

Vijay Subramaniam Mahadevan

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Computational Scientist,
Consultant to Argonne National Laboratory,
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EDUCATION

- 2010** *Ph.D.*, Nuclear Engineering, Texas A&M University, USA
Dissertation: [High-resolution numerical methods for coupled nonlinear multiphysics simulations with applications in reactor analysis](#)
Advisors: Jean C. Ragusa (TAMU), Jean-Luc Guermond (TAMU), Marvin L. Adams (TAMU), Jim E. Morel (TAMU), Vincent A. Mousseau (SNL)
- 2006** *M.S.*, Nuclear Engineering, Texas A&M University, USA
Thesis: [Nonlinearly consistent schemes for coupled problems in reactor analysis](#)
Advisors: Jean C. Ragusa (TAMU), Jean-Luc Guermond (TAMU), Marvin L. Adams (TAMU)
- 2002** *B.Tech.*, Chemical Engineering, Regional Engineering College, Trichy, India

PROFESSIONAL EXPERIENCE

- Computational Scientist** *Mar 2018 – Current*
Tech Trans International Inc, Toronto, Canada
Consultant to Argonne National Laboratory, USA
- Assistant Computational Scientist** *Aug 2013 – Mar 2018*
Mathematics and Computational Science division, Argonne National Laboratory, USA
- Computational Postdoctoral Fellow** *Sep 2010 – Jul 2013*
Nuclear Engineering/Mathematics and Computational Science divisions, Argonne National Laboratory, USA
- Graduate research and teaching assistant** *Sep 2004–Aug 2010*
Nuclear Engineering department, Texas A&M University, USA
- Givens Research Associate** *Oct–Dec, 2008*
Mathematics and Computational Science division, Argonne National Laboratory, USA
- Research engineer** *Jun–Aug, 2007 & Jun–Aug, 2008 & Jun–Aug, 2009*
Multi-physics Division, Idaho National Laboratory, USA
- Senior Software Developer** *Jul 2002–Jun 2004*
Strategic Software Development Division, Dell Computers Inc., Bangalore, India

AWARDS AND HONORS

- 2010** – *Computational Sciences Certificate*, The Institute for Scientific Computation (ISC), Texas A&M University
- 2008** – *Givens Fellow*, Argonne National Laboratory
- 2008, 2009** – *Modeling, Experimentation and Validation (MeV) School*, Idaho National Laboratory, USA
- 2007** – *Alpha Nu Sigma society*, Texas A&M University
- 2004** – *Regents Fellow*, Texas A&M University

ACADEMIC SERVICE

- Associate editor of Journal of Open Research Software (JORS)
- Served as member of the prestigious Wilkinson Postdoctoral Fellowship Committee, Argonne National Lab, 2016
- [ATPESC](#): Conducted tutorials in the Argonne Training Program on Extreme-Scale Computing with focus on scalable, unstructured mesh based PDE solvers (2014–2016)
- Conference and minisymposium chair/organization
 - Robust, Accurate, and Scalable Algorithms for Coupling in Earth System Models, Platform for Advanced Scientific Computing (PASC), Davos, Switzerland, 2023.
 - Accurate and Efficient Solution Remapping Strategies for Coupled Multiphysics Systems, 15th World Congress on Computational Mechanics (WCCM), Yokohama, Japan, 2022.
 - Component Coupling in Earth System Models: Better Numerics for Stable and Accurate Solvers, 2020 SIAM Conference on Mathematics of Planet Earth (virtual).

Reviewer

- SIAM Journal on Scientific Computing (SISC)
- Journal of Computational Physics (JCP)
- Journal of Open-Source Software (JOSS)
- Geoscientific Model Development (GMD)
- Journal of Open Research Software (JORS)
- Future Generation Computer Systems (FGCS)
- The Visual Computer (Springer Vis Comput)
- Nuclear Science and Engineering (NSE)
- Annals of Nuclear Energy (ANE)
- Progress in Nuclear Energy (PNE)
- Nuclear Engineering and Design (NED)
- Nuclear Engineering and Technology (NET)
- American Nuclear Society Annual and Topical conferences (2009 – 2022)
- American Nuclear Society PHYSOR conferences (2008 – 2016)
- American Nuclear Society M&C conferences (2009 – 2019)
- International Meshing Roundtable(IMR) (2015 – 2021)
- Computer Graphics International (CGI) (2023)
- ASME International Conference on Nuclear Engineering (ICONE), 2016 – 2017
- Department of Energy (DOE) and SBIR/STTR proposals (2014 – 2018, 2023)
- Nuclear Energy University Program (NEUP) (2013 – 2015)
- Argonne National Lab LDRD proposals (2013 – 2016)

Research Supervisor

- Feb 2014 - Present: Dr. Iulian Grindeanu, Mathematics and Computational Science Division, Argonne National Lab
- Feb 2014 - Mar 2018: Rajeev Jain, Mathematics and Computational Science Division, Argonne National Lab
- Feb 2014 - Sep 2016: Danqing Wu, Mathematics and Computational Science Division, Argonne National Lab

