Atharva Sunil Sathe

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Education

Columbia University in the city of New York Jan 2021 - Present
Doctor of Philosophy in Civil Engineering & Engineering Mechanics *New York, NY*
Specialties: Environmental Fluid Mechanics, Urban Climate, Turbulence Modeling, High Performance Computing

Indian Institute of Technology Bombay July 2015 - Aug 2020
Bachelor-cum-Master of Technology (Dual Degree) in Aerospace Engineering (GPA: 9.39 / 10.00) *Mumbai, MH*
Specialties: Computational Fluid Dynamics, Numerical Modeling, High Performance Computing

Research Experience

Columbia University Jan 2021 – Present
Graduate Researcher, Environmental Flow Physics Lab *New York, NY*

Project #1: *Published in JFM, 3 Conference Presentations*

- Conducted a comprehensive analysis of domain size impacts in canopy flow simulations, demonstrating how inadequate sizing compromises turbulent structures and flow statistics.
- Identified significant flaws in conventional scale separation testing method. Developed a novel, superior alternative for accurate isolation of scale separation effects.
- Discovered a critical interplay between canopy element arrangement and the existence of inertial sublayer in the atmosphere, challenging the previous understanding that scale separation was the sole factor.

Project #2: *Under preparation for submission to JFM, 2 Conference Presentations*

- Investigated the structure and dynamics of roughness-induced secondary flows in turbulent boundary layers over multi-column roughness, revealing the critical role of topographic clustering.
- Identified the spacing of roughness elements at cluster edges as a crucial factor determining secondary flow polarity.
- Analyzed the instantaneous behavior of secondary flows, demonstrating their inherent unsteadiness and the non-periodic, chaotic reversals of high- and low-momentum pathways.
- Showcased the persistent and intrinsic variability in vertical momentum transport as a fundamental characteristic of secondary flow dynamics.

Indian Institute of Technology Bombay July 2015 – Aug 2020
Undergraduate and Graduate Researcher *Mumbai, MH*

Master Thesis Project: *Published in IEEE–ICCE*

- Developed a novel multidimensional extension of the Large Time-Step (LTS) method using the Radon Transform's intertwining property, addressing errors common in dimensional splitting.
- Validated the algorithm for electromagnetic wave propagation, achieving a remarkable 14x speedup while simultaneously reducing error by a factor of 4.
- Proved the effectiveness of the first-order Mur absorption boundary condition within this approach, demonstrating its ability to minimize reflections.

Bachelor Thesis Project:

- Contributed to the development of arcFOAM, a magnetohydrodynamic solver built upon sonicFOAM with the addition of essential source terms in the momentum and enthalpy conservation equations.
- Validated arcFOAM against both the analytical solution for current flow in an infinite rod and by replicating results from the 2D transferred arc geometry presented in Sass-Tissovskaya thesis.
- Employed arcFOAM to investigate flow properties in arc heaters, simulating various arc lengths (4mm, 10mm, 20mm) to gain comprehensive insights.

Peer Reviewed Journal and Conference Publications

- **Sathe, A.S.** and Giometto, M.G. (2024) 'Impact of the numerical domain on turbulent flow statistics: scalings and considerations for canopy flows', Journal of Fluid Mechanics, 979, p. A36. doi:10.1017/jfm.2023.1041.
- **Sathe A.S.**, Anderson W., Calaf M., Giometto M.G., (2025) 'On the structure and dynamics of secondary flows over multi-column roughness in turbulent boundary layers', Journal of Fluid Mechanics *(under preparation)*

- Schmid, M.F., **Sathe, A.S.**, Giometto, M.G. (2025) 'Towards residual-free turbulent budget closure in numerical simulations of complex flows', Boundary Layer Meteorology *(under preparation)*
- **Sathe, A.S.**, Makwana, N., Chatterjee, A., Pillai, H. (2020) 'FVTD Large Time-Step Method Using Radon Transform', IEEE International Conference on Computational Electromagnetics, Singapore, 25-27 March.

Selected Conference Presentations

- **Sathe A.S.,** Anderson W., Calaf M., Giometto M.G., Rearrangement of secondary flows in multi-column roughness configurations. *Oral Presentation.* In APS DFD Meeting, November 2024, Salt Lake City, Utah.
- **Sathe A.S.,** Anderson W., Calaf M., Giometto M.G., Rearrangement of secondary flows in multi-column roughness configurations. *Oral Presentation.* In AGU Fall Meeting, December 2024, Washington D.C.
- **Sathe A.S.,** Giometto M.G., Impact of numerical domain on turbulent flow statistics: scalings and considerations for canopy flows. *Oral Presentation.* In APS DFD Meeting, November 2023, Washington D.C.
- **Sathe A.S.,** Giometto M.G., Impact of numerical domain on turbulent flow statistics: scalings and considerations for canopy flows. *Poster Presentation.* In AGU Fall Meeting, December 2023, San Francisco, California.
- **Sathe A.S.,** Giometto M.G., Impact of numerical domain on turbulent flow statistics: scalings and considerations for canopy flows. *Oral Presentation.* In AGU Fall Meeting, December 2022, Chicago, IL.

