. A Practical Randomized CP Tensor Decomposition. Casey Battaglino, Grey Ballard, Tamara Kolda. *SIAM Journal on Matrix Analysis and Applications*. Volume 39, Number 2, pp. 876–901. 2018. *Impact factor: 1.9*
7. MPI-FAUN: An MPI-Based Framework for Alternating-Updating Nonnegative Matrix Factorization. Ramakrishnan Kannan, Grey Ballard, Haesun Park. *IEEE Transactions on Knowledge and Data Engineering*, Volume 30, Issue 3, pp. 544–558. 2018. *Impact factor: 3.9*
8. Dynamic Functional Connectivity and Individual Differences in Emotions during Social Stress. Michael J. Tobia, Koby Hayashi, Grey Ballard, Ian Gotlib, Christian Waugh. *Human Brain Mapping*, Volume 38, Number 12, pp. 6185–6205. 2017. *Impact factor: 4.9*
9. Hypergraph Partitioning for Sparse Matrix-Matrix Multiplication. Grey Ballard, Alex Druinsky, Nicholas Knight, Oded Schwartz. *ACM Transactions on Parallel Computing*, Volume 3, Issue 3, pp. 18:1–18:34. 2016.
10. Exploiting Multiple Levels of Parallelism in Sparse Matrix-Matrix Multiplication. Ariful Azad, Grey Ballard, Aydin Buluc, James Demmel, Laura Grigori, Oded Schwartz, Sivan Toledo, Samuel Williams. *SIAM Journal on Scientific Computing*, Volume 38, Number 6, pp. C624-C651. 2016. *Impact factor: 2.2*
11. Improving the Numerical Stability of Fast Matrix Multiplication Algorithms. Grey Ballard, Austin Benson, Alex Druinsky, Benjamin Lipshitz, and Oded Schwartz. *SIAM Journal on Matrix Analysis and Applications*, Volume 37, Number 4, pp. 1382-1418. 2016. *Impact factor: 2.2*

12. Reducing Communication Costs for Sparse Matrix Multiplication within Algebraic Multigrid. Grey Ballard, Christopher Siefert, and Jonathan Hu. *SIAM Journal on Scientific Computing*. Volume 32, Issue 3, pp. C203-C231. 2016. *Impact factor: 2.2*
13. Reconstructing Householder Vectors from Tall-Skinny QR. Grey Ballard, James Demmel, Laura Grigori, Mathias Jacquelin, Nicholas Knight, and Hong Diep Nguyen. *Journal of Parallel and Distributed Computing*. Volume 85, pp. 3-31. 2015. *Impact factor: 1.3*
14. Avoiding Communication in Successive Band Reduction. Grey Ballard, James Demmel, and Nicholas Knight. *ACM Transactions on Parallel Computing*. Volume 1, Issue 2, pp. 11:1-11:37. 2015.
15. Communication-Avoiding Symmetric-Indefinite Factorization. Grey Ballard, Dulceneia Becker, James Demmel, Jack Dongarra, Alex Druinsky, Inon Peled, Oded Schwartz, Sivan Toledo and Ichitaro Yamazaki. *SIAM Journal on Matrix Analysis and Applications*. Volume 35, Issue 4, pp. 1364-1406. 2014. *Impact factor: 1.6*
16. Communication Lower Bounds and Optimal Algorithms for Numerical Linear Algebra. Grey Ballard, Erin Carson, James Demmel, Mark Hoemmen, Nicholas Knight, Oded Schwartz. *Acta Numerica*. Volume 23, pp. 1-155. 2014. *Impact factor: 7.4*
17. Communication Costs of Strassen's Matrix Multiplication. Grey Ballard, James Demmel, Olga Holtz, and Oded Schwartz. *Communications of the ACM*. Volume 57, Number 2, pp. 107-113. 2014. *Impact factor: 3.6*
18. Asymptotic Behavior of the Eigenvalues of Toeplitz Integral Operators Associated with the Hankel Transform. Grey Ballard and John Baxley. *Dynamic Systems and Applications*, Volume 23, pp. 505-530, 2014. *Impact factor: 0.4*
19. Graph Expansion and Communication Costs of Fast Matrix Multiplication. Grey Ballard, James Demmel, Olga Holtz, and Oded Schwartz. *Journal of the ACM*. Volume 59, Issue 6, Article 32. 2012. *Impact factor: 2.4*
20. Minimizing Communication in Linear Algebra. Grey Ballard, James Demmel, Olga Holtz, and Oded Schwartz. *SIAM Journal on Matrix Analysis and Applications*, Volume 32, Issue 3, pp. 866-901. 2011. *Impact factor: 1.4*
21. Communication-optimal parallel and sequential Cholesky decomposition. Grey Ballard, James Demmel, Olga Holtz, and Oded Schwartz. *SIAM Journal on Scientific Computing*. Volume 32, Issue 6, pp. 3495-3523. 2010. *Impact factor: 3.0*
22. Existence of Solutions for a Class of Singular Nonlinear Third Order Autonomous Boundary Value Problems. Grey Ballard and John Baxley. *Communications in Applied Analysis*. Volume 15, No. 2-4, pp. 195-202. 2011.
23. The Friedrichs extension of certain singular differential operators. Grey Ballard and John Baxley. *Electronic Journal of Qualitative Theory of Differential Equations*. Special Edition I, No. 5, pp. 1-11. 2009. *Impact factor: 0.5*
24. Qualitative behavior and computation of multiple solutions of nonlinear boundary value problems. Grey Ballard, John Baxley, and Nisrine Libbus. *Communications on Pure and Applied Analysis*. Volume 5, No. 2, pg. 251-259. 2006. *Impact factor: 0.9*

