KT Prajwal Prathiksh

Curriculum Vitae

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Education

2018–Present **Dual Degree (B Tech + M Tech)**, *Department of Aerospace Engineering, Indian Institute of Technology, Bombay, Mumbai, India - GPA 8.85/10.0.*

2018 **Intermediate**, *JSS Public School, Bangalore, India - 95.60%.*

2016 **Matriculation**, *Chinmaya Vidyalaya, Bangalore, India - 97.16%.*

Research Interests

- Computational Fluid Dynamics
- Optimization Theory
- Numerical Analysis
- Biomimetics

Publications

- Ranade, A.R., Prathiksh, K., et al. *"Survey and Analysis of Payloads for Missions on PSLV's Orbital Platform."* in the AIAA SciTech Forum 2021, Nashville, TN
- Katla V., Prathiksh, K., et al. *"An Approach to Star Tracker Design for Nano-Satellite Application"* extended abstract presented in National Conference on Small Satellite Technology and Applications 2020, Trivandrum, India

Research Projects

Dec 2020- Present **Numerical study of SPH integrators for incompressible flow**

Guide: *Prof. Prabhu Ramachandran, Department of Aerospace Engineering, IIT Bombay*

Objective: *To study the effects of numerical time-discretization schemes on stability, accuracy and order of convergence (OOC) in Smoothed Particle Hydrodynamics (SPH)*

- Studied various numerical time-integrators which comprised of the Runge-Kutta, the Symplectic, and the Multi-step classes of integrators in the context of SPH
- Developed code to test and compare the OOC of all the time-integrators against benchmark cases such as the Harmonic Oscillator and Lennard-Jones Oscillator problems
- Performed a systematic comparison of the accuracy, stability, and runtime of the time-integrators against the Taylor-Green Vortex (TGV) problem using the EDAC scheme
- Studying the effects of the Courant–Friedrichs–Lewy (CFL) number and spatial-discretization schemes of SPH on the OOC of the time-integrators

May 2021 - Present **Study of self-propelled bodies in incompressible fluid**

Guide: *Prof. Prabhu Ramachandran, Department of Aerospace Engineering, IIT Bombay*

Objective: *To study and model the mechanics of a self-propelled body, in order to identify the optimum motion and trajectory for the swimmer in an incompressible fluid*

- Conducting a literature review of computational and theoretical modelling of swimmer/s to understand the mechanics of self-propulsive motion in an incompressible fluid
- Modelling a swimmer as the point-vortices observed in its wake in the context of potential flow theory to probe and understand the forces and moments that act on the body

Dec 2019 - Nov 2020 **Numerical simulation of the motion of a fish-like swimmer using δ^+ SPH scheme**

Guide: *Prof. Prabhu Ramachandran, Department of Aerospace Engineering, IIT Bombay*

Objective: *The project aimed to reproduce the work of Sun, P.N, et al. on the self-propulsive fish-like swimming hydrodynamics*

- Studied key concepts and applications of SPH - a Lagrangian, meshfree, particle method used for simulating the mechanics of fluid flow, and simulated problems in Python
- Implemented the WCSPH scheme using the Numba library, to solve the 1D Sod shock-tube problem as well as the 2D dam-break problem in Python, resulting in a decreased runtime over native Python code
- Implemented the δ^+ SPH scheme to solve the 2D TGV problem in PySPH and analyzed the performance and accuracy of the scheme against known results in academic literature

Jul 2019 - Present **Atmospheric-based ionic propulsion**

Guide: *Prof. Kowsik Bodi, Department of Aerospace Engineering, IIT Bombay*

Objective: *To develop a solid-state propulsion system employing the principles of Electrohydrodynamic (EHD) thrust to demonstrate sustained flight as part of a three-member team*

- Built a High Voltage Power Circuit based on a flyback driver to generate 120 kV DC
- Developed a sensitive and reliable experimental technique to measure the thrust density using hexagonal electrodes and a ballistic thrust plate, resulting in a resolution of 0.1 mN
- Surveyed numerical techniques to simulate the phenomenon of EHD thrust caused due to corona-induced ionic winds, and currently working on its implementation in COMSOL

Technical Projects

IIT Bombay Student Satellite Program

A 70-member student team dedicated to the vision of making IIT Bombay a centre of excellence in space technology

Aug 2019 - Present *Controls Engineer* | **Star-Tracker-based Attitude Determination System (STADS)**

