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Experience

Senior Scientist. Center for Computing Research Sandia National Labs, May 1998-present. Principle member 1998-2004, Distinguished member 2004-2016, Senior Scientist 2016 – present. Conduct research and development of numerical methods for scientific and engineering applications on large-scale parallel computers. Participate on program and standards committees in areas of expertise. Lead the Trilinos libraries project, the Mantevo applications performance-modeling project and HPCG Benchmark.

Director of Software Technology. The US Department of Energy Exascale Computing Project, November 2017-present. Lead DOE efforts to create the software stack for Exascale computing platforms. Portfolio includes programming model, runtimes, development tools, math libraries, data, I/O and visualization products.

Scientist in Residence and Adjunct Faculty Member. Department of Computer Science, Saint John's University, September 1998-present, Scientist in Residence 2004-present. Teach courses in Numerical Analysis, Parallel Computing, Computer Science Research Methodologies and Software Engineering. Direct undergraduate research theses in parallel computing and related areas. Participate in curriculum development.

Group Leader. Scalable Computing, Algorithms and Capability Prototyping Groups, SGI/Cray Research, March 1995-May 1998. Led a team of specialists in scientific computing. Directed activities and participated in development, porting and optimization of large-scale parallel applications for SGI/Cray systems. Participated in and led standardization efforts for scientific computing. Led efforts in development of new application capabilities. Provided applications analysis and requirements to future computer systems development including the Cray T3E, T90, J90, SV1 and SV2.

Numerical Analyst. CFD Group, Engineering Applications, Cray Research, September 1993-February 1995. Responsible for research and development of numerical methods for engineering applications in CFD, structural analysis, electronics and reservoir simulation. Worked with application developers on Cray vector multiprocessors and distributed memory machines. Particular areas of interest were the solution of sparse and dense linear systems, iterative methods, parallel algorithms and large-scale scientific computation. Served as consultant on numerical methods for Cray Research customers and application specialists.

Numerical Analyst. Mathematical Software Research Group, Cray Research, October 1988-September 1993. Conducted research and development of numerical linear algebra libraries. Served as consultant on numerical methods for Cray Research customers and application specialists. Developed libraries of high-performance software for Cray Research computer systems.

Education

Ph.D. Mathematics. May 1989, Colorado State University, Fort Collins, Colorado.

M.S. Mathematics. August 1986, Colorado State University, Fort Collins, Colorado.

B.A. Mathematics. December 1983, Saint John's University, Collegeville, Minnesota.

Professional Awards

- Fellow, Society for Industrial and Applied Mathematics (SIAM).
- Senior Member, IEEE, 2018.
- 2015 HPCWire “People to Watch 2015” selection.
- 2014 FLC Regional Technology Transfer Award for Mantevo.
- R&D 100 Award for Mantevo 1.0, 2013, project initiator and leader.
- Best Poster Award, SC11 Conference, November 2011.
- Distinguished Member of the Association for Computing Machinery, October 2009.
- ASC Salutes Profile, NNSA/ASC profile, September 2007.
- R&D 100 Award for Trilinos 3.1, 2004, project initiator and leader.
- SC2004 HPC Software Challenge Award, 2004.
- Member of Cray Research Gordon Bell Prize Finalist Team, 1996.
- Sandia Employee Awards:
 - Mantevo Team R&D 100 Award and External Impact on HPC Co-Design, 2013.
 - Winning X-caliber proposal for the DARPA/UHPC Program, 2011.
 - Educating the next generation of computational scientists, 2010.
 - IAA Algorithms Team, 2009.
 - Organizing Next-generation Applications Workshop, 2008.
 - Xyce/Charon/Algorithms Team, 2008.
 - Supercomputing Architecture & Programming Environment Team, 2008.
 - Leading Trilinos 7.0 Release, 2006.

- Leadership of Trilinos Project, 2004.
- Xyce Development, 2004.
- Efforts in Nanosciences Initiative, 2003.
- Algorithms for Circuit Simulation, 2001.
- Parallel Circuit Simulation Code, 2000.

Professional Leadership

- Member, Publications Board of the Association for Computing Machinery (ACM), 2020 – present, Chair of the New Publications Committee.
- Committee Member, Sidney Fernbach Prize in High Performance Computing, 2018 – 2021.
- Committee Member, NISO Committee on Reproducibility and Badging, 2019 – 2020.
- Reproducibility advisor to the Conference Chair, Supercomputing 2019 Conference.
- Reproducibility Chair, Supercomputing 2018 Conference.
- Technical Papers Chair, Supercomputing 2017 Conference.
- Gordon Bell Prize Committee member, 2016 – 2019.
- Chair, SC16 Test of Time Award Committee.
- Scientific Libraries Lead, DOE Exascale Computing Project, 2016 – 2017.
- Chair of the NITRD, multi-agency workshop on Computational Science and Engineering Sustainability and Software Productivity (CSESSP) Challenges., October 15 – 16, 2015, Washington, DC.
- Principle architect and developer of the HPCG benchmark code.
- Editor-in-Chief, ACM Transactions on Mathematical Software, 2010 – 2017.
- Created the Replicated Computational Results review for ACM Transactions on Mathematical Software, 2013 – 2015.
- Member of SC Conference Test of Time Award Committee, 2014 – 2015.
- Applications Program Chair, SC13 Technical Program, 2013.
- Editor, SIAM Book Series on Software, Environments and Tools, 2012-present.
- Subject Area Editor, Journal on Parallel and Distributed Computing, 2011-2016.
- Lead writer of Software Section in the International Exascale Software Project (IESP), 2011.
- Chair of DOE Application readiness review for Titan 20PF computer system, 2010.
- Created Career and Junior Scientist Awards for SIAM SIAG/SC, 2009-2010.

- Led SIAG/SC committee to select Career/Junior Scientist winners, 2009-2010.
- Led SIAG/SC committee to select 2010-2011 officers, 2009.
- Wrote whitepaper for NSF on sustainable software engineering, 2009.
- Member, International Exascale Software Project (IESP), 2008-2013.
- Sandia rep, DOE/ASCR Breakthroughs Report, 2009.
- Sandia PI, The Exascale Software Center (ESC), 2010-2012.
- Sandia PI, The SciDAC-2 TOPS-2 project, 2005-2010.
- Sandia PI, The Extreme-scale Algorithms & Software Institute (EASI), 2009-2012.
- Sandia PI, Institute for Advanced Architectures & Algorithms, 2008-2010.
- Associate Editor for SIAM Journal on Scientific Computing, 2010-2016.
- Chair of the SIAM Supercomputing Special Interest Group, 2008-2009.
- Program Director for SIAM Supercomputing Special Interest Group, 2000-2003.
- Program Chair for 2004 SIAM Parallel Processing Conference.