Postdoctoral Mentor

- Mar 2014 – July 2016: Dr. Navamita Ray, Mathematics and Computational Science Division, Argonne National Lab; Currently at Los Alamos National Lab

Student Mentor

- 2017: Matthew Eklund (Rensselaer Polytechnic Institute): Experimental modeling and validation of high-fidelity multi-physics solvers for reactor analysis
- 2016: Xinglin Zhao (Stony Brook University): High-order surface reconstruction
- 2015: Cao Lu (Stony Brook University): Generalized Finite Difference solvers with DM-Moab
- 2015: Xinglin Zhao (Stony Brook University): Uniform mesh refinement techniques with array-based data-structures
- 2014: Andrew Till (Texas A&M University): FEM-based multigroup resolution methods
- 2014: Carolyn McGraw (Texas A&M University): Scalable sweeping transport solvers
- 2014: Donald Bruss (Texas A&M University): Efficient check-pointing for time-dependent depletion calculations

Thesis Committee

- 2021: Yipeng Li, Phd, Department of Applied Mathematics and Statistics, Stony Brook University
- 2016: Xinglin Zhao, Phd, Department of Applied Mathematics and Statistics, Stony Brook University

PROFESSIONAL AFFILIATIONS

- Member of Society for Industrial and Applied Mathematics, 2010 – Present
- Member of the American Nuclear Society, 2005 – 2018

TEACHING EXPERIENCE

- Numerical Methods* (Spring 2011)
CSPP 58001, Masters, University of Chicago, IL
- Design of Nuclear Reactors* (Fall 2006)
NUEN 610, Masters, Texas A&M University, TX
- Reactor Analysis and Experimentation* (Spring 2006)
NUEN 606, Masters, Texas A&M University, TX
- Radiation Interaction and Shielding* (Fall 2005)
NUEN 604, Masters, Texas A&M University, TX
- Introduction to Radiation Transport* (Spring 2005)
NUEN 202, Undergraduate, Texas A&M University, TX

RESEARCH INTERESTS

- Scalable, adaptive, coupled multiphysics and multiscale modeling techniques
- Stable, consistent and higher-order accurate spatio-temporal discretization schemes
- Unstructured mesh generation and adaptive algorithms for complex geometry
- High performance iterative solvers and preconditioners for stiff, nonlinear systems
- Hybrid-Krylov preconditioned solvers for simple and generalized eigenvalue problems
- Development of scientific research software for computational problems
- Nuclear engineering and Climate science simulations

**REFEREED
PUBLICATIONS**

- **V. S. Mahadevan**, T. Peterka, I. Grindeanu, D. Lenz, "Accelerating Multivariate Functional Approximation Computation with Domain Decomposition Techniques", *Journal of Computational Science*, **78**, 102268, 2024. [DOI](#)
- Peterka, T., Lenz, D., Grindeanu, I., **Mahadevan, V. S.**, "Towards Adaptive Refinement for Multivariate Functional Approximation of Scientific Data", In 2023 IEEE 13th Symposium on Large Data Analysis and Visualization (LDAV), 32-41, IEEE Computer Society, Oct 2023. [DOI](#)
- D. Lenz, R. Yeh, **V. S. Mahadevan**, I. Grindeanu, T. Peterka, "Customizable Adaptive Regularization Techniques for B-Spline Modeling", *Journal of Computational Science*, **71**, 102037, 2023. [DOI](#)
- D. Lenz, O. Marin, **V. S. Mahadevan**, R. Yeh, T. Peterka, "Fourier-Informed Knot Placement Schemes for B-Spline Approximation", *Mathematics and Computers in Simulation*, **213**, 374-393, 2023. [DOI](#)
- **V. S. Mahadevan**, T. Peterka, I. Grindeanu, D. Lenz, "Accelerating Multivariate Functional Approximation Computation with Domain Decomposition Techniques", In: Mikyška, J., de Mulatier, C., Paszynski, M., Krzhizhanovskaya, V.V., Dongarra, J.J., Sloot, P.M. (eds) Computational Science – ICCS 2023, Lecture Notes in Computer Science (LNCS **14073**), Springer, Cham. [DOI](#)
- **Mahadevan, V. S.**, Guerra, J. E., Jiao, X., Kuberry, P., Li, Y., Ullrich, P., Marsico, D., Jacob, R., Bochev, P., and Jones, P.: Metrics for Intercomparison of Remapping Algorithms (MIRA) protocol applied to Earth system models, *Geosci. Model Dev.*, **15**, 6601–6635, 2022. [DOI](#)
- D. Lenz, R. Yeh, **V. S. Mahadevan**, I. Grindeanu, T. Peterka, "Adaptive Regularization of B-Spline Models for Scientific Data", In: Groen, D., de Mulatier, C., Paszynski, M., Krzhizhanovskaya, V.V., Dongarra, J.J., Sloot, P.M.A. (eds) Computational Science – ICCS 2022, Lecture Notes in Computer Science (LNCS **13350**), Springer, Cham. [DOI](#)
- **Mahadevan, V. S.**, Grindeanu, I., Jacob, R., and Sarich, J., "Improving climate model coupling through a complete mesh representation: a case study with E3SM (v1) and MOAB (v5.x)", *Geosci. Model Dev.*, **13**, 2355–2377, 2020. [DOI](#)
- I. Grindeanu, T. Peterka, **V. S. Mahadevan**, Y. Nashed, "Scalable, High-Order Continuity Across Block Boundaries of Functional Approximations Computed in Parallel", In proceedings of the 2019 IEEE International Conference on Cluster Computing (CLUSTER), Albuquerque, New Mexico, Sep 24-27, 2019. [DOI](#)
- Y. Nashed, T. Peterka, **V. S. Mahadevan**, I. Grindeanu, "Being Rational: Weighted Adaptive Approximation of Scientific Data", In proceedings of the International Conference on Computational Science, Faro, Portugal, June 2019. [DOI](#)
- T. Peterka, Y. Nashed, I. Grindeanu, **V. S. Mahadevan**, R. Yeh, X. Tricoche, "Foundations of Multivariate Functional Approximation for Scientific Data", 8th IEEE Symposium on Large Data Analysis and Visualization in conjunction with IEEE VIS 2018, Berlin, DE, Oct 2018. [DOI](#)
- M. D. Eklund, M. Dupont, P. F. Caracappa, W. Ji, **V. S. Mahadevan**, C. Lee, "Neutronics Modeling and Simulation of Temperature-Dependent Experiments Performed at the Walthousen Reactor Critical Facility (RCF) Using Proteus-SN", In proceedings of the ANS PHYSOR Reactor Physics International Conference, Cancun, Mexico, Apr 2018. [Link](#)
- E. VanderZee, **V. S. Mahadevan**, I. Grindeanu, "Open-source advancing front surface meshing for MeshKit", In proceedings of the 25th International Meshing Roundtable, Washington DC, Sep 2016.

