Alexey Voronin

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EDUCATION

University of Illinois at Urbana-Champaign *Aug 2018 - May 2024 (expected)*
Doctor of Philosophy (Ph.D.) in Computer Science
· Thesis Title: Monolithic Multigrid Preconditioners for Saddle-Point Systems
· Research Areas: Scientific Computing and High-Performance Computing
· Advisor: Luke N. Olson
· Current GPA: 3.86/4.0

University of California, San Diego *Jun 2015*
Bachelor of Science (B.S.)
· B.S. in Applied Mathematics
· B.S. in Computational Physics

RESEARCH EXPERIENCE

Scientific Computing Group Dept. of Computer Science, UIUC *Aug 2018 - Present*
Graduate Research Assistantship *Urbana, IL*

· Focused on developing multilevel methods for the solution of the discrete saddle point systems arising from the mixed finite-element discretization of the incompressible Navier-Stokes equations.
  - Supervisors: Luke Olson, Scott MacLachlan
  - Research Areas: PDE Systems, Mixed-finite element methods, Multi-level methods, Design of Schwarz-type relaxation methods, HPC Tensor Algebra

Sandia National Laboratories, Center for Computing Research *Summers 2020-2022*
Graduate Student Intern *Livermore, CA*

· Conducted research on novel algebraic multigrid coarsening approaches and inexact relaxation methods for problems with coupled fields such as Stokes equations.
  - Supervisor: Raymond Tuminaro
  - Research Areas: Algebraic Coarsening Algorithms, Patch Relaxation Methods

Lawrence Livermore National Laboratory, CASC *May 2018 - Aug 2018*
Computer Scientist in Computation Division, CASC *Livermore, CA*

· Explored alternative approaches to forming multigrid components, aiming to decrease the overall setup costs for nonlinear time-dependent systems.
  - Supervisor: Ulrike Meier Yang
  - Research Areas: Algebraic Multigrid, Non-linear PDEs

Lawrence Livermore National Laboratory, Computation Division *Jul 2015 - Aug 2018*
Computer Scientist in Application Simulation, and Quality Group *Livermore, CA*

· Optimized the performance of the particle-in-cell (PIC) plasma code used by LLNL's plasma physics group.
  - Supervisor: Andrea Schmidt
  - Research Areas: Scalability, Load Balancing, Preconditioned Krylov Methods, Hybrid MPICH/OpenMP parallelization framework
· Contributed to the development of the Livermore Design Optimization (LiDO) code, based on Modular Finite Element Discretization (MFEM) Library.
  - Supervisor: Daniel White and Daniel Tortorelli
  - Research Areas: Matrix-free solvers, CUDA, Emerging Architectures, Topology Optimization

Skaggs School of Pharmacy and Pharmaceutical Sciences *Jun 2012 - Jun 2014*
Undergraduate Researcher *La Jolla, CA*

· Co-developed a new molecular dynamics approach to answer whether the shifts in electron density induced by external charges are best replicated by changes in atom-centered charges or by the addition of atom-centered dipoles.

TEACHING EXPERIENCE

University of Illinois at Urbana-Champaign
Graduate Teaching Assistant, Computer Science Department *Urbana, IL*

· Graduate-level course in Numerical Methods for PDEs (CS555) *Spring 2023*
  - Collaborated with faculty to develop and refine course content, led engaging discussion, and delivered lectures on advanced numerical techniques for initial and boundary value problems in partial differential equations.

· Undergraduate level course in Numerical Methods (CS357) *Spring & Fall 2021*
  - Created and delivered course content on introductory topics in scientific computing and data analysis. Incorporated real-world applications to enhance understanding of complex concepts.

· Undergraduate/Graduate level course in Numerical Analysis (CS450) *Fall 2018 & Spring 2019*
  - Led interactive discussion sessions and developed course material for an introductory course in scientific computing. Assisted students in understanding numerical problem formulation and solution strategies.

