



Soham Banerjee
Systems & Control Engineering
Indian Institute of Technology Bombay

25M2005
M.Tech.
Gender: Male
DOB: 12/12/2002

Examination	University	Institute	Year	CPI / % Credits
Post Graduation	IIT Bombay	IIT Bombay	2027	9.52 Core: 26 Total: 50
Graduation	IEST Shibpur	IEST Shibpur	2025	9.8
Graduation Specialization: Mechanical Engineering				
Intermediate	West Bengal Council of Higher Secondary Education	Kagram A.N.M High School	2021	95.20%
Matriculation	West Bengal Board of Secondary Education	Kagram A.N.M High School	2019	92.57%

EXPERIENCE

VEHC Lab, Indian Institute of Technology Madras

Mechanical Engineering Intern

Chennai, Tamilnadu

May 2024 - July 2024

- Investigated the nonlinear dynamics of a vertical cantilever beam subjected to inclined base excitations at varying angles, with a focus on energy harvesting using integrated piezoelectric material.
- Developed and analyzed the nonlinear dynamic model using Wolfram Mathematica, MATLAB, and Simulink to simulate the response of the system under different excitation conditions.

M.TECH THESIS AND SEMINAR

Control of Underactuated Bipedal Locomotion with Ankle Push-Off

May 2026 - July 2027

Guide: Prof. Arpita Sinha, Systems and Control, IIT Bombay

Co-Guide: Prof. Vivek Sangwan, Dept. of Mechanical Engg., IIT Bombay

- Objective:**
 - Study and analyze the effect of Ankle Push-Off in bipedal locomotion under different Control approaches.
- Completed Work:**
 - Developed an open-loop simulation framework for an **underactuated planar biped with pneumatic push-off actuation** and no knee joint; implemented and evaluated **PID and Model Predictive Control (MPC)** for achieving desired **step sizes** and stable walking.
 - Modified the **biped hardware, electronics, and actuation system**, including pneumatic and hydraulic components, and characterized the **mechanical model and motor dynamics** using **dSPACE**.
 - Conducted **simulation and hardware experiments** across multiple initial configurations and step sizes to validate walking performance; developed the complete **modeling, simulation, and control framework from scratch**.
- Ongoing Work:**
 - Designing and developing a **foot mechanism with proper kinematics** and formulating a **continuous-time control model** for the complete biped system.
 - Extending the simulation and experimental framework to evaluate **PID and MPC-based walking control**, with plans to incorporate **knee joints** and validate the resulting system on hardware.
 - Developing **MPC-based trajectory generation** and exploring **vision-based online trajectory generation** and **Vision-Language-Action (VLA) models** for higher-level autonomous biped control.

Control Approaches for Planar Bipedal Locomotion

January 2026 - April 2026

Guide: Prof. Arpita Sinha, Systems and Control, IIT Bombay

- Reviewed **HZD** and **H-LIP**-based approaches for **planar bipedal locomotion**, along with **CLF-based Reinforcement Learning** methods for stable and adaptive robotic control.

PROJECTS

Autonomous Mobile Robot Motion Planning and Navigation | Course Project

January 2026 - April 2026

Course: SC 627, Motion Planning & Coordination of Autonomous Vehicles | Prof. Arpita Sinha

- Generated a **2D occupancy grid map** using SLAM and formulated the robot's **configuration space (C-space)** by inflating obstacles with the robot radius and safety margin; implemented **A* path planning from scratch** using a priority queue and Euclidean heuristic.
- Deployed the planning framework on a physical **TurtleBot**, integrating **AMCL** and tuning costmap and path-following parameters; evaluated multiple planners through **simulation and hardware experiments** using time-to-goal, path length, and minimum obstacle distance.

Receding Horizon Control for Autonomous Crazyflie Navigation | Course Project January 2026 - April 2026
Course: SC 627, Motion Planning & Coordination of Autonomous Vehicles | Prof. Arpita Sinha

- o Formulated the **Crazyflie navigation problem** as a **double-integrator optimal control problem** and generated **collision-free trajectories** using trajectory optimization with obstacle constraints; implemented open-loop trajectory execution in Gazebo.
- o Developed a closed-loop **Receding Horizon Controller** using MPC for real-time trajectory re-planning and deployed it on a physical **Crazyflie** using **Qualisys motion capture** feedback; analyzed the **sim-to-real gap** through simulation and hardware experiments.

