Steven Byram Roberts — Curriculum Vitae

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Education

Lawrence Livermore National Laboratory

Sydney Fernbach Postdoctoral Fellow Mentored by Dr. Carol Woodward

Virginia Tech

Ph.D. in Computer Science and Applications, 3.97 GPAFall 2016–Summer 2021Member of Computational Science Laboratory and advised by Dr. Adrian SanduFall 2016–Summer 2021

Virginia Tech

B.S. in Computer Science and B.S. in Mathematics, 3.98 GPA Highest GPA in both graduating classes Fall 2012–Spring 2016

Fall 2021-present

Skills and Qualifications

Mathematics: Strong background in numerical analysis with a focus on discretization methods for ordinary differential equations and differential-algebraic equations

Programming Languages: Proficient in MATLAB and Mathematica, experienced with C, C++, Python, C#, and Java

High Performance Computing: Experienced with OpenMP, MPI, CUDA, and Slurm

Machine Learning: Basic knowledge of PyTorch and Tensorflow libraries

Web Development: Experienced in HTML, JavaScript, Node.js, CSS, and creating Chrome Extensions

Work History

Lawrence Livermore National Laboratory

Sydney Fernbach Postdoctoral Fellow

- Developing techniques to accelerate time integration methods with machine learning and surrogate models.
- Investigating feasibility of implementing time integration methods on machine learning hardware accelerators such as the Cerebras CS-2 and Graphcore IPU.
- Proposing remedies to the order reduction phenomenon which mars many Runge-Kutta methods
- Enhancing the time-stepping capabilities of the BISICLES ice sheet model
- Contributing to the SUite of Nonlinear and DIfferential/ALgebraic equation Solvers (SUNDIALS)

Virginia Tech Computational Science Laboratory

Research Assistant

- Designed, analyzed, and tested new multirate time integrators for numerically solving multiscale differential equations
- Developed new implicit-explicit (IMEX) methods suitable for stiff problems and differential algebraic equations.

CS 4234/5234: Parallel Computation

Graduate Teaching Assistant

- Held weekly office hours to help students with assignments
- Taught ten of the classes on topics including OpenMP, parallel performance metrics, and GPU computing with CUDA

Lawrence Livermore National Laboratory

Intern

Spring 2015–Fall 2021

Fall 2019–Spring 2020

Fall 2021-present

Summer 2019

- Developed new implicit multirate Runge-Kutta methods for solving stiff, multiscale systems of ordinary differential equations
- O Compared and implemented variants of multirate backward differentiation formula methods

Lawrence Livermore National Laboratory

Intern

- Implemented and optimized finite element operators for GPUs using CUDA
- Achieved 10 to 100 times speedup over other CPU and GPU implementations
- Contributed to the open-source project libCEED

NASA Glenn Research Center

Intern

- Created 1D hybrid direct kinetic simulation of a Hall thruster
- \bigcirc Developed software in C++ from the ground up
- O Modeled time-dependent velocity distribution functions of various species in plasma
- Gained experience solving hyperbolic partial differential equations with the finite volume method and using visualization tools

Insurance Institute for Highway Safety (IIHS)

Intern

- Worked on C# applications for managing vehicle records stored in SQL databases
- Redesigned and updated mobile website
- Set up an OAUTH server
- Worked with several frontend web frameworks
- O Gained firsthand experience in software development life cycle

Web Developer

Freelance

- Developed and maintained the website for the Computational Science Laboratory
- Designed and created websites for two Virginia Tech Materials Science and Engineering professors' research groups
- \odot Created four Chrome Extensions used by more than 100,000 users

Recognitions and Accomplishments

Outstanding Paper Award

27th Annual IEEE Conference on High Performance Extreme Computing Fall 2023 Awarded for the paper titled "Leveraging Mixed Precision in Exponential Time Integration Methods"

Sidney Fernbach Postdoctoral Fellow

Lawrence Livermore National Laboratory "A highly competitive postdoctoral position that is awarded to candidates with exceptional talent, scientific track records, and potential for significant achievements in computational mathematics, computer science, data science, and/or scientific computing"

Graduate STEM Research Fellowship Virginia Space Grant Consortium Awarded for research proposal aligned with NASA's mission	Fall 2018–Spring 2020
Davenport Fellowship	
Virginia Tech	2017
Awarded for research performance and promise	
David Heilman Memorial Award	
Virginia Tech	2016
Awarded for outstanding undergraduate research	
Outstanding Senior, Applied Computational Mathematics Option	
Virginia Tech	2016
Computer Science Sophomore, Junior, and Senior Scholar Awards	
Virginia Tech	2014–2016
Award to undergraduate with the most outstanding academic record	

