Christopher Siefert
Curriculum Vitæ

Sandia National Laboratories
P.O. Box 5800, MS 1323
Albuquerque, NM 87185-1323
(505) 844-4696

U.S. Citizen

http://www.cs.sandia.gov/~csiefer

csiefer@sandia.gov

Research Interests

Numerical Linear Algebra, Preconditioners, Algebraic Multigrid, Scalable Computing and Computational Electromagnetics.

Education

2000–2006	University of Illinois at Urbana-Champaign Ph.D. in Computer Science with Computational Science and Engineering Option (GPA 3.93/4.0). Advisor: Eric de Sturler.
1996–2000	College of William and Mary B.S. in Computer Science and Mathematics, May 2000. Highest Honors in Computer Science (GPA 3.95/4.0).

Employment

2015–present	Principal Member of the Technical Staff, Scalable Algorithms Group, Sandia National Laboratories.
2008–2015	Senior Member of the Technical Staff, Computational Multiphysics Group, Sandia National Laboratories.
2006–2008	Limited Term Technical Staff, Scalable Algorithms Group, Sandia National Laboratories.
2005–2006	Research Assistant, Department of Computer Science (UIUC).
2003–2005	Research Assistant, Center for Simulation of Advanced Rockets (UIUC).
2000–2003	National Science Foundation Graduate Fellow, Department of Computer Science (UIUC).
Summer 2001	Summer Research Intern, Computational Sciences and Mathematical Research (Sandia Livermore National Laboratory).
Summer 2000	Summer Research Student, Department of Computer Science (College of William and Mary) and Computational Sciences and Mathematical Research (Sandia Livermore National Laboratory).

Awards and Honors

2000–2003	National Science Foundation Fellow.
2000	Winner of the Lord Botetourt Medal (One issued each year).

Refereed Publications and Proceedings

[1] C. Siefert, C. Pearson, S. Olivier, A. Prokopenko, J. Hu and T. Fuller. Latency and Bandwidth Microbenchmarks of US Department of Energy Systems in the June 2023 Top 500 List. Proceedings of the SC'23 Workshops of The International Conference on High Performance Computing, Network, Storage, and Analysis (PMBS 2023).

[2] N. Moore, E. Cyr, P. Ohm, C. Siefert and R. Tuminaro. Graph Neural Networks and Applied Linear Algebra. Accepted for publication in SIAM Review.

[3] J. Niederhaus, S. Bova, J. Carleton, . Carpenter, K. Cochrane, M. Crockatt, W. Dong, T. Fuller, B. Granzow, D. Ibanez, S. Kennon, C. Luchini, R. Moral, C. O'Brien, M. Powell, A. Robinson, A. Rodriguez, J. Sanchez, W. Scott, C. Siefert, A. Stagg, I. Tezaur, T. Voth and J. Wilkes. ALEGRA: Finite element modeling for shock hydrodynamics and multiphysics. *International Journal of Impact Engineering.* 180(104693), 2023.

[4] E. Padilla, H. Komkov, C. Siefert, A. Hecht, R. Kamm, K. Weinfurther and J. Valencia. List-Mode Inference using Linear Classifiers for Nuclear Arms Control Verification. *ESARDA Bulletin - The International Journal of Nuclear Safeguards and Non-proliferation*, 65, pp.10–18, December 2023.

[5] C. Siefert, S. Olivier, G. Voskuilen and J. Young. Observed Memory Bandwidth and Power Usage on FPGA Platforms with OneAPI and Vitis HLS: A Comparison with GPUs. Proceedings of the International Conference on High Performance Computing (H3 2023).

[6] J. Hu, C. Siefert and R. Tuminaro. Smoothed aggregation for difficult stretched mesh and coefficient variation problems. *Numerical Linear Algebra and Applications* 29(6), 2022.

[7] C. Siefert, S. Olivier, G. Voskuilen and J. Young. Multigrid on FPGA using data parallel C++. Proceedings of the 23rd IEEE International Workshop on Parallel and Distributed Scientific and Engineering Computing (PDSEC 2022).

[8] J. Elliott and C. Siefert. Low Thread-count Gustavson: A multithreaded algorithm for sparse matrix-matrix multiplication using perfect hashing. Proceedings of the 9th Workshop on Latest Advances in Scalable Algorithms for Large-Scale Systems (ScalA18), November 2018.