- N. Ray, I. Grindeanu, X. Zhao, **V. S. Mahadevan**, X. Jiao, "Array-based, Parallel Hierarchical Mesh Refinement Algorithms for Unstructured Meshes", *Computer Aided Design*, **85**, 68–82, Aug 2016. [DOI](#)
- X. Zhao, R. Conley, N. Ray, **V. S. Mahadevan**, X. Jiao, "Conformal and Non-conformal Adaptive Mesh Refinement with Hierarchical Array-based Half-Facet Data Structures", *Procedia Engineering (24th International Meshing Roundtable (IMR24))*, **124**, 304–316, Oct 2015. [DOI](#)
- N. Ray, I. Grindeanu, X. Zhao, **V. S. Mahadevan**, X. Jiao, "Array-Based Hierarchical Mesh Generation in Parallel", *Procedia Engineering (24th International Meshing Roundtable (IMR24))*, **124**, 291–303, Oct 2015. [DOI](#)
- R. Jain, **V. S. Mahadevan**, R. O'Bara, "Simplifying Workflow for Reactor Assembly and Full-Core Modeling", [invited](#), In proceedings of Joint International Conference on Mathematics and Computation, Nashville, April 2015. [Link](#)
- **V. S. Mahadevan**, E. Merzari, T. Tautges, R. Jain, A. Obabko, M. Smith, P. Fischer, "High-resolution coupled physics solvers for analysing fine-scale nuclear reactor design problems", [invited](#), *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, **372** (2021), 20130381, June 2014. [DOI](#)
- **V. S. Mahadevan**, E. Merzari, T. J. Tautges, "SHARP Coupled Multiphysics toolkit for reactor analysis", [invited](#), In proceedings of International Congress on Advances in Nuclear Power Plants (ICAPP), Charlotte, North Carolina, Apr 2014.
- A. Siegel, K. Smith, P. Fischer, **V. S. Mahadevan**, "Analysis of communication costs for domain decomposed Monte Carlo methods in the context of reactor analysis", *Journal of Computational Physics*, **231**, 8, 3119-3125, April 2012. [DOI](#)
- **V. S. Mahadevan**, J. C. Ragusa, V. A. Mousseau, "A verification exercise in multi-physics simulations for coupled reactor physics calculations", *Progress in Nuclear Energy*, **55**, 12-32, November 2011. [DOI](#)
- **V. S. Mahadevan**, M. A. Smith, "Scalable multi-grid preconditioning techniques for the even-parity S_N solver in UNIC", In proceedings of the ANS Mathematics, Computations and Supercomputing in Nuclear Applications (M&C 2011) International Conference, Rio de Janeiro, Brazil, May 2011.
- **V. S. Mahadevan**, J. C. Ragusa, V. A. Mousseau, "Space and time convergence studies for nonlinearly coupled applications", In proceedings of the ANS Mathematics, Computations and Supercomputing in Nuclear Applications (M&C 2009) International Conference, Saratoga Springs, NY, May 2009.
- J. C. Ragusa, **V. S. Mahadevan**, "Consistent and accurate schemes for coupled neutronics thermal-hydraulics reactor analysis", *Nuclear Engineering and Design*, **239**, 3, 566-579, March 2009. [DOI](#)
- **V. S. Mahadevan**, J. C. Ragusa, "Novel scheme to compute several dominant eigenmodes for reactor analysis problems", In proceedings of the ANS PHYSOR Reactor Physics International Conference, Interlaken, Switzerland, Sep 2008.
- **V. S. Mahadevan**, J. C. Ragusa, "Application of high-order implicit schemes for nonlinear multi-physics simulations", In proceedings of the ANS Mathematics, Computations and Supercomputing in Nuclear Applications (M&C-SNA 2007) International Conference, Monterey, CA, Apr 2007.
- **V. S. Mahadevan**, J. C. Ragusa, "Consistent accelerated schemes for nonlinear coupling problems in reactor analysis", In proceedings of the ANS PHYSOR Reactor Physics International Conference, Vancouver, Canada, Sep 2006.

