Isha Mukherjee

ishamukherjee2024@gmail.com | isha-mukherjee.github.io | Isha Mukherjee

Education

Indian Institute of Technology Bombay (IIT Bombay) Expected graduation date: May. 2024
B.Tech. in Aerospace Engineering with Honors | Link to all courses ***GPA: 8.51/10***

Conference Publications

- Singh. A., **Mukherjee. I.**, Nair. V., 2024. *"Instability Amplitude Suppression in a Double Orifice Flow Through External Periodic Forcing"* *(Abstract Accepted for ASME 2024 Conference)*
- **Mukherjee. I.**, Singh. A., Nair. V., 2024. *"Identification of Lock-in boundary using Matveev and Cullick Model using Experimental methods"* *(In Preparation for ICTAM 2024 Conference)*

Honors & Fellowships

- Awarded **Undergraduate Research Award** for exceptional research carried out in **Bachelor Thesis Project** *(2023)*
- Ranked **8th** out of 92 students in the Department of Aerospace Engineering based on CPI, and 1st among girls *(Present)*
- Stood among **Top 3** in a class of **98 students** in course of **Compressible Fluid Mechanics** *(2022)*
- Received a **scholarship** for outstanding performance in **AITSE** by Children Education Trust *(2017)*
- Achieved 97.50 percentile in JEE Advanced & 99.28 percentile in JEE Mains among 0.86M candidates in India *(2020)*

Professional Experience

Gulfstream Aerospace Corporation Savannah, GA, United States

Aircraft Performance Intern *(May 2023 - July 2023)*

- Developed an extensive **Take-off Profile Generation Algorithm** to find appropriate Thrust cutback point
- Performed time-step integration & distance step integration, calculating Rate of Climb, Acceleration Factor, Drag, Flight Path Angle, Altitude, at each step using complex architecture in **MATLAB**
- Developed **unit testing frameworks** for Gulfstream G700 aircraft's Takeoff Performance Chart Generation Tools, ensuring 100% code coverage and reliability in the Aircraft Flight Manual certification
- Underwent guided training on Aviation Safety Management, Hazard Communication & Environment,Health & Safety

Advanced Systems Laboratory | DRDO, Govt. of India Hyderabad, India

Computational Fluid Dynamics Intern *(May 2022 - July 2022)*

- Conducted thorough literature review on supersonic flow through **Convergent-Divergent Nozzle**, gaining insights into shock formation, Area Ratio influence on Throat to Nozzle, and the impact of back pressure
- Conducted turbulent flow simulations using the **k-epsilon** turbulence model on a NACA-0012 Airfoil with ANSYS Fluent
- Analyzed CFD simulations for flow through nozzles of different geometries, validating results with numerical solutions.
- Developed a **Python Program** to determine Mach Number from Area Ratio using **Bisection Method**

Research Experience

Investigation of Lock-in Phenomenon of Vortex Shedding | Bachelor's Thesis Project IIT Bombay

Prof. Vineeth Nair | *Acoustics & Flow Diagnostics Laboratory* *(Sept. 2022 - Present)*

- Analytically investigated the lock-in phenomenon of vortex shedding frequency in flows excited by single and double external frequencies and identified the **lock-in boundary** in the frequency-amplitude domain
- Validated the analytical results and trends obtained via different routes, by carrying out experiments on a **double-orifice aero-acoustic setup**, analyzing the data and plotting the analytical and theoretical results in MATLAB Software
- Utilized **return maps, Feigenbaum Diagrams** for data-visualization and identifying lock-in frequency after transient
- Devised a **novel** algorithm to determine uncertainty in the experimental data when compared against analytical results
- Developed an novel **3D visualization method** tailored to identify the lock-in boundary in scenarios involving dual-frequency excitation and formulated a **unique** method to solve a convergence problem using 3D graphs

Development of Flow Visualization Setup for Rotor Flows | Supervised Learning Project IIT Bombay

Prof. Dhwanil Shukla | *Low Speed Experimental Aerodynamics Laboratory* *(Nov. 2021 - April 2021)*

- Conducted literature survey on flow visualization techniques, **Particle Image Velocimetry** and rotor flows
- Developed a low cost flow visualization set-up to seed **oil droplets** and **smoke** particles that have negligible impact on the flow conditions and provide ample scattering of laser light for clear visualization of the fluid flow
- Came up with an optimal illumination method using inexpensive **continuous wave lasers & optical lenses** combination to visualize the seeder particles inserted in the flow domain

Identification of Propulsion System Performance Requirements of an Aircraft IIT Bombay

