

Michael L. Parks

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U.S. Citizen

Research Interests

- Numerical analysis
- Multiscale mathematics, Atomistic-to-continuum coupling
- Numerical linear algebra, Linear solvers
- Domain decomposition methods, Mesh-tying

Education

Ph.D., Computer Science, May 2005

University of Illinois at Urbana-Champaign, Urbana, IL.

GPA: 3.92/4.00

Completed CSE degree option (demonstrating proficiency in numerical computation)

The Iterative Solution of a Sequence of Linear Systems Arising From Nonlinear Finite Element Analysis

Ph.D. Dissertation

Eric de Sturler (chair), Michael T. Heath, Paul E. Saylor, Keith D. Hjelmstad

M.S., Computer Science, May 2000

Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, VA.

GPA: 3.96/4.00

Efficient Numeric Computation of a Phase Diagram in Biased Diffusion of Two Species

Masters Thesis

Calvin J. Ribbens (chair), Donald Allison, Royce K. P. Zia, Beate Schmittmann

B.S., Computer Science, Summa Cum Laude, May 1998

B.S., Physics, Summa Cum Laude, In Honors, May 1998

Minor, Mathematics

Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, VA.

GPA: 3.87/4.00

The Construction and Analysis of Factorial Experiments: Application to Tribochemical Vapor Deposition

Honors Thesis (Physics)

Jimmy Ritter (chair), Beate Schmittmann, Jerome Long

Research and Technical Experience

2007–Present Senior Member of the Technical Staff, Applied Mathematics and Applications Dept.,
Sandia National Laboratories

- 2004–2007 Postdoctoral Employee, Computational Mathematics and Algorithms Dept., Sandia National Laboratories
Conducted research in multiscale modeling and analysis
- 2001–2004 Research Assistant, Dept. of Computer Science, University of Illinois
Developed new solvers and preconditioners for ill-conditioned sparse linear systems
- Summer 1998 Applications Programmer, Dept. of Physics, Virginia Tech
Constructed custom interactive laboratory software for use in undergraduate physics labs
- 1996–1997 Research Assistant, Dept. of Physics, Virginia Tech
Developed software to drive experimental apparatus; Aided in experiment design, data collection, and analysis

Teaching Experience

- Summer 1999 **Instructor**, Dept. of Computer Science, Virginia Tech
Taught Object-Oriented Software Design and Construction course (60 students)
Managed teaching assistants
Prepared lectures, homework, programming assignments, and exams
- Fall 2000 **Teaching Assistant**, Dept. of Computer Science, University of Illinois
Graded assignments and exams, held office hours
Assisted with Programming Languages and Compilers course (300 students)
- 1998–2000 **Teaching Assistant**, Dept. of Computer Science, Virginia Tech
Graded assignments and exams, held office hours, and taught lab sections
Assisted with Object-Oriented Software Design and Construction and Numerical Methods courses

Selected Honors, Awards and Fellowships

- 2008, 2006 Sandia Award for Excellence
- 2003–2004 Computational Science and Engineering Fellow, University of Illinois (10 awarded per year)
- 2002–2003 Computational Science and Engineering Fellow, University of Illinois (10 awarded per year)
- 2000 Outstanding Graduate Teaching Award, Department of Computer Science, Virginia Tech
- 1997–1998 Barry M. Goldwater Scholar (300 awarded nationally per year)
- 1997 Phi Beta Kappa
- 1997 Upsilon Pi Epsilon, the International Honor Society for the Computing and Information Disciplines
- 1997 Sigma Pi Sigma, the National Physics Honor Society

Publications

All papers can be downloaded from <http://www.sandia.gov/~mlparks/>.

Journal Articles

- M. L. PARKS, R. B. LEHOUCQ, S. J. PLIMPTON, AND S. A. SILLING, *Implementing Peridynamics within a Molecular Dynamics Code*. Computer Physics Communications, 179(11), pp. 777-783, 2008.
- G. J. WAGNER, R. E. JONES, J. A. TEMPLETON, M. L. PARKS, *An Atomistic-to-Continuum Coupling Method for Heat Transfer in Solids*. Computer Methods in Applied Mechanics and Engineering, 197, pp. 3351-3365, 2008.