Academic Service

- Reviewer, *Boundary Layer Meteorology* and *Philosophical Transactions of the Royal Society A*.
- Sorter, Wind Energy Sessions, *APS Division of Fluid Dynamics (DFD) Meeting*, November 2024, Salt Lake City, Utah.

Teaching and Mentorship

- Received **two Teaching Assistant Excellence Awards** at Columbia University for outstanding student mentorship and instruction: one for Fluid Mechanics (2022), and another for Dynamics and Vibrations (2023).
- Delivered substitute lectures at Columbia University:
  - Graduate course (Turbulence Theory and Modeling, Spring 2024): Taught Kolmogorov hypotheses and similarity laws.
  - Undergraduate course (Fluid Mechanics, Fall 2024): Explained derivations of Euler and Navier-Stokes equations.
- Institute Student Mentor at IIT Bombay (2017–2020): Mentored 22 freshmen students across two years, providing academic, social, and wellness support; promoted to Senior Mentor to lead and train a cohort of 15 mentors.

Scholastic Achievements

- Awarded **Institute Silver Medal** at 58th Convocation, IIT Bombay 2020
- **Ranked 1st** in the Dual Degree batch of the Aerospace Engineering Department.
- Awarded the prestigious **NTU-India connect program scholarship** for academic excellence. 2018
- Earned the **Institute Academic Award** for exceptional academic performance. 2017
- Secured a **top 0.71%** percentile in JEE (Advanced) and a **top 0.14%** percentile in JEE (Main). 2015
- Qualified for the Indian National Chemistry Olympiad, placing within the **top 1%** of participants nationwide. 2015

High Performance Computing Grants

Our research relies heavily on high-fidelity simulations of turbulent boundary layers, which require significant high performance computing (HPC) resources. I have taken primary responsibility for writing and submitting successful HPC proposals to XSEDE, TACC, and ACCESS programs on behalf of our group. Selected awarded projects include:

- **550,400** Node Hours on Stampede3 and **90M** Core Hours on Anvil *(ACCESS — $489,045)* 2024-2025
  Investigators: PI: Giometto M.G., Co-PIs: Sathe A.S., Chandiramani P., Schmid M.F., Janin J.A., Sathia K.R.
- **152k** Node Hours on Frontera *(TACC — $35,409)* 2024-2025
  Investigators: PI: Giometto M.G., Co-PI: Sathe A.S.
- **69M** Core Hours on Anvil *(ACCESS — $287,040)* 2023-2024
  Investigators: PI: Giometto M.G., Co-PIs: Sathe A.S., Schmid M.F., Chandiramani P.
- **144k** Node Hours on Frontera *(TACC — $33,546)* 2023-2024
  Investigators: PI: Giometto M.G., Co-PI: Sathe A.S.

Technical Skills

Softwares: MATLAB, ANSYS, OpenFOAM, Gmsh, Maple, Solidworks, AutoCAD
Programming: Python, FORTRAN, C++, C, CUDA, OpenGL

Extracurricular Activities

Experiment Leader: Paper Planes Unleashed — Girls' Science Day, Columbia University Nov 2023, 2024

- Contributed to Columbia Engineering's Girls' Science Day, leading hands-on science experiment for middle school girls and fostering STEM interest within NYC communities.
- Designed an engaging experiment demonstrating how principles of aircraft design can be applied to enhance paper plane flight using a single paper clip.

Counseling and Training Cabinet Head — Student Mentor Program, IIT Bombay July 2018 – May 2020

- Led a collaboration between the Student Wellness Center and Student Mentor Program, driving 100% undergraduate participation in mental health screening through innovative integration into mentor-led activities.
- Orchestrated institute-wide orientation for new department academic mentors (DAMP), incorporating faculty introductions, program objectives, and counselor-led case studies to promote mentor-student connection.
- Partnered with TATA Institute of Social Sciences to design and deliver an 8-hour mentor training program focused on communication and problem-solving skills.
- Organized mandatory POSH orientation for first-year students, promoting a gender-neutral campus at IIT Bombay.
- Revamped the Institute Student Mentor and DAMP Mentor handbooks and updated the First-Year Student Guide, enhancing mentor knowledge and promoting academic ethics, institute rules, and campus engagement for students.