Prof. T. Chandra Sekar | *Dept. of Aerospace Engineering* *(July 2022 - Dec. 2022)*

- Conducted deep literature survey on performance characteristics of **turbojet engine** and flight mechanics
- Designed a trajectory for take-off, cruise,landing & certain maneuvers for fighter aircrafts by deciding upon =parameters like Rate of Climb and solved equations of motion using MATLAB
- Developed an algorithm in Python Programming to determine thrust as a function of time and flight path

Design of Compressor Stage for A Low Pressure Compressor | **Honors Project** IIT Bombay

Prof. A. M. Pradeep | *Dept. of Aerospace Engineering* *(Oct. 2022 - Nov. 2022)*

- Determined parameters like stage loading coefficient, flow coefficient, degree of reaction for last stage of LPC for given design constraints like pressure ratio, blade speed and radii, and imposed stability constraints on **diffusion factor**
- Performed **3-D Analysis** of Blade Shape using Free Vortex Law, derived relations and plotted the variation of various blade angles and parameters along the blade from hub to tip using python programming
- Obtained velocity triangles at different radii using **Meangen**, performed 3D Multistage calculations in **MultAll** to predict overall performance, checked for convergence of stage & developed blade 3D CAD Model in **SolidWorks**

Autonomous Air Ambulance Helicopter for Siachen Glacier IIT Bombay

Prof. Dhwanil Shukla | *Dept. of Aerospace Engineering* *(Jan. 2023 - May. 2023)*

- Designed a rotor encompassing **thrust, torque & trim** calculations, w.r.t cyclic and collective pitch inputs by utilizing **BET & BEMT**, deciding upon parameters like radius, root cut-out, airfoil, twist & chord length
- Engineered autonomous helicopter simulator achieving max range of **1512.26 km** and endurance of **8.704 hrs**
- Conducted patient pick-up and drop **mission planning** for optimal power, speed & ceiling in various flight scenarios

Morphing Wing | **Conference Project** IIT Bombay

Prof. Dhwanil Shukla | *Dept. of Aerospace Engineering* *(Jan. 2023 - May. 2023)*

- Completed literature survey project on types of wing morphing, especially applications of **inflatable wing** technology
- Researched helicopter rotor system morphing, exploring variations in blade twist, chord, rotor radius, & speed
- Attended conferences on various advanced aerodynamic topics like **tilt rotors, ornithopters, blended wing**

Satellite Image Processing | **Mini Project** IIT Bombay

Prof. Avik Bhattacharya | *Microwave Remote Sensing Laboratory* *(Jan. 2022 - July 2022)*

- Reviewed multiple research papers on **Burned Area Mapping, Fire Indices** and **Spectral Curves**
- Implemented JavaScript code to process images of satellites **LANDSAT-8** using **Google Earth Engine**
- Studied the Spread of Dixie Fire of 2021 and mapped Burned Area in California using a novel fire index called **NBRSWIR** and compared it to results of earlier used fire indices like **NBR**
- Received an outstanding **AA grade** in project due to great presentation and viva in final evaluation

Selected Course & Technical Projects

Solid Engine Model Rocket | Synodic Rocket Design Challenge

Synodic Space Settlement Pvt. Ltd. *(Sept. 2021 - Oct 2021)*

- Designed model rocket using **Open Rocket** software with the desired payload, apogee & efficient recovery system
- Analysed the effect of different configurations on the drag characteristics and **longitudinal stability** of the rocket
- Placed in the **Top 3** among **50+** teams nationwide in a National Level Rocket Design Challenge

Longitudinal & Lateral Dynamics of Convair-880 Jet Aircraft | **Course Project** IIT Bombay

Prof. Arnab Maity, Prof. Aditya Paranjape | *Flight Mechanics - II* *(Jan. 2023 - May 2023)*

- Analyzed stability derivatives for Convair-880 Aircraft, deriving transfer functions for **longitudinal and lateral** states
- Created **MATLAB** & **Simulink** models to plot flight path angle, speed, and angle of attack responses with elevator and throttle inputs. Also, plotted responses for velocity components & attitude angles with aileron deflection

Controller Design | **Course Project** IIT Bombay

Prof. Arnab Maity | *Control Theory* *(Nov. 2022)*

- Designed **PD Controller** using **bode plot** for a given model to get minimal error and maximum phase margin
- Determined values of gain, peak overshoot, settling time, gain margin & bandwidth of compensated system