Conference Proceedings

1. Brief Announcement: Tight Memory-Independent Parallel Matrix Multiplication Communication Lower Bounds. Hussam Al Daas, Grey Ballard, Laura Grigori, Suraj Kumar, and Kathryn Rouse. *Proceedings of the 34th Annual ACM Symposium on Parallelism in Algorithms and Architectures*. ACM, New York, NY, USA. 2022.
2. Parallel Tensor Train Rounding using Gram SVD. Hussam Al Daas, Grey Ballard, and Lawton Manning. *Proceedings of the 36th IEEE International Parallel and Distributed Processing Symposium*, IEEE Computer Society, Washington, DC, USA, 930-940. 2022.

3. Visualizing Parallel Dynamic Programming using the Thread Safe Graphics Library. Grey Ballard and Sarah Parsons. *Proceedings of the Workshop on Education for High-Performance Computing.* IEEE Computer Society Press, Los Alamitos, CA, USA, 24-31. 2021.
4. Parallel Tucker Decomposition with Numerically Accurate SVD. Zitong Li, Qiming Fang, and Grey Ballard. *Proceedings of the 50th International Conference on Parallel Processing.* ACM, New York, NY, USA, Article 49. 2021. *Acceptance rate: 27%*
5. Accelerating Neural Network Training using Arbitrary Precision Approximating Matrix Multiplication Algorithms. Grey Ballard, Jack Weissenberger, and Luoping Zhang. *Proceedings of the 50th International Conference on Parallel Processing Workshops.* ACM, New York, NY, USA, Article 16. 2021.
6. Parallel Hierarchical Clustering using Rank-Two Nonnegative Matrix Factorization. Lawton Manning, Grey Ballard, Ramakrishnan Kannan, and Haesun Park. *Proceedings of the 27th IEEE International Conference on High Performance Computing, Data, and Analytics.* IEEE Computer Society Press, Los Alamitos, CA, USA, 141-150. 2020. *Acceptance rate: 26%*
7. Distributed-Memory Parallel Symmetric Non-negative Matrix Factorization. Srinivas Eswar, Koby Hayashi, Grey Ballard, Ramakrishnan Kannan, Haesun Park, and Richard Vuduc. *Proceedings of the International Conference on High Performance Computing, Networking, Storage and Analysis.* IEEE Computer Society Press, Los Alamitos, CA, USA, 1041-1054. 2020. *Acceptance rate: 25%*
8. General Memory-Independent Lower Bound for MTTKRP. Grey Ballard and Kathryn Rouse. *Proceedings of the SIAM Conference on Parallel Processing for Scientific Computing.* SIAM, Philadelphia, PA, USA, 1–11. 2020.
9. Parallel Nonnegative CP Decomposition of Dense Tensors. Grey Ballard, Koby Hayashi, and Ramakrishnan Kannan. *Proceedings of the 25th IEEE International Conference on High Performance Computing, Data, and Analytics.* IEEE Computer Society, Washington, DC, USA, 22-31. 2018. *Acceptance rate: 22%*
10. Partitioning and Communication Strategies for Sparse Non-negative Matrix Factorization. Oguz Kaya, Ramakrishnan Kannan, and Grey Ballard. *Proceedings of the 47th International Conference on Parallel Processing.* ACM, New York, NY, USA, 90:1-90:10. 2018. *Acceptance rate: 29%*
11. Communication Lower Bounds for Matricized Tensor Times Khatri-Rao Product. Grey Ballard, Nicholas Knight, and Kathryn Rouse. *Proceedings of the 32nd IEEE International Parallel and Distributed Processing Symposium.* IEEE Computer Society, Washington, DC, USA, 557-567. 2018. *Acceptance rate: 24%*
12. A 3D Parallel Algorithm for QR Decomposition. Grey Ballard, James Demmel, Laura Grigori, Mathias Jacquelin and Nicholas Knight. *Proceedings of the 30th ACM Symposium on Parallelism in Algorithms and Architectures.* ACM, New York, NY, USA, 55-65. 2018. *Acceptance rate: 30%*
13. Extended Abstract: Shared Memory Parallelization of MTTKRP for Dense Tensors. Koby Hayashi, Grey Ballard, Yujie Jiang, and Michael J. Tobia. *Proceedings of the 23rd ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming.* ACM, New York, NY, USA, 393-394. 2018. *Acceptance rate: 19%*
14. A Communication-Avoiding Parallel Algorithm for the Symmetric Eigenvalue Problem. Edgar Solomonik, Grey Ballard, James Demmel, Torsten Hoefler. *Proceedings of the 29th ACM Symposium on Parallelism in Algorithms and Architectures.* ACM, New York, NY, USA, 111-121. 2017. *Acceptance rate: 24%*
15. Network Topologies and Inevitable Contention. Grey Ballard, James Demmel, Andrew Gearhart, Benjamin Lipshitz, Yishai Oltchik, Oded Schwartz and Sivan Toledo. *Proceedings of the First Workshop on Optimization of Communication in HPC.* IEEE Press, Piscataway, NJ, USA, 39-52. 2016.
16. Parallel Tensor Compression for Large-Scale Scientific Data. Woody Austin, Grey Ballard, and Tamara Kolda. *Proceedings of the 30th IEEE International Parallel and Distributed Processing Symposium.* IEEE Computer Society, Washington, DC, USA, 912-922. 2016. *Acceptance rate: 23%*
17. A High-Performance Parallel Algorithm for Nonnegative Matrix Factorization. Ramakrishnan Kannan, Grey Ballard, and Haesun Park. *Proceedings of the 21st ACM Symposium on Principles and Practice of Parallel Programming.* ACM, New York, NY, USA, 9:1-9:11. 2016. *Acceptance rate: 22%*

