

Gopal R. Yalla | Curriculum Vitae

Department of Mechanical Engineering — The Johns Hopkins University
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Professional Summary

Computational scientist with a strong background in engineering and mathematics, specializing in mathematical modeling, high-performance computing, and numerical PDEs. Extensive proficiency and research experience in the fields of turbulence and turbulence modeling. Proven ability to work on both theoretical and applied problems. Eager to leverage computational skills and multidisciplinary expertise to tackle diverse, real-world applications.

Education

University of Texas at Austin

Oden Institute for Computational Engineering and Sciences

Ph.D., Computational Science, Engineering, and Mathematics

Concentration in Teaching and Mentoring

Austin, TX

2022

M.S., Computational Science, Engineering, and Mathematics

2017

College of the Holy Cross

B.A., Mathematics and Computer Science

Summa Cum Laude, Mathematics High Honors

Worcester, MA

2015

Research Experience

Postdoctoral Research at Johns Hopkins University

PI: Dr. Tamer Zaki

Baltimore, MD

2022-Present

Data Assimilation of Scalar and Velocity Observations in Stratified Turbulence

- Performing data assimilation on experimental sphere-wake measurements in a stratified fluid using adjoint-variational techniques. Analyzing the sensitivity of radiated internal gravity waves and the origin of vorticity structures in stratified wakes through adjoint-based statistical analysis.
- Contributing to the development of forward and discrete adjoint codes in Fortran using a fractional step, staggered grid representation of the Boussinesq equations in curvilinear coordinates with immersed boundary capabilities and MPI integration.

Doctoral Thesis at the University of Texas at Austin

Advisors: Dr. Robert Moser, Dr. Björn Engquist

Austin, TX

2016-2022

Numerical Discretization Effects in the Large Eddy Simulation of Turbulence

- Investigated the effects of numerical discretization on the flow represented in an LES including the issues of resolution inhomogeneity/anisotropy and numerical dispersion error. Developed subgrid-scale models capable of representing the statistical characteristics of the flow introduced by these complex discretizations.
- This work was part of the ECP: *Exascale Predictive Wind Plant Flow Physics Modeling* and was joint work with NREL, Sandia, and Oak Ridge. Several modeling advancements are being used in the *Nalu-Wind* codebase.
- Software development involved a hybrid MPI/OpenMP code written in Fortran/C++ that utilized a mixed Fourier-Bspline representation of the Navier-Stokes equations. Scientific computing packages included *FFTW*, *PETSC*, and *GSL*.

Collaborative Research at the University of Texas at Austin

PI: Dr. Björn Engquist

Austin, TX

2015-2017

Parallel in Time Algorithms for Multiscale Dynamical Systems

- Developed a coarse scale solver for a parallel-in-time algorithm that can be defined through interpolation or a neural network.
- Applied the algorithm to high oscillatory dynamical systems in molecular dynamics and celestial mechanics problems with strong forces localized in time.

Undergraduate Honors Thesis at College of the Holy Cross

PI: Dr. Edward Soares

Collaborators: Dr. Kevin Walsh, Dr. Amber Hupp

Worcester, MA

2013-2015

Classification and Statistical Analysis of Biofuels

- Developed a methodology for the optimization of chromatogram alignment using a class separability measure and applied the results to biodiesel data.
- Machine learning techniques were applied to the optimally aligned data to classify different biodiesels based on their chemical components.

Research Experience for Undergraduates at Brown University

Leadership Alliance Program

PI: Dr. Johnny Guzman

Collaborators: Sami Davis

Providence, RI

2014

On Globally Defined Solutions of the Generalized Constantin-Lax-Majda Equations

- Investigated the behavior of solutions of the generalized model vorticity equations to provide insight into the global existence and uniqueness of solutions to the Euler equations.

Research Experience for Undergraduates at College of the Holy Cross

PI: Dr. Gareth Roberts

Collaborators: Margaret Hauser

Worcester, MA

2013

Linearly Stable Equilibria Utilizing a Dominant Mass

- Investigated the effect of a dominant mass on the linear stability of relative equilibrium in n -body problems.

