Sreeram Venkat

Computational Science · HPC · Digital Twins

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Education

Oden Institute, University of Texas Austin — *Austin, Texas*

Ph. D. Candidate in Computational Science, Engineering, and Mathematics (GPA: 4.0) — *August 2021 - Present*

Relevant Courses: Parallel Algorithms for Scientific Computing, Multiscale Methods in Computational Fluid Dynamics, Tools and Techniques for Computational Science, Stochastic Processes, Partial Differential Equations, Functional Analysis, Numerical Linear Algebra, Numerical PDEs, Mathematical Modeling (fluid/solid mechanics, electromagnetism, quantum mechanics, stat. mechanics)

Oden Institute, University of Texas Austin — *Austin, Texas*

M.S. in Computational Science, Engineering, and Mathematics (GPA: 4.0) — *August 2021 - August 2024*

Relevant Courses: See above.

North Carolina State University — *Raleigh, North Carolina*

B.S. in Applied Mathematics (GPA: 4.0), B.S. in Physics (GPA: 4.0) — *August 2017 - May 2021*

Relevant Courses: (*graduate level)**:** Mathematical Modeling*, Numerical Analysis*, Partial Differential Equations*, Functional Analysis and Measure Theory*, Linear and Lie Algebra*, Topology and Smooth Manifolds*, Riemannian Geometry*, Algebraic Topology*, Uncertainty Quantification*, Complex Analysis*, Abstract Algebra*, Data-Driven Methods*, Inverse Problems*, Probability Theory, Mechanics, Electromagnetism, Quantum Mechanics, Thermodynamics, General Relativity*.

Research Experience

Research Assistant — *Austin, Texas*

OPTIMUS — Advisor: Omar Ghattas — *August 2021 - Present*

- Developing framework for digital twins of extreme-scale physical phenomena with real-time inference capability — application to tsunami early-warning systems
- Designing and implementing algorithms that are scalable and incorporate hardware acceleration through GPUs
- Running applications at scale on large HPC machines at TACC

Argonne Training Program for Extreme-Scale Computing (ATPESC) — *St. Charles, IL*

Argonne National Laboratory — *July 2024 - August 2024*

- Attended two week training program on key skills, approaches, and tools needed to conduct computational science and engineering research on today's and tomorrow's high-end supercomputers.
- **Relevant Skills:** CUDA/HIP/SYCL, OpenMP, MPI, Profilers/Debuggers, AI/ML techniques, Software Sustainability, Visualization

Research Assistant — *Los Alamos, New Mexico*

Los Alamos National Laboratory XCP Summer Workshop on Computational Physics — Advisors: Bertrand Rouet-Leduc and Christopher Ren — *June 2021 - August 2021*

- Trained Generative Adversarial Networks (GANs) for generating synthetic InSAR data.
- Studied several architectures including Wasserstein GANs and Cycle GANs.
- Application to denoising networks for InSAR data.

Research Assistant — *Raleigh, North Carolina*

NSF Research Training Group, Applied Mathematics, North Carolina State University — Advisors: Tim Kelley and Ralph Smith — *October 2018 - May 2021*

- Developing reduced-order models that preserve conservation laws using linear and nonlinear projection methods.
- Creating software packages to enable easy implementation and reproduction of research methods.
- Working with several faculty members and graduate students in the Applied Mathematics department to discuss and learn methods for mathematical modeling, numerical analysis, and uncertainty quantification.

Research Assistant — *Los Angeles, California*

Computational and Applied Mathematics REU, UCLA — Advisors: Andrea Bertozzi, Weiqi Chu, Wen Li — *June 2020 - August 2020*

- Studied how the addition of nanopores in a silicon-based anode would affect the mechanical stress and strains in Li-Ion batteries.
- Created a finite-element solver for fourth-order, nonlinear, time-dependent system of PDEs.
- Analyzed hysteresis loops from numerical simulations to determine that the addition of nanopores increases the mechanical stability of the batteries over time.

