Curriculum Vitae

Soham Sachin Purohit ⋄ Ph.D. in Mechanical Engineering Applicant ⋄ UMID: 34031530

EDUCATION

University of Michigan – Ann Arbor *August 2023 - Dec 2024*
Master of Science in Robotics GPA: 4/4

Indian Institute of Technology Bombay *July 2019 - May 2023*
Bachelor of Technology in Mechanical Engineering with Honors GPA: 9.11/10
Minor in Artificial Intelligence and Data Science

PUBLICATIONS

- **S. S. Purohit**, C. Chen and R. Vasudevan, "Reachable Sets of Homogeneous Polynomial Dynamical Systems Using Exact Solutions," in IEEE Control Systems Letters, vol. 8, pp. 742-747, 2024
- **S. S. Purohit** and A. Sinha, "Coverage patterns generated by two unicycles pursuing each other," 2023 European Control Conference (ECC), Bucharest, Romania, 2023, pp. 1-6.

RESEARCH EXPERIENCE

Job-Shop Scheduling Using Quantum Annealing *January 2024 - Present*
Prof. Bogdan Epureanu | Epureanu Research Group *University of Michigan, USA*

- Formulated a binary encoding method for transforming the job-shop scheduling problem in QUBO form and obtained solutions using DWave's Hybrid Solver and Simulated Annealer
- Used unbalanced penalization and redundant constraint removal for reducing qubit complexity

Reachable Sets of HPDS Using Exact Solutions *August - December 2023*
Prof. Ramnarayan Vasudevan | ROAHM Lab *University of Michigan, USA*

- Devised methods to overapproximate the reachable sets of odeco Homogeneous Polynomial Dynamical Systems (odeco-HPDS) using their exact solutions obtained using tensor algebra
- Formulated a zonotope decomposition method for odeco HPDS with zero and constant control
- Displayed an improvement in performance over the existing reachability analysis tool, CORA

Multi-agent Pattern Generation using Only Range *August 2022 - June 2023*
Prof. Arpita Sinha | Dept. of Systems and Control *IIT Bombay, India*

- Established conditions for hypotrochoid patterns to be generated through pursuit dynamics between two unicyclic agents about a fixed point, through a range-only control law
- Enabled customization of patterns using control law adaptation by a switching rule
- Extended the analysis for equal-velocity multi-agent patterns, applicable to any agent count

Magnetic Shape Sensing of Continuum Robot Segments *May - July 2022*
Prof. Eric Diller | Microrobotics Laboratory *University of Toronto, Canada*

- Designed experiments to evaluate the performance of an embedded magnetic shape-sensing system for the 3D bending of a constant curvature, single-segment, centimeter-scale, continuum robot
- Manufactured a continuum robot segment and an experimental setup, performed data acquisition using Arduino-Uno, and manipulation using MATLAB as a part of the evaluation experiments
- Formulated effective solutions, yielding a 12% decrease in bending angle error

Kalman Filtering on Lie Groups *May 2021 - May 2022*
Prof. Ravi Banavar | Dept. of Systems and Control *IIT Bombay, India*

- Modeled a rotating ground robot as a smooth manifold and implemented an observer design on Lie Groups to determine its orientation in the ground frame
- Plotted and compared the behavior of the observer and determined optimal observer design based on the convergence rate, overshoot, and steady-state errors for the set of parameters

PROFESSIONAL EXPERIENCE

Advanced Engineering Intern — Powertrain Control *May 2024 - Present*
Isuzu Technical Center of America *Plymouth, USA*

- Assisted in the model-based development of a 2-stage MPC for the temperature control of the aftertreatment system of a commercial diesel vehicle using MATLAB/Simulink
- Improved the MiL setup through problem reformulation, making it ready for HiL simulation
- Set up CAN communications between ECU and PC to perform HiL testing of the developed MPC

Machine Learning Intern *December 2021 - February 2022*
Lateetud *Pune, India*

- Performed a comparative study of 5 deep learning methods for the identification of 11 US tax forms
- Integrated EAST (Efficient and Accurate Scene Text) with Tesseract OCR to achieve 95%+ accuracy

SELECT TECHNICAL PROJECTS

SLAM and Navigation of a Differential Drive Robot *October - December 2023*

- Implemented a cascaded PID controller for wheel and motion control, the A* algorithm for path planning, and a frontier exploration method in a differential drive robot for navigation
- Implemented a full SLAM system using Monte-Carlo Localization through a particle filter and occupancy-grid mapping using a 2D LiDAR

Autonomous Object Manipulation using Robotic Arm *August - October 2023*

- Developed algorithms for autonomous block stacking/unstacking using forward and inverse kinematic modeling and path planning of a 5-DoF ReactorX200 Robot Arm on ROS2
- Implemented a block detection system including color and height detection using OpenCV

Nonlinear MPC Design for ADAS in Autonomous Vehicles *August - December 2023*

- Implemented an LQR controller for Adaptive Cruise Control and Lane Assist for self-driving cars
- Developed a nonlinear MPC for autonomous overtaking and obstacle avoidance using CasADI

KEY COURSES UNDERTAKEN

- **Control Theory** — Model Predictive Control, Embedded Controls and Robotics, Distributed Optimization, Nonlinear Dynamics, Automatic Control, Self-driving Cars, Robotic Systems Lab
- **Computer Science** — Machine Learning, Deep Learning, Reinforcement Learning, Data Science
- **Mathematics** — Optimization, Linear Algebra, Numerical Analysis, Game Theory, Calculus

HONORS AND AWARDS

- Co-chair of session on Robot Navigation at European Control Conference 2023 **Jun 2023**
- Narotam Sekhsaria Undergraduate Excellence Award: *50,000 INR, top 3 in India* **Jan 2023**
- MITACS Globalink Research Internship Award: *7,000 USD* **May 2022**
- KVPY Scholarship, Government of India: *top 0.1%, two-time recipient* **Feb 2019**

TECHNICAL SKILLS

Languages	Python, MATLAB, C++, Java
Software	Simulink, SolidWorks, ROS, ROS 2, FORCESPRO, CasADI
Hardware	Verilog, CodeWarrior, LABCAR-Operator, Vector CANdb++

EXTRACURRICULAR ACTIVITIES

- **Table Tennis**— University of Michigan Varsity Team, Winner of several inter-college awards
- **Journalism** — Institute Journalism Special Mention; Article featured in the Times of India
- **Parliamentary Debating**— Achievements in 23 National and International Tournaments
- **Astronomy**—Hostel Technical Special Mention 2020; General Championship Winner