Gaurav Kumar

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EDUCATION

Indian Institute of Technology (IIT), Kanpur — *Kanpur, India*
Ph.D, Aerospace Engineering | GPA: 9.0/10.0 — *Aug 2016 – Mar 2021*

Indian Institute of Technology (IIT), Kanpur — *Kanpur, India*
B.Tech - M.Tech (Dual Degree), Aerospace Engineering
GPA: 10.0/10.0 (PG), 7.7/10.0 (UG) — *Jul 2011 – Jul 2016*

WORK EXPERIENCE

Postdoctoral Research Associate — *Reno, Nevada, USA*
Nair's Lab, University of Nevada, Reno — *Mar 2023 – Current*
Mentor: Dr. Aditya Nair

- 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 — *Bengaluru, India*
TSFPE Lab, Indian Institute of Science — *Apr 2021 – Feb 2023*
Mentor: Dr. Duvvuri Subrahmanyam

- Conducted experiments in hypersonic wind tunnel and simulated corresponding flows to understand aeroacoustic resonance mechanisms in compressible flows. **[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 — *Singapore*
*Institute of High Performance Computing, A*STAR, Singapore* — *Jan 2016 – May 2016*
Mentors: Dr. Harish Gopalan, Dr. Vinh-Tan Nguyen

- 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 — *Bengaluru, India*
National Aerospace Laboratories (NAL), Bangalore, India — *May 2014 – July 2014*
Mentor: Dr. Venkat Iyengar

- Surveyed the global progress in research and development on *endothermic fuel technology* for propulsion and cooling in Scramjet Engines.
- 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.

THESIS PROJECTS

Doctoral Research *Aug 2016 – Mar 2021*
Numerical study of viscous interaction between shock waves and separation region **[Thesis document]**
Advisor: Prof. Ashoke De, IIT Kanpur, India

- 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 using this new solution algorithm to understand 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 *May 2015 – Jun 2016*
Investigation of turbulent separated flow using hybrid RANS-LES models **[Thesis document]**
Advisors: Prof. Ashoke De, IIT Kanpur, India,
*Dr. Harish Gopalan, IHPC, A*STAR, Singapore*

- 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

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SKILLS

Programming & Scripting languages: C, C++, Python, Matlab, Octave, BASH, LaTeX.

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.