Research Assistant

Ithaca, New York

Summer Program for Undergraduate Research in Mathematics, Cornell University — Advisors: Kasso Okoudjou (Tufts University), Robert Strichartz (Cornell)

June 2019 - August 2019

- Studied orthogonal polynomials on fractal domains such as the Sierpinski Gasket using analytical and numerical methods.
- Derived recurrence relations, interpolation rules, quadrature rules for Sobolev Orthogonal Polynomials on the Sierpinski Gasket.
- Created a comprehensive software package in Python that was used to study the properties of these polynomials and enable fast numerical implementations (`https://e.math.cornell.edu/sites/op_on_sg/html/`).

Summer Research Assistant

Raleigh, North Carolina

Research in Mathematical Modeling, North Carolina State University — Advisor: Ralph Smith

May 2018 - August 2018

- Developed numerical algorithms for using Mean Fischer Information Matrices for Global Sensitivity Analysis.
- Learned numerical analysis and linear algebra techniques using software libraries in Python and MATLAB.

Research Assistant

Durham, North Carolina

Research in Mathematics, North Carolina School of Science and Mathematics and Duke University — Advisors: William Pardon (Duke University) and Dan Teague (NCSSM)

August 2016 - May 2017

- Studied abstract algebra topics (group, ring, and field theory) to understand cryptology algorithms such as RSA.
- Implemented numerical algorithms for prime number tests and number-field sieves.

Research Assistant

Raleigh, North Carolina

Research in Physics, North Carolina State University — Advisor: Thomas Schaefer

May 2015 - February 2017

- Studied models of spintronic transistors and associated PDE models of spin diffusion.
- Learned how to search for, review, and analyze scientific literature as contextual information for research.

Publications

1. Henneking, S., Venkat, S., & Ghattas, O. (2025) Goal-Oriented Real-Time Bayesian Inference for Linear Autonomous Dynamical Systems With Application to Digital Twins for Tsunami Early Warning. *arXiv preprint* — submitted to JCP.
2. **Venkat, S.**, Fernando, .M, Henneking, S., & Ghattas, O. (2024) Fast and Scalable FFT-Based GPU-Accelerated Algorithms for Hessian-Vector Products Arising in Inverse Problems Governed by Autonomous Dynamical Systems. *arXiv preprint arXiv:2407.13066 (2024)* — in review at SISC.
3. **Venkat, S.**, Smith, R. C., & Kelley, C. T. (2021). Convolutional Autoencoders for Reduced-Order Modeling. arXiv preprint arXiv:2108.12453.
4. Jiang, Q., Lan, T., Okoudjou, K. A., Strichartz, R. S., Sule, S., **Venkat, S.**, & Wang, X. (2021). Sobolev Orthogonal Polynomials on the Sierpinski Gasket. *Journal of Fourier Analysis and Applications*, 27(3), 1-38.
5. **Venkat S**, Milind N, and Reddy, N. "Migration to Mars." The UMAP Journal 38, no. 2 (2017): 197-232.
6. **Venkat S.** "Developing a Flight Plan to Reduce Aircraft Noise Exposure in Cities ." AAAS 2017 Annual Meeting. February 16-20, 2017.

Presentations

Oral Presentation

Fort Worth, TX

SIAM CSE 2025

March 2025

Venkat, S., Fernando, .M, Henneking, S., & Ghattas, O. (2024) Fast and Scalable FFT-Based GPU-Accelerated Algorithms for Hessian-Vector Products Arising in Inverse Problems Governed by Autonomous Dynamical Systems.

Oral and Poster Presentation

Vancouver, British Columbia

WCCM-PANACM 2024

July 2024

Venkat, S., Fernando, .M, Henneking, S., & Ghattas, O. (2024) Real-Time High-Fidelity Algorithms for Extreme-Scale Bayesian Inverse Problems Involving Shift-Invariant Systems

Oral Presentation

Baltimore, Maryland

SIAM PP 2024

March 2024

Venkat, S., Fernando, .M, Henneking, S., & Ghattas, O. (2024) Fast and Scalable FFT-Based GPU-Accelerated Algorithms for Hessian-Vector Products Arising in Inverse Problems Governed by Autonomous Dynamical Systems

Oral Presentation

Atlanta, Georgia

SIAM UQ 2022

April 2022

Venkat, S., Smith, R. C., & Kelley, C. T. (2022). Convolutional Autoencoders for Reduced-Order Modeling.