Professional Service

- Program committee member (past 3 years): SIAM PP18, SC16, SC15, CCGrid 2015, EX14, ICCS 2014, ICS 2014, ScalA 2016, 2015, SEHPCCSE17, 16, WACCPD14.
- Visiting committee member, CEA high performance computing review.
- Advisory Board Member, NSF-funded FLAME project, U of Texas at Austin.
- Reviewer for NSF in computational science and scalable computing, 2003-2016.
- PhD committee, Daniel Sunderland, University of Utah, 2014-present.
- PhD committee, Fan Ye, Masion de Simulation, Saclay-Paris, 2014-2016.
- PhD committee, France Boillod-Cerneax, University of Lille, Paris, 2014.
- PhD committee, Radu Popescu, Ecole Polytechnique Federale de Lausanne, 2012-2013.
- PhD committee, Sarah Knepper, Emory University, 2010-2011.
- PhD committee, Bryan Marker, University of Texas at Austin, 2010-2011.
- Referee for SIAM Journal of Scientific Computing, SIAM Review, ACM Transactions on Mathematical Software, IEEE Transactions on Parallel and Distributed Systems, 1999-present.

Professional Memberships

- Fellow, The Society for Industrial and Applied Mathematics.
- Distinguished Member, The Association for Computing Machinery.
- Senior Member, IEEE.

Community Contributions and Impact

- **Community scientific software research and development:**
 - I initiated the Trilinos project 18 years ago as an effort to produce a compatible collection of independently developed mathematical software tools.
 - I have led the Trilinos project through several distinct transition phases: First, the expansion of project functionality beyond solvers; then the transition from a Sandia-centric project to one that includes non-Sandians as first class developers; then the (still ongoing) transition to scalable manycore, accelerator and heterogeneous systems and now the expansion of the Trilinos ecosystem to include non-native packages.
 - Trilinos has grown from the original 3 packages to 60 and it represents the single largest active mathematical software project in the world.
 - Trilinos has user communities across the world. We host several tutorial events and host annual user group meetings in the US and Europe.
 - Trilinos provides the collaboration and delivery framework for many Sandia activities including most ASC algorithms efforts, numerous LDRDs, Office of Science projects and CRADAs.
- **Numerical Linear Algebra:**
 - Underlapping for domain decomposition: I developed the original concept of using “underlapped” subgraphs and subdomains that permit the use of standard preconditioners for communication avoiding (s-step) Krylov solvers. This idea led to the first practical preconditioning strategy for CA iterative methods.
 - Complex linear systems solution methods: I developed (with David Day) new algorithms and spectral theory for solving complex-valued linear systems via equivalent real formulations. These formulations permit the use of commonly available real-valued math software for which there is no similar complex-valued version (which is very common). This work has been wide used, especially in the electromagnetics community.

- **Proxy applications for HPC co-design:**
 - I implemented the first miniapp (HPCCG) and led the Mantevo project from the beginning. With colleagues at Sandia I demonstrated the value of miniapps in co-design activities.
 - Every co-design effort across DOE uses miniapps (or more generally proxy apps) in the way that Mantevo does.
 - Mantevo miniapps are cited in more than 200 publications over the past four years.
 - Mantevo has expanded to be an international community project with contributions from 7 institutions outside of Sandia, and a community web portal at <http://www.mantevo.org>.
 - Mantevo 3.0 was released during SC'14, including 16 packages, five of which are new since release 2.0 from a year ago.

- **Resilience:**
 - I have developed a taxonomy for application-driven resilient computing models, including two new approaches that I pioneered:
 - **Local-failure-local-recovery (LFLR):** This approach promotes a recovery model whose cost and scope is proportional to scope of failure. LFLR has emerged as a promising next step for practical application resilience for cases where global checkpoint-restart is costly or infeasible.
 - **Selective Reliability:** This model permits application and library developers to declare data and compute regions to be more (or less) reliable than the default execution environment. This kind of selectivity enables the development of new algorithms where the majority of data and computation are in low reliability mode, but some portion of data and computation are in high reliability mode, ensuring the resilience of application execution.
 - I have developed and promoted an additional model, relaxed bulk synchronous parallel (rBSP), that some application teams have implemented as a way to mitigate performance variability on emerging systems.
 - LFLR is integrated into ASC product R&D plans and its scalable recovery has been demonstrated on more than 10,000 processes.

- **Community benchmark for HPC Systems:**
 - Five years ago, I started a new benchmarking effort called HPCG at the request of NNSA, in collaboration with Jack Dongarra. I initiated the HPCG strategy to complement the LINPACK benchmark for the TOP 500 list.
 - I am the architect and implementer of the reference version of the benchmark code and have worked directly with community members and vendors on design and implementation features.
 - I organized a series of community meeting to build understanding and acceptance of the benchmark in the international community.
 - We have announced two lists of results, first at ISC'14 with 15 of the top machines participating, then at SC'14 with 25 machines on the list.
 - All major computer vendors have an optimized version of HPCG, displaying the critical features we want probed for future systems.
 - HPCG has received considerable coverage in the HPC press and is the subject of more than 400 publications since its release three years ago.
 - HPCG is officially part of the TOP500 benchmark suite since ISC2017.

- **Scientific Productivity:**
 - I have participated in the definition, scoping and strategic discussions for a productivity-focused approach to advancing computational science and engineering.
 - I have participated in six workshops on productivity over the past two years and the writing of 3 DOE reports.
 - I was the keynote speaker at an inter-agency workshop on productivity in August 2014 and an invited member for an SC'14 panel on scientific productivity.
 - I lead (with Lois McInnes, Argonne and David Moulton, LANL) the IDEAS Project, the first DOE project funded on scientific productivity.
 - Trilinos project efforts on software engineering processes, lifecycles and community collaboration models serve as a reference for the IDEAS project.

Publicly-available Software

- **HPCG Benchmark (hpcg-benchmark.org)** Official TOP500 benchmark along with LINPACK for ranking the performance of the top high performance computing systems. I am the benchmark designer and implementer of the reference code.
- **The Trilinos Project (trilinos.org)**: Open Source (LGPL/BSD), Initiated and lead the project, 2001-present. *Trilinos is a 2004 R&D 100 winner and the world's largest open source computational science and engineering libraries project.* It is a collection of nearly sixty open source software packages supported by a common software engineering infrastructure and community development model.
 - **Trilinos package development**: Each Trilinos package is a self-contained software product with its own scope of development. These are the packages I have designed and developed:
 - **Epetra**: Principal designer and implementer. Epetra is the predecessor to Tpetra and is one of the two most popular scalable data class libraries on the planet (PETSc is the other). Epetra is used by thousands of application and library developers for constructing and using scalable sparse and dense linear algebra objects.
 - **AztecOO**: Principal designer and implementer. An object-oriented version of the popular Aztec linear solver library. AztecOO is the most widely used iterative solver package in Trilinos, used by thousands of people, providing the core linear solver capabilities for many Sandia and DOE applications.
 - **Tpetra and Kokkos**: Initial designer and developer; remain an algorithm designer and funding source.
 - **Ifpack**: Principle designer and implementer. A collection of algebraic sparse preconditioners and smoothers. Widely used in Sandia and DOE applications.
 - **Ifpack2**: Initial designer. Next-generation of Ifpack targeting scalable manycore architectures.
 - **Amesos**: Principal designer. A package of interfaces to common direct sparse solvers. Widely used at Sandia and other DOE labs.
 - **Amesos2**: Initial designer. Next-generation of Amesos targeting scalable manycore architectures.
 - **Belos**: Designer. Follow-on to AztecOO as a collection of scalable, state-of-the-art iterative methods.
 - **Komplex**: Principal designer and implementer. A package of solvers for complex-valued systems using equivalent real formulations.