[9] G. Becker, C. Siefert, R. Tuminaro, H. Sun, D. Valiveti, A. Mohan, J. Yin and H. Huang. High resolution viscous gingering simulation in miscible displacement using a p-adaptive discontinuous Galerkin method with algebraic multigrid preconditioner. *Journal of Computational Physics* Volume 374(1), pp. 495–514.

[10] R. Kramer, C. Siefert, T. Voth and P. Bochev. Formulation and computation of dynamic, interface-compatible Whitney complexes in three dimensions. *Journal of Computational Physics*, Volume 359, pp. 45–76, 2018.

[11] G. Ballard and C. Siefert and J. Hu. Reducing Communication Costs for Sparse Matrix Multiplication within Algebraic Multigrid. *SIAM Journal on Scientific Computing*, Volume 38(3), pp. C203–C231, 2016.

[12] P. Lin, M. Bettencourt, S. Domino, T. Fisher, M. Hoemmen, J. Hu, E. Phipps, A. Prokopenko, S. Rajamanickam, C. Siefert, E. Cyr and S. Kennon. Towards extreme-scale simulations for low-Mach fluids with second-generation Trilinos. *Parallel Processing Letters*, Volume 24(4), 2014.

[13] P. Plunkett, J. Hu, C. Siefert and P. Atzberger. Spatially adaptive stochastic methods for fluid-structure interactions subject to thermal fluctuations in domains with complex geometries. *Journal of Computational Physics*, Volume 277, pp. 121–137, 2014.

[14] R. Kramer, P. Bochev, C. Siefert and T. Voth. Algebraically constrained extended edge element method (**e**XFEM-AC) for resolution of multi-material cells. *Journal of Computational Physics*, Volume 276, Pages 596–612, 2014.

[15] P. Lin, M. Bettencourt, S. Domino, T. Fisher, M. Hoemmen, J. Hu, E. Phipps, A. Prokopenko, S. Rajamanickam, C. Siefert, E. Cyr and S. Kennon. Towards extreme-scale simulations with next-generation Trilinos: a low Mach fluid application case study. *Workshop on Large-Scale Parallel Processing (LSPP)*, May 2014.

[16] C. Siefert, R. Tuminaro, A. Gerstenberger, G. Scovazzi, and S. Collis. Algebraic multigrid techniques for discontinuous Galerkin methods with varying polynomial order. *Computational Geosciences* Volume 18, Issue 5, pp. 597–612, 2014.

[17] R. Kramer, P. Bochev, C. Siefert and T. Voth. An extended finite element method with algebraic constraints (XFEM-AC) for problems with weak discontinuities. *Computer Methods in Applied Mechanics and Engineering*, Volume 266, pp. 70–80, 2013.

[18] R. Pawlowski, E. Phipps, A. Salinger, S. Owen, C. Siefert and M. Staten. Automating embedded analysis capabilities and managing software complexity in multiphysics simulation, Part II: Application to partial differential equations. *Scientific Programming*, Volume 20, Number 3, 2012.

[19] J. Gaidamour, J. Hu, C. Siefert and R. Tuminaro. Design considerations for a flexible multigrid preconditioning library. *Scientific Programming*, Volume 20, Number 2, 2012.

[20] P. Bochev, K. Peterson and C. Siefert. Analysis and Computation of Compatible Least-Squares Methods for Div-Curl Equations. *SIAM Journal on Numerical Analysis*, Volume 49, Number 1, pp. 159–181, 2011.

[21] J. Lai, P. Bochev, L. Olson, K. Peterson, D. Ridzal, and C. Siefert. Discontinuous Velocity Least Squares Finite Element Methods for Improved Mass Conservation. *CSRI Summer Proceedings 2010*, pp. 15–31, 2010.

[22] N. Roberts, D. Ridzal, P. Bochev, L. Demkowicz, K. Peterson and C. Siefert. Application of a Discontinuous Petrov-Galerkin Method to the Stokes Equations. *CSRI Summer Proceedings 2010*, pp. 32–46, 2010.

[23] P. Bochev, J. Hu, C. Siefert and R. Tuminaro. An Algebraic Multigrid Approach Based on a Compatible Gauge Reformulation of Maxwell's Equations. *SIAM Journal on Scientific Computing* Volume 31, Issue 1, pp. 557–583, 2008.