PREPRINT

– **V. S. Mahadevan**, I. Grindeanu, R. Jacob, "A new coupler for E3SM.v3 based on the portable MOAB library", *in preparation*, submission to *Journal of Advances in Modeling Earth Systems (JAMES)*.

CONFERENCE PROCEEDINGS

– P. O'Leary., J. Becker, R. O'Bara, D. Thompson, R. Jain, **V. S. Mahadevan**, "Providing a Graphical Tool for Modeling Reactor Cores", Transactions of the American Nuclear Society, 118 (1), 2018. [Link](#).

– **V. S. Mahadevan**, R. Jacob, "Adaptive multiresolution strategies for coupled climate simulations", in proceedings of Advancing X-cutting Ideas for Computational Climate Science (AXICCS 2016), Rockville, Washington DC, USA, Sep. 12-13, 2016. [DOI](#)

– R. Jain, N. Ray, I. Grindeanu, D. Wu, **V. S. Mahadevan**, "Scalable Mesh Generation for HPC Applications", In proceedings of 27th SuperComputing conference, Austin, TX, Nov 15-20, 2015.

– **V. S. Mahadevan**, A. Siegel, "The curse of growing scales: from inception to sustainable scientific software development", in proceedings of Computational Science & Engineering Software Sustainability and Productivity Challenges (CESSP Challenges), Rockville, Washington DC, USA, Oct. 15-16, 2015. [DOI](#).

– **V. S. Mahadevan**, E. Merzari, I. Grindeanu, "A glass box coupling methodology for rigorously solving strongly coupled phenomena in nuclear reactors", *invited*, In proceedings of VI International Conference on Coupled Problems in Science and Engineering, San Servolo, Venice, Italy, May 2015.

– **V. S. Mahadevan**, M. A. Smith, "Stabilized finite element schemes for consistent discretization of neutron transport equation", In proceedings of the ANS Winter Meeting, Washington, DC, Nov 2013.

– **V. S. Mahadevan**, E. Merzari, R. Jain, A. Obabko, M. A. Smith, T. Tautges, P. Fischer, W. D. Pointer, R. Ferencz, "SHARP fuel assembly coupled simulation demonstrations", In proceedings of the ANS Winter Meeting, Washington, DC, Nov 2013.

– **V. S. Mahadevan**, J. C. Ragusa, "Uncertainty quantification of coupled problems in reactor analysis", In proceedings of the ANS Winter Meeting, Las Vegas, Nevada, November 2010.

BOOK CHAPTER

– Peterka, T., Nashed, Y., Grindeanu, I., **Mahadevan, V.**, Yeh, R., Lenz, D., Multivariate Functional Approximation of Scientific Data. Book chapter to appear in In Situ Visualization for Computational Science, edited by Childs, Garth, Bennett, 2021. [DOI](#)

THESES

– **Mahadevan, Vijay Subramaniam** (Aug 2010). High Resolution Numerical Methods for Coupled Non-linear Multi-physics Simulations with Applications in Reactor Analysis. Doctoral dissertation, Texas A&M University. [Available electronically](#).

– **Mahadevan, Vijay Subramaniam** (Dec 2006). Nonlinearly consistent schemes for coupled problems in reactor analysis. Master's thesis, Texas A&M University. [Available electronically](#).

TECHNICAL REPORTS

– N. Goldring, D. Bruhwiler, B. Nash, Z. Wu, R. Nagler, J. Carter, J. Lerch, K. Suthar, P. Den Hartog, R. Jain, and **V. Mahadevan**, "Multiphysics Design and Optimization of Complex Vacuum Chambers", prepared for DOE Office of Science ASCR SBIR Phase II Contract SC0015209, United States, 2020. [DOI](#).

