

Gaurav Kumar

Postdoctoral Researcher

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[[Google scholar](#)] [[Github](#)] [[Homepage](#)]

EDUCATION

Indian Institute of Technology (IIT), Kanpur

Ph.D, Aerospace Engineering | GPA: 9.0/10.0

Kanpur, India

Aug 2016 – Mar 2021

Indian Institute of Technology (IIT), Kanpur

*B.Tech - M.Tech (Dual Degree), Aerospace Engineering
GPA: 10.0/10.0 (PG), 7.7/10.0 (UG)*

Kanpur, India

Jul 2011 – Jul 2016

WORK EXPERIENCE

Postdoctoral Research Associate

Nair's Lab, University of Nevada, Reno

Mentor: Dr. Aditya Nair

Reno, Nevada, USA

Mar 2023 – Current

- Developed an accurate and efficient Adaptive Mesh Refinement strategy for high resolution CFD simulations based on the idea of interaction maximization among flow features. [[Conference](#)]
- Developed a turbulent flow control strategy called selective modification of flow invariants; Currently working on applications related to optimization of aerodynamic performances in practical scenarios. [[Publication](#)][[Conference](#)]
- Developed a GPU-accelerated compressible flow solver in OpenFOAM capable of simulating wide range of flows from subsonic to hypersonic Mach numbers. [[Github](#)]
- Developing data driven analysis techniques to extract and analyse important flow dynamics and stability properties of a complex dynamical system. [[Github](#)]
- Trained 2 undergraduate and 4 graduate students in fluid dynamics, programming and CFD research.

Postdoctoral Research Associate

TSFPE Lab, Indian Institute of Science

Mentor: Dr. Duvvuri Subrahmanyam

Bengaluru, India

Apr 2021 – Feb 2023

- Conducted experiments in hypersonic wind tunnel and simulated corresponding flows to understand aeroacoustic resonance mechanism in compressible flows which addresses a crucial design challenge in hypersonic flight vehicles. [[Publication1](#)] [[Publication2](#)]
- Performed Spectral Proper Orthogonal Decomposition to clean noisy experimental data and extract meaningful information from the fluid flow data. [[Video](#)] [[Publication](#)]
- Worked on several collaborative projects in the research group providing CFD expertise to successfully achieve project goals. [[Publication](#)]
- Mentored 1 undergraduate and 2 graduate students on their research projects.

Research Assistant

*Institute of High Performance Computing, A*STAR, Singapore*

Mentors: Dr. Harish Gopalan, Dr. Vinh-Tan Nguyen

Singapore

Jan 2016 – May 2016

- Performed hybrid RANS-LES turbulent flow simulations over square columns that support oil rigs.
- Developed reduced-order force prediction models using Principal Component Analysis (PCA) and Dynamic Mode Decomposition (DMD) to model the vortex induced vibration of square columns.

Research Assistant

National Aerospace Laboratories (NAL), Bangalore, India

Mentor: Dr. Venkat Iyengar

Bengaluru, India

May 2014 – July 2014

- Surveyed the global progress in research and development on *endothermic fuel technology* for propulsion and cooling in Scramjet engines of hypersonic flight vehicles.
 - Planned a road-map to develop and incorporate this technology in an indigenously designed Scramjet engine in India and realize a Technology Readiness Level up to 4.
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THESIS PROJECTS

Doctoral Research

Numerical study of viscous interaction between shock waves and separation region
Advisor: Prof. Ashoke De, IIT Kanpur, India

Aug 2016 – Mar 2021

[\[Thesis document\]](#)

- Designed and implemented a new high-fidelity parallelized solution algorithm for solving compressible flows in a C++ based OpenFOAM CFD toolbox. [\[Publication\]](#) [\[Github\]](#)
- Simulated high-speed flow configurations over hypersonic vehicle intake using this new solution algorithm to understand instabilities arising from unsteady interactions between shock-waves and separation region. [\[Publication\]](#)
- Identified 2 major types of flow unsteadiness in shock-wave separation-region interaction namely pulsation and oscillation and another rare type of unsteadiness called vibration. [\[Publication\]](#)
- Initiated hypersonic flow research in the lab and developed state-of-the-art CFD capabilities which led to a large research grant approval from Defense Research and Development Organisation, India to study the unstart characteristics of hypersonic intakes in the lab.
- Mentored 1 master's student in OpenFOAM CFD simulations and aeroelasticity for research towards dissertation. [\[Publication\]](#)

Master's Research

Investigation of turbulent separated flow using hybrid RANS-LES models
Advisors: Prof. Ashoke De, IIT Kanpur, India,
Dr. Harish Gopalan, IHPC, A*STAR, Singapore

May 2015 – Jun 2016

[\[Thesis document\]](#)

- Developed a non-linear hybrid RANS-LES turbulence model in OpenFOAM CFD toolbox for accurate prediction of flow separation in numerical simulations. [\[Publication\]](#)
- Demonstrated improved accuracy and low grid sensitivity of the new turbulence model for predicting massive flow separations. [\[Publication\]](#)
- Collaborated on a project to demonstrate improved prediction of flow transition in a laminar separation bubble using non-linear unsteady RANS simulations. [\[Publication\]](#).

AWARD

- A research grant of INR 2.2 million under National Postdoctoral Fellowship (2022) awarded by SERB, Department of Science and Technology, India

SKILLS

Programming & Scripting languages: C, C++, Python, Matlab, Octave, BASH, L^AT_EX.

Programming libraries: Numpy, Pandas, Scikit, Seaborn, Pytorch, OpenCV, CUDA, MPI.

Computational Tools: OpenFOAM CFD toolbox, Ansys CFD Tools, High performance computing tools.

Experimental Techniques: Flow visualisation using Schlieren and Shadowgraphy, High speed imaging and image processing, pressure measurement using pressure transducers.

Softwares: Paraview, Tecplot, Gnuplot, Inkscape, Microsoft office.

Languages: English (Professional working proficiency), German (Elementary), Chinese (Elementary).

INITIATIVES, SERVICES & EXTRA-CURRICULAR ACTIVITIES

- Started a lecture series called '*Thursday CFD Series*' for teaching numerical methods and Computational Fluid Dynamics (CFD) to undergraduate and graduate students joining from University of Nevada Reno and IIT Madras. [\[Link\]](#)
- Started an internet blog for sharing ideas with CFD enthusiasts. [\[Link\]](#)
- Active member in an NSF funded AI research collaboration. ([AI Institute in Dynamic Systems](#))
- Referee for journals and conferences such as Physics of Fluids, Journal of computational physics, International Journal of Heat and Fluid Flow, AIAA SciTech conference *etc.*
- I like to go hiking and play tennis for recreation and fun.