- **Teuchos:** Designer and developer. The core services package in Trilinos. Widely used.
- **The Mantevo Project (mantevo.org):** Open Source (LGPL), Initiated and continue to lead the project, 2006-present. *Mantevo is the first project to concretely define the concept of a miniapplication as a co-design vehicle for next generation applications and computer systems.* Mantevo is a collection of 16 open-source, stand-alone miniapplications that serve as performance proxies for Sandia's large-scale applications.
 - **Mantevo package development:** Each Mantevo miniapplication is a self-contained software product. These are the packages that I have designed and developed:
 - **HPCCG:** Principal designer and developer. Performance proxy for a scalable finite-volume/finite-difference single physics PDE application. *HPCCG has been used in dozens of performance studies for new system design. Rewritten 6 times using new programming languages and programming models.*
 - **MiniFE:** Designer and developer. Follow-on to HPCCG as a proxy for unstructured finite element single physics applications. Used to prototype manycore algorithms and parallel pattern implementations that are now in production use in Trilinos. Used in numerous systems performance studies on mixed precision and hybrid MPI+threading programming environments.
- **Tramonto (software.sandia.gov/tramonto):** Open Source (LGPL), Lead scalable algorithms designer and developer, 2004-present. Tramonto is an open source application for modeling and simulation of inhomogeneous fluids using classical density functional theories. *Tramonto has unique modeling capabilities for a wide variety of applications, including biophysics applications for new pharmaceuticals based on anti-microbial peptides.*
- **Aztec (www.cs.sandia.gov/CRF/aztec1.html):** Open Source (Special license), Lead developer, 1998-2000. *Popular open source preconditioned iterative solver package that is still download frequently (250 downloads this year).*
- **Sparse BLAS (math.nist.gov/spblas):** Open Source (no license), Lead designer, 1999-2002. The sparse BLAS are a *de facto* standard for sparse kernel computations.
- **BPKIT (sourceforge.net/projects/bpkit):** Open Source (LGPL), Lead designer, 1995-1996. BPKIT was one of the first object-oriented math software packages, and it remains a popular prototyping environment for preconditioned iterative methods.
- **GEMMW (www.mgnet.org/~douglas/ccd-free-software.html):** Open Source (no license), Developer, 1994. GEMMW is a portable parallel implementation of Strassen-Winograd dense matrix-matrix multiplication.

- **Cray Sparse Solvers:** Distributed with Cray Scientific Libraries (LIBSCI), Principal designer and developers of the preconditioned sparse solvers, 1989-1993. ***Provided optimized libraries for sparse linear systems on Cray vector multiprocessor and MPP machines.***
- **Cray Optimized BLAS/LAPACK:** Distributed with LIBSCI, developer of YMP/C90 kernels for vector multiprocessor systems, 1989-1993. ***Developed unique hybrid implementation for single vector processor and multiple vector processors.***
- **Cray vectorized tridiagonal solvers:** Distributed with LIBSCI, principal developer, 1989-1993. ***Developed 3:1 cyclic reduction and burn-at-both-ends algorithms for vector processors.***

Selected Invited Presentations

- **Keynote: *The Extreme-scale Scientific Software Stack (E4S) for Collaborative Open Source Software***, Excalibuer SLE Conference, Bristol, UK (virtual), July 2020.
- **Keynote: *The Extreme-scale Scientific Software Stack (E4S) for Collaborative Open Source Software***, The 2nd R-CCS International Symposium, Kobe, Japan, February 2020
- **Keynote: *The Extreme-scale Scientific Software Stack (E4S) and Its Promise for the Exascale Era***, The 10th Workshop on Latest Advances in Scalable Algorithms for Large-Scale Systems, ScalA19, SC19, November 2019.
- **Keynote: *About the US Exascale Project and Why ANSYS Might Care***, ANSYS R&D Conference, Pittsburgh, PA, October 2019
- **Keynote: *The Exascale Computing Project's Software Strategy***, HPC User Forum, Lugano, Switzerland, October 2019.
- **Keynote: *Accelerated Sparse Linear Algebra: Emerging Challenges and Capabilities for Numerical Algorithms and Software***, Numerical Algorithms for High Performance Computational Science, London, UK, April 2019.
- **Keynote: *The Extreme-scale Scientific Software Stack (E4S)***, The HPC User Forum, Santa Fe, NM, April 2019.
- **Keynote: *Making Reproducibility Indispensable: Changing the Incentives that Drive Computational Science***, SPPEXA Workshop, Paris, France, March 2019.
- **Keynote: *Accelerated Sparse Linear Algebra: Some Lessons, Challenges and Opportunities***, ISC18, Frankfurt, Germany, June 2018
- **Keynote: *Productive and Sustainable: More Effective CSE***, SIAM Conference on Computational Science and Engineering 2017, Atlanta, GA, February 2017.
- **Keynote: *Strategies for Next Generation HPC Applications and Systems***, ACSI Conference 2016, Fukuoka, Japan, January 2016.
- **Keynote: *A Task-centric/Dataflow Application Architecture for Scalable Systems***, SCALA Workshop 2015, SC'13, Austin, TX, November 2015.
- **Keynote: *Effective use of Miniapps for co-design***. WRAP Workshop, IEEE Cluster, September 2015.
- **Invited: *Efficiency or Productivity: Pick One***. Panelist. SC'14, New Orleans, LA, November 2014.
- **Tutorial: *Scalable Manycore Computing for Sparse Computation***, SC'11, SC'12, SC'13, SC'14.
- **Invited: *Improving Scientific Productivity: Practical Approaches Toward an Elusive Goal***, CEA Invited Talk, Paris, France, October 2014.