– G. Sabin, B. O'Neill, B. Norris, **V. S. Mahadevan**, "Automated Solver Selection for Nuclear Engineering Simulations", prepared for DOE Office of Science ASCR SBIR Phase II Contract, Nov 2017. [SBIR](#).

- Heroux, A. M., Allen, G., "Computational Science and Engineering Software Sustainability and Productivity (CSESSP) Challenges Workshop Report", Arlington, VA: Networking and Information Technology Research and Development (NITRD) Program, Sep 2016. Retrieved from [NITRD Website](#).
- **V. S. Mahadevan**, I. Grindeanu, R. Jain, "SIGMA v1.3 User manual", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, ANL/MCS-TM-366, Sep 2016.
- R. Jain, E. Vanderzee, I. Grindeanu, **V. S. Mahadevan**, "Mesh Generation Algorithms Development for NEAMS", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, ANL-P60660916, Sep 2016.
- Y. Q. Yu, E. R. Shemon, J.W. Thomas, **V. Mahadevan**, R. Rahaman, J. Solberg, "SHARP User Manual", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, ANL/NE-16/6, Mar 2016. [DOI](#).
- Y. Q. Yu, **V. S. Mahadevan**, E. Shemon, R. Rahaman, "SHARP Multiphysics Tutorials", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, ANL/NE-16/1, Feb 2016. [DOI](#).
- R. Jain, **V. S. Mahadevan**, "Documentation for the MeshKit Reactor Geometry (& mesh) Generator", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, ANL/MCS-TM-354, September 2015. [DOI](#).
- R. Jain, E. Vanderzee, **V. S. Mahadevan**, "Update on Development of Mesh Generation Algorithms in MeshKit", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, ANL/MCS-TM-355, September 2015. [DOI](#).
- **V. S. Mahadevan**, R. Rahaman, "SHARP pre-release v1.0 - Current status and documentation", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, ANL/MCS-TM-356, September 2015. [DOI](#).
- **V. S. Mahadevan**, I. Grindeanu, N. Ray, "SIGMA release v1.2 - Capabilities, enhancements and fixes", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, ANL/MCS-TM-357, September 2015. [DOI](#).
- F. M. Hoffman, D. Bergman, P. B. Bochev, P. J. Cameron-Smith, R. C. Easter, Jr., S. M. Elliott, S. J. Ghan, I. Grindeanu, O. Guba, X. Liu, R. B. Lowrie, D. D. Lucas, P. Ma, **V. S. Mahadevan**, K. J. Peterson, W. J. Sacks, M. Shrivastava, B. Singh, T. J. Tautges, M. A. Taylor, M. Vertenstein, P. H. Worley, K. Zhang, "ACES4BGC: Applying Computationally Efficient Schemes for BioGeochemical Cycles", U.S. Department of Energy Scientific Discovery through Advanced Computing (SciDAC-3) Partnership Project Annual Report, Nov. 2014.
- **V. S. Mahadevan**, "Coupled Physics Environment (CouPE) library - Design, implementation and release", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, ANL/MCS-TM-345, September 2014. [DOI](#).
- E. Merzari, **V. S. Mahadevan**, I. Grindeanu, J. Solberg, R. Ferencz, R. Whitesides, "Preliminary Multiphysics Simulations with Online Mesh Deformation", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, September 2014.
- R. Jain, **V. S. Mahadevan**, "MeshKit Release v1.2", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, September 2014. [DOI](#).
- M.S. Breitenfeld, Q. Koziol, N. Fortner, T.J. Tautges, **V.S. Mahadevan**, I.R. Grindeanu, "MOAB's Case Studies and Improvements Using HDF5", July 2014.
- E. Merzari, E.R. Shemon, Y. Yu, J.W. Thomas, A. Obabko, R. Jain, **V. Mahadevan**, J. Solberg, R. Ferencz, R. Whitesides, "Full Core Multi-Physics Simulation with Offline Mesh Deformation", April 2014. [DOI](#).