Publications

- 2023 **G. R. Yalla**, and R. D. Moser. "An Eddy-damped Quasi-normal Markovian theory for the filtered turbulence in LES" (in preparation).
- 2021 **G. R. Yalla**, T. A. Oliver, and R. D. Moser. "Numerical dispersion effects on the energy cascade in large-eddy simulation" *Physical Review Fluids*.
- 2021 R. D. Moser, S. W. Haering, and **G. R. Yalla**. "Statistical properties of subgrid-scale turbulence models" *Annual Review of Fluid Mechanics*.
- 2021 **G. R. Yalla**, T. A. Oliver, S. W. Haering, B. Engquist, and R. D. Moser. "Effects of resolution inhomogeneity in large-eddy simulation" *Physical Review Fluids*.
- 2018 **G. R. Yalla** and B. Engquist. "Parallel in time algorithms for multiscale dynamical systems using interpolation and neural networks" *Proceedings of the High Performance Computing Symposium*.
- 2015 E. J. Soares, **G. R. Yalla**, J. B. O'Connor, K. A. Walsh, and A. M. Hupp, "Hotelling trace criterion as a figure of merit for the optimization of chromatogram alignment" *Journal of Chemometrics*.

Contributed Talks

- 2022 **European Fluid Mechanics Conference 14**
Numerical dispersion effects on the energy cascade in LES and implications for SGS modeling.
- 2022 **Mechanical Engineering Seminar Series, The Johns Hopkins University**
Numerical Discretization Effects in Large Eddy Simulation.
- 2021 **Division of Fluid Dynamics, American Physical Society**
Discretization induced statistical artifacts in large-eddy simulation.
- 2020 **Division of Fluid Dynamics, American Physical Society**
Impacts of numerical discretization on large eddy simulation.
- 2019 **Division of Fluid Dynamics, American Physical Society**
Modeling the effects of resolution inhomogeneity on large eddy simulation.
- 2018 **High Performance Computing Symposium, SCS Spring Simulation Multi-Conference**
Parallel in time algorithms for multiscale dynamical systems using interpolation and neural networks.
- 2018 **Student Forum Series, Institute for Computational Engineering and Sciences**
Parallel in time algorithms for multiscale dynamical systems using interpolation and neural networks.
- 2015 **Joint Mathematics Meeting, Statistics Special Session**
Hotelling trace criterion as a figure of merit for the optimization of chromatogram alignment.
- 2014 **Brown University Summer Research Symposium**
On globally defined solutions of the generalized Constantin-Lax-Majda equation.
- 2014 **Leadership Alliance National Symposium**
On globally defined solutions of the generalized Constantin-Lax-Majda equation.

Honors and Awards

Awards

- 2022 **Oden Institute Outstanding Dissertation Award**, University of Texas at Austin
- 2021 **SIAM Mentorship Certificate of Recognition**, University of Texas at Austin
- 2019 **Professional Development Award**, University of Texas at Austin
- 2019 **SIAM Certificate of Recognition**, University of Texas at Austin
- 2019 **Teaching Preparation Certificate of Recognition**, University of Texas at Austin
- 2015 **The Gertrude McBrien Mathematics Prize**, College of the Holy Cross

Fellowships

- 2015 **CSEM Fellowship**, University of Texas at Austin
- 2015 **National Science Foundation Graduate Research Fellowship**, Honorable Mention

Technical Skills

Programming Languages

C++, Fortran, Python, Bash, MATLAB

Software Development

Operating Systems: *Unix/Linux, MacOS*

HPC: *MPI, OpenMP*

Version Control: *Git, Svn*

Documentation: *Doxygen, Sphinx*

Testing: *Unit/Verification Tests, Icov*

Profiling: *Tau, gprof, cProfile/snakeviz*

Build Systems: *Make*

Visualization Tools: *Paraview, Tecplot*

Technical Writing: *Latex*

Computer Science

HPC, Computer Architecture, Data Structures, Algorithms, Machine learning, basic Networking

Mathematics

Numerical PDEs and Linear Algebra, Multiscale Modeling, Optimization/Inverse Problems, Probability/Statistics, Real/Functional Analysis, basic Uncertainty Quantification

Science and Engineering

Turbulence Theory and Modeling, Fluid Mechanics, DNS/LES/RANS, Stratified Flows, basic E&M, Molecular Dynamics, and Quantum Mechanics

Leadership and Service

Leadership

2016 - 2020 **President**, *UT Austin's Chapter of the Society for Industrial and Applied Mathematics*
Fostering a community of mathematicians, scientists, and engineers by hosting conferences, research/industry talks, reading groups, and social events.