- **Keynote: *Productivity for Productivity***, Inter-agency Productivity Workshop, University of Indiana, Bloomington, IN, August 2014.
- **Keynote: *Challenges and Opportunities for Scalable Finite Element Setup & Assembly***, FE Assembly Workshop, Albuquerque, NM, May 2014.
- **Invited: *System Software: A Necessary but Ill-prepared Hero***, Salishan Conference, Salishan, OR, April 2014.
- **Invited: *Toward the Next Generation of Parallel and Resilient Algorithms & Libraries***, Advances in Numerical Algorithms and High Performance Computing, University College London, England, April 2014.
- **Keynote: *Toward the Next Generation of Scalable and Resilient Algorithms***, FP3C Workshop, Maison de Simulation, Paris, France, March 2014.
- **Keynote: *Toward the Next Generation of Parallel and Resilient Algorithms & Applications***, SPPEXA Workshop 2014, Cologne, Germany, December 2013.
- **Keynote: *Toward the Next Generation of Parallel and Resilient Algorithms***, SCALA Workshop 2013, SC'13, Denver, CO, November 2013.
- **Keynote: *Toward Resilient Algorithms and Applications***, FTXS 2013, New York, NY, June 2013.
- **Keynote: *Toward Effective Parallel Programming: What we Need and Don't Need***, HIPS Workshop, IPDPS 2013, Boston, MA, May 2013.
- **Invited: *The Virtues of Data Transparency***, SOS 17, Jekyll Island, SC, March 2013.
- **Invited: *What Every SIAM Member Should Know about Computing on Emerging Architectures***, 2012 SIAM Annual Meeting, Minneapolis, MN, July 2012.
- **Invited: *Scalability of Trilinos: People, Processes, Parallelism***, 2012 ESCO Conference, Pilsen, Czech Republic, June 2011.
- **Invited: *Numerical Libraries on Emerging Architectures***, 2011 Supercomputing Conference Tutorial, Seattle, WA, November 2011.
- **Invited: *Emerging Architectures and UQ: Implications and Opportunities***, IFIP Workshop on uncertainty quantification, Boulder, CO, August 2011.
- **Invited: *Building the Next Generation of Parallel Applications and Libraries***, INT Workshop on Exascale Computing, Seattle, WA, June 2011.
- **Invited: *Toward Portable Programming of numerical linear algebra on manycore nodes***, CEA-EDF-INRIA 2011 Summer School, Nice, France, June 2011.
- **Keynote: *Scalability of Trilinos: People, Processes, Parallelism***, 3rd International Conference on Computational Methods in Engineering and Science (FEMTEC 2011), South Lake Tahoe, NV, May 2011.
- **Invited: *Building the Next Generation of Parallel Applications***, Salishan Conference on High Speed Computing, April 2011.

- **Invited: *Miniapplications: Vehicles for Co-Design***, Engelberg, Switzerland, March 2011.
- **Invited: *Requirements on Next-Generation Programming Models***, U of Houston, January 2011.
- **Invited: *Trilinos for Extreme-scale for Computing***, U Texas, Austin, January 2011.
- **Invited: *Software Engineering for Computational Science and Engineering***, Cray, Inc., January 2011.
- **Invited: *Building the Next Generation of Parallel Applications and Libraries***, IAM, April 2011.
- **Invited: *Bi-modal MPI-only & MPI+threading***, Cray, Inc., December 2010.
- **Invited: *The Extreme-scale Algorithms & Software Institute***, Fall Creek Falls Conference, October 2010, Memphis, TN.
- **Invited: *Building the Next Generation of Scalable Applications***, Future of the Field Workshop, Snowbird, UT, July 2010.
- **Keynote: *Building the Next Generation of Parallel Applications***, Int'l Workshop on OpenMP, Tsukuba, Japan, June 2010.
- **Keynote: *Trilinos for Extreme-scale Computing***, SPEEDUP Workshop, ETH-Zurich, September 2010.
- **Invited: *Trilinos Overview and Tutorial***, Purdue University, September 2009.
- **Invited: *Software Needs for Next-generation systems***, SOS13, Hilton Head, SC, March 2009.
- **Invited: *Algorithms for 1M cores: What Might and Might not Work***, Simulating the Future Workshop, Paris, France, September 2008.
- **Organizer: *When MPI-only is not Enough: Building the Next Generation of Scalable Applications Workshop***, Santa Fe, NM, May 2008.
- **Invited: *Design Issues for Numerical Libraries on Multicore Systems***, SciDAC Conference, July 2008, Seattle, WA.
- **Invited: *An Overview of Trilinos***, Oak Ridge National Laboratory, TN, October 2007.
- **Keynote: *Optimal Kernels to Optimal Solutions: Algorithm and Software Issues in Solver Development***, PDP07, February 2007, Naples, Italy.

Articles and Refereed Proceedings

- [1] Michael A. Heroux, Elsa Gonsiorowski, Rinku Gupta, Reed Milewicz, J. David Moulton, Gregory R. Watson, Jim Willenbring, Richard J. Zamora, and Elaine M. Raybourn. Lightweight software process improvement using productivity and sustainability improvement planning (psip). In Guido Juckeland and Sunita Chandrasekaran, editors, *Tools and Techniques for High Performance Computing*, pages 98–110, Cham, 2020. Springer International Publishing.
- [2] Hartwig Anzt, Erik Boman, Rob Falgout, Pieter Ghysels, Michael Heroux, Xiaoye Li, Lois Curfman McInnes, Richard Tran Mills, Sivasankaran Rajamanickam, Karl Rupp, Barry Smith, Ichitaro Yamazaki, and Ulrike Meier Yang. Preparing sparse solvers for exascale computing. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 378(2166):20190053, 2020.
- [3] Keren Bergman, Tom Conte, Al Gara, Maya Gokhale, Mike Heroux, Peter Kogge, Bob Lucas, Satoshi Matsuoka, Vivek Sarkar, and Olivier Temam. Future high performance computing capabilities: Summary report of the advanced scientific computing advisory committee (ascac) subcommittee. *DOE ASCAC Report*, 3 2019.
- [4] Irina Demeshko, Jerry Watkins, Irina K Tezaur, Oksana Guba, William F Spitz, Andrew G Salinger, Roger P Pawlowski, and Michael A Heroux. Toward performance portability of the albania finite element analysis code using the kokkos library. *The International Journal of High Performance Computing Applications*, 33(2):332–352, 2019.
- [5] Daniel S. Katz, Lois Curfman McInnes, David E. Bernholdt, Abigail Cabunoc Mayes, Neil P. Chue Hong, Jonah Duckles, Sandra Gesing, Michael A. Heroux, Simon Hettrick, Rafael C. Jimenez, Marlon Pierce, Belinda Weaver, and Nancy Wilkins-Diehr. Community organizations: Changing the culture in which research software is developed and sustained. *Computing in Science and Engg.*, 21(2):824, March 2019.
- [6] Michael A. Heroux, Lois McInnes, David Bernholdt, Anshu Dubey, Elsa Gonsiorowski, Osni Marques, J. David Moulton, Boyana Norris, Elaine Raybourn, Satish Balay, Roscoe A. Bartlett, Lisa Childers, Todd Gamblin, Patricia Grubel, Rinku Gupta, Rebecca Hartman-Baker, Judith Hill, Stephen Hudson, Christoph Junghans, Alicia Klinvex, Reed Milewicz, Mark Miller, Hai Ah Nam, Jared O Neal, Katherine Riley, Ben Sims, Jean Schuler, Barry F. Smith, Louis Vernon, Gregory R. Watson, James Willenbring, and Paul Wolfenbarger. Advancing scientific productivity through better scientific software: Developer productivity and software sustainability report. *Exascale Computing Project*, 2 2020. ECP-U-RPT-2020-0001.
- [7] Michael A. Heroux. Trust me. QED. *SIAM News*, 52(06), 7 2019.
- [8] Michael A. Heroux, Jonathan Carter, Rajeev Thakur and Jeffrey Vetter, Lois Curfman McInnes, James Ahrens, Todd Munson, and Rob Neely. Ecp software technology capability assessment report. Technical Report ECP-RPT-ST-0002-2020, Exascale Computing Project, 2020.
- [9] Michael A. Heroux, Lorena Barba, Manish Parashar, Victoria Stodden, and Michela Taufer. Toward a compatible reproducibility taxonomy for computational and computing sciences. Technical Report SAND2018-11186, 10 2018.
- [10] C Kris Garrett, Stephen Lien Harrell, and Michael A Heroux. Special issue on scc17 reproducibility initiative. *Parallel Computing*, 2018.
- [11] Ulrich Ruede, Karen Willcox, Lois Curfman McInnes, Hans De Sterck, and Michael A. Heroux. Research and Education in Computational Science and Engineering. *SIAM Review*, 60, 2018.

