

Saptarshi Joshi

[Google Scholar](#) | Senior Undergraduate, IIT Bombay, Mumbai, Maharashtra, India | 190100059@iitb.ac.in

RESEARCH INTERESTS

[HYPERLINKS](#) AT APPROPRIATE PLACES

Experimental Fluid Mechanics, Computational Fluid Dynamics, Heat Transfer, Multiphase flows, Turbulence, Machine Learning

EDUCATION

Indian Institute of Technology Bombay

Bachelor of Technology with Honors in Mechanical Engineering; GPA: 9.46/10.0 (after 6 semesters)

Mumbai, India

Expected July 2023

- Pursuing a Minor degree in Artificial Intelligence and Data Sciences

Present

CONFERENCES & PUBLICATIONS

- Hossein Hassanzadeh, **Saptarshi Joshi**, Seyed Mohammed Taghavi, "From mixing to fingering", *Poster presentation at Society of Rheology SoR 93rd Annual Meeting 2022*, Chicago, Illinois [Poster](#)
- Mohammad Khalid Jawed, Sangmin Lim, **Saptarshi Joshi**, Charbel Habchi, "Resistive Force Theory vs. Slender Body Theory as Hydrodynamic Models in Simulation of Bacterial Flagella", *APS March Meeting 2022*, Chicago [Abstract](#)
- Sachin S B, **Saptarshi Joshi**, Janani S Murallidharan, Abhimanyu Singh, Guruswamy Kumaraswamy, Krishnendu Sinha, "CFD Analysis of Ventilation of High Occupancy Rooms of IIT Bombay", *Resonance Journal*, under review [Submission](#)
- **Saptarshi Joshi**, Hossein Hassanzadeh, Seyed Mohammed Taghavi, "Predictive modeling of buoyant jet characteristics using machine learning algorithms", *in preparation*, [Draft](#)
- Hossein Hassanzadeh, **Saptarshi Joshi**, Seyed Mohammed Taghavi, "Buoyant Miscible Jets in a Viscoplastic Medium With Applications in Plug and Abandonment of Oil and Gas Wells", *ASME OMAE 2023 Conference*, in preparation [Abstract](#)

RESEARCH EXPERIENCE

Experimental investigation of Buoyant Jets

Université Laval, Canada

[Prof. Seyed M. Taghavi](#)

May 2022-Ongoing

Non-intrusive experimental techniques are employed to investigate the effects of injection velocity, density difference and the yield stress of the ambient fluid on the buoyant jet behaviour useful in plug and abandonment operations in oil & gas wells.

- Reviewed 15+ research papers focusing on jet flow characteristics and regime map of negatively buoyant jets
- Developed an image analysis pipeline in MATLAB for extraction of large-scale jet flow features such as various rise heights, steady state oscillation amplitudes and frequencies, mixing indices etc. using the [Canny edge detection](#) algorithm
- Performed 200+ illuminated setup high-speed imaging experiments, 50+ Tomographic **Particle Image Velocimetry** experiments, 10+ Ultrasonic Doppler Velocimetry experiments and Rheometry tests for 10+ viscoplastic fluids
- Analysed experimental data and **identified 6 regimes** for Newtonian and Viscoplastic ambient fluids for Re (800-12000) and Fr (10-250) ranges based on the negatively buoyant jet morphology, rise heights, steady state jet characteristics

Predictive Modeling of Buoyant Jet Characteristics

Université Laval, Canada

[Prof. Seyed M. Taghavi](#)

May 2022-Ongoing

Correlations for laminar length for positively buoyant jets in the semi-turbulent regime, alone, are insufficient for jet shape prediction. To build more accurate models, supervised learning been utilized for statistical modelling of the jet characteristics.

- Generated dataset for laminar lengths and jet spread angle of semi-turbulent positively buoyant jet for its variation with Reynolds Number and Archimedes number from experiments and literature
- Trained 5 machine learning algorithms on the log-normalized data, analysed model performances using various loss metrics, improving on the R^2 value of 0.93 reported in literature by predicting the jet shape with a R^2 value of **0.98**

Heat Transfer Enhancement in Pin-Fin Channels | Undergraduate Thesis

IIT Bombay

[Prof. R. P. Vedula](#)

August 2022 - Ongoing

This work aims to numerically and experimentally investigate the heat transfer enhancement by in-stream flow turbulators in staggered rectangular pin-fin channels used for cooling of trailing edge sections in gas turbine blades.