[24] C. Siefert and E. de Sturler. Probing Methods for Saddle-Point Problems. *Electronic Transactions in Numerical Analysis (ETNA)*, Special Volume on Saddle Point Problems: Numerical Solution and Applications, Volume 22, pp. 163–183, April 2006.

[25] C. Siefert and E. de Sturler. Preconditioners for Generalized Saddle-Point Problems. *SIAM Journal on Numerical Analysis*, Volume 44, Number 3, pp. 1275–1296, 2006.

[26] J. Liesen, E. de Sturler, A. Sheffer, Y. Aydin, and C. Siefert. Efficient Computation of Planar triangulations. *Proceedings of the 10th International Meshing Roundtable*, 2001.

Non-Refereed Reports

[27] C. Hughes, S. Olivier, M. Peterson, C. Siefert, G. Voskuilen, and D. Zwick. Quantifying the Performance of Co-Designed FPGA Accelerators for Computational Science Applications. SAND 20223-10580R, October, 2023.

[28] C. Siefert and R. Moral. Mixed Element Electrical Conductivity and Joule Power Partitioning Models. SAND2023-12436. March, 2023.

[29] N. Moore and E. Cyr and C. Siefert. Learning an algebraic multigrid interpolation operator using a modified GraphNet architecture. SAND 2022-3579. March, 2022.

[30] C. Siefert and T. Smith and E. Ridgway. Evaluation of Programming Language-Aware Diffs for Improving Developer Productivity. SAND 2021-13588. October, 2021.

[31] J. Niederhaus, J. Pacheco, J. Wilkes, R. Hooper, C. Siefert and R. Goeke. Modeling a ring magnet in ALEGRA. SAND2020-9623, September 2020.

[32] A. Rodriguez, C. Siefert and J. Niedherhaus. Resistive heating in an electrified domain with a spherical inclusion: an ALEGRA verification study. SAND2020-10208, September 2020.

[33] C. Siefert. Adding magnetization to the eddy current approximation of Maxwell's equations. SAND2020-3813, March 2020.

[34] R. Doney, C. Siefert and J. Niederhaus. "Improved Solver Settings for 3D Exploding Wire Simulations in ALEGRA," U.S. Army Research Laboratory Technical Report ARL-TR-7748, August 2016.

[35] A. Prokopenko, C. Siefert, J. Hu, M. Hoemmen, and A. Klinvex. "Ifpack2 User's Guide 1.0," SAND2016-6338, June 2016.

[36] A. Prokopenko, J. Hu, T. Wiesner, C. Siefert, and R. Tuminaro "MueLu User's Guide 1.0," SAND2014-18874, October 2015.

[37] A. Robinson, S. Carrol, R. Drake, G. Hansen, D. Hensinger, R. Kramer, D. Labreche, E. Love, C. Luchini, S. Mosso, S. Petney, J. Sanchez, C. Siefert, O. Strack, J. Niederhaus, C. Ober, W. Rider, V. Wiers, M. Wong, T. Haill. "Alegra User Manual," SAND2014-16031, June 2014.

[38] C. Siefert, T. Voth and P. Bochev. Electromagnetic eXtended finite elements for accurate resolution of multi-material cells. *Proceedings of the Army Research Laboratory Research in Ballistic Protection Technologies Workshop*, May 2012.

[39] C. Siefert and A. Robinson. A Fully Implicit Method for 3D Quasi-Steady State Magnetic Advection-Diffusion. SAND2009-6091, Sandia National Laboratories, September 2009.

[40] T. Russo, C. Turner, A. Robinson, C. Siefert, R. Kaye, G. Torres, C. Garasi and D. Lamppa. The Xygra EM Gun Simulation Tool. SAND 2009-6729. Sandia National Laboratories, September 2009.

[41] J Hu, C. Siefert, I. Karlin, R. Tuminaro, S. Domino and A. Robinson. Highly Scalable Linear Solvers on Thousands of Processors. SAND2009-6197, Sandia National Laboratories, September 2009.

[42] P. Bochev, C. Siefert, R. Tuminaro, J. Xu and Y. Zhu. Compatible Gauge Approaches for H(div) Equations. Technical Report, SAND 2007-5384P, Sandia National Laboratories, August 2007.

[43] M. Gee, C. Siefert, J. Hu, R. Tuminaro and M. Sala. ML 5.0 Smoothed Aggregation Users Guide. SAND2006-2649, Sandia National Laboratories, May 2006.