A CubeSat-compatible attitude determination system, to be tested onboard ISRO's PS4-OP

- Surveyed star-matching algorithms based on the performance and accuracy constraints of STADS, for the identification of guide stars from the centroids of stars on an image
- Implemented the 4-Star Matching Method in MATLAB along with a novel verification step to reduce the number of false star matches, resulting in its reduction by 85%
- Contributed to the quality-assured Open Loop Simulation framework, which simulates space environmental conditions to test the flight code and algorithmic blocks of STADS

Jul 2019 - Aug 2019 *Member, Payload Subsystem* | **PS4-OP Mission**

Designing a space-based experiment to be flown on the PS4-OP

- Actively conceptualized suitable experimental payloads which can be launched on-board Stage 4 of ISRO's PSLV, keeping in mind the constraints imposed by ISRO
- Surveyed payloads including an active thermal control system for CubeSats, inter-satellite optical communication systems and deployment of inflatable UHF/VHF antenna
- Performed feasibility analyses for the execution of missions designing and fabricating these by the satellite team with the given time and resource constraints

Feb 2019 - Jun 2019 *Controls Engineer* | **Advitiy**

Advitiy is the 2^{nd} satellite by IITBSSP, a technically advanced and efficient version of the first, Pratham

- Compared the accuracy and robustness of Cowel's method against Simplified General Perturbations Model 4 for orbit-propagation of a Low-Earth-Orbit Satellite in Python
- Implemented Cowel's method with a drag model and verified the results against the data generated by GMAT, an open-source software developed by NASA

Summer 2019 **Summer of Science: Computational Fluid Dynamics**

A self-learning project under the guidance of the Maths and Physics Club, IIT Bombay

- Studied the fundamental equations of fluid mechanics derived from conservation laws
- Explored the fundamental aspects of discretization, numerical analysis and grid transform

Work Experience

May 2021 - Jul 2021 **Delivery Route Optimization**

Data Scientist - B.R.E.W Intern, Anheuser-Busch InBev

Objective: *To link underutilized shipments and create optimum multi-load routes that adhere to business rules, therein reducing the variable logistics costs for the UK and Russian markets*

- Designed modular python code using OSRM and Google OR-Tools to obtain optimized loads from underutilized shipments, and plan routes for using real-time geographical data
- Incorporated various business constraints such as vehicle capacity, geographical priorities, one-way/round-trip requirements, freight charge and maximum transport distance and time
- Validated the performance and accuracy of the code against existing practices that involved proprietary ERM and route-planning software and a dedicated team for manual analysis
- Achieved a 67% improvement in load-linking efficiency, and an 8% and 10% reduction in the number of trucks employed and VLC costs respectively compared to existing practices
- Packaged the code into a stand-alone executable file for Windows-OS using PyInstaller, along with an interactive and extensive documentation for easier access to the end-user

Select Course Projects

Jan 2021 - Apr 2021 **Path Optimization for Combinatorial Problems**

Guide: *Prof. Abhijit Gogulapati, Department of Aerospace Engineering, IIT Bombay*

Objective: *To develop multiple optimization tools in order to solve a modified variant of the travelling-salesman problem in the context of a tourist in the Louvre Museum*

- Devised heuristic and exact algorithms for the optimization of integer programming problem
- Performed comparative analysis of Genetic, Ant Colony, Simulated Annealing and Branch & Bound methods to find the most holistic tour considering the satisfaction of a tourist
- Compared the algorithms on metrics such as efficiency, reliability and quality of solution
- Validated the code for its accuracy and runtime against standard TSP library test cases

Oct 2020 - Dec 2020 **Modelling of a Biological System**

Guide: *Prof. Abhijit Gogulapati, Department of Aerospace Engineering, IIT Bombay*

Objective: *To study the hummingbird and estimate the energy cost for its flight through a multi-degree of freedom engineering model using rigid and flexible links, springs and dampers*

- Estimated the energy cost per cycle in the case of hovering and normal flight ($< 15\%$ error)
- Developed a 3D Simulink model to analyze the internal and aerodynamic forces and moments over each cycle of the hummingbird's 'figure-of-eight' wing trajectory

Sept 2020 - Dec 2020 **Modelling a Magnetohydrodynamic (MHD) Slurry Pump**

Guide: *Prof. Avishek Ranjan, Department of Mechanical Engineering, IIT Bombay*

Objective: *To model and analyze an MHD pump for different types of industrial slurries and draw detailed comparisons between the MHD pumps and conventional centrifugal pumps*