- A. Bennett, **V. S. Mahadevan**, J. J. Billings, "Integrated Build System of the SHARP Software Suite", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, Oak Ridge, TN, USA, March 2014.
- E. Merzari, E. Shemon, J.W. Thomas, A. Obabko, R. Jain, **V. S. Mahadevan**, T. Tautges, J. Solberg, R. Ferencz, R. Whitesides, "Multi-Physics Demonstration Problem with the SHARP Reactor Simulation Toolkit", prepared for the U.S. Department of Energy, Office of Nuclear Energy, ARC Milestone Technical Report, ANL-ARC-283, January 2014. [DOI](#).
- M. A. Smith, **V. S. Mahadevan**, E. R. Wolters, "Continued Research for Improvement of PROTEUS-SN", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, M3MS-13AN06030216, September 2013. [DOI](#).
- E. Merzari, **V. S. Mahadevan**, T. J. Tautges, R. Jain, A. Obabko, M. A. Smith, E. Wolters, R. M. Ferencz, "SHARP Multi-Assembly Multiphysics Demonstration Simulations", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, M2MS-13AN06030216, September 2013.
- T. J. Tautges, P. Fischer, I. Grindeanu, R. Jain, **V. S. Mahadevan**, A. Obabko, M. A. Smith, E. Merzari, "Complete Assembly Scale Integrated Multi-Physics Simulation", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, M2MS-13AN06030219, April 2013.
- T. J. Tautges, P. Fischer, I. Grindeanu, R. Jain, **V. S. Mahadevan**, A. Obabko, M. A. Smith, S. Hamilton, K. Clarno, M. Baird, M. Berrill, "A Coupled Thermal/Hydraulics - Neutronics - Fuel Performance Analysis of an SFR Fuel Assembly", prepared for the U.S. Department of Energy, Office of Nuclear Energy, Milestone Technical Report, M2MS-12AN0603278, April 2012.
- **V. S. Mahadevan**, "High-order spatio-temporal schemes for coupled, multi-physics reactor simulations", prepared for the U.S. Department of Energy, Office of Nuclear Energy, INL/EXT-08-14884, September 2008. [DOI](#).
- **V. S. Mahadevan**, Jean Ragusa, "Coupling schemes for multi-physics reactor simulations", prepared for the U.S. Department of Energy, Office of Nuclear Energy, INL/EXT-07-13490, September 2007. [DOI](#).

**CONFERENCE/
WORKSHOP
PRESENTATIONS**

- "SOMA: Scalable operator abstractions for representing unstructured meshes", 16th World Congress on Computational Mechanics, Vancouver, Canada, Jul 21–26, 2024.
- "Boosting the numerical and computational performance of the E3SM coupler", 9th European Seminar on Computing (ESCO), Pilsen, Czech Republic, Jun 10–14, 2024.
- "Topology-aware Coupler for Energy Exascale Earth System Model", 18th Copper Mountain Conference On Iterative Methods, Copper Mountain, USA, Apr 14–19, 2024.
- "A New Coupler Infrastructure for E3SM Simulator", SIAM Conference on Parallel Processing for Scientific Computing (PP24), Baltimore, USA, Mar 5–8, 2024.
- "Consistent Coupling of Multiscale MPAS and ROMS Ocean Models", SIAM Conference on Parallel Processing for Scientific Computing (PP24), Baltimore, USA, Mar 5–8, 2024.
- "Scalable, High Order Remapping Methods for Multimodel Problems", SIAM Conference on Computational Science and Engineering, Amsterdam, The Netherlands, Feb 26–Mar 3, 2023.
- "Parallel Domain Decomposition Techniques Applied to Multivariate Functional Approximation of Discrete Data", SIAM Conference on Parallel Processing for Scientific Computing, Seattle, USA, Feb 23–26, 2022.

- "Accelerating Coupled Climate Simulations Using Efficient Remapping Techniques", SIAM Conference on Parallel Processing for Scientific Computing, Seattle, USA, Feb 23–26, 2022.
- "Data couplers for Climate Simulation Workflows: Offline, hybrid or fully online remappers?", [invited](#), In proceedings of IX International Conference on Coupled Problems in Science and Engineering, [virtual conference](#), June 2021.
- "Scalable, and Accurate Remapping Techniques for Coupled Climate Workflows", SIAM Conference on Computational Science and Engineering, [virtual conference](#), Mar 1–15, 2021.
- "Fourier-Informed Knot Placement Schemes for B-Spline Approximations", SIAM Conference on Computational Science and Engineering, [virtual conference](#), Mar 1–15, 2021.
- "Advanced Partitioning Strategies for Scalable Remapping in Climate Models", Poster, SIAM Conference on Computational Science and Engineering, [virtual conference](#), Mar 1–15, 2021.
- "Comparison Study of Spatial Remapping Schemes in Climate Simulations for High-Order Field Discretizations", World Congress in Computational Mechanics (WCCM), [virtual congress](#), Jan 11–15, 2021.
- "Couplers for E3SM: Comparisons between a fully online vs an offline-online remapping workflow", [invited](#), Fifth Workshop on Coupling Technologies for Earth System Models, [virtual workshop](#), Sep 23–25, 2020.
- "A Comparison of Different Higher-Order Remapping Schemes in Climate Models", SIAM Conference on Mathematics of Planet Earth, [virtual conference](#), Aug 3–14, 2020.
- "Flexible, scalable, conservative spatial coupling infrastructure for climate models in E3SM", [invited](#), VIII International Conference on Coupled Problems in Science and Engineering, Sitges, Barcelona, Jun. 3–5, 2019.
- , "MFA: A Continuous Model of Discrete Scientific Data", Poster in the SIAM Conference on Computational Science and Engineering (CSE19), Spokane, Washington, Feb 25–Mar 1, 2019.
- "MeshKit-QuadAdvance: An Open-Source Advancing-Front Quadrilateral Surface Mesher", Symposium on Trends in Unstructured Mesh Generation, 15th U.S. National Congress on Computational Mechanics, Austin, TX, Jul 28–Aug 1, 2019.
- "Improving climate model coupling through a complete mesh representation", Poster in the Energy Exascale Earth System Model (E3SM) PI Meeting, Potomac, MD, Nov 5–9, 2018.
- "A multiphysics simulation tool for vacuum system design and optimization for next generation light sources", 25th Conference on Application of Accelerators in Research and Industry (CAARI), Grapevine, TX, Aug 12–17, 2018.
- "Domain Decomposition in Climate Models", [invited](#), 25th International Domain Decomposition Conference (DD XXV), St. John's, Newfoundland, Canada, July 23–27, 2018.
- "Controlling the solution transfer error in multi-physics coupling for Climate problems", [invited](#), Special session on Heterogeneous Numerical Methods, 13th World Congress in Computational Mechanics (WCCM), New York, July 23–27, 2018.
- "Improving climate model coupling through complete mesh representation", 3rd workshop on Physics Dynamics Coupling (PDC18), Reading, UK, July 10–12, 2018.
- "Use of the COMSOL Server License to Simulate Next-Generation Synchrotron Light Sources", COMSOL Day, San Jose, June 24, 2018.