- Prepared a literature review of 12+ journal papers entailing the innovations in pin-fin shape, orientation, arrangements, flow turbulator devices, the Numerical Methodology followed and Thermal Performance Factor (TPF) improvements
- Validated steady RANS (Reynolds-averaged Navier-Stokes using $k-\omega$ two equation SST) data with Standard [Dittus-Boelter correlation](#) and rib-roughened channel data with [Griffith et.al. \(2003\)](#) and [Bai et.al. \(2019\)](#)

Discrete Elastic Rods (DER) algorithm is an efficient new method to simulate and analyse the behaviour of slender structures. In this work, the slower external fluid force calculation by RSS algorithm, is replaced by introducing deep neural networks.

- Converted codes for comprehensive data generation using Regularized Stokeslet Segments ([RSS](#)) from MATLAB to C++ for the case of hydrodynamic propulsion by a helical bacterial flagellum for geometries given in [Rodenborn et.al. \(2013\)](#)
- Generated the training data for the **Neural Network** by parallel processing on a 64 core CPU achieving higher computational efficiency by reducing computational time from several weeks to 5 days
- Studied the [Discrete Elastic Rods \(DER\) Algorithm](#) from the course *Discrete simulation of slender structures* by simulating multiple mass-spring damper systems and elastic beams as programming assignments in MATLAB
- Assisted in the training of a $(128 \times 256 \times 512)$ Multi-layered Perceptron and integrated it into the DER framework using the CppFlow Keras API in C++ and compared the novel MLDER Algorithm with RSS and [Gray & Hancock RFT](#)

ENGINEERING EXPERIENCE

Unmanned Aerial Vehicles | [Team Rakshak](#)

Prof. Krishnendu Haldar

IIT Bombay

August 2020-Ongoing

Student initiative to develop a fleet of fixed-wing and rotary-wing Unmanned Aerial Vehicles (UAVs) for Search and Rescue Operations in the event of disaster aiming for the [AUVSI SUAS](#) 2023 Competition.

Team Leader

July 2022-Ongoing

- Leading an interdisciplinary 3-tier team of **55+** members across 4 subsystems for SUAS 2023 competition while spearheading team initiatives such as Rakshak RnD, focused on research in the field of fixed wing UAVs
- Led a 2-stage team recruitment process while leading a 12 member core committee responsible for maintaining the workflow of the team and showcased the team's Hangar at Tech & RnD Expo, IIT Bombay

Aerodynamics Subsystem Vice Head and Design Engineer

August 2020-June 2022

- Conducted preliminary aircraft design, modeled a **CAD** assembly of the UAV using SolidWorks consisting of **200+** parts and one of the Unmanned Ground Vehicle (UGV) consisting of **50+** parts and assisted in **Manufacturing** of the UAV
- Determined the most suitable airfoil using **airfoil analysis** and performed **aerodynamic plane analysis** using XFLR5, performed Static structural, Impact analysis dynamic analysis using ANSYS, hydrodynamic hull drag of amphibian plane

SELECTED COURSE & TECHNICAL PROJECTS

Numerical Simulation of Nozzle Sprays

Prof. Janani Murallidharan

IIT Bombay

January-May 2022

- Simulated initial jet breakup using **VoF-to-DPM Transition Model** on a coarse nozzle mesh to obtain injection files and then performed [DPM](#) spray nozzle simulations using fine mesh injection files for sanitizing sprays in a railway lavatory
- Analysed the spray surface coverage and the wall film thickness for single nozzle and four nozzles configurations

Forced Convection over Bluff Body Arrangement of Cylinders

Prof. Janani Murallidharan

IIT Bombay

January-May 2022

- Validated aerodynamic force coefficients, Nusselt number, Strouhal number against the reference [Sarkar et.al.](#) through laminar numerical simulations in **OpenFOAM**, post-processing in ParaView and FFT with $\approx 2 - 6\%$ deviation in Nu
- Modified the pimpleFoam solver by incorporating energy equation to conduct transient heat transfer simulations and investigated velocity, temperature contours streamlines and published research migration project on FOSSEE [Link](#)

Thermo-economic Optimization of Steam Power Cycles

Prof. Avinash Bhardwaj & Prof. Makarand Kulkarni

IIT Bombay

January-May 2022

- Modelled various steam power cycles in Matlab using [XSteam](#) to calculate the efficiency and net work output and **parameterized** the model to observe variation in efficiency with change in process parameters for optimization
- Developed 11 polynomial fits for the water phase diagrams with degree up to 10 for constrained nonlinear optimization with [fmincon](#) and **maximized** power plant **profit** via cost-revenue analysis, inventory modelling and uncertainty analysis

Analysis of Ventilation for Covid-19 Prevention

Prof. Janani Murallidharan

IIT Bombay

August 2021-January 2022

- Performed grid independence study, localized mesh refinement and studied flow field for re-circulation zone mitigation
- Modelled exhaust, rotating ceiling fans in a $35 \times 28 \times 10$ ft large room and achieved [ACH](#) value of **13.2** compared to 4-6 ACH recommended for Covid-19 and compiled findings in a [Resonance Journal](#) Article submission under review

