**Soham Shirish Phanse** | **19D170030**
**Aerospace Engineering** | **B.Tech.**
**Indian Institute of Technology, Bombay** | **Gender: Male**
**DOB: 26-11-2000**

| Examination | University | Institute | Year | CPI / % |
|---|---|---|---|---|
| Graduation | IIT Bombay | IIT Bombay | 2023 | 8.87 |
| Intermediate | Maharashtra State Board | Mahila Samiti Jr. College | 2018 | 92.46% |
| Matriculation | Maharashtra State Board | VidyaNiketan High School | 2016 | 95.80% |

- Pursuing a **Minor** in **Artificial Intelligence and Data Science, IIT Bombay** *(2021)*

## Scholastic Achievements

- Awarded **Undergraduate Research Award 01** (IIT Bombay) for developing a *Systems Theory based framework for modelling Static and Dynamic energy usage in Industry* *(2021)*
- Secured a merit-based **Branch Change** to Department of **Aerospace Engineering**, IIT Bombay *(2020)*
- Awarded **Scholarship for Higher Education** (SHE) under **INSPIRE** by virtue of performance within the **top 1%** of the Maharashtra State Board at the Class XII level *(2018)*

## Publications

- Katla V., **Phanse S.** et al, "An Approach to Star Tracker Design for Nano-Satellite Applications" (extended abstract) presented in **National Conference on Small Satellite Technology & Applications**, India, 2020

## Technical Projects

### IIT Bombay Student Satellite Program *(Mar 2020 - Present)*

*A 70-member student team dedicated to the vision of making IITB a center of excellence in space technology*

**Star Tracker based Attitude Determination System | Mechanical Subsystem**

*A CubeSat-compatible Star Tracker based Attitude Determination System (STADS) to be tested on PS4-OP*

- Successfully conceptualized and designed structure of star tracker by making **CAD** models on **SolidWorks**
- Performed static structural, modal, harmonic response and random vibration analysis in **ANSYS** (FEM) to simulate launch loads from **PSLV** and check for structural integrity of the system
- Finalised the configuration by comparing modelling, simulations, manufacturing and integration methods
- Created **ICD** (Interface Control Document) and Integration Sequence for better traceability of interfaces
- Modified the structural design to include OV7670 as the imaging system and **3D printed** a prototype

### System Dynamics based Modelling of Energy Usage *(Jun 2020 - Jul 2021)*

*Research Project | Guide: Prof. Rangan Banerjee, Department of Energy Science and Engineering*

- Constructed a **systems theory-based framework** to analyze static and dynamic energy usage
- Implemented **Interface Control Document**-based structures, **Process Flow Diagrams** and **Stock** and **Flow** diagrams to depict energy balance of steel, aluminium and paper industries with **Sankey** diagrams
- Formulated discrete-time governing equations and created **Causal Loop Diagrams** for dynamic modelling of energy usage with a case of **Population Dynamics** and energy usage of IITB campus

### Design Optimization with FEniCS *(Oct 2020 - Jun 2021)*

*Research Project | Guide: Prof. Amuthan Ramabathiran, Department of Aerospace Engineering*

- Implemented numerical techniques like **Finite Difference Method**, **Backward and Forward Euler Methods** in Python, and **Finite Element Method** (Galerkin Approximation) for ODE in **Python**
- Implemented numerical solutions of PDEs governing deflection of membrane with point load, 2D linear elastic analysis of a cantilever beam, time-dependent heat equations with the **Finite Element Method** in **FEniCS**
- Explored **Calculus of Variations**, **Functional Optimization** with Euler-Lagrange equations and applied it to **Shape** and **Topology** Optimisation problems like compliance minimisation of a cantilever beam

### Systems Engineering Analysis of Autonomous Surveillance System *(Jan 2021 - May 2021)*

*Course Project | Guide: Prof. Hemendra Arya, Department of Aerospace Engineering*

- Conceptualised multiple configurations for the system and finalised one by comparing parameters like surveillance unit topology, vehicle parameters, communication protocols with help of **Decision Matrices**
- Decomposed the system to obtain clear **System Hierarchy**, and conceptualised the **System Architecture**
- Formulated exhaustive **functional**, **performance**, **transition**, **support** and **disposal** requirements and an exhaustive **testing plan** for verification and validation testing while ensuring **bi-directional traceability**
- Implemented Operational Capabilities, System Architecture and Operational Scenario Diagrams in **Capella**