- "Providing a graphical tool for modeling reactor cores", ANS Annual Meeting, Philadelphia, June 17–21, 2018.
- "Cloud-based Vacuum System Design and Optimization for Next Generation Light Sources", International Conf. on Synchrotron Radiation Instrumentation, Taipei, June 13, 2018.
- "A Multiphysics Simulation Tool for Vacuum System Design and Optimization for Next Generation Light Sources", 9th International Particle Accelerator Conference (IPAC'18), Vancouver, BC, Canada, May 2018.
- "Adding MOAB to CIME's MCT driver", CESM Software Engineering Working Group Meeting, National Center for Atmospheric Research, Boulder, Colorado, Feb 27 2018.
- "Improving coupling workflow in ACME through a common infrastructure", Poster at the ACME All-Hands PI Meeting, Washington DC, June 2017.
- "Optimizing the computational Rubik's cube: Balancing numerics, performance, and abstractions in multimodel solvers", invited, VII International Conference on Coupled Problems in Science and Engineering, Rhodes Island, Greece, Jun. 12-14, 2017.
- "Comparison of scalable solution remapping algorithms for climate problems", invited, Fourth Workshop on Coupling Technologies for Earth System Models, Princeton, WA, USA, Mar. 20-22, 2017.
- "Lessons learned from integrating scientific libraries within a plugin-based architecture", minisymposium session on Software Productivity and Sustainability for CSE and Data Science, SIAM CS&E, Atlanta, GA, Feb 27-Mar 3, 2017.
- "Solution transfer error in multi-physics coupling", invited, 2nd workshop on Physics Dynamics Coupling in Weather and Climate Models, Richland, WA, USA, Sep. 20-22, 2016.
- "Adaptive multiresolution strategies for coupled climate simulations", Poster in Proceedings of Advancing X-cutting Ideas for Computational Climate Science (AXICCS 2016), Rockville, Washington DC, USA, Sep. 12-13, 2016.
- "A review of multiscale coupling tools to improve scientific productivity", workshop on Multiscale Modelling and Simulation, in Proceedings of International Conference on Computational Science (ICCS 2016), San Diego, CA, USA, Jun. 6-8, 2016.
- "The curse of growing scales: from inception to sustainable scientific software development", invited, workshop on Computational Science & Engineering Software Sustainability and Productivity Challenges (CSESSP Challenges), Rockville, Washington DC, USA, Oct. 15-16, 2015.
- "SIGMA: Scalable Interface for Geometry and Mesh Based Applications", U.S. Department of Energy Scientific Discovery through Advanced Computing (SciDAC-3) PI Meeting, Washington DC, July 2015.
- "Easing computational workflows through flexible and scalable tools", invited, 3rd Joint Lab for Extreme Scale Computing Workshop, Barcelona, Spain, Jun 29 – Jul 1, 2015.
- "FASTMath Unstructured Mesh (MOAB) Solver (PETSc) Interactions", In Proceedings of SIAM Computational Science and Engineering (SIAM CS&E15), Salt lake City, Utah, Mar 2015.
- "Efficient Unstructured Mesh Traversal Methods Based on Array-Based Half Facets", In Proceedings of SIAM Computational Science and Engineering (SIAM CS&E15), Salt lake City, Utah, Mar 2015.
- "OCC-Based Meshing for RGG Applications Using MeshKit", In Proceedings of SIAM Computational Science and Engineering (SIAM CS&E15), Salt lake City, Utah, Mar 2015.