18. Diamond Sampling for Approximate Maximum All-pairs Dot-product (MAD) Search. Grey Ballard, Tamara Kolda, Ali Pinar, C. Seshadri. *Proceedings of the 2015 IEEE International Conference on Data Mining*. IEEE Computer Society, Washington, DC, USA, 11-20. 2015. *Acceptance rate: 8%*
19. Brief Announcement: Hypergraph Partitioning for Parallel Sparse Matrix-Matrix Multiplication. Grey Ballard, Alex Druinsky, Nicholas Knight, and Oded Schwartz. *Proceedings of the 27th Annual ACM Symposium on Parallelism in Algorithms and Architectures*. ACM, New York, NY, USA, 86-88. 2015. *Acceptance rate: 24%*
20. A Framework for Practical Parallel Fast Matrix Multiplication. Austin Benson and Grey Ballard. *Proceedings of the 20th ACM Symposium on Principles and Practice of Parallel Programming*. ACM, New York, NY, USA, 42-53. 2015. *Acceptance rate: 15%*
21. Reconstructing Householder Vectors from TSQR. Grey Ballard, James Demmel, Laura Grigori, Mathias Jacquelin, Hong Diep Nguyen, and Edgar Solomonik. *Proceedings of the 28th IEEE International Parallel and Distributed Processing Symposium*. IEEE Computer Society, Washington, DC, USA, 1159-1170. 2014. *Acceptance rate: 21%*
22. Communication Optimal Parallel Multiplication of Sparse Random Matrices. Grey Ballard, Aydin Buluc, James Demmel, Laura Grigori, Benjamin Lipshitz, Oded Schwartz and Sivan Toledo. *Proceedings of the 25th Annual ACM Symposium on Parallelism in Algorithms and Architectures*. ACM, New York, NY, USA, 222-231. 2013. *Acceptance rate: 24%*
23. Communication Efficient Gaussian Elimination with Partial Pivoting using a Shape Morphing Data Layout. Grey Ballard, James Demmel, Benjamin Lipshitz, Oded Schwartz and Sivan Toledo. *Proceedings of the 25th Annual ACM Symposium on Parallelism in Algorithms and Architectures*. ACM, New York, NY, USA, 232-240. 2013. *Acceptance rate: 24%*
24. Implementing a Blocked Aasen's Algorithm with a Dynamic Scheduler on Multicore Architectures. Grey Ballard, Dulceneia Becker, James Demmel, Jack Dongarra, Alex Druinsky, Inon Peled, Oded Schwartz, Sivan Toledo and Ichitaro Yamazaki. *Proceedings of the 27th IEEE International Parallel and Distributed Processing Symposium*. IEEE Computer Society, Washington, DC, USA, 895-907. 2013. *Acceptance rate: 22%*
25. Communication-Avoiding Parallel Strassen: Implementation and Performance. Benjamin Lipshitz, Grey Ballard, Oded Schwartz, James Demmel. *Proceedings of the International Conference on High Performance Computing, Networking, Storage and Analysis*. IEEE Computer Society Press, Los Alamitos, CA, USA, 101:1–101:11. 2012. *Acceptance rate: 21%*
26. Communication-Optimal Parallel Algorithm for Strassen's Matrix Multiplication. Grey Ballard, James Demmel, Olga Holtz, Benjamin Lipshitz, Oded Schwartz. *Proceedings of the 24th Annual ACM Symposium on Parallelism in Algorithms and Architectures*. ACM, New York, NY, USA, 193-204. 2012.
27. Brief Announcement: Strong Scaling of Matrix Multiplication Algorithms and Memory-Independent Communication Lower Bounds. Grey Ballard, James Demmel, Olga Holtz, Benjamin Lipshitz, Oded Schwartz. *Proceedings of the 24th Annual ACM Symposium on Parallelism in Algorithms and Architectures*. ACM, New York, NY, USA, 77-79. 2012. *Acceptance rate: 26%*
28. Graph Expansion Analysis for Communication Costs of Fast Rectangular Matrix Multiplication. Grey Ballard, James Demmel, Olga Holtz, Benjamin Lipshitz, Oded Schwartz. *Proceedings of the 1st Mediterranean Conference on Algorithms*. Springer, Berlin, Germany. Lecture Notes in Computer Science, Vol. 7659, 13–36. 2012.
29. Communication Avoiding Successive Band Reduction. Grey Ballard, James Demmel, Nicholas Knight. *Proceedings of the 17th ACM Symposium on Principles and Practice of Parallel Programming*. ACM, New York, NY, USA, 35-44. 2012. *Acceptance rate: 26%*
30. Graph Expansion and Communication Costs of Fast Matrix Multiplication. Grey Ballard, James Demmel, Olga Holtz, and Oded Schwartz. *Proceedings of the 23rd Annual ACM Symposium on Parallelism in Algorithms and Architectures*. ACM, New York, NY, USA, 1-12. 2011. *Acceptance rate: 30%*