- [12] M Asch, T Moore, R Badia, M Beck, P Beckman, T Bidot, F Bodin, F Cappello, A Choudhary, B de Supinski, E Deelman, J Dongarra, A Dubey, H Fu G Fox, S Girona, W Gropp, M Heroux, Y Ishikawa, K Keahey, D Keyes, W Kramer, JF Lavignon, Y Lu, S Matsuoka, B Mohr, D Reed, S Requena, J Saltz, T Schulthess, R Stevens, M Swany, A Szalay, W Tang, G Varoquaux, JP Vilotte, R Wisniewski, Z Xu, and I Zacharov. Big data and extreme-scale computing: Pathways to Convergence-Toward a shaping strategy for a future software and data ecosystem for scientific inquiry. *Int. J. High Perform. Comput. Appl.*, 32, 2018.
- [13] Jack Dongarra, Michael A. Heroux, and Piotr Luszczek. The high-performance conjugate gradients benchmark. *SIAM News*, 51(01), 2018.
- [14] Michael A. Heroux and C. Kristopher Garrett. Editor Introduction: Special Issue on SC16 Student Cluster Competition Reproducibility Initiative. *Parallel Computing*, December 2017.
- [15] A Chien, Pavan Balaji, Nan Dun, Aiman Fang, Hajime Fujita, Kamil Iskra, Zachary Rubenstein, Ziming Zheng, Jeff Hammond, Ignacio Laguna, D Richards, Anshu Dubey, Brian van Straalen, Mark Hoemmen, M Heroux, Keita Teranishi, and A Siegel. Exploring versioned distributed arrays for resilience in scientific applications: global view resilience. *Int. J. High Perf. Comp. Appl.*, 31, 2018.
- [16] Roscoe Bartlett, Irina Demeshko, Todd Gamblin, Glenn Hammond, Michael Allen Heroux, Jeffrey Johnson, Alicia Klinvex, Xiaoye Li, Lois Curfman McInnes, J. David Moulton, Daniel Osei-Kuffuor, Jason Sarich, Barry Smith, James Willenbring, and Ulrike Meier Yang. xSDK Foundations: Toward an Extreme-scale Scientific Software Development Kit. *Supercomputing Frontiers and Innovations*, 4(1), 2017.
- [17] Marc Gamell, Keita Teranishi, Hemanth Kolla, Jackson Mayo, Michael A Heroux, Jacqueline Chen, and Manish Parashar. Scalable Failure Masking for Stencil Computations using Ghost Region Expansion and Cell to Rank Remapping. *SIAM J. of Sci. Comp.*, 39, 2017.
- [18] Jack Dongarra, Michael A. Heroux, and Piotr Luszczek. A new metric for ranking high-performance computing systems. *National Science Review*, 3, Januaryr 2016.
- [19] Victoria Stodden, Marcia McNutt, David H. Bailey, Ewa Deelman, Yolanda Gil, Brooks Hanson, Michael A. Heroux, John P.A. Ioannidis, and Michela Taufer. Enhancing reproducibility for computational methods. *Science*, 354(6317):1240–1241, 2016.
- [20] Jack Dongarra, Michael A Heroux, and Piotr Luszczek. High-performance conjugate-gradient benchmark. *Int. J. High Perform. Comput. Appl.*, 30(1):3–10, February 2016.
- [21] Radu Popescu, Michael A. Heroux, and Simone Deparis. Parallel subdomain solver strategies for the algebraic additive schwarz preconditioner. *Parallel Computing*, 57:137 – 153, 2016.
- [22] Michael Heroux. Exascale Programming: Adapting What We Have Can (and Must) Work, 2016. <https://www.hpcwire.com/2016/01/14/24151/>.
- [23] Michael A. Heroux. Editorial: ACM TOMS replicated computational results initiative. *ACM Trans. Math. Softw.*, 41(3):13:1–13:5, June 2015.
- [24] Marc Gamell, Keita Teranishi, Michael A. Heroux, Jackson Mayo, Hemanth Kolla, Jacqueline Chen, and Manish Parashar. Local recovery and failure masking for stencil-based applications at extreme scales. In *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis*, SC 15, New York, NY, USA, 2015. ACM.