- "SIGMA: Scalable Interface for Geometry and Mesh Based Applications", In Proceedings of SIAM Computational Science and Engineering (SIAM CS&E15), poster in CS&E Software mini-symposium, Salt lake City, Utah, Mar 2015.
- "Scalable Advection Algorithms for Multi-Tracers in Climate Codes", In Proceedings of SIAM Computational Science and Engineering (SIAM CS&E15), Salt lake City, Utah, Mar 2015.
- "Unstructured Mesh-Solver interactions", U.S. Department of Energy Scientific Discovery through Advanced Computing (SciDAC-3) PI Meeting, Washington DC, July 2014.
- "Applying Computationally Efficient Schemes for BioGeochemical Cycles (ACES4BGC)", U.S. Department of Energy Scientific Discovery through Advanced Computing (SciDAC-3) PI Meeting, Washington DC, invited, July 2014.
- "Unstructured Meshing Techniques", U.S. Department of Energy Scientific Discovery through Advanced Computing (SciDAC-3) PI Meeting, Washington DC, July 2014.
- "Tools Supporting the Assembly of Multiphysics Simulation Codes from Standalone Parallel Physics Codes", proceedings of SIAM Parallel Processing (SIAM PP14), Portland, Oregon, Feb 2014.
- "CIAN Coupling Proxy App: Performance and Accuracy of CESAR Data Coupling", CESAR Annual Review Meeting, Argonne National Laboratory, Dec 2013.
- "Software strategies in multi-physics coupling for reactor simulation and climate applications", Workshop on Multiscale Modeling and Computing, Leiden, the Netherlands, April 2013.
- "Interoperable Solution Transfer Tool for Coupled Multi-Physics Simulations", 2013 SIAM Conference on Computational Science and Engineering, Boston, MA, February 25 - March 1, 2013.
- "Mesh-based Data and Algorithms across the Simulation Process: anecdotes, activities, and opportunities", UIUC-Argonne-INRIA Joint Lab workshop, Argonne National Laboratory, Argonne, IL, Nov 2012.
- "KARMA: A Simulation Framework for Multi-Physics Problems in Reactor Analysis", Poster in Energy Engineering & Systems Analysis review meeting, Argonne National Laboratory, Argonne, IL, November 10, 2011.
- "A multi-physics simulation framework for problems in reactor analysis", 4th Annual Postdoctoral Research Symposium, Argonne National Laboratory, Argonne, IL, October 27, 2011.
- "Application of non-intrusive stochastic methods for uncertainty estimation for nonlinear diffusion equations", Poster in Statistical and Applied Mathematical Sciences Institute (SAMSI) Workshop on Uncertainty Quantification, Rayleigh, NC, September 7-10, 2011.
- "Reactor Physics Simulation on Leadership Computing Facilities", MeV Summer School, Argonne, IL, July 19-28, 2011.
- "Parallel, high-order implicit solution procedure for nonlinear diffusion problems", ANS Student Conference, College Station, TX, 2008.

TUTORIALS

- "FASTMath Unstructured Mesh Technologies and hands-on sessions", Argonne Training Program on Extreme-Scale Computing (ATPESC) workshop, St. Charles, IL, invited, August 2016. [Link](#), [MOAB Hands-on](#).
- "FASTMath Unstructured Mesh Technologies and hands-on sessions", invited, Argonne Training Program on Extreme-Scale Computing (ATPESC) workshop, St. Charles, IL, August 2015. [Link](#), [MOAB Hands-on](#).

- "FASTMath Unstructured Mesh Technologies and hands-on sessions", Argonne Training Program on Extreme-Scale Computing (ATPESC) workshop, St. Charles, IL, [invited](#), August 2014. [Link](#), [MOAB Hands-on](#).

SCIENTIFIC SOFTWARE DEVELOPMENT

SIGMA – Current lead and developer for all tools provided under the umbrella of the Scalable Interfaces for Geometry and Mesh-based Applications toolkit. SIGMA provides several components to simplify geometry/mesh creation (**CGM** and **MeshKit**), handling and runtime manipulation of unstructured meshes (**MOAB**), with tightly knit interfaces to solvers such as PETSc ([DMMoab](#)).

E3SM Contributor to the spatial solution remapping algorithms used in the coupled, parallel simulations of climate model problems.

CANGA Primary investigator in analyzing numerics related to spatial solution remapping algorithms, their implementations and properties for Finite Volume (FV), Spectral Element (SE) discretizations on representative unstructured meshes.

SHARP Software architect and developer of SHARP, a high-fidelity nuclear reactor analysis toolkit with coupled neutronics, thermal-hydraulics and nonlinear mechanics models.

- Primary designer and developer of **CouPE** and **KARMA** – flexible coupled multi-physics software toolkits with support for high-order discretization, and a variety of scalable solver methods applied to nuclear engineering problems.

- Extensive experience and contributions to open-source scientific software libraries

PETSc – Portable Extensible Toolkit for Scientific computing

SLEPc – The Scalable Library for Eigenvalue Problem Computations

libMesh – Parallel adaptive, unstructured Finite Element library

Deal.II – A general purpose Object-Oriented Finite Element library

PROTEUS – A FEM radiation transport code for fast nuclear reactor analysis

Nek5000 – A highly scalable computational fluid dynamics code

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