ADITYA KARTHIK SARAVANAKUMAR

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Research Interests: Computational Fluid Dynamics, Machine Learning, Finite Element Analysis, High-Performance Computing

EDUCATION

Doctor of Philosophy, Massachusetts Institute of Technology — **May 2023 - Present**
Major: Scientific Computing and Mechanical Engineering — GPA: 5.00/5.00
Minor: Machine Learning

Master of Science, Massachusetts Institute of Technology — **Sep 2021 - May 2023**
Major: Computational Science and Engineering — GPA: 5.00/5.00

Bachelor of Engineering, Birla Institute of Technology & Science — **Sep 2017 - May 2021**
Major: Mechanical Engineering — GPA: 9.78/10.00

AWARDS

DAAD WISE 2020 Fellowship
Fully-funded 12-week internship at RWTH Aachen University

Undergraduate Merit Scholarship
Full-tuition waiver awarded to students with GPA in the top 1%

PROGRAMMING LANGUAGES AND SIMULATION FRAMEWORKS

C++ Python PyTorch git vim bash ANSYS Fluent COMSOL deal.II FEniCS SolidWorks

RESEARCH PROJECTS

Development of an Adaptive High-Order Locally Non-Hydrostatic Ocean Model — **Massachusetts Institute of Technology**
Graduate Research Project | Guide: Prof. Pierre Lermusiaux — *Sep 2021 - Ongoing*
Designed a novel ocean model that locally resolves complex dynamics and achieves computational savings compared to traditional globally-non-hydrostatic models. Currently incorporating this model into a C++ hybridizable Discontinuous Galerkin solver and devising numerical techniques to overcome computational limitations and conduct large-scale regional ocean simulations.

Machine Learning and Stochastic Modeling Projects — **Massachusetts Institute of Technology**
Reinforcement Learning: Deep reinforcement learning models to precondition linear systems arising from PDE discretization.
Deep Learning: Vision transformer models, optimized for GPUs, to predict large multi-scale time-series fluid dynamics data.
Numerical Methods for Stochastic PDE: Multilevel Monte Carlo methods for variance reduction in stochastic elliptic PDE solutions.

Analysis and Extension of a Rarefied Gas Dynamics Solver — **RWTH Aachen University**
Bachelor Thesis | Guide: Prof. Manuel Torrilhon — *May 2020 - Jan 2021*
Studied the stability of a FEniCS-based Discontinuous Galerkin FEM solver that solves the linearized regularized 13 (R13) moment equations to study non-equilibrium gas dynamics problems. Extended solver to accommodate non-linear conservation equations.

Numerical Investigation of Flapping Dynamics of Multi-Layered Plates — **Birla Institute of Technology and Science**
Undergraduate Research Project | Guide: Prof. Pardha S. Gurugubelli — *Feb 2020 - May 2021*
Employed a MATLAB-based finite element method code to study fluid-structure interaction dynamics of multi-layered plates flapping in a uniform flow. Enhanced solver to allow coupling between high-order fluid elements and low-order structural elements.

Detached Eddy Simulations of Flow Past Cylinder at High Reynolds Numbers — **Birla Institute of Technology and Science**
Undergraduate Research Project | Guide: Prof. Sabareesh G. Rajasekharan — *Aug 2019 - Jan 2021*
Optimized building design for the LIGO India observatory to minimize wind load and vibrations through corner modification and windbreaks. Executed 3D Detached Eddy Simulations on ANSYS FLUENT to capture turbulence at high Reynolds number regimes.

INDUSTRY EXPERIENCE

Magnetohydrodynamic Simulations of Flow in Induction Pumps — **Indira Gandhi Center for Atomic Research**
Research Intern (Thermal Hydraulics Division) | Guide: Dr. Kumaresan Natesan — *May 2019 - Jul 2019*
Simulated MHD flows by coupling Navier-Stokes and Maxwell's equations in COMSOL. Validated the method with Hunt's benchmark laminar solution and conducted preliminary simulations for Annular Linear Induction Pumps used in fast breeder reactors.

PUBLICATIONS

Saravanakumar, A. K., C. Foucart, C. Mirabito, P. J. Haley Jr., and P. F. J. Lermusiaux (2024). "An Adaptive High-Order Locally-Non-Hydrostatic Ocean Model". In: To be submitted to Ocean Modeling.

Saravanakumar, A. K. (2023). "Towards Coupled Nonhydrostatic-Hydrostatic Hybridizable Discontinuous Galerkin Method". SM thesis. Massachusetts Institute of Technology, Computational Science and Engineering.

Saravanakumar, A. K., K. Supradeepan, et al. (2021). "A numerical study on flapping dynamics of a flexible two-layered plate in a uniform flow". In: *Physics of Fluids* 33.1, p. 017108. ISSN: 1070-6631. DOI: 10.1063/5.0033049.

Vishwanath, N., A. K. **Saravanakumar**, et al. (2022). "3D Numerical investigation of a rounded corner square cylinder for supercritical flows". In: *Wind and Structures* 35.1, pp. 55–66. ISSN: 1226-6116. DOI: 10.12989/was.2022.35.1.055.

Brahmini Priya, P. V., A. K. **Saravanakumar**, et al. (2023). "Numerical Analysis of Two-Degrees of Freedom Vortex-Induced Vibrations of an Elastically Mounted Circular Cylinder Placed Very Close to a Wall". In: *Sub-Judice*. DOI: 10.2139/ssrn.4470199.

PRESENTATIONS

Saravanakumar, A. K., C. Foucart, C. Mirabito, P. J. Haley, and P. F. Lermusiaux (2024a). "Adaptive Nonhydrostatic-Hydrostatic Hybridizable Discontinuous Galerkin Ocean Solver". In: *Ocean Sciences Meeting, New Orleans, Louisiana, 2024*. AGU.

Saravanakumar, A. K., C. Foucart, C. Mirabito, P. J. Haley, and P. F. Lermusiaux (2024b). "An Adaptive High Order Locally-Nonhydrostatic Ocean Solver". In: *Mathematics of Planet Earth, Portland, Oregan, 2024*. SIAM.