31. Brief Announcement: Communication Bounds for Heterogeneous Architectures. Grey Ballard, James Demmel, and Andrew Gearhart. *Proceedings of the 23rd Annual ACM Symposium on Parallelism in Algorithms and Architectures*. ACM, New York, NY, USA, 257-258. 2011. *Acceptance rate: 30%*
32. Communication-Avoiding QR Decomposition for GPUs. Michael Anderson, Grey Ballard, James Demmel, and Kurt Keutzer. *Proceedings of the 25th IEEE International Parallel and Distributed Processing Symposium*. IEEE Computer Society, Washington, DC, USA, 48-58. 2011. *Acceptance rate: 20%*
33. Efficiently Computing Tensor Eigenvalues on a GPU. Grey Ballard, Tamara Kolda, and Todd Plantenga. *Proceedings of the 25th IEEE International Parallel and Distributed Processing Symposium Workshops and PhD Forum*. IEEE Computer Society, Washington, DC, USA, 1340-1348. 2011. *Acceptance rate: 20%*
34. Communication-Optimal Parallel and Sequential Cholesky Decomposition. Grey Ballard, James Demmel, Olga Holtz and Oded Schwartz. *Proceedings of the 22nd Symposium on Parallelism in Algorithms and Architectures*. ACM, New York, NY, USA, 245-252. 2009. *Acceptance rate: 31%*

Expository Articles

1. CP and Tucker Tensor Decompositions. Grey Ballard. *SIAG/OPT Views and News*. Volume 27, Number 1, pp. 1-7, 2019.

Technical Reports

1. GentenMPI: Distributed Memory Sparse Tensor Decomposition. Karen Devine and Grey Ballard. Sandia Report SAND2020-8515. 2020.
2. A Generalized Randomized Rank-Revealing Factorization. Grey Ballard, James Demmel, Ioana Dumitriu, Alexander Rusciano. arXiv Technical Report 1909.06524. 2019.
3. Sequential Communication Bounds for Fast Linear Algebra. Grey Ballard, James Demmel, Olga Holtz and Oded Schwartz. UC Berkeley Technical Report EECS-2012-36. 2012.
4. Minimizing Communication for Eigenproblems and the Singular Value Decomposition. Grey Ballard, James Demmel, Ioana Dumitriu. UC Berkeley Technical Report EECS-2011-14. 2011.

Student Journals

1. Qualitative behavior and computation of multiple solutions of singular nonlinear boundary value problems. Grey Ballard and John Baxley. *Involve, a Journal of Mathematics*. Volume 1, No. 1, pp. 21-31. 2008.
2. Modeling protein dependency networks using CoCoA. Grey Ballard. *ACM Crossroads*. Issue 13.1. 2006.

Theses

1. Avoiding Communication in Dense Linear Algebra. Grey Ballard. PhD Thesis. University of California Berkeley. 2013.
2. Asymptotic behavior of the eigenvalues of Toeplitz integral operators associated with the Hankel transform. Grey Ballard. Master's Thesis. Wake Forest University. 2008.

Talks

- Efficient Algorithms for Computing Tensor Decompositions. Invited talk at the University of Utah Applied Math Seminar in March 2022 (virtual).
- Parallel Tensor Train Rounding using Gram SVD. Presented at the SIAM Conference on Parallel Processing for Scientific Computing in February 2022 (virtual).
- Visualizing Parallel Dynamic Programming using the Thread Safe Graphics Library. Presented at the Workshop on Education for High-Performance Computing (EduHPC) in November 2021 (hybrid).

