

# Christopher Siefert

## Curriculum Vitæ

Sandia National Laboratories  
P.O. Box 5800, MS 1323  
Albuquerque, NM 87185-1323  
(505) 844-4696  
<http://www.cs.sandia.gov/~csiefer>

9500 Osuna Rd. NE #728  
Albuquerque, NM 87111  
(505) 323-1541  
U.S. Citizen  
csiefer@sandia.gov

### Research Interests

Numerical Linear Algebra, Preconditioners, KKT Systems, 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, Computational Multiphysics 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] 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.
- [2] 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.

- [3] K. Lewis, J. Solberg, M. Barham, S. Roberts, C. Siefert, J. Michopoulos, M. Young and J. Barber. Verification and Code Comparison for Sliding Electrical Contact. Proceedings of the 4th DoD Innovative Science and Technology EM Railgun Workshop, October, 2014.
- [4] 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.
- [5] R. Kramer, P. Bochev, C. Siefert and T. Voth. Algebraically constrained extended edge element method (eXFEM-AC) for resolution of multi-material cells. *Journal of Computational Physics*, Volume 276, Pages 596–612, 2014.
- [6] 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.
- [7] 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.
- [8] 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.
- [9] 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.
- [10] J. Gaidamour, J. Hu, C. Siefert and R. Tuminaro. Design considerations for a flexible multigrid preconditioning library. *Scientific Programming*, Volume 20, Number 2, 2012.
- [11] 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.
- [12] 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.
- [13] 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.
- [14] 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.
- [15] 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.
- [16] 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.
- [17] 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

- [18] A. Prokopenko, C. Siefert, J. Hu, M. Hoemmen, and A. Klinvex. “Ifpack2 Users Guide 1.0,” SAND2016-6338, June 2016.
- [19] 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.

- [20] C. Siefert and A. Robinson. A Fully Implicit Method for 3D Quasi-Steady State Magnetic Advection-Diffusion. SAND2009-6091, Sandia National Laboratories, September 2009.
- [21] 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.
- [22] P. Bochev, C. Siefert, R. Tuminaro, J. Xu and Y. Zhu. Compatible Gauge Approaches for  $H(\text{div})$  Equations. Technical Report, SAND 2007-5384P, Sandia National Laboratories, August 2007.
- [23] 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.
- [24] 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.
- [25] C. Siefert. Preconditioners for Generalized Saddle-Point Problems. PhD Thesis. 2006.
- [26] 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.
- [27] C. Siefert. Model-Assisted Pattern Search. Undergraduate Honors Thesis. Accepted with Highest Honors. 2000.

## Technical Presentations

- [28] “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.
- [29] “Implicit Solvers for Higher-Order Discretizations” – Talk at 7th International Conference on Numerical Methods for Multi-Material Fluid Flow (MultiMat), September 2015.
- [30] “Linear solver strategy for coupled and implicit discontinuous Galerkin method to model miscible displacement with adverse mobility ratio” – Talk at USNCCM 13, July 2015.
- [31] “Extended and Conformal Decomposition Finite Elements for 3D Compatible Discretizations” – Talk at SIAM CSE, March 2015.
- [32] “Local Smoothers for CDFEM with Sub-element Discontinuities” – Talk at the SIAM Annual Meeting, July 2014.
- [33] “Local Smoothers for CDFEM with Sub-element Discontinuities” – Talk at the 13th Copper Mountain Conference on Iterative Methods, March, 2014.
- [34] “Extended Finite Elements for Multi-material Electromagnetics ” — Poster at MultiMat 2013, September 2013.
- [35] “Algebraically-Constrained Tied Heaviside Methods for Computational Electromagnetics” — Talk at 12th U.S. National Congress on Computational Mechanics, July 2013.
- [36] “Electromagnetic XFEM with Weak Discontinuities” — Talk at SIAM Annual Meeting 2013, July 2013.
- [37] “Multilevel Preconditioners for the XFEM with Weak Discontinuities” – Talk at the 16th Copper Mountain Conference on Multigrid Methods, March 2013.
- [38] “Electromagnetic eXtended Finite Elements for Accurate Resolution of Multi-material Cells” — Talk at ARL Research in Ballistics Protection Workshop, May 2012.
- [39] “Mimetic Least Squares Methods with Preconditioners for Darcy Flow” — Talk at the 12th Copper Mountain Conference on Iterative Methods, March 2012.
- [40] “Smoothed-Aggregation Algebraic Multigrid for Porous Media Simulations” — Talk at SIAM Parallel Processing, 2012, February 2012.
- [41] “Block Preconditioning for Implicit Ocean Systems” — Talk at 7th International Congress on Industrial and Applied Mathematics (ICIAM), July 2011.
- [42] “Block Preconditioning for Implicit Ocean Models” — Talk at the 11th Copper Mountain Conference on Iterative Methods, April 2010.