Rotor Shaft Structural Analysis | Course Project IIT Bombay

Prof. Krishnendu Haldar | *Solid Mechanics* *(Oct. 2021 - Nov 2021)*

- Solved the **Boundary Value Problem** of a Rotor Shaft under a radial load using **FEM** Software
- Visualized deformation of the body and the stress-strain plots of the solution using **Ansys Static Structural**

Vibrational Analysis of Single DOF System | Course Project — IIT Bombay

Prof. Abhijit Gogulapati | *Vibrations & Structural Dynamics* — *(Oct. 2022 - Nov 2022)*

- Developed a **Single Degree of Freedom (SDOF)** pendulum and estimated natural frequency of system
- Calculated the damping ratio for viscous damping analytically and compared the numerical results of amplitude v/s time of oscillations with experimental data and validated the time-period of oscillation
- Estimated the type of damping and performed **error analysis** using **MS Excel** and **Python** Interpolation tools

Exoplanet Data Analysis | **Course Project** — IIT Bombay

Prof. Prabhu Ramachandran, Prof. Amuthan Ramabathiran | *Data Analysis & Interpretation* — *(May 2021 - June 2021)*

- Inspected & evaluated the data over **5700+ exoplanets of cosmos** using statistical tools to observe various trends
- Performed exploratory Data Analysis using Python libraries to model & process correlations between variables
- Performed data analysis of exoplanet data, along with verification of **Kepler's Second Law and Orbital Resonance**

Teaching Assistantships

Teaching Assistant | **Basics of Electricity and Magnetism (PH108)** — IIT Bombay

Course Instructors: ***Prof. Alok Shukla, Prof. Raghunath Chelakkot*** | *Department of Physics* — *(Mar. 2022 - June 2022)*

- Conducted **weekly tutorial sessions** and solved doubts of around **40 students** on topics like Vector Calculus, Image Charges, Solutions To Laplace Equation, Multipole Expansion,Magnetodynamics, EM Waves
- Assisted the course instructors in smooth conduction of **examination** & **correction of answer sheets**

Teaching Assistant | **Differential Equations (MA207)** — IIT Bombay

Course Instructor: ***Prof. Harsha Hutridurga*** | *Department of Mathematics* — *(Sept. 2022 - Nov. 2022)*

- Conducted **weekly tutorial sessions** and mentored **44 sophomore students** on Differential Equation Methods

Leadership Experience

Technical Team | **Rakshak** — IIT Bombay

Core Team Member | *Aerodynamics & Manufacturing Subsystem* — *(Jan. 2022 - July 2022)*

- Performed **Preliminary Design Analysis** of aircrafts and contributed in different development phases of final UAV through different methods of manufacturing like soldering, laser-cutting, 3-D Printing
- Designed fuselage & wings of an aircraft using SolidWorks, performed **CFD Analysis** of the flow over it using Ansys Fluent and compared with results obtained from **3D Analysis** using XFLR5 software

Aeromodelling Club — IIT Bombay

Technical Convener — *(May 2021 - May 2022)*

- Organized **TriviaJet**, The Aviation Quiz with **120+ participation** from all over the country
- Organized **RC Plane Competition**, Flagship Event of the Club for **120+ sophomore students** from IIT Bombay by training students to build Remote Controlled Planes & flying using transmitter
- Mentored **15+ Freshmen** in & taught them basic aircraft nomenclature in **Glider Making Workshop**

Industrial Visits

- INS (Indian Naval Service) SHIKRA — *(Oct. 2022)*
- Hindustan Aeronautics Limited, Nashik — *(Nov. 2022)*
- Thakur Institute of Aviation Technology, Mumbai — *(Oct. 2023)*
- Gulfstream, USA - Production, Flight Test, Experimental Test, Integrated Test Facility, Completions — *(May - July 2023)*

Skills

Programming: C, C++, Python, Javascript, SQL

Softwares: OpenRocket, Ansys, MATLAB, Simulink, Solidworks, Multall, XFLR5

Extra-curriculars

- Stood **second** in **State Level** Essay Writing Competition organized by **Hindustan Times PACE** in senior category
- Secured **first** position in Theme Based **Photography Competition** among **1100** residents of **Hostel 10**
- Completed one year of training in **National Cadet Cops** under NOCS at IIT Bombay
- Volunteered in activities of SAATHI - a **LGBTQI+ community** of IIT Bombay
- Developed a **bluetooth controlled robotic car** for a racing competition XLR8 organized by ERC, IIT Bombay
- Completed Summer School of Cult training in **Flute** in summer of 2022
- Volunteered as a organizer in **Techfest 2022**, Asia's largest technology festival