Summer 2018

Summer 2017

Summer 2013-2016

2015-present

Virginia Tech

Publications

- Alex C. Fish, Daniel R. Reynolds, and Steven B. Roberts. "Implicit-explicit multirate infinitesimal stage-restart methods". In: *Journal of Computational and Applied Mathematics* 438 (2024), p. 115534. DOI: 10.1016/j.cam.2023.115534.
- [2] Abhijit Biswas, David I Ketcheson, Steven Roberts, Benjamin Seibold, and David Shirokoff. "Explicit Runge–Kutta Methods that Alleviate Order Reduction". In: arXiv preprint arXiv:2310.02817 (submitted to SIAM Journal on Numerical Analysis 2023).
- [3] Cody J Balos, Steven Roberts, and David J Gardner. "Leveraging Mixed Precision in Exponential Time Integration Methods". In: arXiv preprint arXiv:2307.09498 (to appear in the Proceedings of the 27th Annual IEEE Conference on High Performance Extreme Computing 2023). Outstanding Paper Award.
- [4] Steven Roberts and Adrian Sandu. "Eliminating Order Reduction on Linear, Time-Dependent ODEs with GARK Methods". In: *arXiv preprint arXiv:2201.07940* (submitted to *Journal of Scientific Computing* 2022).
- [5] Steven Roberts, Andrey A. Popov, Arash Sarshar, and Adrian Sandu. "A Fast Time-Stepping Strategy for Dynamical Systems Equipped with a Surrogate Model". In: SIAM Journal on Scientific Computing 44.3 (2022), A1405–A1427. DOI: 10.1137/20M1386281.
- [6] Severiano González-Pinto, Domingo Hernández-Abreu, Maria S. Pérez-Rodríguez, Arash Sarshar, Steven Roberts, and Adrian Sandu. "A unified formulation of splitting-based implicit time integration schemes". In: *Journal of Computational Physics* 448 (2022), p. 110766. DOI: 10.1016/j.jcp.2021.110766.
- [7] Arash Sarshar, Steven Roberts, and Adrian Sandu. "Alternating directions implicit integration in a general linear method framework". In: *Journal of Computational and Applied Mathematics* 387 (2021), p. 112619. DOI: 10.1016/j.cam.2019.112619.
- [8] Steven Roberts, John Loffeld, Arash Sarshar, Carol S Woodward, and Adrian Sandu. "Implicit multirate GARK methods". In: *Journal of Scientific Computing* 87.1, 4 (2021). DOI: 10.1007/ s10915-020-01400-z.
- [9] Adrian Sandu, Michael Günther, and Steven Roberts. "Linearly implicit GARK schemes". In: Applied Numerical Mathematics 161 (2020), pp. 286–310. DOI: 10.1016/j.apnum.2020.11. 014.
- [10] Steven Roberts, Arash Sarshar, and Adrian Sandu. "Parallel Implicit-Explicit General Linear Methods". In: Communications on Applied Mathematics and Computation (2020). DOI: 10.1007/s42967-020-00083-5.
- [11] Steven Roberts, Arash Sarshar, and Adrian Sandu. "Coupled Multirate Infinitesimal GARK Schemes for Stiff Systems with Multiple Time Scales". In: SIAM Journal on Scientific Computing 42.3 (2020), A1609–A1638. DOI: 10.1137/19M1266952.
- [12] Arash Sarshar, Steven Roberts, and Adrian Sandu. "Design of High-Order Decoupled Multirate GARK Schemes". In: SIAM Journal on Scientific Computing 41.2 (2019), A816–A847. DOI: 10.1137/18M1182875.

Presentations

FASTMath Seminar

Improved Time-Stepping for the BISICLES Ice-Sheet Model Steven Roberts, Daniel Martin, Hans Johansen, David Gardner, Carol Woodward

Los Alamos Workshop on Time Integration for Multiphysics <i>Overcoming First Order</i> Steven Roberts	Los Alamos, NM August 10, 2023	
International Conference on Scientific Computation and Diff Eqs A Multirate Approach to Accelerating Time-Steppers with Surrogate Models Steven Roberts, Andrey A Popov, Arash Sarshar, and Adrian Sandu SIAM Annual Meeting Accelerating Time-Stepping Methods with Surrogate Models Steven Roberts, Andrey A Popov, Arash Sarshar, and Adrian Sandu	Reykjavík, Iceland July 27, 2022 Virtual July 13, 2022 DEs Virtual May 12, 2022	
		Workshop on Efficient High-Order Time Discretization Methods for PD Implicit-Explicit Generalized Additive Runge-Kutta Methods Steven Roberts and Adrian Sandu
International Conf on Computational Methods and Applications in EngineeringVirtualA Parallel Ensemble Approach to Constructing Stable, High-Order Time-SteppersMay 7, 2022Steven Roberts, Arash Sarshar, Adrian SanduMay 7, 2022		
SIAM Conference on Computational Science and Engineering A New Multirate Time-Stepping Strategy for ODE Systems Equipped with a Surrogate Model	Virtual	
Steven Roberts, Andrey A Popov, Arash Sarshar, and Adrian Sandu	Warch 5, 2021	
Sayas Numerics Seminar Parallel implicit-explicit general linear methods Steven Roberts, Arash Sarshar, and Adrian Sandu	Virtual October 20, 2020	
International Conference on Scientific Computation and Diff Eqs Implicit Multirate GARK Methods Steven Roberts, John Loffeld, Arash Sarshar, Adrian Sandu, and Carol Woodward	Innsbruck, Austria July 23, 2019	
Virginia Space Grant Consortium Student Research Conference <i>Practical Multirate Time Integration Methods</i> Steven Roberts and Adrian Sandu	Hampton, VA April 8, 2019	
SIAM Conference on Computational Science and Engineering <i>Implicit Multirate Generalized Additive Runge–Kutta Methods</i> Steven Roberts, John Loffeld, Arash Sarshar, Adrian Sandu, and Carol Woodward	Spokane, WA March 1, 2019	
Software		
ODE Test Problems A MATLAB suite of initial value problems Steven Roberts, Andrey Popov, Arash Sarshar, and Adrian Sandu https://github.com/ComputationalScienceLaboratory/ODE-Test-Problems	Lead Developer	
Integreat A Mathematica package for analyzing time integration methods Steven Roberts	Lead Developer	

https://github.com/ComputationalScienceLaboratory/Integreat