Deep Reinforcement Learning for Robot Locomotion | Course Project January 2026 - April 2026
Course: IE 620, Reinforcement Learning Algorithms | Prof. Nandyala Hemachandra

- o Reproduced a **Deep Reinforcement Learning** based robotic control approach and developed custom environments for training and evaluation using **PyBullet** and **Gymnasium**.
- o Implemented the **ADDPG** actor-critic framework **from scratch** and trained RL policies for autonomous robotic control.

Autonomous Navigation in Fire Environment using Drone | Course Project August 2025 - November 2025
Course: SC 662, Robotics Capstone Project | Prof. Leena Vachhani

- o Simulated **indoor fire scenarios** using **PyroSim/FDS** and developed a **ROS2-based** fire-source localization framework.
- o Implemented **Hill Climbing** and **Multi-Armed Bandit** algorithms with **Greedy**, ϵ -**Greedy**, and **UCB** strategies.

Modeling and System Identification of a Mobile Manipulator | Course Project August 2025 - November 2025
Course: SC 658, Modelling of Aero-Mechanical Systems | Prof. Srinath Sukumar

- o Developed **forward** and **inverse kinematics** and dynamical EOM using **Lagrangian** method, validated in **Simscape**.
- o Performed **linear system identification** using **subspace identification** method about a global equilibrium point.

Computed Torque Control with RPP for Robotic Manipulators | Research Project January 2025 - August 2025
In collaboration with Anirudh Nath and Prof. Anirban Nag, IIST Shibpur

- o Designed **Computed Torque Control (CTC)** for **2-DOF** and **6-DOF robotic manipulators**, incorporating nonlinear dynamics and formulating **LMI-based Regional Pole Placement (RPP)** for prescribed stability and damping constraints.
- o Conducted **MATLAB/Simulink** simulations to evaluate trajectory tracking, stability, and robustness, including comparative analysis **with and without joint friction**.

TECHNICAL SKILLS

Programming: Python, C++, MATLAB **Hardware:** Arduino Uno/Nano/Giga, ESP32, Jetson AGX orin , Pi
Control & Modeling: Control Systems, System Modeling & Dynamics, Simulink, Simscape, dSPACE
Development Tools: Cursor, Arduino IDE, PlatformIO, Linux, Git/GitHub, Docker, Kubernetes
Robotics: ROS/ROS2, Gazebo, Webots, MuJoCo **CAD & Simulation:** SolidWorks, Fusion 360, ANSYS, COMSOL

AREAS OF INTEREST

- | | | |
|--------------------------------|---------------------------------|---------------------------|
| • System Modeling and Dynamics | • Linear and Non-linear Control | • Robotics and Automation |
| • Embedded Programming | • Deep Reinforcement Learning | • Language-Action Models |

ACHIEVEMENTS

- Received **Gold Medal** for outstanding academic performance in **B.Tech. in Mechanical Engineering**.
- Published research on **Nonlinear Dynamics of a Vertical Cantilever Beam Under Biaxial Base Excitation** in the *Journal of Computational and Nonlinear Dynamics*, investigating the nonlinear response of the beam under inclined base excitations and its potential for **piezoelectric energy harvesting**.
- Co-authored and published a paper titled **Design of Computed Torque Control with LMI based Regional Pole Placement for Two-Link Robotic Manipulator** in the ICSTCC 2025 conference proceedings, indexed in **IEEE Xplore**.
- Co-authored a research paper on **Modeling and Numerical Study of Thermoelectric Generators**, published as a **book chapter by Springer** following its presentation at ICEEGT 2025, organized by NITTTR, Kolkata.

POSITION OF RESPONSIBILITY

IMechE Student Chapter | Vice Chairman, IIST Shibpur July 2024 - July 2025

- o Led and coordinated **technical, outreach, and industrial initiatives**, including CAD 2.0, star-gazing sessions, and industrial visits; served as **Organizing Lead for the SOFE Eastern Region Finals (Oct 2023)**, overseeing event execution and logistics.