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Madhav Joshi

Education

2019–2024 **Indian Institute of Technology Bombay, Mumbai, India**
- Major: **Mechanical Engineering**
  GPA: **9.27/10 (Department Rank: 2 out of 40)**
- Minor: **Systems and Controls Engineering**
  GPA: **9.25/10**

Awards and Achievements

2022 Awarded **Institute Academic Award** for performing 2nd best for a whole year

2019 Among **Top 1.5%** out of 200,000 students in JEE Advanced 2019

2019 Secured **99.54 percentile** among 1.15M candidates in **JEE Mains 2019**

2019 Secured **All India Rank 74** among 15,000 students in **UCEED** (Design Entrance)

2019 **Ranked 107th** out of 0.39 million examinees in Maharashtra Common Entrance Test

Internships and Technical Teams

May'22-
Jul'22 **Modelling and Control of Compliant Mechanisms | Research Internship**
Guide: Dr. Abhijeet Joshi | Siemens Technology India
- Examined open source **SOFA framework** targeting real time for interfacing mesh, solvers, collision models and material properties to simulate a soft robot
- Implemented a research paper on **system modellig** using Koopman operator and **MPC control** of **soft robot** on compliant springs using strings coupled with brushed DC motors
- Hardware utilized **Raspberry Pi 4B** as controller and to interface camera, Arduinos and a PWM driver (PCA9685) using **I2C** communication protocol
- Installed **ROS** on Raspbian OS and developed a ROS package which could be expanded to more complex robots whose controller achieved an accuracy of **±3 mm**

Jul'21 –
May'22 **Stride | Student Technical Team**
Focuses on building a quadruped which can walk autonomously on all terrain | IIT Bombay
- Coded Newton-Euler method in **MATLAB** to find the reaction forces and torques required to produce desired angular velocities and acceleration in any configuration
- Reviewed **MIT Cheetah 3 robot** design, **MPC** implementation using QP formulation in **ROS** and tried to simulate Gazebo and RViz
- Researched trajectory generation using Bezier curves, localization and mapping of the quadruped in the given environment

Dec'20 –
Jan'21 **Microwave Metal Heating - 3D Modelling**
Guide: Prof Shruti Bhatt | Mechanical Engineering Dept | Nirma University, Gujrat, India
- Modelled **transient electromagnetic heating** of AA6061 specimen using COMSOL 3.5a
- Calculated time required for reaching melting temperature and verify using experimental data with **95%+ accuracy** to conclude that microwave metal casting process is more efficient than conventional casting methods

Research Publications

Shruti, C. B., Nilesh, D. G., & **Madhav, J.** (2021). Multiphysics simulation and validation of microwave melting characteristics of AA6061 by finite element analysis. *Advances in Materials and Processing Technologies.* doi:10.1080/2374068X.2021.1948708

Projects

Feb'22 –
May'22
Two Degrees of Freedom Robotic Arm
Course: Robotics | Guide: Prof. Abhishek Gupta | Mechanical Engineering, IIT Bombay
- Built a 2 Degree-of-Freedom Robotic Arm which moves in a plane to coordinates pointed by a red spot detected by phone camera around the bot
- Designed a **CAD model** for the robot in **Solidworks** consisting of Servo motors, joints and links of robot to **3-D print** all components required to assemble the robot
- Developed red spot detection algorithm, Forward and Inverse Kinematics in **MATLAB** for calculating joint parameters, current and desired position of end-effector
- Integrated **Arduino** with MATLAB for implementing **closed loop feedback control**

Mar'22 –
Apr'22
Optimization of Swiggy Instamart Hub Locations
Course: IEOR | Guide: Prof. Avinash Bharadwaj | Mechanical Engineering, IIT Bombay
- Modelled the revenue system of Swiggy Instamart as an **integer programming problem** by considering investment costs, operating costs and profits from all probable hub locations
- Optimized the net profit for the cases where hubs have limited or infinite capacity to store the products using CPLEX solver in **AMPL**
- Checked model robustness by performing uncertainity and risk analysis

Aug'21 –
Nov'21
Foot Pump Manufacturing Design
Course: Manufacturing Processes | Guide: Prof. Deepak Marla | Mechanical Engineering, IITB
- Studied manufacturing aspects of foot-pump including **Material and Process selection, Design and Inspection**
- Modelled every part of the pump and assembled them in **Solidworks**
- Carried out **cost analysis** based on the pump dimensions, materials and process used

Jan'21 –
Jul'21
Topology Optimization | iSURP - In Semester UG Research Program
Guide: Prof Amuthan A Ramabathiran | Aerospace Department, IIT Bombay
- Analyzed **density based** Topology Optimization in context of linear elasticity and applied it to a heat sink design optimization problem using open source **FEniCS** project in Python
- Implemented various numerical methods: gradient descent, forward/backward Euler, FDM and FEM in Python
- Formulated primal and adjoint equations for **Poisson membrane** problem to calculate the derivative of objective function using advanced analytical methods in variational calculus for **constrained optimization** problem