PEER-REVIEWED PUBLICATIONS

[1] Voronin, A, MacLachlan, S, Olson, LN, Tuminaro, R. Monolithic Algebraic Multigrid Preconditioners for the Stokes Equations. Arxiv (submitted for publication). https://arxiv.org/abs/2306.06795

[2] Voronin, A, He, Y, MacLachlan, S, Olson, LN, Tuminaro, R. Low-order preconditioning of the Stokes equations. Numer Linear Algebra Appl. 2021;e2426. https://doi.org/10.1002/nla.2426

[3] White, D, Voronin, A. "A computational study of symmetry and well-posedness of structural topology optimization." Structural and Multidisciplinary Optimization 59, no. 3 (2019): 759-766

[4] Li, A, Voronin, A, Fenley, A, Gilson, M. "Evaluation of Representations and Response Models for Polarizable Force Fields." The Journal of Physical Chemistry B 120, no. 33 (2016): 8668-8684

TECHNICAL REPORTS AND PROCEEDINGS

[1] Voronin, A, Tuminaro, R. Monolithic Algebraic Multigrid Preconditioners for Stokes Systems, in Computer Science Research Institute Summer Proceedings 2022, S.K. Seritan and J.D. Smith, eds., Technical Report SAND2022-10280R, Sandia National Laboratories, 2022, pp. 185-–196.

[2] Voronin, A, Tuminaro, R. Algebraic Multigrid based on Low-order Systems, in Computer Science Research Institute Summer Proceedings 2021, J.D. Smith and E. Galvan, eds., Technical Report SAND2022-0653R, Sandia National Laboratories, 2020, pp. 147–158.

[3] Voronin, A, Tuminaro, R, Olson, LN, MacLachlan, S. AMG for Mixed Finite Element Representations of PDE Systems, in Computer Science Research Institute Summer Proceedings 2020, A.A. Rushdi and M.L. Parks, eds., Technical Report SAND2020-12580R, Sandia National Laboratories, 2020, pp. 127–137.

CONFERENCE TALKS AND INVITED MINISYMPOSIA PRESENTATIONS

[1] Monolithic AMG Preconditioners for Stokes Equations, *21st Copper Mountain Conference On Multigrid Methods (2023)*

[2] Monolithic AMG Preconditioners for Stokes Equations, *SIAM Conference on Computational Science and Engineering (2023)*

[3] Monolithic SA-AMG for Saddle-point Systems, *AMG Summit (2021)*

[4] AMG for Mixed Finite Element Representations of Systems of PDEs, *SIAM Conference on Computational Science and Engineering (2021)*

[5] LFA of Low-Order Preconditioners for the Stokes equations, *20th Copper Mountain Conference On Multigrid Methods (2021)*

[6] Performance Optimization of Bloch-wave Code for the CORAL Systems, *Applications, Simulations and Quality (ASQ) seminar at LLNL Seminar Series (2018)*

AWARDS, GRANTS AND ACHIEVEMENTS

[1] Autumn School - Scientific Machine Learning and Dynamical Systems Workshop - Travel Award *(2023)*

[2] Graduate College Presentation Award to present at SIAM Conference on Computational Science and Engineering *(2023)*

[3] NSF-CBMS Conference on Parallel Time Integration - Travel Award *(2022)*

[4] Argonne Training Program on Extreme-Scale Computing (ATPESC) - Travel Award *(2017)*

[5] President's Volunteer Service Award *(2010)*

TECHNICAL SKILLS

Programming Languages: C, C++, Python

Parallel Programming and GPU Computing: MPI, OpenMP, Pthread, CUDA, OpenCL, OpenACC

HPC Technologies & Libraries: MFEM, *hypre*, PETSc, Firedrake, deal.II, PyTorch

Debugging & Profiling Tools: TAU, TotalView, GDB, NVIDIA Visual Profiler, Valgrind

Software Development Tools: Git, CMake, Travis CI, Docker

OTHER WORK EXPERIENCE

Cymer, ASML *Jun - Sep 2014*
Data Analyst Intern *San Diego, CA*

· Collaborated in designing and implementing a Markov chain Monte Carlo simulator using Python. This tool was developed to enhance the precision of part failure predictions in existing laser systems, thereby improving overall operational efficiency.

SLAC National Accelerator Laboratory *Jun - Aug 2009 and 2010*
Summer Intern *Menlo Park CA*

· Streamlined the process of X-ray diffraction data collection by automating the merging of various file formats, leading to increased efficiency in data management.

· Conducted X-ray crystallography experiments, collected diffraction data, and utilized this data to solve and refine protein molecular structures, contributing to the broader understanding of protein function and structure.

SERVICE

SIAM Student Chapter Treasurer (UIUC) *Aug 2019 - Aug 2022*
SIAM Student Chapter Officer (UIUC) *Aug - May 2018*