# Ishar Singh Saini

Aerospace Engineer

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## About Me

Presented hypersonic CFD analysis at SAROD 2024 and validated TBCC propulsion performance using OEM data. I'm an Aerospace graduate specializing in high-speed aerodynamics, CFD, and propulsion systems. Known for rapid problem-solving and hands-on troubleshooting in high-pressure environments; applied across CFD simulations, CAD modelling, and UAV prototyping. My work bridges theory, simulation, and real-world application, and I'm now ready to solve cutting-edge challenges in next-gen propulsion and aerothermal systems.

## Experiences / Internships

**TATA Advanced Systems Limited** *Bengaluru, India*
*Concept Design Intern* *June 2024 - Aug 2024*

- Worked in the Concept Design Department under Dr. A. K. Ghosh analyzing the conceptual designs capabilities with the help of CFD.
- Simulated hybrid UAV performance under crosswind and hover conditions; observed that rear rotors produced **up to 50% greater** thrust and power due to equal RPM distribution. Analyzing crosswinds and test data conditions required **iterative RPM input adjustments** to balance mechanical power.
- Operated TASL's Linux-based High-Performance Computer (HPC) for computational solving using HiFUN and Python.
- Investigated Pitot tube accuracy when in proximity to the fuselage, identifying stagnation-induced errors when static inlets are close to the fuselage **up to 2%**, with greater inaccuracies at high speeds conditions like headwinds or dives.
- Conducted aerodynamic analysis of radome modules of aircraft. Results highlight that the new leeward-curved design led to **7% drag reduction**; suggested curvature if applied to the older yet more streamlined design could yield even lower drag.
- Generated high-quality meshes and mesh-compatible geometries from complex NMGs (Numerical Master Geometries) of the UAVs and aircrafts, ensuring solver compatibility and convergence.

**Semester Long Intern** *(Remote) Mumbai, India*
*FOSSEE, IIT Bombay* *March 2024 – June 2024*

- Conducted CFD simulations using OpenFOAM, an open-source CFD software for the research migration project titled, '*High-speed compressible flow over blunt and re-entry bodies*'.
- Validated turbulent compressible flow behavior over blunt re-entry capsules against experimental data; identified limitations **up to 13% discrepancy** of the sonicFoam solver in hypersonic regimes.
- Performed mesh independence studies to determine optimal grid structure, ensuring solver stability and convergence across Mach regimes.
- Analyzed shock structure and aerodynamic effects as a **function of Mach number**, identifying key trends relevant to re-entry vehicle design.
- Secured **1st Rank** in the national screening for project selection.
- This project was presented in **SAROD 2024** symposium.

**Project & Research Intern** *Mumbai, India*
*IIT Bombay, Department of Aerospace Engineering* *June 2023 – Aug 2023*

- Worked on a Precision Landing Drone project under Prof. Arnab Maity, in the Department of Aerospace Engineering, focusing on FEM simulations, structural integrity analysis of composite materials, assembly and testing.
- Conducted detailed static and localized load analyses using Ansys, **validating** carbon fiber composite performance against aluminum through stress-strain and deformation comparisons resulting in almost **50% weight reduction** of the drone.
- Designed PLA components in SolidWorks; oversaw machining, assembly, and integration of electronics and sensor calibration.
- Implemented a dual-phase precision landing system using RTK GPS and ArUco markers, achieving autonomous landings with up to **2 cm accuracy**.

## Skills

**Technical Skills:** Prototype Designing, Research and Analytical skills, Unmanned Aerial Systems Piloting (Fixed-Wing and Rotary-Wing), Wind Tunnel Testing

**Software Tools:** Ansys, HiFUN, FreeFlyer, OpenFOAM, SimScale, OpenVSP, XFLR5, GasTurb, MatLab, Scilab, Visual Studio Code, CAD, SolidWorks, CATIA, GridPro, ICEM

**Programming Tools:** C, C++, Python, Linux, GitHub, LaTex

**Interpersonal Skills:** Leadership qualities, Innovation, Creativity, Strong verbal and written, Communication skills, Critical-Thinking, Problem-Solving, Teamwork

**Languages:** English, German (A2), Hindi, Punjabi, Marathi

## Education

**Amity University Mumbai** *2021 – 2025*
*B.Tech in Aerospace Engineering*

- CGPA: 8.33/10.0
- 50% merit scholarship awarded at admission
- GATE (AE) 2025: 21.0/100.0

## Awards

**Emerging Talent in Open Source** — *July 17, 2025*
*IIT Bombay National FOSSEE Awards 2025 (Edition II)* — *FOSSEE, IIT Bombay*

