

# KT Prajwal Prathiksh

## Curriculum Vitae

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📄 [prajwal-prathiksh.github.io/](https://prajwal-prathiksh.github.io/)

### 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
- Numerical Analysis
- Optimization Theory
- Biomimetics

### Publications

- Ranade, A.R., Prathiksh, K., et al. "[Survey and Analysis of Payloads for Missions on PSLV's Orbital Platform](#)." presented 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- **Numerical study of SPH integrators for incompressible flow**

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

Present 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 - **Numerical simulation of the motion of a fish-like swimmer using  $\delta^+$  SPH scheme**  
 Nov 2020 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  $\delta^+$  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 - **Atmospheric-based ionic propulsion**  
 Present 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 - Controls Engineer | **Star-Tracker-based Attitude Determination System (STADS)**  
 Present 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 - Member, Payload Subsystem | **PS4-OP Mission**  
 Aug 2019 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 - Controls Engineer | Advitiy

Jun 2019 Advitiy is the 2<sup>nd</sup> 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

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## Work Experience

May 2021 - **Delivery Route Optimization**

Jul 2021 Data Scientist - B.R.E.W Intern, [Anheuser-Busch InBev](#)

**Objective:** To reduce the variable logistics costs for the UK and Russian markets, by linking underutilized shipments and creating optimum multi-load routes that adhere to business rules

- 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

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## Select Course Projects

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

Apr 2021 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 - **Modelling of a Biological System**

Dec 2020 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 - **Modelling a Magnetohydrodynamic (MHD) Slurry Pump**  
 Dec 2020 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- **Big Data Analysis**  
 Apr 2019 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
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- ## Institute Positions
- Jul 2020 - **Institute Student Mentor**  
 Jun 2021 *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 - **Department Student Mentor**  
 Jun 2021 *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 - **Manager, Controls & Dynamical Systems Student Reading Group (CDS-SRG)**  
 Mar 2021 *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 - **Teaching Assistant - Biology (BB 101)**  
 Nov 2019 **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 - **Prevention of Sexual Harassment (PoSH) Member**

Jul 2020 *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

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## Relevant Courses

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

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## Achievements

- 2016 Recipient of National Talent Search Examination Scholarship ([NTSE](#)) given by NCERT, India
- Aug 2018 Secured First place in [EnB Buzz - 2018](#) Buzz Competition out of 100+ teams for exceptional performance in presenting a fictitious business idea and a corresponding Business Model Canvas (BMC)

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## Extra-Curricular Activities

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