- Tensor Decompositions: Applications and Algorithms. Minitutorial presented at the SIAM Annual Meeting in July 2021 (virtual).
- Undergraduate Teaching Experiences with Parallel and Distributed Computing. Presented at the CSinParallel Summer 2021 Virtual Workshop in June 2021.
- Randomized Algorithms for Rounding the Tensor Train Format. Presented at the SIAM Conference on Applied Linear Algebra (virtual) and the SAMSI Numerical Analysis in Data Science Transition Workshop (virtual) in May 2021.
- Computing Tensor Decompositions using Parallel Algorithms. Smith Colloquium Lecture at University of Kansas in April 2021 (virtual).
- Parallel Algorithms for Tensor Decompositions. Invited talk at Microsoft Research in September 2020 (virtual).
- Scalable Deterministic Algorithms for Tensors in TT Format. Presented at the SAMSI Working Group on Numerical Linear Algebra in September 2020 (virtual).
- Scalable Algorithms for Tensors in Tensor Train Format. Presented at the SIAM Conference on Mathematics of Data Science in June 2020 (virtual).
- Tensor Decompositions and Brain Imaging Data. Presented at the Network Science meeting at Wake Forest University School of Medicine in May 2020 (virtual).
- Communication Lower Bounds for Rectangular MTTKRPs. Presented at the SIAM Conference on Parallel Processing for Scientific Computing in February 2020 in Seattle, WA.
- Parallel Algorithms for CP, Tucker, and Tensor Train Decompositions. Keynote talk at the Workshop on Power-Aware Computing (PACO) in November 2019 at the Max Planck Institute in Magdeburg, Germany.
- Parallel Algorithms for CP Decomposition. Presented at the International Linear Algebra Society meeting in July 2019 in Rio de Janeiro, Brazil.
- Parallel Algorithms for CP and Tucker Decompositions. Presented at the Workshop on Low-Rank Optimization and Applications at Max Planck Institute in April 2019 in Leipzig, Germany.
- Parallel Algorithms for the Multiple Tensor-Times-Matrix Computation. Presented at the SIAM Conference on Computational Science and Engineering in February 2019 in Spokane, WA.
- Communication-Optimal Algorithms for CP Decompositions of Dense Tensors. Presented at the SIAM Conference on Applied Linear Algebra in May 2018 in Hong Kong.
- What is the Shape of Your Data? Presented at the Wake Forest University New Ideas Symposium in April 2018 in Winston Salem, NC.
- Tensor Decompositions for Multidimensional Data Analysis. Presented at the NC State Numerical Analysis Seminar in February 2018 in Raleigh, NC.
- Communication Lower Bounds for Matricized-Tensor Times Khatri-Rao Product. Presented at the SIAM Annual Meeting in July 2017 in Pittsburgh, PA.
- Discovering Fast Matrix Multiplication Algorithms. Presented at Householder Symposium XX (poster) in June 2017 in Blacksburg, VA; at Texas A&M University in May 2017 in College Station, TX, and at Winthrop University in March 2017 in Rock Hill, SC.
- Discovering Fast Matrix Multiplication Algorithms via Tensor Decomposition. Presented at SIAM Conference on Computational Science and Engineering in March 2017 in Atlanta, GA.
- Parallel Multiway Data Compression using the Tucker Decomposition. Presented at Wake Forest University Physics Colloquium in February 2017 in Winston Salem, NC.
- Reducing Communication and Computation in Scientific Computing. Presented at Sandia National Laboratories in June 2016 in Livermore, CA.
- Diamond Sampling for Approximate Maximum All-Pairs Dot-Product Search. Presented at ICDM in November 2015 in Atlantic City, NJ.

- Hypergraph Partitioning for Parallel Sparse Matrix-Matrix Multiplication. Presented at SIAM Conference on Applied Linear Algebra in October 2015 in Atlanta, GA.
- Parallel Tensor Compression for Large-Scale Scientific Data. Presented at the Development of Modern Methods for Linear Algebra (DMML) Workshop in October 2015 in Berkeley, CA and at the SIAM Conference on Parallel Processing for Scientific Computing in April 2016 in Paris, France.
- Algorithmic Improvements for Dense Symmetric Tridiagonalization. Invited talk at the International Workshop on Eigenvalue Problems: Algorithms, Software, and Applications in September 2015 in Tsukuba, Japan.
- Hypergraph Partitioning for Sparse Matrix-Matrix Multiplication. Presented at SPAA in June 2015 in Portland, OR.
- Reducing Communication Costs for Sparse Matrix Multiplication in Algebraic Multigrid. Presented at SIAM Conference on Computational Science and Engineering in March 2015 in Salt Lake City, UT and at Copper Mountain Conference on Multigrid Methods in March 2015 in Copper Mountain, CO.
- Reducing Computation and Communication in Scientific Computing. Presented at Wake Forest University in January 2015 in Winston-Salem, NC, at the College of William & Mary in February 2015 in Williamsburg, VA, and at Georgia Tech in February 2015 in Atlanta, GA.
- How Practical is Fast Matrix Multiplication?. Presented at the Matrix Computations Seminar (UC Berkeley) in October 2014 in Berkeley, CA and at the Simons Institute in December 2014 in Berkeley, CA.
- Communication-Avoiding Algorithms and Fast Matrix Multiplication. Presented at Microsoft Research in September 2014 in Redmond, WA.
- Algorithms with Provably Minimal Communication: Algorithmic Improvements for QR Decomposition. Presented at Duke University in July 2014 in Durham, NC.
- Avoiding Communication in Linear Algebra. Invited talk at the Microsoft Research Faculty Summit in July 2014 in Redmond, WA.
- Reconstructing Householder Vectors from TSQR. Presented at SIAM Conference on Parallel Processing for Scientific Computing in February 2014 in Portland, OR, at the Matrix Computations Seminar (UC Berkeley) in February 2014 in Berkeley, CA, at the University of Texas in March 2014 in Austin, TX, at International Parallel and Distributed Processing Symposium in May 2014 in Phoenix, AZ, at Householder Symposium XIX in June 2014 in Spa, Belgium, and at the Linear Algebra and Optimization Seminar (Stanford) in January 2015 in Stanford, CA.
- Searching for Fast Matrix Multiplication Algorithms. Presented at the Dean Seminar (Sandia National Labs) in November 2013 in Livermore, CA.
- Communication-Optimal Parallel Algorithm for Strassen's Matrix Multiplication. Presented at the Simons Institute in October 2013 in Berkeley, CA.
- Communication Efficient Gaussian Elimination with Partial Pivoting using a Shape Morphing Data Layout. Presented at SPAA in July 2013 in Montreal, Canada.
- Communication-Avoiding Algorithms and Autotuning. Presented at the Par Lab End-of-Project Celebration in May 2013 in Berkeley, CA.
- Avoiding Communication in Linear Algebra. Presented at the University of Virginia in April 2013 in Charlottesville, VA.
- Avoiding Communication in Dense Linear Algebra. Dissertation talk presented at UC Berkeley in April 2013 in Berkeley, CA.
- Avoiding Communication in Parallel Bidiagonalization of Band Matrices. Presented at SIAM Conference on Computational Science and Engineering in March 2013 in Boston, MA.
- Reducing Computation and Communication in Scientific Computing. Presented at Sandia National Laboratories in January 2013 in Livermore, CA and Albuquerque, NM.