- M. L. PARKS, P. B. BOCHEV, AND R. B. LEHOUCQ, *Connecting Atomistic-to-Continuum Coupling and Domain Decomposition*. Multiscale Modeling and Simulation, 7, pp. 362–380, 2008.
- S. BADIA, M. L. PARKS, P. B. BOCHEV, M. GUNZBURGER, AND R. B. LEHOUCQ, *On Atomistic-to-Continuum (AtC) Coupling by Blending*. Multiscale Modeling and Simulation, 7, pp. 381–406, 2008.
- S. BADIA, P. B. BOCHEV, J. FISH, M. D. GUNZBURGER, R. B. LEHOUCQ, M. A. NUGGEHALLY, M. L. PARKS, *A Force-Based Blending Model for Atomistic-to-Continuum Coupling*. International Journal for Multiscale Computational Engineering, 5, pp. 387-406, 2007.
- J. FISH, M. A. NUGGEHALLY, M. S. SHEPHARD, C. R. PICU, S. BADIA, M. L. PARKS, AND M. GUNZBURGER, *Concurrent AtC coupling based on a blend of the continuum stress and the atomistic force*, Computer Methods in Applied Mechanics and Engineering, 196, pp. 4548-4560, 2007.
- M. L. PARKS, L. A. ROMERO, AND P. B. BOCHEV, *A Novel Lagrange-Multiplier Based Method for Consistent Mesh Tying*, Computer Methods in Applied Mechanics and Engineering, 196, pp. 3335-3347, 2007.
- M. L. PARKS AND L. A. ROMERO, *Taylor-Aris Dispersion in High Aspect Ratio Columns of Nearly Rectangular Cross Section*, Mathematical and Computer Modelling, 46, pp. 699-717, 2007.
- M. L. PARKS, E. DE STURLER, G. MACKEY, D. JOHNSON, AND S. MAITI, *Recycling Krylov Subspaces for Sequences of Linear Systems*, SIAM Journal on Scientific Computation, 28(5), pp. 1651-1674, 2006.

Conference Proceedings Articles

- E. ASKARI, F. BOBARU, R. B. LEHOUCQ, M. L. PARKS, S. A. SILLING, O. WECKNER, *Peridynamics for multiscale materials modeling*, in SciDAC 2008, Seattle, Washington, vol. 125 of Journal of Physics: Conference Series, (012078) 2008.
- S. BADIA, P. B. BOCHEV, M. D. GUNZBURGER, R. B. LEHOUCQ, M. L. PARKS, *Bridging Methods for Coupling Atomistic and Continuum Models*, in Large-Scale Scientific Computing 6th International Conference, Sozopol, Bulgaria, June 5-9, 2007, I. Lirkov, S. Margenov, and J. Wasniewski, eds., vol. 4818 of Lecture Notes in Computer Science, 2007, pp. 16–27.

Technical Reports

- P. SELESON, M. L. PARKS, AND M. GUNZBURGER, *Peridynamics as an upscaling of Molecular Dynamics*, in CSRI Summer Proceedings, D. Ridzal and S. S. Collis, eds., Sandia National Laboratories, 2008, pp. 177-184. Available as Sandia National Laboratories Technical Report SAND2008-8257P.
- M. L. PARKS, P. SELESON, S. J. PLIMPTON, R. B. LEHOUCQ, AND S. A. SILLING, *Peridynamics with LAMMPS: A User Guide*, Technical Report SAND2008-0135, Sandia National Laboratories, January 2008.
- P. B. BOCHEV, S. S. COLLIS, R. E. JONES, R. B. LEHOUCQ, M. L. PARKS, G. SCOVAZZI, S. A. SILLING, J. A. TEMPLETON, G. J. WAGNER, *A Mathematical Framework for Multiscale Science and Engineering: the Variational Multiscale Method and Interscale Transfer Operators*, Technical Report SAND2007-6179, Sandia National Laboratories, October 2007.
- S. BADIA, P. BOCHEV, M. GUNZBURGER, R. LEHOUCQ, AND M. L. PARKS, *Blended Atomistic-to-Continuum Coupling Analyses and Methods*, Technical Report SAND2007-0905, Sandia National Laboratories, February 2007.
- E. B. VANDERZEE, M. L. PARKS, AND P. KNUPP, *Numerical experiments for local quasicontinuum analysis*, in NECIS Summer Proceedings, S. S. Collis, J. Lee, and J. Zimmerman, eds., Sandia National Laboratories, 2006, pp. 194-202. Available as Sandia National Laboratories Technical Report SAND2006-6564.