**1st Consolation Prize** — *Feb 20, 2025*
*Scilab Case Study Hackathon* — *FOSSEE, IIT Bombay*

**1st Place** — *Sept 26, 2024*
*Project Presentation - Innovation Day* — *Amity University Mumbai*

**3rd Place** — *Feb 24, 2023*
*Poster Presentation - Innovation Day* — *Amity University Mumbai*

## Certifications

**Aircraft Design**
*NPTEL* — *May 2025*

**Fundamentals of Supersonic and Hypersonic Flows**
*NPTEL* — Elite + Silver Medal — *May 2024*

**FreeFlyer Level 1 Certification**
*a.i. solutions* — *April 2023*

## Publications

1. Saini, I. S., Chourushi, T., et al. (2025). Assessment of Existing OpenFOAM Solvers for Incompressible Flow Over a 2D Prism. CFD Letters 17(10):184-197, 2025. https://doi.org/10.37934/cfdl.17.10.184197
2. Saini, I. S., Khadka, B., & Chourushi, T. (2024). Numerical Simulation of High–Speed Compressible Flow over Re-entry Vehicles using the OpenFOAM. 10th Symposium on Applied Aerodynamics and Design of Aerospace Vehicles & SPICES Workshop (SAROD 2024). (Paper ID - 57)

## Projects

**Conceptual & Numerical study of Turbine-based Combined Cycle Engines and their mode transition**
*Final Year Project (Dissertation)* — *Amity University Mumbai*

- Investigated a TBCC propulsion configuration integrating an afterburning low-bypass turbofan **(GE F404-IN20)** with a ramjet, enabling **three operational modes** from subsonic to high supersonic (Mach 0.8–4) and identified the critical mode transition zone between **Mach 2.8–3.2** marked by a thrust imbalance.
- Employed a coupled simulation approach using GasTurb for combustion analysis and custom MATLAB thermodynamic codes to model thrust sharing and air-splitting strategy; results showed **increased specific thrust** and **improved TSFC** performance post-transition, **peaking near Mach 2.75**.

**Conceptual Design of Supersonic Unmanned Combat Aerial Vehicle**
*National Aerospace Conceptual Design Competition (NACDeC-VIII)* — *Aeronautical Society of India*

- Led and mentored a team of sophomores in the conceptual design of a supersonic UCAV, targeting a **5,000 kg payload** delivery over a **1,000 km combat radius** within a **one-hour mission cycle**.
- Employed Aerodynamic modelling and Wing configuration, Performance and stability analysis, Propulsion sizing, Stealth design, Structural considerations, Sub-systems design, etc. to finalize a **18800 kg** take-off gross weight and mission fuel fraction of **0.346**, with performance analysis conducted in IRA conditions.
- Selected a delta wing configuration and a turbofan with afterburner for Mach 2 cruise, enabling high-speed penetration and precision strike while ensuring **sub-2,000 m** take-off/landing performance.

**Conceptual Design for a TLAM (Tomahawk Land Attack Missile)**
*Personal Project*

- Designed a long-range, subsonic cruise missile for precision land strikes, launched from ships and submarines, offering strategic versatility and deep strike capability.
- Built to carry a warhead payload of up to **500 kg** and has an operational range of at least 1500 km and operational up to speeds of Mach 0.8 at altitude between **30–50 meters AGL**, to evade radar detection.
- Additional high altitude cruise mode enabling long-range efficiency. Optimized fuselage employing Whitcomb Area Rule to reduce total drag up to **8%** while in the transonic cruise stage.

**Design and Development of an Autonomous Navigation Aerial Vehicle (ANAV) for GPS-Denied Environments**
*ISRO Robotics Challenge - URSC (IRoC-U)* — *U. R. Rao Satellite Centre (URSC), ISRO*

- Participated in the IRoC-U challenge with a focus on implementing LiDAR-based 3D mapping, SLAM algorithms, and machine learning models for autonomous navigation and landing in GPS-denied environments.
- Engineered a modular, dual-mode (manual/autonomous) system with a Emergency Response System (ERS), with high-accuracy terrain analysis and precision landing under dynamic conditions with a **50 cm landing radius** accuracy, supported by real-time telemetry, redundancy systems.

**Minimum Length Rocket Nozzle Design using Method of Characteristics**
*Scilab Case-Study Hackathon* — *FOSSEE, IIT Bombay*

- Developed a 2D minimum-length rocket nozzle design using the Theory of Characteristics, aiming for optimal Mach number and uniform flow at the exit and implemented a Scilab-based numerical solver for supersonic, inviscid, and irrotational flow equations.
- Incorporated a **surrogate-based optimization** approach to refine the nozzle profile, **improving aerodynamic efficiency** while reducing computational load; emphasized performance optimization in the diverging section.

**Validation and Verification of Aerospike Designs in Supersonic Flow**
*OpenFOAM Case Study Project* — *FOSSEE, IIT Bombay*

- Conducted a numerical study in OpenFOAM to analyze supersonic flow over blunt bodies with and without an aerospike, evaluating the effects of varying Mach numbers with a constant Reynold's number on pressure distribution, velocity profiles, and temperature gradients; **validated results** against Crawford's experimental data.