- Avoiding Communication in Linear Algebra. Presented at Lawrence Berkeley National Laboratory in January 2013 in Berkeley, CA.
- Communication-Avoiding Parallel Strassen: Implementation and Performance. Presented at SC in November 2012 in Salt Lake City, UT and Bay Area Scientific Computing Day in December 2012 in Palo Alto, CA.
- Communication-Optimal Parallel Algorithm for Strassen's Matrix Multiplication. Presented at Sandia National Labs in August 2012 in Livermore, CA.
- Communication-Avoiding Successive Band Reduction. Presented at Householder Symposium XVIII on Numerical Linear Algebra in June 2011 in Tahoe City, CA and PPoPP in February 2012 in New Orleans, LA.
- Communication-Avoiding Nonsymmetric Eigensolver using Spectral Divide & Conquer. Presented at SIAM Conference on Parallel Processing for Scientific Computing in February 2012 in Savannah, GA and at IWASEP 9 in June 2012 in Napa, CA.
- Lower Bounds for Communication in Linear Algebra. Presented at Workshop on Synchronization-reducing and Communication-reducing Algorithms and Programming Models for Large-scale Simulations in January 2012 in Providence, RI.
- Graph Expansion and Communication Costs of Fast Matrix Multiplication. Presented at SPAA in June 2011 in San Jose, CA.
- Communication Bounds for Heterogeneous Architectures. Presented at SPAA in June 2011 in San Jose, CA.
- Efficiently Computing Tensor Eigenvalues on a GPU. Presented at at Sandia National Labs Student Intern Symposium in August 2010 in Livermore, CA and PDSEC Workshop in conjunction with IPDPS in May 2011 in Anchorage, AK.
- Communication-Avoiding Dense Linear Algebra. Presented at CScaDS Autotuning Workshop in August 2010 in Snowbird, UT.
- Mapping Communication-Avoiding QR Decomposition to Various Architectures. Presented at SIAM Annual Meeting in July 2010 in Pittsburgh, PA.
- Communication Bounds for Sequential and Parallel Eigenvalue Problems. Presented at SIAM Conference on Parallel Processing for Scientific Computing in February 2010 in Seattle, WA and at AMS Western Section Meeting and at Sandia National Labs in April 2010 in Albuquerque, NM.
- Minimizing Communication in Linear Algebra. Presented at Par Lab Summer Retreat in June 2009 in Santa Cruz, CA and at SIAM Workshop on Combinatorial and Scientific Computing in October 2009 in Monterey, CA.
- Communication-Optimal Parallel and Sequential Cholesky Decomposition. Presented at SPAA in August 2009 in Calgary, Canada.