- M. L. PARKS, L. A. ROMERO, AND J. WHITING, *A Reduced Order Model for the Study of Asymmetries in Linear Gas Chromatography for Homogeneous Tubular Columns*, Technical Report SAND2005-4868, Sandia National Laboratories, August 2005.
- M. L. PARKS, *The Iterative Solution of a Sequence of Linear Systems Arising From Nonlinear Finite Element Analysis*, Ph.D. Dissertation, Dept. of Computer Science at the University of Illinois at Urbana-Champaign, 2005. Available as University of Illinois Technical Report UIUCDCS-R-2005-2497.
- M. L. PARKS, *Efficient Numeric Computation of a Phase Diagram in Biased Diffusion of Two Species*, Master's Thesis, Dept. of Computer Science at the Virginia Polytechnic Institute and State University (Virginia Tech), 2000. Available as Virginia Tech Electronic Thesis etd-05172000-14430029.

Proceedings Edited

- M. L. PARKS AND S. S. COLLIS, editors. *CSRI Summer Proceedings 2007*, The Computer Science Research Institute at Sandia National Laboratories, Albuquerque, NM, 2007.

Other

- M. L. PARKS AND R. B. LEHOUCQ, *Researchers Discuss Atomistic-to-Continuum (AtC) Coupling*, SIAM News, Vol. 39, No. 7 (September 2006).

Invited Presentations

- *Towards Multiscale Materials Modeling With Peridynamics*, Center for Computation and Technology, Louisiana State University, Nov. 14, 2008.
- *Molecular dynamics at larger scales: Peridynamics as an upscaling of molecular dynamics*, Fourth International Conference on Multiscale Materials Modeling, Tallahassee FL., October 27-31, 2008.
- *Mesoscale Simulations with Microscale Tools: Peridynamics in a Molecular Dynamics Code*, SIAM Conference on Mathematical Aspects of Materials Science, Philadelphia, PA., May 11-14, 2008.
- *The Fast Solution of Sequences of Linear Systems via Subspace Recycling*, School of Computational Science, Florida State University, Oct. 13, 2007.
- *Analysis of Krylov-subspace recycling for sequences of linear systems*, 6th International Congress on Industrial and Applied Mathematics, Zurich, Switzerland, July 16-20, 2007.
- *Connecting Domain Decomposition and Atomistic-to-Continuum (AtC) Coupling*, Oak Ridge National Laboratories, Oak Ridge, TN., May 1-2, 2007.
- *Connections Between Domain Decomposition and Atomistic-to-Continuum (AtC) Coupling*, Department of Mathematics, Virginia Tech, Oct. 4-6, 2006.
- *Fast Solution of Long Sequences of Linear Systems in Computational Mechanics*, 7th World Congress on Computational Mechanics, Los Angeles, CA., July 16-22, 2006. (Filled in for Eric de Sturler, who was unable to attend.)
- *Relating Atomistic-to-Continuum Coupling and Domain Decomposition*, 7th World Congress on Computational Mechanics, Los Angeles, CA., July 16-22, 2006.
- *Analysis of Krylov Subspace Recycling for Sequences of Linear Systems*, SIAM Conference on Computational Science and Engineering, Orlando, FL., February 12-15 2005.
- *Recycling Krylov Subspaces for Sequences of Linear Systems*, Annual Computational Science and Engineering Research Symposium, University of Illinois, April 27, 2004.
- *Robust Preconditioners and Solvers for Ill-Conditioned Equations from Nonlinear Finite Element Analysis*, Annual Computational Science and Engineering Research Symposium, UIUC, April 25, 2003.