Oral Presentation

Los Angeles, California

UCLA Summer Research Exhibition

July 2020

Bertozzi, A., Chu, W., Fromcke, T., Li, W., Schreiber, I., & **Venkat, S.** Phase-Separation and Volume Expansion in Lithium-Ion Batteries. Presented virtually at the UCLA Summer Research Exhibition for REU programs.

Oral and Poster Presentations

Various Locations

Young Mathematicians Conference 2019, NCSU Summer Research Symposium 2019, SUMS Conference 2019, Joint Mathematics Meeting 2020, Brown University SUMS Conference 2021

2019 - 2021

Jiang, Q., Lan, T., Okoudjou, K., Strichartz, R., Sule, S., **Venkat, S.**, & Wang, X. (2020). *Sobolev Orthogonal Polynomials on the Sierpinski Gasket.* Presented at the Young Mathematicians Conference 2019, NCSU Summer Research Symposium 2019, SUMS Conference 2019, Joint Mathematics Meeting 2020, and Brown University SUMS Conference 2021.

Extracurricular Activities

Participant

St. Charles, Illinois

Argonne Training Program for Extreme Scale Computing (ATPESC)

August 2024

- Learn skills for designing and implementing applications that can effectively leverage the power of exascale and leadership class computing facilities.
- Interact through hands-on demonstrations and talks with research and industry professionals in HPC.
- Gain experience running software on different HPC platforms with heterogeneous architectures (NVIDIA, AMD, Intel, etc.).

Ambassador

Raleigh, North Carolina

North Carolina Science Olympiad

October 2017 - May 2021

- Organize regional, state, and national tournaments by writing tests, volunteering at events, and working at outreach programs.
- Work with teams and schools in urban areas to help rural areas increase awareness and support for Science Olympiad.
- Advocate interdisciplinary thinking to young scientists in my community and beyond.

Goodnight Scholar

Raleigh, North Carolina

North Carolina State University

August 2017 - Present

- The Goodnight Scholarship at NC State University is a highly selective, merit scholarship awarded on the basis of outstanding accomplishments and potential in STEM.
- Participating in programs to increase STEM awareness and accessibility in NC; engaging in leadership and communication workshops; working with the NC Rural Center to address issues in health, broadband, and economy.
- Participating in programs to increase STEM awareness and accessibility in NC.

Service Raleigh Web Committee

Raleigh, North Carolina

North Carolina State University

August 2018 - Present

- Service Raleigh is an organization that holds an annual day of service to empower nonprofit organizations and charities in the community.
- Maintaining and upgrading the website for the Service Raleigh organization which allows volunteers and partner organizations to become a part of the initiative.

Undergraduate Research Club Outreach Coordinator

Raleigh, North Carolina

North Carolina State University

August 2018 - Present

- Lead workshops and information sessions to help new undergraduate students find research projects, learn research etiquette, and present their work.
- Work with faculty mentors to develop a mentor-matching program to match undergraduates with research programs.
- Increase awareness for research programs by working with other on-campus organizations.

Honors, Awards, & Grants

2024	**Best Paper**, USACM-TTA Student Competition on UQ and Probabilistic Modeling	*Vancouver, BC*
2024	**Best Poster**, WCCM Student Poster Competition on Data-Driven Modeling, UQ, and Optimization	*Vancouver, BC*
2024	**Co-Recipient**, ALCC Supercomputing Allocation on *Perlmutter-GPU*	*Berkeley, CA*
2021	**Recipent**, NSF Graduate Research Fellowship	*Alexandria, VA*
2021	**Recipent**, CSEM Fellowship, UT Austin Oden Institute	*Austin, TX*
2017	**Recipient**, US Presidential Scholar	*Washington D.C.*

Technical Skills

- **Computer Languages**: C/C++/CUDA, Python, Julia, MATLAB, Java, HTML/CSS/JavaScript, Netlogo, Maple, Mathematica, LabVIEW.
- **Software**: LaTeX, Microsoft Office, Google Apps, Vernier Logger Pro/Vernier Lab Software.