2017 - 2018 **Co-organizer**, *UT SIAM Data Science Team*
Organized instructional activities and participated in competitions related to data science applications.

2016 - 2017 **Graduate Student Assembly Representative**, *Oden Institute*
Represented the Oden Institute at the Graduate Student Assembly.

2011 - 2015 **Chair**, *Student Advisory Committee*
Represented students at faculty meetings and acted as a liaison between students and faculty.

2013 - 2015 **President**, *Mathematics and Computer Science Club*
Led the organization of academic and social events to promote mathematics and computer science at the College of the Holy Cross.

2014 - 2015 **Vice-President**, *Holy Cross's Chapter of Pi-Mu-Epsilon Honor Society*
Promoted the mission of Pi Mu Epsilon mathematics honor society.

2014 - 2015 **Head Tutor**, *Holy Cross Calculus Workshop*
Led a nightly workshop of calculus tutors.

Service

2023 **Collaboration with the Army's 82nd Airborne Division**
Performing statistical analysis of Serious Incident Report (SIR) data to quantify the effectiveness of current strategies to reduce

- 2021 **SIAM Applied Mathematics Mentorship Program**
Mentored an undergraduate student interested in graduate studies in applied mathematics and engineering. Developed an NSF-GRFP proposal that was awarded to the student.
- 2017 **Texas Applied Mathematics and Engineering Symposium**
Co-organized a conference that brought together nearly one hundred researchers from over twenty different universities. The conference was picked up by the Texas-Louisiana Section of SIAM and turned into an annual conference. Learn more at <https://users.oden.utexas.edu/~gopal/tames.io>.
- 2016-2021 **SIAM Industry Series**
An on-going seminar series geared at connecting students with companies in industry and national labs.
- 2016 - 2017 **Oden Institute Graduate Student Representative**
Acted as the official avenue for student concerns, assisted the Graduate Coordinator, and represented students at the annual Board of Visitors meeting.
- 2012-2015 **Tutor, Holy Cross's Calculus Workshop**
Worked as a calculus tutor for fellow students.
- 2012 **Noyce Scholar, Nativity School of Worcester**
Taught and mentored underprivileged middle school students during an internship at the Nativity School of Worcester.

Teaching

Experience

Graduate Courses

- 2019 **Teaching Assistant, Introduction to Mathematical Modeling in Science and Engineering**, University of Texas at Austin

Undergraduate Courses

- 2013-2015 **Teaching Assistant, Data Structures**, College of the Holy Cross
 2015 **Teaching Assistant, Multivariable Calculus**, College of the Holy Cross
 2015 **Teaching Assistant, Linear Algebra**, College of the Holy Cross

Pedagogical Training

TIDES: Concentration in Teaching and Mentoring

UT Austin

A program comprised of four semester-long requirements that foster fundamental teaching strategies and explore integrated course design principles.

Evidence-Based Teaching, TIDES

Spring 2018

- Focused on the ability to select instructional topics based on common challenges and misconceptions, developed appropriate assessments and learning objectives, and explored active learning strategies.

Inclusive Teaching, TIDES

Fall 2018

- Explored a range of student diversity and backgrounds, recognized implicit bias and stereotyping are solvable problems in student retention, proposed approaches to leverage diversity to enhance learning experience, and identified strategies for making classrooms more inclusive.

Lesson Plan Development, TIDES

Spring 2019

- Centered around creating lesson plans using backward design.

Instructional Practice, TIDES

Fall 2019

- Implemented a unique lesson plan using active learning strategies in a first year graduate course.

Teaching Preparation Series

UT Austin

Seminar series to learn, observe, practice, receive feedback on, and reflect upon classroom teaching techniques.

Workshops

Argonne Training Program on Extreme-Scale Computing

Argonne National Lab

Saint Charles, IL

2017

Multiscale Problems: Algorithms, Numerical Analysis and Computation

Hausdorff Research Institute for Mathematics

Bonn, Germany

2017

Scientific Computing in Python

Texas Advanced Computing Center

Austin, TX

2016

Integrating Dynamics and Stochastics

Brown University

Providence, RI

2015

Professional Organizations

American Physical Society, Society for Industrial and Applied Mathematics