# Gaurav **Gupta**

Scientist/Engineer-SC

*Space Application Centre, Ahmedabad*

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## Summary


Fluid dynamicist specializing in computational studies of biological and bio-inspired flow problems. Primary experience encompasses investigating avian flight aerodynamics, modeling microgravity two-phase flows, and developing custom flow-solver and post-processing subroutines in Fortran and Python respectively. Currently working on capillary-driven flows and interfacial phenomena under microgravity at ISRO.

**Research Interests:** Biological fluid mechanics; animal locomotion; low-Reynolds number aerodynamics; vortex dynamics; fluid-structure interactions; turbulent and interfacial flows.


## Research Experience

### Space Application Centre, Indian Space Research Organization (ISRO)

*Ahmedabad, Gujarat*

Scientist/Engineer - SC

*Jul. 2025 - Present*

***Microgravity Fluid Mechanics***

- Formulated the conceptual system architecture for a space-based recirculating aquatic life support payload.
- Conducted **two-phase simulations** to investigate the **capillary-driven fluid flow and transport** under microgravity using OpenFOAM.
- Currently, investigating stability and dynamics of an **air-water interface** under microgravity using OpenFOAM.
- Member of Gravity-dependent Research and Development Task Team.

***Opto-Mechanical Engineering for Opto-Quantum Payloads***

- Developed space-qualified opto-mechanical systems and automated CAD/CAE workflows using Siemens NX Open

### Indian Institute of Technology, Kharagpur

*Kharagpur, India*

Research Intern (Supervisors: Dr. Sandeep Saha and Dr. Manu K. V.)

*Mar. 2023 - May. 2025*

- Investigated **avian-tail aerodynamics** in gliding flight through **high-fidelity computational methods**, with emphasis on assessing the influence of tail geometry.
- Developed a representative common swift geometry based on the experimental configuration of P.Henningsson et al. (2011) to enable comparison with the published data.
- Constructed a structured mesh of the common swift geometry using multi-block topology in Pointwise
- Investigated high-fidelity computational approaches, evaluating the suitability of **DNS**, **RANS-assisted DNS**, **DES** and **RANS** methods for resolving flow features and wake vortices at relevant Re.
- Conducted **2D RANS-assisted DNS** (using NEK5000), and **3D hybrid LES-RANS** (using SU2) of the common swift geometry at $Re = 10000 - 20000$.
- Contributed to an **ANRF** research proposal integrating avian aerodynamics and biological studies of tail morphology and evolution, in collaboration with the **Zoological Survey of India (ZSI)**.

## Education

### Indian Institute of Space Science and Technology

*Thiruvananthapuram, India*

B.Tech. in Aerospace Engineering

*Dec. 2021 - Jun. 2025*

- Cumulative Grade Point Average (CGPA): 8.28/10
- Relevant coursework: Aerodynamics, Computational Fluid Dynamics, Aircraft Design, Boundary Layer Theory, Finite Element Method, Flight Dynamics & Control, Introduction to Astrobiology

## Scientific Software & Open-Source Contributions

### Incompact3D

*CFD, Fortran*

High-order finite difference flow solver

- Developed and integrated a Fortran subroutine calculating aerodynamic forces from **3D immersed body simulations** in Incompact3D.
- Working on improving the performance of importing STL files for high-fidelity simulations using Incompact3D.

### PyMech

*CFD, Python, NEK5000*

A Python software suite for NEK5000 and SIMSON

- Improving the in-built open_dataset function to support unstructured datasets produced using NEK5000.
- Used for post-processing of high-fidelity simulation data using NEK5000.

### TurbCourse

*CFD, Python, NEK5000*

A course in Turbulence simulation

- Developed and optimized **POD** and **DMD** modules for extracting coherent structures and frequency data from high-fidelity simulations.
- Uses PyMech for reading/writing of NEK5000 data.

**FreeFEM-Euler** *CFD, FreeFEM++, GMSH*

FreeFEM based incompressible Euler solver.

- An incompressible inviscid flow solver based on **Artificial Compressibility Method** was developed using FreeFEM++.
- The code is capable of solving 2D problems based on in-built FreeFEM++ and GMSH meshes.

# Publications

## Research Articles

[1] **Gaurav Gupta** and Md Laraib Salam, "Determining surface tension of various liquids and shear modulus of paper using crumpling effect," *Journal of Emerging Investigators*, vol. 4, 2021. DOI: 10.59720/21-104

[2] **Gaurav Gupta**, Laraib Salam, and Arunabha Adhikari, "Formation and sticking of air bubbles in water in d-block containers," *Journal of Emerging Investigators*, vol. 4, 2021. DOI: 10.59720/21-010

## Conference/Technical Proceedings

[3] **Gaurav Gupta** and Ankit Sharma, "Enabling automation in opto-quantum communication program through APIs," in *ISRO/DOS Seminar on Computer Technology, Cyber Security and Mission IT*, Internal proceedings; Non-Public, 2026.

# Honors

**Scientist of the Future 2020** *Moscow State University (Online)*

4th Place (Physics and Astronomy) *2020*

- Research project titled *Formation and sticking of air bubbles in water in d-block containers*.
- Subsequently published in the Journal of Emerging Investigators.

# Research Methods

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|---|---|
| **Flow Physics** | Unsteady aerodynamics, multiphase and interfacial flows, fluid-structure interaction |
| **Numerical Methods** | DNS, RANS-assisted DNS, DES, immersed-boundary methods |
| **Data Analysis** | POD, DMD and frequency analysis |
| **Scientific Computing** | Parallel computing, numerical simulations and scientific programming |

# Technical Skills

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|---|---|
| **Solvers** | Incompact3D, NEK5000, SU2, NEKTAR++, OpenFOAM |
| **Meshing/Post-Processing** | GMSH, Pointwise, ParaView, VisIt |
| **Programming** | C++, Fortran, FreeFEM++, Julia, Python, MATLAB |
| **Tools** | Linux, Git, LaTeX |
| **CAD/CAE** | Siemens NX, Solidworks |

# Selected Certificates & Examinations

Mar 2025 **Graduate Aptitude Test - Aerospace Engineering**, Indian Institute of Technology, Roorkee *All India Rank 60*

Apr 2024 **High Performance Computing,** IIT Bombay and NPTEL

# Extracurricular

- Directed IIST's technical festival (Conscientia) for 1000+ participants as Chief Coordinator, managing a INR 2.2 million budget and securing an INR 400,000 profit.
- Led team initiatives in designing fixed-wing and rotor aircraft as Student Coordinator, while orcherstrating UAV design workshops and competitions.