[44] C. Siefert. Preconditioners for Generalized Saddle-Point Problems. PhD Thesis. 2006.

[45] C. Siefert, V. Torczon and M.W. Trosset. Model-Assisted Pattern Search Methods for Optimizing Expensive Computer Simulations. *ASA Proceedings of the Joint Statistical Meeting*, 2002. pp. 3236-3241.

[46] C. Siefert. Model-Assisted Pattern Search. Undergraduate Honors Thesis. Accepted with Highest Honors. 2000.

Technical Presentations

[47] "Trilinos Tools: Identifying Host-to-Device Transfers and State of the Code" — Talk at Trilinos Users Group Meeting, October, 2023.

[48] "Combined On/Off Node Performance Model for SPMV in Multigrid" — Talk at ICIAM, August, 2023.

[49] "My Very First Large(ish) Language Model" — Talk at Sandia Machine Learning / Deep Learning Workshop, July 2023.

[50] "Observed Memory Bandwidth and Power Usage on FPGA Platforms with OneAPI and Vitis HLS: A Comparison with GPUs" — Talk at H3 Workshop at ISC, May 2023.

[51] "Machine Learning & Trilinos" — Talk at Trilinos Users Group Meeting, October, 2022.

[52] "Tpetra in FY23" — Talk at Trilinos Users Group Meeting, October, 2022.

[53] "What's new in Tpetra and Data Services?" — Talk at EuroTUG, September, 2022.

[54] "Multigrid on FPGA using data parallel C++" — Talk at PDSEC Workshop at IPDPS, May 2022.

[55] "GNNs: An AI/ML metaphor we can use for iterative methods on unstructured meshes" — Talk at 17th Copper Mountain Conference on Iterative Methods, March 2022.

[56] "Multilevel Methods for Maxwell's Equations " — Talk at SIAM ALA, May 2021.

[57] "A Cut-Based Coarsening Algorithm for Smoothed Aggregation Algebraic Multigrid" — Talk at SIAM CSE, February 2021.

[58] "Case Study: Debugging Other People?s Libraries via PRELOAD" — Talk at Collegeville Workshop 2020.

[59] "Machine Learning for Linear Solvers" — Talk at Sandia Machine Learning / Deep Learning Workshop, July 2019.

[60] "MueLu: Algebraic Multigrid in Trilinos" — Talk at Kokkos Users Group Meeting, April 2019.

[61] "Sparse Matrix-Matrix Multiplication: An MPI+X Story" — Seminar at the University of New Mexico, October 2018.

[62] "Sparse Matrix-Matrix Multiplication and Related Kernels on Knights Landing" — Talk at SIAM Annual Meeting, July 2018.

[63] "Low Communication Neighbor Discovery for Matrix Migration" — Talk at SIAM PP, March, 2018.

[64] "Verification for Magnetic Materials in MHD" — Poster at 8th International Conference on Numerical Methods for Multi-Material Fluid Flow (MultiMat), September 2017.

[65] "Towards a More Algebraic hp-Multigrid" – Talk at 18th Copper Mountain Conference On Multigrid Methods, March 2017.

[66] "Computation of Derived Variables for the Eddy Current Maxwell's Equations" – Talk at SIAM CSE 2017, February 2017.

[67] "Won't you be my neighbor? A look at neighbor discovery for algebraic multigrid" – Talk at the 14th Copper Mountain Conference on Iterative Methods, March 2016.

[68] "Implicit Solvers for Higher-Order Discretizations" – Talk at 7th International Conference on Numerical Methods for Multi-Material Fluid Flow (MultiMat), September 2015.

[69] "Linear solver strategy for coupled and implicit discontinuous Galerkin method to model miscible displacement with adverse mobility ratio" – Talk at USNCCM 13, July 2015.

[70] "Extended and Conformal Decomposition Finite Elements for 3D Compatible Discretizations" – Talk at SIAM CSE, March 2015.

[71] "Local Smoothers for CDFEM with Sub-element Discontinuities" – Talk at the SIAM Annual Meeting, July 2014.

[72] "Local Smoothers for CDFEM with Sub-element Discontinuities" – Talk at the 13th Copper Mountain Conference on Iterative Methods, March, 2014.

[73] "Extended Finite Elements for Multi-material Electromagnetics " — Poster at MultiMat 2013, September 2013.

[74] "Algebraically-Constrained Tied Heaviside Methods for Computational Electromagnetics" — Talk at 12th U.S. National Congress on Computational Mechanics, July 2013.