- Surveyed theoretical research on MHD pumps and the properties of industrial slurries
- Modelled MHD pump for various water-based and copper concentrate slurries on COMSOL
- Compared the flow characteristics against results from theoretical analysis of MHD pumps
- Studied the effects of gravity on the nature of flow against various angles of inclination

Mar 2019- Apr 2019 **Big Data Analysis**

Guide: *Prof. Prabhu Ramachandran, Department of Aerospace Engineering, IIT Bombay*

Objective: *To analyze student survey data (2013) collected from 1000+ students of the FSEV UK University, Bratislava - Slovakia*

- Implemented outlier detection using Gaussian distributions to remove false data entries
- Inspected data using statistical tools to examine the alcoholic and smoking behaviour amongst teenagers and their preferences in music, movies, sports and hobbies

Institue Positions

Jul 2020 - Jun 2020 **Institute Student Mentor**

Student Mentor Program, IIT Bombay

- One of the only 12 third-year undergraduate students selected via a rigorous procedure comprising of SOP, peer reviews and interviews, to mentor a group of incoming first-year undergraduate students amongst a batch of 1000+
- Mentored a group of 14 students to provide the necessary support, academic and otherwise

Jul 2020 - Jun 2020 **Department Student Mentor**

Department of Aerospace Engineering, IIT Bombay

- Selected into a team of 19 mentors based on extensive peer reviews and interviews, to monitor the academic performance of 6 second-year undergraduate students and provide academic guidance and counsel
- Involved in bridging the student-faculty gap and enhancing the students' academic experience

Mar 2020 - Mar 2020 **Manager, Controls & Dynamical Systems Student Reading Group (CDS-SRG)**

Institute Technical Council, IIT Bombay

- Conceptualized and organized a series of lectures to introduce newcomers to key concepts in control theory such as PID control, Kalman filtering and their industrial applications
- Hosted research talks by students and professors to familiarize systems & controls engineering amongst undergraduate students and to drive them to pursue research in these areas
- Ideated and coordinated the Summer Learning Projects-2020, which provided a platform for 20+ students to work collaboratively on various fundamental topics of control theory
- Managed and tailored content for the CDS-SRG FB page with a reach over 2500+ students

Sept 2019 - Nov 2019 **Teaching Assistant - Biology (BB 101)**

Guide: *Prof. Ambarish Kunwar, Department of Biosciences & Bioengineering, IIT Bombay*

- Managed a batch of 50+ students and conducted weekly tutorial sessions and quizzes
- Clarified doubts of academically weaker students to motivate and boost their performance

Jun 2019 - Jul 2020 **Prevention of Sexual Harassment (PoSH) Member**

Gender Cell, IIT Bombay

- Attended a two-day training workshop conducted by PoSH at Work on understanding Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 and creating awareness about it
- Conducted sessions on gender sensitization, and the institute's policy on sexual harassment and its redressal on behalf of the Gender Cell for 100+ first-year undergraduate students

Relevant Courses

- Optimization for Engineering Design
- Differential Equations
- Global Geophysics
- Incompressible Fluid Mechanics
- Aerodynamics
- Modelling and Simulation
- Signals and Systems
- Continuum Mechanics*
- Compressible Fluid Mechanics
- Spaceflight Mechanics
- Magnetohydrodynamics and its engineering applications

** ongoing*

Achievements

2016 Recipient of National Talent Search Examination Scholarship (NTSE) given by NCERT, India

Aug 2018 Secured First place in EnB Buzz Competition out of 100+ teams for exceptional performance in presenting a fictitious business idea and a corresponding Business Model Canvas (BMC)

Extra-Curricular Activities

Jul 2018 - Apr 2019 Conducted classes on interactive science experiments for underprivileged school students under NSS Prayog (Middle School) and NSS Asha initiative (High School) with NGO Asha

Jun 2020 Authored an article titled "Biomimicry" which was featured in the Airspace magazine - India's first national student magazine on aerospace engineering by the students of IIT Bombay

Jan 2021 Co-authored a white paper as a GGI Fellow 2021 titled "Internationalisation of Higher Education in India 2021"

An avid reader; particularly enjoy genres such as science-fiction, dystopian & coming-of-age

An active squash player; passionately follow tennis, Formula 1 & Liverpool F.C.