- [25] Marc Gamell, Keita Teranishi, Michael A. Heroux, Jackson Mayo, Hemanth Kolla, Jacqueline Chen, and Manish Parashar. Exploring failure recovery for stencil-based applications at extreme scales. In *Proceedings of the 24th International Symposium on High-Performance Parallel and Distributed Computing*, HPDC '15, pages 279–282, New York, NY, USA, 2015. ACM.
- [26] Ichitaro Yamazaki, Sivasankaran Rajamanickam, Erik G. Boman, Mark Hoemmen, Michael A. Heroux, and Stanimire Tomov. Domain decomposition preconditioners for communication-avoiding krylov methods on a hybrid cpu/gpu cluster. In *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis*, SC '14, pages 933–944, Piscataway, NJ, USA, 2014. IEEE Press.
- [27] Keita Teranishi and Michael A. Heroux. Toward local failure local recovery resilience model using mpi-ulfm. In *Proceedings of the 21st European MPI Users' Group Meeting*, EuroMPI/ASIA '14, pages 51:51–51:56, New York, NY, USA, 2014. ACM.
- [28] S. S. Dosanjh, R. F. Barrett, D. W. Doerfler, S. D. Hammond, K. S. Hemmert, M. A. Heroux, P. T. Lin, K. T. Pedretti, A. F. Rodrigues, T. G. Trucano, and J. P. Luitjens. Exascale design space exploration and co-design. *Future Gener. Comput. Syst.*, 30:46–58, January 2014.
- [29] Michael A. Heroux. Toward resilient algorithms and applications. In *Proceedings of the 3rd Workshop on Fault-tolerance for HPC at Extreme Scale*, FTXS '13, pages 1–2, New York, NY, USA, 2013. ACM.
- [30] Roscoe A. Bartlett, James M. Willenbring, and Michael A. Heroux. Overview of the TriBITS lifecycle model: A Lean/Agile software lifecycle model for research-based computational science and engineering software. In *Proceedings of the 2012 IEEE 8th International Conference on E-Science (e-Science)*, E-SCIENCE '12, pages 1–8, Washington, DC, USA, 2012. IEEE Computer Society.
- [31] Michael A. Heroux. Riding the new commodity curves for scientific computing. *SIAM News*, 45(10), 2012.
- [32] Chris Baker, Erik Boman, Mike Heroux, Eric Keiter, Siva Rajamanickam, Rich Schiek, and Heidi Thornquist. Enabling next-generation parallel circuit simulation with trilinos. In *Euro-Par'11: Proceedings of the 2011 International conference on Parallel Processing*, pages 315–323, Berlin, Heidelberg, 2012. Springer-Verlag.
- [33] Richard F. Barrett, X. S. Hu, Sudip S. Dosanjh, S. Parker, Michael A. Heroux, and J. Shalf. Toward codesign in high performance computing systems. In *ICCAD '12: Proceedings of the International Conference on Computer-Aided Design*, pages 443–449, New York, NY, USA, 2012. ACM.
- [34] Sivasankaran Rajamanickam, Erik G. Boman, and Michael A. Heroux. Poster: a hybrid-hybrid solver for manycore platforms. In *SC '11 Companion: Proceedings of the 2011 companion on High Performance Computing Networking, Storage and Analysis Companion*, pages 35–36, New York, NY, USA, 2011. ACM.
- [35] Sudip Dosanjh, Richard Barrett, Mike Heroux, and Arun Rodrigues. Achieving exascale computing through hardware/software co-design. In *EuroMPI'11: Proceedings of the 18th European MPI Users' Group conference on Recent advances in the message passing interface*, pages 5–7, Berlin, Heidelberg, 2011. Springer-Verlag.
- [36] Patrick G. Bridges, Mark Hoemmen, Kurt B. Ferreira, Michael A. Heroux, Philip Soltero, and Ron Brightwell. Cooperative application/os dram fault recovery. In *Euro-Par'11: Proceedings of the 2011 International conference on Parallel Processing*, pages 241–250, Berlin, Heidelberg, 2012. Springer-Verlag.
- [37] Siva Rajamanickam, Erik Boman, and Michael A. Heroux. Shylu: A hybrid-hybrid solver for multicore platforms. In *Proceedings of the 26th IEEE International Parallel & Distributed Processing Symposium (IPDPS)*, 2012.

- [38] Richard Barrett, Michael A. Heroux, Paul Lin, Courtenay Vaughn, and Alan Williams. Mini-applications: Vehicles for co-design (poster presentation). In *Proceedings of Supercomputing 2011 (SC11)*, 2011. Best Conference Poster Award.
- [39] L.J. Frink, A. Frischknecht, M. Heroux, M.L. Parks, and A. Salinger. Towards quantitative coarse-grained models of lipids with fluids density functional theory. *Journal of Chemical Theory and Computation*, 2011. Submitted.
- [40] Jack Dongarra, Pete Beckman, Terry Moore, Patrick Aerts, Giovanni Aloisio, Jean-Claude Andre, David Barkai, Jean-Yves Berthou, Taisuke Boku, Bertrand Braunschweig, Franck Cappello, Barbara Chapman, Chi Xuebin, Alok Choudhary, Sudip Dosanjh, Thom Dunning, Sandro Fiore, Al Geist, Bill Gropp, Robert Harrison, Mark Hereld, Michael Heroux, Adolfo Hoisie, Koh Hotta, Jin Zhong, Yutaka Ishikawa, Fred Johnson, Sanjay Kale, Richard Kenway, David Keyes, Bill Kramer, Jesus Labarta, Alain Lichnewsky, Thomas Lippert, Bob Lucas, Barney Maccabe, Satoshi Matsuoka, Paul Messina, Peter Michielse, Bernd Mohr, Matthias Mueller, Wolfgang Nagel, Hiroshi Nakashima, Michael Papka, Dan Reed, Mitsuhsa Sato, Ed Seidel, John Shalf, David Skinner, Marc Snir, Thomas Sterling, Rick Stevens, Fred Streitz, Bob Sugar, Shinji Sumimoto, William Tang, John Taylor, Rajeev Thakur, Anne Trefethen, Mateo Valero, Aad Van Der Steen, Jeffrey Vetter, Peg Williams, Robert Wisniewski, and Kathy Yelick. The International Exascale Software Project roadmap. *Int. J. High Perform. Comput. Appl.*, 25:3–60, February 2011.
- [41] Sudip Dosanjh, Richard Barrett, Mike Heroux, and Arun Rodrigues. Achieving exascale computing through hardware/software co-design. In *Proceedings of the 18th European MPI Users' Group conference on Recent advances in the message passing interface*, EuroMPI'11, pages 5–7, Berlin, Heidelberg, 2011. Springer-Verlag.
- [42] Robert W. Numrich and Michael A. Heroux. Self-similarity of parallel machines. *Parallel Comput.*, 37:69–84, February 2011.
- [43] Michael A. Heroux. Improving CSE software through reproducibility requirements. In *Proceedings of the 4th International Workshop on Software Engineering for Computational Science and Engineering*, SECSE '11, pages 28–31, New York, NY, USA, 2011. ACM.
- [44] Chris Baker, Erik Boman, Michael A. Heroux, Eric Keiter, Siva Rajamanickam, Rich Schiek, and Heidi Thornquist. Enabling Next-Generation Parallel Circuit Simulation with Trilinos. In *Workshop on High-Performance Scientific Software (HPSS2011)*, Bordeaux, France, 2011.
- [45] Michael M. Wolf, Michael A. Heroux, and Erik G. Boman. Hybrid MPI/Multithreaded PCG: A Use Case for MPI Shared Memory Allocation. In *Proceedings of Supercomputing 2010*, New Orleans, LA, USA, 2010.
- [46] Ken Alvin, Brian Barrett, Ron Brightwell, Sudip Dosanjh, Al Geist, Scott Hemmert, Michael Heroux, Doug Kothe, Richard Murphy, Jeff Nichols, Ron Oldfield, Arun Rodrigues, and Jeff Vetter. On the Path to Exascale. *Intl J. of Distributed Systems and Technologies*, 1(2), May 2010.
- [47] Christopher G. Baker, Michael A. Heroux, H. Carter Edwards, and Alan B. Williams. A Light-weight API for Portable Multicore Programming. In *Proceedings of PDP2010*. IEEE, 2010.
- [48] Michael M. Wolf, Michael A. Heroux, and Erik G. Boman. Factors Impacting Performance of Multithreaded Sparse Triangular Solve. In *Proceedings of VECPAR 2010*, Berlin, 2010. Lecture Notes in Computer Science, Springer.