Grants and Funding

Robust, Scalable, and Practical Low-Rank Approximation 2021–2024
PI, National Science Foundation, $225K
(Collaborative project with PIs Haesun Park and Rich Vuduc at Georgia Tech, total of $500K)

Communication-Avoiding Tensor Decomposition Algorithms 2020 – 2025
PI, National Science Foundation (CAREER), $560K

Parallel Tensor Decompositions for Massive Data 2017 – 2019
PI, Subcontract with Sandia National Laboratories, $67K

Innovations in Statistical Image Analysis and Applications to 3D Imaging 2018
Co-PI, Air Force Office of Scientific Research, $72K
(Collaborative project with PI Sudhakar Prasad, University of New Mexico)

Scalable MTTKRP for Non-Negative Tensor Factorization 2017
PI, Subcontract with Oak Ridge National Laboratory, $24K

High Performance Low Rank Approximation for Scalable Data Analytics 2016 – 2020

PI, National Science Foundation (SI2-SSE), $168K

(Collaborative project with PI Haesun Park at Georgia Tech, total of $500K)

Linear and Multilinear Techniques for Data Analysis 2016

PI, Subcontract with Sandia National Laboratories, $22K

Truman Fellowship in National Security Science and Engineering 2013 – 2016

PI, Sandia National Laboratories (DOE) Laboratory Directed Research and Development Program, $780K

Teaching

Instructor Wake Forest University

CSC 111: Introduction to Computer Science, Fall 2017

CSC 112: Introduction to Computer Science, Fall 2019

CSC 165: Problem Solving Seminar, Fall 2019, Fall 2021

CSC 191: Special Topics: Introduction to MATLAB, Spring 2018, Spring 2019, Spring 2020

CSC 222: Data Structures and Algorithms II, Spring 2017, Fall 2017, Spring 2019, Spring 2020

CSC 301: Algorithms, Fall 2021

CSC 355/655 and MST 355/655: Introduction to Numerical Methods, Spring 2018

CSC 721: Theory of Algorithms, Spring 2017

CSC 726: Parallel Algorithms, Fall 2019, Fall 2022

CSC 790: Multidimensional Data Analysis, Fall 2021

CSC 352/652 and MTH 326/626: Numerical Linear Algebra, Fall 2016, Spring 2019

Guest Lecturer UC Berkeley

CS 270: Communication-Avoiding Algorithms, Spring 2016

Graduate Student Instructor UC Berkeley

CS 170: Efficient Algorithms and Intractable Problems with Satish Rao, Fall 2012

CS 267: Applications of Parallel Computers with James Demmel and Katherine Yelick, Spring 2011

Reader UC Berkeley

Math 221: Matrix Computations/Numerical Linear Algebra with James Demmel, Fall 2011

Teaching Assistant Wake Forest University

Math 109: Probability and Statistics with Julie Connolly, Spring 2008

Math 121: Linear Algebra with Jim Kuzmanovich, Fall 2007

Math 112: Calculus II with Miaohua Jiang, Spring 2007

Math 113: Vector Calculus with Stephen Robinson, Fall 2006

Math 112: Calculus II with Hugh Howards, Summer 2006

Mentoring

Undergraduate Students Wake Forest University

Qiming Fang, WFU Research Fellowship (Summer 2021), on to MS program at Brown University
Matt Desoutter, Mathematics Honors Project (Fall 2020 – Spring 2021), on to position at Siemens
Yixin Zhang, Statistics Honors Project (Fall 2020 – Spring 2021), on to PhD program at Duke University
Luoping (Robin) Zhang, WFU Research Fellowship (Summer 2020), on to MS program at Columbia University
Binfeng (Bill) Xu, WFU Research Fellowship (Summer 2019), on to MS program at New York University
Jack Weissenberger, on to Software Engineer position at Capital One
Simin (Steven) Ma, ACC-IAC Fellow (Summer 2018), on to PhD program at Georgia Tech
Benjamin Cobb, WFU Research Fellowship (Summer 2018), on to PhD program at Georgia Tech
Yujie (Jeffrey) Jiang, ACC-IAC Fellow (Summer 2017), on to PhD program in Statistics at Rice University
Irina Viviano, Reynolds Scholar, on to MS program at WFU

Graduate Students Wake Forest University

Xiaotian Liu, Fall 2021 – current
Zitong Li, Spring 2020 – Spring 2022, on to PhD program at UC Irvine
Lawton Manning, Fall 2019 – Spring 2021, on to position at Logikcull
Koby Hayashi, Fall 2016 – Spring 2018, on to PhD program in Comp. Science and Eng. at Georgia Tech
Kathryn Rouse, Fall 2016 – Spring 2018, on to Strategic Analyst position at Inmar

Master's Thesis Committee Wake Forest University

William Fries (Mathematics & Statistics), 2018
Meijian Guan, 2018
Jiajie Xiao, 2018
Larry Rush (Physics), 2017

PhD Thesis Committee Georgia Tech

Srinivas Eswar
Casey Battaglino
Ramakrishnan Kannan, Spring 2016

Graduate Student Interns Sandia National Laboratories

Casey Battaglino (Georgia Tech), Summer 2016
Woody Austin (University of Texas), Summer 2015
Austin Benson (Stanford University), Summer 2014

University and Departmental Service

WFU Graduate Council 2019 – 2022

Credentials committee (2019-20), Policy committee (2021-22), Secretary (2021)