Contributed Presentations

- *Peridynamics for multiscale materials modeling*, Applied Mathematics Principal Investigators Meeting, Argonne National Laboratory, Argonne, IL., October 15-17, 2008.
- *Relating atomistic-to-continuum coupling and domain decomposition*, 6th International Congress on Industrial and Applied Mathematics, Zurich, Switzerland, July 16-20, 2007.
- *The Fast Solution of Sequences of Linear Systems via Subspace Recycling*, Seventh Biennial Tri-Laboratory Engineering Conference, Albuquerque NM., May 7-10, 2007.
- *Analysis of Krylov Subspace Recycling for Sequences of Linear Systems*, 7th IMACS International Symposium of Iterative Methods in Scientific Computing, Toronto, Canada, May 5-6 2005.
- *Recycling Krylov Subspaces for Sequences of Linear Systems*, Midwest Numerical Analysis Day, University of Wisconsin-Milwaukee, April 24, 2004.
- *Improved Krylov Methods and a Framework for the Analysis of Preconditioners for Ill-Conditioned Equations Arising from Nonlinear Finite Element Analysis*, 2003 International Conference On Preconditioning Techniques For Large Sparse Matrix Problems In Scientific And Industrial Applications, Napa, CA., October 27-29, 2003.

Sandia Projects

- 2008–2010 Rapid Production Software Development for Multi-Physics Peridynamics
 Funding: CSRF
 Activities: Create production-quality component-based multiphysics peridynamics code
 Collaborators: S. A. Silling, D. J. Littlewood
- 2007–2009 Peridynamics as a Rigorous Coarse-Graining of Atomistics for Multiscale Materials Design
 Funding: LDRD
 Activities: Develop simulation capability for next generation computational material science.
 Collaborators: S. M. Foiles, R. B. Lehoucq, R. P. Muller, M. P. Sears, and S. A. Silling
- 2006–2008 Analysis of Atomistic-to-Continuum (AtC) Coupling
 Funding: ASCR
 Activities: Numerical analysis of atomistic-to-continuum coupling algorithms
 Collaborators: R. B. Lehoucq, P. B. Bochev, M. Gunzburger (FSU), S. Badia D. Estep (CSU), J. Fish (RPI), and M. Shephard (RPI)
- 2006–2008 System Level Methods for Electrical and Microsystems Applications (Co-PI)
 Funding: CSRF
 Activities: Research on Krylov subspace recycling algorithms; Trilinos development
 Collaborators: E. de Sturler (Virginia Tech), H. Thornquist, D. Day, and T. Coffey
- 2005–2007 A Mathematical Framework for Multiscale Science and Engineering
 Funding: LDRD
 Activities: Development and analysis of atomistic/continuum thermal coupling algorithms
 Collaborators: R. B. Lehoucq, P. B. Bochev, G. Wagner, R. Jones, J. Templeton, and A. Slepoy
- 2005–2006 Generalized Domain Bridging Methods
 Funding: CSRF
 Activities: Development and analysis of mesh tying algorithms for finite element subdomains with inconsistently meshed boundaries
 Collaborators: P. B. Bochev, D. Day, L. A. Romero, and M. Gee

Funded Proposals

- 2006–2008 Peridynamics as a Rigorous Coarse-Graining of Atomistics for Multiscale Materials Design (Co-PI)
Funding Requested: \$1.95M (LDRD)
- 2006–2008 System Level Methods for Electrical and Microsystems Applications (Co-PI)
Funding Requested: \$1.5M (CSRF)

Sandia Service

- 2007 Editor, 2007 CSRI Summer Proceedings.
- 2007 Organizer, CSRI Special Seminar Series (hosted Sandia staff and university faculty for talks on computational science and applications.)
- 2006 Organizer, NECIS Special Seminar Series (hosted university faculty for talks on predictive science for nanotechnology)

Professional Activities

- Associate Editor, Applied Mathematics and Computation (2008-)
- Member, Society for Industrial and Applied Mathematics (SIAM)
- Reviewer for SIAM Review (SIREV), SIAM Journal on Scientific Computing (SISC), SIAM Journal on Numerical Analysis (SINUM), Computer Methods in Applied Mechanics and Engineering (CMAME), Electronic Transactions on Numerical Analysis (ETNA), Discrete and Continuous Dynamical Systems, Journal of Computational Mathematics, Applied Mathematics and Computation.

References

References are available on request.