- [49] Ron Brightwell, Mike Heroux, Zhaofang Wen, and Junfeng Wu. Parallel Phase Model: A Programming Model for High-end Parallel Machines with Manycores. In *Proceedings of the 2009 International Conference on Parallel Processing, ICPP '09*, pages 92–99, Washington, DC, USA, 2009. IEEE Computer Society.
- [50] Michael A. Heroux. Software Challenges for Extreme Scale Computing: Going From Petascale to Exascale Systems. *Int. J. High Perform. Comput. Appl.*, 23(4):437–439, 2009.
- [51] Michael A. Heroux and Robert W. Numrich. A Performance Model with a Fixed Point for a Molecular Dynamics Kernel. In *ISC '09*, Washington, DC, USA, 2009. IEEE Computer Society. June 2009.
- [52] Michael A. Heroux and James M. Willenbring. Barely-Sufficient Software Engineering: 10 Practices to Improve Your CSE Software. In *SECSE '09: Proceedings of the Second International Workshop on Software Engineering for Computational Science and Engineering*, Washington, DC, USA, 2009. IEEE Computer Society.
- [53] Michael A. Heroux, Zhaofang Wen, and Junfeng Wu. Initial Experiences with the BEC Parallel Programming Environment. In *The 7th International Symposium on Parallel and Distributed Computing*, 2008.
- [54] M A Heroux. Design Issues for Numerical Libraries on Scalable Multicore Architectures. *Journal of Physics: Conference Series*, 125:012035 (11pp), 2008.
- [55] Marzio Sala, Kendall S. Stanley, and Michael A. Heroux. On the design of interfaces to sparse direct solvers. *ACM Trans. Math. Softw.*, 34(2):1–22, 2008.
- [56] Marzio Sala, W. F. Spitz, and M. A. Heroux. PyTrilinos: High-performance distributed-memory solvers for Python. *ACM Trans. Math. Softw.*, 34(2):1–33, 2008.
- [57] Michael A. Heroux, Andrew G. Salinger, and Laura J. D. Frink. Parallel Segregated Schur Complement Methods for Fluid Density Functional Theories. *SIAM J. Sci. Comput.*, 29(5):2059–2077, 2007.
- [58] Michael A. Heroux, James M. Willenbring, and Michael N. Phenow. Improving the Development Process for CSE Software. In *Proceedings of PDP 2007*, 2007.
- [59] Michael A. Heroux. Some Thoughts on Multicore. In *Proceedings of the Manycore Workshop, ICS 2007*, 2007.
- [60] James M. Willenbring, Michael A. Heroux, and Robert T. Heaphy. The Trilinos Software Lifecycle Model. In *SE-HPC '07: Proceedings of the 3rd International Workshop on Software Engineering for High Performance Computing Applications*, page 6, Washington, DC, USA, 2007. IEEE Computer Society.
- [61] Jonathan L. Brown, Sue Goudy, Mike Heroux, Shan Shan Huang, and Zhaofang Wen. An Evolutionary Path Towards Virtual Shared Memory with Random Access. In *SPAA '06: Proceedings of the eighteenth annual ACM symposium on Parallelism in algorithms and architectures*, pages 117–117, New York, NY, USA, 2006. ACM.
- [62] Michael A. Heroux. A Solver-Independent API for multi-DOF Applications using Trilinos. *Int. J. of Computational Science and Engineering*, 2007.
- [63] Michael A. Heroux, Padma Raghavan, and Horst D. Simon. *Parallel Processing for Scientific Computing*, chapter Opportunities and Challenges for Parallel Computing in Science and Engineering. SIAM, 2006.
- [64] Michael A. Heroux, Padma Raghavan, and Horst D. Simon. *Parallel Processing for Scientific Computing*, chapter Frontiers of Scientific Computing: An Overview. SIAM, 2006.
- [65] Michael A. Heroux, Padma Raghavan, and Horst D. Simon. *Parallel Processing for Scientific Computing*. SIAM, 2006.

- [66] Michael A. Heroux and Marzio Sala. The Design of Trilinos. In *Proceedings of PARA'04*, 2005.
- [67] Michael A. Heroux, Roscoe A. Bartlett, Vicki E. Howle, Robert J. Hoekstra, Jonathan J. Hu, Tamara G. Kolda, Richard B. Lehoucq, Kevin R. Long, Roger P. Pawlowski, Eric T. Phipps, Andrew G. Salinger, Heidi K. Thornquist, Ray S. Tuminaro, James M. Willenbring, Alan Williams, and Kendall S. Stanley. An Overview of the Trilinos Project. *ACM Trans. Math. Softw.*, 31(3):397–423, 2005.
- [68] R. A. Bartlett, B. G. van Bloemen Waanders, and M. A. Heroux. Vector reduction/transformation operators. *ACM Trans. Math. Softw.*, 30(1):62–85, March 2004.
- [69] I. Duff, M. Heroux, and R. Pozo. An Overview of the Sparse Basic Linear Algebra Subprograms: The New Standard from the BLAS Technical Forum. *ACM Trans. Math. Softw.*, 28(2):239–267, June 2002.
- [70] S. Blackford, J. Demmel, J. Dongarra, I. Duff, S. Hammarling, G. Henry, M. Heroux, L. Kaufman, A. Lumsdaine, A. Petitet, R. Pozo, K. Remington, and R. C. Whaley. An Updated Set of Basic Linear Algebra Subprograms (BLAS). *ACM Trans. Math. Softw.*, 28(2):135–151, June 2002.
- [71] David Day and Michael A. Heroux. Solving Complex-Valued Linear Systems via Equivalent Real Formulations. *SIAM J. Sci. Comput.*, 23(2):480–498, 2001.
- [72] David E. Womble, Bruce A. Hendrickson, David S. Greenberg, James L. Tomkins, Sudip S. Dosanjh, Steve J. Plimpton, and Michael A. Heroux. An Overview of MP Computing and Applications. *Parallel Computing*, March 2000.
- [73] M. A. Heroux, H. Simon, and A. E. Koniges. The Future of Industrial parallel Computing. In A. E. Koniges, editor, *Industrial Strength Parallel Computing*, chapter 25. Morgan Kaufman, 2000.
- [74] A. E. Koniges, D. C. Eder, and M. A. Heroux. Designing Industrial parallel applications. In A. E. Koniges, editor, *Industrial Strength Parallel Computing*, chapter 24. Morgan Kaufman, 2000.
- [75] Edmond Chow and Michael A. Heroux. An Object-oriented Framework for Block Preconditioning. *ACM Trans. Math. Softw.*, 24(2):159–183, June 1998.
- [76] Eugene L. Poole, Michael A. Heroux, Pravin Vaidya, and Anil Joshi. Performance of Iterative Methods in ANSYS on Cray Parallel/Vector Supercomputers. *Computing Systems in Engineering*, 6:251–259, 1995.
- [77] C. C. Douglas, M. Heroux, G. Slishman, and R. M. Smith. GEMMW: A portable Level 3 BLAS Winograd variant of Strassen’s matrix–matrix multiply algorithm. *J. Comput. Phys.*, 110:1–10, 1994.
- [78] Michael A. Heroux and J. W. Thomas. A Comparison of FAC and PCG Methods for Solving Composite Grid Problems. *Communications in Applied Numerical Methods*, 8, 1992.
- [79] Michael A. Heroux, Phuong Vu, and Chao Wu Yang. A Parallel Preconditioned Conjugate Gradient Package for Solving Sparse Linear Systems on a Cray Y-MP. *Applied Numerical Mathematics*, 8, 1991.
- [80] M. Heroux, S. McCormick, S. McKay, and J. W. Thomas. Applications of the fast adaptive composite grid method. In *Lecture Notes in Pure and Applied Mathematics*. Marcel–Decker, 1988.