- [43] “Multigrid Scalability for Least Squares Finite Element Problems” — Poster at SIAM Parallel Processing 2010, February 2010.
- [44] “Smoothed Aggregation AMG Solvers for Least-Squares Finite Element Systems” — Talk at SIAM Applied Linear Algebra 2009, October 2009.
- [45] “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.
- [46] “Partitioning for Multigrid Solvers” — Invited Talk at the Workshop on Combinatorial Scientific Computing and Petascale Simulations (CSCAPES) 2008.
- [47] “Recent Algorithmic (and Practical) Developments in ML” — Talk at the 10th Copper Mountain Conference on Iterative Methods, April 2008.
- [48] “Introduction to Multilevel Solvers for the Physical Sciences” — Invited CSUMS Lecture, College of William and Mary, December 2007.
- [49] “Algebraic Multigrid and a Compatible Gauge Reformulation of Maxwell’s Equations” — Invited Computer Science Seminar, College of William and Mary, November 2007.
- [50] “What’s New in ML? New Features in Trilinos 8.0” — Trilinos Users Group Meeting 2007, November 2007.
- [51] “Algebraic Multigrid and Algebraic Reformulations of the Eddy Current Equations, Part II” — Talk at the 13th Copper Mountain Conference on Multigrid Methods, March 2007.
- [52] “Algebraic Multigrid and Algebraic Reformulations of the Eddy Current Equations” — Invited Talk for CSE 2007, February 2007.
- [53] “What’s New in ML? New Features in Trilinos 7.0” — Trilinos Users Group Meeting 2006, November 2006.
- [54] “AMG and a Discrete Reformulation for Maxwell’s Equations” — Computer Science Research Institute Seminar at Sandia National Laboratory, October 2006.
- [55] “Probing Methods for Generalized Saddle-Point Problems” — Contributed Talk for Preconditioning 2005, May 2005.
- [56] “Generalized Saddle-Point Preconditioners and Approximate Schur Complements” — Invited Talk for CSE 2005, February 2005.
- [57] “Preconditioners for Generalized Saddle-Point Problems” — Talk for Midwest Numerical Analysis Day, April 2004.
- [58] “Preconditioners for Generalized, Stabilized Saddle-Point Problems” — Contributed Talk for Preconditioning 2003 Conference, October 2003.
- [59] “Model-Assisted Pattern Search Methods for Optimizing Expensive Computer Simulations” — Topic Contributed/Invited Talk at Joint Statistics Meeting, August 2002.
- [60] “MAPS: An algorithm for non-parametric Response Surface Methodology” — Poster Session at the 2000 SRCOS/ASA Conference.
- [61] “Model-Assisted Pattern Search” — Talk at Sandia National Laboratory, August 2000.
- [62] “Model-Assisted Pattern Search” — Invited Talk for the Board of Visitors of the College of William and Mary, Spring 2000.

## Professional Societies and Service

<i>Societies</i>	SIAM, ACM.
<i>Service</i>	SIAM Professional Development Working Group 2012-2014, UIUC Computer Science Graduate Student Organization Coordinator 2002-2003.