High Pressure Turbine Design

Prof. A. M. Pradeep

IIT Bombay

August-December 2022

- Performed mean-line, hub and tip calculation for given inlet conditions using relaxed-vortex law, generated blade coordinates by 3D CFD optimization in [Multall](#) from calculated inputs, developed a CAD model of full-scale turbine

Finite Element Analysis of Cold Extrusion Process

Prof. Soham Mujumdar

IIT Bombay

August-December 2021

- Modelled the cold extrusion process using a cylindrical billet in an area reducing die in **ABAQUS explicit dynamics** and researched the effect of variation in 3 extrusion parameters; extrusion ratio, die angle, and coefficient of friction

Fluid Flow and Heat Transfer in Gas Tugsten Arc Welding

Prof. Rakesh Mote

IIT Bombay

January-May 2021

- Modelled and analysed the GTAW arc and weld pool using appropriate assumptions and studied the effect of change in welding parameters; arc length, voltage and position, on the process

Machine Learning Projects

Prof. Amit Sethi, Prof. Biplab Banerjee, Prof. P Balamurugan

IIT Bombay

August 2020-December 2021

- Temperature Forecasting:** Verified global warming trends through exploratory data analysis and tuned hyperparameters for two different **RNN-LSTM** models yielding **90%** accuracy in time-series forecasting of temperatures
- Music Genre Classification:** Established baseline with classical algorithms for pre-processed audio with MFCC, integrated the baseline models with Dilated **CNN** boosting the accuracy to **70%**, developed a 60% accurate LSTM Network
- Dynamic Convolution:** Experimented with source code for [Dynamic Convolution](#) Network on MNIST, CIFAR-10 & CIFAR-100, improved by adding convolution in attention increasing non-linearity in our novel model **ConvDyConv**

ACADEMIC HONOURS

- Awarded the [Globalink Research Internship](#) by **Mitacs** for carrying research work in Canada 2022
- Conferred with the Research Internship for Young Academics (**RIYA**) Program offer by **Ohio State University, USA** 2022
- Awarded **AP** (Advanced Performer) grade for exceptional performance in **Fluid Mechanics** and **Machine Learning** 2021
- Amongst **top 0.02%** candidates in JEE Mains amongst **1.3 million**, achieved **All India Rank (AIR) 518** in JEE Advanced amongst 0.15 million candidates - Entrance exams to IIT's 2019
- Awarded [Kishore Vaigyanik Protsahan Yojana \(KVPY\)](#) Fellowship by the Indian Government securing AIR 973 2018

TEACHING & MENTORSHIP EXPERIENCE

Teaching Assistant | Quantum Physics and Application

Instructor : [Prof. C V Tomy](#)

IIT Bombay

November 2020-March 2021

- Entrusted with teaching the concepts of an introductory level Quantum Physics course to **38** students; conducted weekly sessions consisting of problem solving, concept discussions; assisted in grading and maintaining performance records

Mentor | Department - Career Assistance Mentorship Program (D-CAMP)

Department of Mechanical Engineering, IIT Bombay

IIT Bombay

June 2022-Ongoing

- Delivered a **session** on research and university internship applications including Q&A with **100+** attendees and mentoring 5 pre-final year UGs, providing guidance throughout the Resume/CV preparation and application process

RELEVANT COURSEWORK & TECHNICAL SKILLS

Coursework in TFE, Mathematics and ML

- Fluid Mechanics, CFD, Heat Transfer, Applied Thermodynamics, Aerodynamics of Compressors & Turbines, Allied Laboratories, Numerical Analysis, Calculus, Programming for Data Sciences, Machine Learning, Deep Learning

Programming & Software

- C/C++, Python, MATLAB, Scilab, Octave, Paraview, OpenFOAM, Ansys (Fluent | Structural), ABAQUS, ADAMS, Solidworks, AutoCAD, XFLR5, Machine Learning & Data Science Packages (Keras, PyTorch, Scikit-learn, Pandas, Seaborn)

EXTRACURRICULARS

- Social Work:** Conducted educational activities for **20+** school-going children from slum areas and participated in **voluntary work** of labour in the form of digging wells in **2** drought stricken villages
- Completed intermediate **Guitar** course at Summer School of Cultural, National Sports Organization **Aquatics** program
- Predicted the *Future of Brain Drain in India: a psychological perspective*, won **2nd** prize in high school
- Election **Campaign Manager** for General Secretary Candidate; brainstormed manifesto & did door to door campaigning