Jun'21 –
Jul'21
Algorithmic Trading | FinSearch
Finance Club of IIT Bombay
- Grasped stock market knowledge from **financial modules** of Zerodha Varsity on basics of stock market, technical and fundamental analysis, Futures & Options and their strategies, trading systems like pairs trading
- Scouted various trading strategies and implemented **pairs trading** strategy after back-testing results in Python and were among **top 6 teams** awarded with a cash prize of Rs 5 K for exemplary performance

Jun'20
Analemma | Krittika Summer Project
Krittika - Astronomy Club of IIT Bombay
- Inspected the motion of sun using different **celestial coordinate systems** and developed a python code to generate the data points of Analemma and calculated its various properties with **98% accuracy**
- Generated **2D** and **3D interactive plots** and **colormaps** of Analemma and its properties using Matplotlib and calculated its properties like shape, size and position to study their variation with the orbital parameters both qualitatively and quantitatively

Apr'20
Frequency Analysis of Linear Systems
Controls and Dynamical Systems Group of IIT Bombay
- Implemented MATLAB codes to design **low pass** and **high pass** filters in frequency domain to study the trade-off between smoothness and sharpness while filtering noise from an image
- Analysed the use of **frequency domain** in **spatial** and **time** domain analysis of systems by applying the knowledge of Signals and Feedback Systems including Time-Frequency analysis, Filters and Convolution

Key Courses and Technical Skills

Automation	Mechatronics, Robotics, Vibro-Acoustics, Machine Learning, Advanced PID Control, Linear and Non Linear systems, Signals and Feedback systems
Labs	Microprocessors and Automatic Controls, Mechanical Measurements, Manufacturing Processes, Mechanical Workshop, Computer Programming
Coding	C, C++, Python (Numpy, Pandas, Tensorflow, Requests, FEniCS), MATLAB, LaTeX
Hardware	Arduino, ESP32, TIVA-C, Raspberry Pi 4B, Stepper and DC motor, I2C communication
Softwares	SolidWorks, AutoCad, Adams, ROS, LABView, MS-Office, G-Suite, COMSOL, SOFA
Languages	English, Hindi, Marathi and learning French

Position of Responsibility

Sept'21- Sept'22 — **Water Polo Team Captain | Aquatics, IIT Bombay Sports**

*Synergized **13 member** institute **water polo** team in Inter IIT Aquatics meet 2022*

- Revamped the training process and the team structure after the 2 year COVID-19 pandemic break, as a result of which IIT Bombay reached **Semi Finals** after 6 years
- Scouted for players, identified each player's strong points, scheduled regular team practices, matches and discussions for improving our game

Feb'20 – Mar'21 — **Events Convener | Institute Sports Council | IIT Bombay**

36-member team responsible for execution of sports events for 10K+ students and faculties

- Ideated and organized first-ever **Virtual Run** with **1.2K+ runners** across the country to promote physical activity during the pandemic and raised INR 15K for **COVID relief** campaign by NGO-Goonj
- Conducted **Virtual Cup** for hostels through fantasy leagues and virtual General Championship; **India's largest** 1-Day Online Chess tournament attracting **550+** players (15 GMs) with prizes worth Rs70K
- Organized IIT Bombay's annual sports fest **Aavhan** which attracted a lot of sports enthusiasts from **150+ colleges** across the country and **Blackcats Championship** a virtual fitness event for **200+** inter IIT players across 14 sports

May'20 – Jan'21 — **Events Coordinator | TechFest**

*Asia's Largest Science and Technology Festival | Events: **280+** | Footfall: **175K+***

- Assisted in HOPE - **150+** virtual workshops on **Mental Health Awareness** in association with 10+ NGOs
- Collaborated with **100+ neurologists** and Mar de Somnis, a global non-profit organisation to train teachers in **150+ schools** to respond to epileptic seizures, under the aegis of HEAL, a social initiative by Techfest

Extra Curriculars

Sports

2022 — Secured 2nd position in 4×100 medley relay 55th Inter-IIT Aquatics meet and won **Gold** medal in medal in **50**m Butterfly and **Bronze** in 4×50m Medley relay in Inter Hostel General Championship held at IIT Bombay

2015–2016 — Represented School at **Zonal** and **State Level** Swimming competitions

2016 — Participated in Inter-School **Football** League organized by YMCA

2013 — Completed **State Level Sea Swimming** Competition (3km) held at Chivla beach, Malvan organized by Sindhudurg District Aquatic Association

Others

2022 — Selected **among 16 buddies** out of 115 applicants for Student Buddy Program which helps foreign exchange students breeze through their stay at our institute

2014-2017 — Proficient in playing Tabla and have cleared exams with distinction organized by 'Gandharva Akhil Bharatiya Mahavidyalay'

2015-2017 — Member of Road Safety Patrol in Nagpur city for three consecutive years