CS Graduate Committee 2016 – 2020

CS Curriculum Committee 2017 – 2020

International Collegiate Programming Contest Coach 2019, 2021

Reynolds, Stamps, and Gordon Scholarships Selection Committee 2017 – 2020, 2022

CHM 311 Introduction to Mentored Research – CS Guest Lecturer 2021

Upsilon Pi Epsilon Faculty Sponsor 2016 – 2017

Growth Mindset in STEM Pre-Orientation Program 2019 – 2021

Melson Award Committee (Graduate School) 2021

Three Minute Thesis Judge (Graduate School) 2019

Professional Activities

Program Committee Track Co-Chair 2022
IEEE Cluster Conference - Algorithms, Applications and Libraries Track

Panelist 2017, 2021
National Science Foundation

Panelist 2019
Department of Energy, Office of Science

Program Committee 2016, 2018, 2019, 2020, 2021
The International Conference for High Performance Computing, Networking, Storage and Analysis (SC)

Program Committee 2014, 2017, 2018, 2019, 2021
IEEE International Parallel and Distribution Processing Symposium (IPDPS)

Program Committee 2015, 2018, 2020
ACM Symposium on Parallelism in Algorithms and Architectures (SPAA)

Program Committee 2022
SIAM Conference on Parallel Processing for Scientific Computing (PP)

Program Committee 2019
IEEE International Conference on High Performance Computing, Data, and Analytics (HiPC)

Program Committee 2019, 2020
International Conference on Parallel Processing (ICPP)

Guest Editor 2017
ACM Transactions on Parallel Computing (TOPC) Special Issue: Invited papers from PPoPP 2016

Program Committee 2015, 2020
ACM Symposium on Principles and Practice of Parallel Programming (PPoPP)

Program Committee 2014-2019
IEEE International Workshop on Parallel and Distributed Scientific and Engineering Computing (PDSEC)

Program Committee 2011-2015
Euromicro International Conference on Parallel, Distributed, and Network-Based Processing (PDP)

Prize Committee 2019
SIAM Activity Group on Supercomputing (SIAG/SC) Best Paper Prize

Minisymposium Organizer

SIAM Conference on Applied Linear Algebra 2021: "Algorithmic Advances in Tensor Decompositions"

SIAM Conference on Applied Linear Algebra 2018: "Constrained Low-Rank Matrix and Tensor Approximations"

SIAM Annual Meeting 2017: "High Performance Tensor Computations"

SIAM Conference on Computational Science and Engineering 2017: "Tensor Decompositions: Applications and Efficient Algorithms"

SIAM Conference on Parallel Processing for Scientific Computing 2016: "Parallel Algorithms for Tensor Computations"

SIAM Conference on Applied Linear Algebra 2015: "Sparse Matrix-Matrix Multiplication: Applications, Algorithms, and Implementations"

SIAM Conference on Parallel Processing for Scientific Computing 2014: "Minimizing Communication in Linear Algebra"

Workshop Organizer

WFU Computational and Applied Math Retreat, 10 attendees, Winston Salem, NC, 2016

Workshop on Fast Matrix Multiplication, 12 attendees, Berkeley, CA, 2014

Proposal Reviewer

National Science Foundation

U.S. Army Research Office

French National Research Agency (ANR)

Partnership for Advanced Computing in Europe (PRACE)

KU Leuven Research Council (University of Leuven, Belgium)

Reviewer

SIAM Journal on Matrix Analysis and Applications (SIMAX)
SIAM Journal on Scientific Computing (SISC)
SIAM Journal on Applied Geometry and Applications (SIAGA)
SIAM Journal on Mathematics of Data Science (SIMODS)
ACM Transactions on Mathematical Software (TOMS)
ACM Transactions on Parallel Computing (TOPC)
Parallel Computing
Journal of Parallel and Distributed Computing (JPDC)
ACM Symposium on Parallelism in Algorithms and Architectures (SPAA)
IEEE International Parallel and Distributed Processing Symposium (IPDPS)
ACM/IEEE International Conference for High Performance Computing, Networks, Storage, and Analysis (SC)
ACM Symposium on Principles and Practice of Parallel Programming (PPoPP)
Nature
International European Conference on Parallel Processing (Euro-Par)
Platform for Advanced Scientific Computing (PASC)
IEEE International Conference on High Performance Computing (HiPC)
International Conference on Parallel Processing (ICPP)
International Conference on Parallel Processing and Applied Mathematics (PPAM)
IEEE Transactions on Parallel and Distributed Computing (TPDS)
IEEE Transactions on Knowledge and Data Engineering (TKDE)
Journal of Computational Science
Journal of Scientific Computing (JOMP)
Numerical Linear Algebra with Applications (NLA)
Algorithmica
Applied Mathematics and Computation (AMC)
Information Processing Letters (IPL)
Applied Computational and Harmonic Analysis (ACHA)
ACM Symposium on Principles of Programming Languages (POPL)
European Symposium on Algorithms (ESA)
Symposium on Theoretical Aspects of Computer Science (STACS)
International Symposium on Algorithms and Computation (ISAAC)
IEEE Signal Processing Letters (SPL)
IEEE Transactions on Mobile Computing (TOMC)
IEEE Express
Optics Express
AMS Mathematical Reviews

Book Reviewer

SIAM Review (SIREV)

Member

SIAM, ACM, IEEE