### Spacecraft Trajectory Planning and Analysis *(Jan 2021 - Apr 2021)*

*Course Project | Guide: Prof. Ashok Joshi, Department of Aerospace Engineering*

- Analyzed specifications of **Space Shuttle** Mission STS-51G and orbital parameters of payload **ArabSat-1B**
- Designed a burn profile and trajectory with constraints of mass, velocity, acceleration, altitude and range with **Constant Pitch Rate Gravity turn** trajectories for the launch vehicle
- Simulated *Orbital Maneuvers* for the shuttle and **Hoffman Transfers** from *Low Earth Orbit* to the *Geostationary Orbit*, and **Plane Change** maneuvers for ArabSat-1B in Python

### Scramjet Engine Analysis *(Jul 2020 - Nov 2020)*

*Course Project | Guide: Prof. Krishnendu Sinha, Department of Aerospace Engineering*

- Studied about compressible fluids, total enthalpy, normal and oblique shocks, **ram effect**, choked flows etc.
- Analyzed intake, combustor, and nozzle of a **Scramjet** Engine in the hypersonic flow regime
- Studied effect of nozzle geometry on thrust and **Single Ramp Expansion Nozzle** with different values of the **Base Expansion factor** to calculate maximum value of thrust

### Big Data Analysis of NASA's 5 Millennium Solar Eclipse Database *(Mar 2021 - Jun 2021)*

*Course Project | Guide: Prof. Amuthan R. & Prof. Prabhu R., Department of Aerospace Engineering*

- Identified the Random Variables, found population parameters and computed **sampling distributions** of Sample Mean and Sample Variance, and found **confidence intervals** in **Python(scipy)**
- Formulated a **Null** and **Alternate Hypothesis** and tested it with **Z** and **T** tests
- Visualized the data effectively with pie, box, line plots and histograms in **matplotlib** and **pandas**
- Performed **Regression Analysis** on the variables and fitted a linear relation with **Least Squares Estimation**

## Technical Skills

| | |
|---|---|
| **Programming Languages** | Python (numpy, scipy, matplotlib, pandas, FEniCS), C++ |
| **Software Packages** | MATLAB, GitHub, Capella, LaTeX, Google-Office |
| **Simulation and CAD Softwares** | SolidWorks, ANSYS Workbench and AutoCAD |

## Positions of Responsibility

### Subsystem Head | Mechanical Subsystem *(May 2021 - Present)*

*Student Satellite Program, IIT Bombay*

- Leading an interdisciplinary team of 6 members to develop the structural and thermal design of the system
- Executed a **three-step recruitment** process to select **6 students** for the subsystem out of **70+ applicants**
- Compiled rigorous **quality assurance** practices for CAD in SolidWorks and Structural simulations in ANSYS
- Refined existing practices to ensure reliability and reproducibility in results of various simulation tasks

### Department Academic Mentor *(May 2021 - Present)*

*Department of Aerospace Engineering, IIT Bombay*

- Selected into a **team of 23 mentors** based on extensive **peer reviews and interviews**
- Entrusted with the responsibility to monitor the academic performance of **6 second-year** undergraduate students and provide academic guidance and counsel and help improve academic performance
- Involved in bridging the student-faculty gap, thereby enhancing the students' academic experience by **curating reading material** and detailed solutions for improvement in conceptual understanding of students

### Manager, Controls & Dynamical Systems Student Reading Group *(Jun 2021 - Present)*

*Institute Technical Council, IIT Bombay*

- Ideated a series of upcoming events like **Blog**, **Instagram handle** and **talks** by eminent speakers
- Collaborating with Aeromodelling Club to arrange mentors for launching projects like designing ornithopter, autonomous drones and thrust vectoring rocket

## Extra-Curricular Activities

**Volunteering**

- Volunteered to manage **International Conference on Advances on Energy Research (ICAER) 2019** with delegates from India and abroad and authored a newsletter article on the same *(2019)*
- Volunteered as a mentor for **Student Solar Workshop - 2019**, a program to train students to assemble solar study lamp and resulted in a **Guinness World Record** for lighting 6800+ solar lamps simultaneously *(2019)*
- Participated as a mentor for Glider-Making workshop of Aeromodelling Club of IITB for freshmen *(2020)*

**Public Speaking**

- Organised a day-long workshop and delivered a talk on '**Structural Design of Ground Station**' for equipping **150 participants** from **40+ universities** to set up a ground station *(2021)*

**Others**

- Received **SSTV** images broadcasted from the **International Space Station** *(2021)*
- Learned playing acoustic and non-acoustic **Guitars** in a 3 year long course *(2013 - 2015)*
- Devoted **80** hrs of service towards **sustainability** under **National Service Scheme**, IITB *(2019 - 2020)*