[75] "Electromagnetic XFEM with Weak Discontinuities" — Talk at SIAM Annual Meeting 2013, July 2013.

[76] "Multilevel Preconditioners for the XFEM with Weak Discontinuities" – Talk at the 16th Copper Mountain Conference on Multigrid Methods, March 2013.

[77] "Electrogramnetic eXtended Finite Elements for Accurate Resolution of Multi-material Cells" — Talk at ARL Research in Ballistics Protection Workshop, May 2012.

[78] "Mimetic Least Squares Methods with Preconditioners for Darcy Flow" — Talk at the 12th Copper Mountain Conference on Iterative Methods, March 2012.

[79] "Smoothed-Aggregation Algebraic Multigrid for Porous Media Simulations" — Talk at SIAM Parallel Processing, 2012, February 2012.

[80] "Block Preconditioning for Implicit Ocean Systems" — Talk at 7th International Congress on Industrial and Applied Mathematics (ICIAM), July 2011.

[81] "Block Preconditioning for Implicit Ocean Models" — Talk at the 11th Copper Mountain Conference on Iterative Methods, April 2010.

[82] "Multigrid Scalability for Least Squares Finite Element Problems" — Poster at SIAM Parallel Processing 2010, February 2010.

[83] "Smoothed Aggregation AMG Solvers for Least-Squares Finite Element Systems" — Talk at SIAM Applied Linear Algebra 2009, October 2009.

[84] "An Algebraic Multigrid Method for Compatible Least-Squares Formulations of Div-Curl Equations" — Talk at the 14th Copper Mountain Conference on Multigrid Methods, April 2009.

[85] "Partitioning for Multigrid Solvers" — Invited Talk at the Workshop on Combinatorial Scientific Computing and Petascale Simulations (CSCAPES) 2008.

[86] "Recent Algorithmic (and Practical) Developments in ML" — Talk at the 10th Copper Mountain Conference on Iterative Methods, April 2008.

[87] "Introduction to Multilevel Solvers for the Physical Sciences" — Invited CSUMS Lecture, College of William and Mary, December 2007.

[88] "Algebraic Multigrid and a Compatible Gauge Reformulation of Maxwell's Equations" — Invited Computer Science Seminar, College of William and Mary, November 2007.

[89] "What's New in ML? New Features in Trilinos 8.0" — Trilinos Users Group Meeting 2007, November 2007.

[90] "Algebraic Multigrid and Algebraic Reformulations of the Eddy Current Equations, Part II" — Talk at the 13th Copper Mountain Conference on Multigrid Methods, March 2007.

[91] "Algebraic Multigrid and Algebraic Reformulations of the Eddy Current Equations" — Invited Talk for CSE 2007, February 2007.

[92] "What's New in ML? New Features in Trilinos 7.0" — Trilinos Users Group Meeting 2006, November 2006.

[93] "AMG and a Discrete Reformulation for Maxwell's Equations" — Computer Science Research Institute Seminar at Sandia National Laboratory, October 2006.

[94] "Probing Methods for Generalized Saddle-Point Problems" — Contributed Talk for Preconditioning 2005, May 2005.

[95] "Generalized Saddle-Point Preconditioners and Approximate Schur Complements" — Invited Talk for CSE 2005, February 2005.

[96] "Preconditioners for Generalized Saddle-Point Problems" — Talk for Midwest Numerical Analysis Day, April 2004.

[97] "Preconditioners for Generalized, Stabilized Saddle-Point Problems" — Contributed Talk for Preconditioning 2003 Conference, October 2003.

[98] "Model-Assisted Pattern Search Methods for Optimizing Expensive Computer Simulations" — Topic Contributed/Invited Talk at Joint Statistics Meeting, August 2002.

[99] "MAPS: An algorithm for non-parametric Response Surface Methodology" — Poster Session at the 2000 SRCOS/ASA Conference.

[100] "Model-Assisted Pattern Search" — Talk at Sandia National Laboratory, August 2000.

[101] "Model-Assisted Pattern Search" — Invited Talk for the Board of Visitors of the College of William and Mary, Spring 2000.

Professional Societies and Service

Societies   SIAM.

Service   NumFocus Affiliated Projects Committee 2023-present, SIAM Professional Development Working Group 2012-2014, UIUC Computer Science Graduate Student Organization Coordinator 2002-2003.