Technical Reports

- [1] Jack Dongarra, Jeffrey Hittinger, John Bell, Luis Chacon, Robert Falgout, Michael Heroux, Paul Hovland, Esmond Ng, Clayton Webster, and Stefan Wild. Applied mathematics research for exascale computing.
- [2] Hans Johansen, Lois Curfman McInnes, David E. Bernholdt, Jeffrey Carver, Michael Heroux, Richard Hornung, Phil Jones, Bob Lucas, and Andrew Siegel. Workshop on software productivity for extreme-scale science.
- [3] Keita Teranishi and Michael Heroux. Report for the asc csse l2 milestone (4873) – demonstration of local failure local recovery resilient programming model. Technical Report Sandia Technical Report SAND2014-15076, Sandia National Laboratories, 2014.
- [4] Michael Heroux, Jack Dongarra, and Piotr Luszczek. Hpcg technical specification. Technical Report Sandia Technical Report SAND2013-8752, Sandia National Laboratories, 2013.
- [5] Jack Dongarra and Michael Heroux. Toward a new metric for ranking high performance computing systems. Technical Report Sandia Technical Report SAND2013-4744, Sandia National Laboratories, 2013.
- [6] Hans Johansen, David E. Bernholdt, Bill Collins, Michael Heroux, Robert Jacob, Phil Jones, Lois Curfman McInnes, J. David Moulton, Thomas Ndousse-Fetter, Douglass Post, and William Tang. Extreme-scale scientific application software productivity: Harnessing the full capability of extreme-scale computing.
- [7] Michael A. Heroux, Douglas W. Doerfler, Paul S. Crozier, James M. Willenbring, H. Carter Edwards, Alan Williams, Mahesh Rajan, Eric R. Keiter, Heidi K. Thornquist, and Robert W. Numrich. Improving Performance via Mini-applications. Technical Report SAND2009-5574, Sandia National Laboratories, 2009.
- [8] Marzio Sala, Michael A. Heroux, Robert J. Hoekstra, and Alan Williams. Serialization and Deserialization Tools for Distributed Linear Algebra Objects. Technical Report SAND2006-2838, Sandia National Laboratories, 2006.
- [9] Michael A. Heroux, Laura J. D. Frink, and Andrew G. Salinger. Schur complement based approaches to solving density functional theories for inhomogeneous fluids on parallel computers. Technical Report SAND2006-2099, Sandia National Laboratories, 2006.
- [10] Michael A. Heroux. Epetra Performance Optimization Guide. Technical Report SAND2005-1668, Sandia National Laboratories, 2005.
- [11] Michael Heroux, Roscoe Bartlett, Vicki Howle Robert Hoekstra, Jonathan Hu, Tamara Kolda, Richard Lehoucq, Kevin Long, Roger Pawlowski, Eric Phipps, Andrew Salinger, Heidi Thornquist, Ray Tuminaro, James Willenbring, and Alan Williams. An Overview of Trilinos. Technical Report SAND2003-2927, Sandia National Laboratories, 2003.
- [12] E. Boman, K. Devine, R. Heaphy, B. Hendrickson, M. Heroux, and R. Preis. LDRD Report: Parallel Repartitioning for Optimal Solver Performance. Technical Report SAND2004-0365, Sandia National Laboratories, February 2004.
- [13] Michael A. Heroux. AztecOO Users Guide. Technical Report SAND2004-3796, Sandia National Laboratories, 2004.
- [14] Michael A. Heroux and James M. Willenbring. Trilinos Users Guide. Technical Report SAND2003-2952, Sandia National Laboratories, 2003.

- [15] Michael A. Heroux, James M. Willenbring, and Robert Heaphy. Trilinos Developers Guide Part II: ASCI Software Quality Engineering Practices Version 1.0. Technical Report SAND2003-1899, Sandia National Laboratories, 2003.
- [16] Michael A. Heroux, James M. Willenbring, and Robert Heaphy. Trilinos Developers Guide. Technical Report SAND2003-1898, Sandia National Laboratories, 2003.
- [17] K. A. Remington and R. Pozo. NIST Sparse BLAS User’s Guide. Internal Report NISTIR 6744, National Institute of Standards and Technology, Gaithersburg, MD, USA, May 2001.
- [18] Marzio Sala and Michael A. Heroux. Robust Algebraic Preconditioners using IFPACK 3.0. Technical Report SAND2005-0662, Sandia National Laboratories, 2005.
- [19] P. R. Schunk, M. A. Heroux, R. R. Rao, T. A. Baer, S. R. Subia, and A. C. Sun. Preconditioned Iterative Solvers Applied to Mixed V-P Finite element Formulations of Incompressible Flows and coupled transport Processes. Technical Report SAND2001-3512J, Sandia National Laboratories, 2001.
- [20] Sandra Carney, Michael A. Heroux, Guangye Li, and Kesheng Wu. A Revised Proposal for a Sparse BLAS Toolkit. Technical Report 94-034, Army High Performance Computing Research Center, June 1994.
- [21] Guy E. Blleloch, Michael A. Heroux, and Marco Zaghera. Segmented Operations for Sparse Matrix Computations on Vector Multiprocessors. Technical report, School of Computer Science, Carnegie Mellon University, Pittsburgh, PA., August 1993.
- [22] Michael A. Heroux. A Proposal for a Sparse BLAS Toolkit. Technical Report TR/PA/92/90, CERFACS, December 1992.

Contributed Proceedings

- [1] P. R. Schunk and M. A. Heroux. Iterative solver preconditioners for finite element formulations of multiphysics problems including incompressible fluid and solid mechanics. In *Proceedings of the International Conference on Computational Engineering and Sciences, ICES’01*, 2001.
- [2] Serge Kharchenko, Paul Kolesnikov, Andy Nikishin, Alex Yerebin, Michael Heroux, and Qasim Sheikh. Iterative Solution Methods on the Cray YMP/C90. Part II: Dense Linear Systems. In *Proceedings of the 1993 Simulation Multiconference*, 1993.
- [3] Serge Kharchenko, Andy Nikishin, Alex Yerebin, Michael Heroux, and Qasim Sheikh. Iterative Solution Methods on the Cray YMP/C90. Part I. In *Proceedings of 5th Australian Supercomputing Conference*, pages 159–168, 1992.
- [4] Michael A. Heroux. A Reverse Communication Interface for “Matrix-free” Preconditioned Iterative Solvers. In C.A. Brebbia, D. Howard, and A. Peters, editors, *Applications of Supercomputers in Engineering II*, pages 207–213, Boston, 1991. Computational Mechanics Publications.

Dissertation

- [1] Michael A. Heroux. *The Fast Adaptive Composite Grid Method for Time Dependent Problems*. PhD thesis, Colorado State University, 1989.