Neelkumar Ahir

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Education

California State University, Sacramento, CA **Aug 2023 – Aug 2025**
Master of Science in Mechanical Engineering *GPA: 3.8/4*
Coursework : Advance Mathematics, Convex Optimization, Control System Design, Introduction to Robotics, Aerial robotics

Gujarat Technological University, Gujarat, India **July 2019 – May 2023**
Bachelor of Engineering in Mechanical Engineering *GPA: 3.1/4*
Coursework : Programming For Problem Solving(C++), Automation in Manufacturing, Kinematics and Theory of Machine

Technical Skills

Programming Languages: C++, Python, MATLAB/Simulink, Ladder Logic (PLC)
Frameworks/Tools: ROS2, Gazebo, OpenCV, CasADi, Git/GitHub
Control & Perception: PID, LQR, NMPC, Sensor Fusion, SLAM, State Estimation, System Identification
Simulation & CAD: SolidWorks, CATIA, Ansys, FEA
Hardware Platforms: Pixhawk(PX4), IMU, Encoders, GPS, Linux (Ubuntu), HITL/SITL setups

Experience

Robotics Software Engineer – Planning and Control **Dec 2024 – Present**
Competitive Robotics Club – Firefighter Project *California State University, Sacramento*
- Developed motion planning and **PID** control algorithms in **C++** for accurate rover path tracking.
- Built a **sensor fusion** system using **dual IMUs** to enhance real-time state estimation.
- Collaborated in a **team-based** robotics environment using **Git and GitHub** for version control.
- Contributed to autonomous **navigation** strategies for real-world obstacle and fire detection scenarios.

Graduate Teaching Assistant **Aug 2024 – Jan 2025**
California State University, Sacramento *Sacramento, California*
- Assisting/Grading for Advanced Mathematics(ME201, ME202).

Robotics Software Engineer – Controls Intern **Jan 2023 – May 2023**
Larsen and Toubro Defense IC (L&T) *Surat, India*
- Designed and tuned multi-axis **PID** and feedforward controllers for robotic actuators to mimic electric drivetrain response.
- Simulated and validated joint dynamics in **Simulink** to analyze torque-dependent actuator behavior.
- Integrated IMU and encoder data for **sensor fusion**, enhancing control stability under load variation.
- Improved feedback loop performance by refining controller parameters in dynamic conditions.
- Automated inspection report processing with a tolerance-filling system, cutting manual work time by over **40%**.

Design and Manufacturing intern **June 2022 – July 2022**
Rockman advanced composites Pvt Ltd *Surat, India*
- Designed molds and patterns for complex composite parts using **CATIA**, enhancing production readiness.
- Assisted in composite manufacturing processes including lamination, curing, and trimming to ensure component quality.
- Operated 5-axis CNC machinery for precision machining of advanced composite components.

Projects

Thesis: Nonlinear Model Predictive Control of a Quadrotor **Jan 2024 - Present**
- Built a 12-state nonlinear quadrotor model using **MATLAB** and Simulink, including motion and actuator constraints.
- Designed a **cascaded-loop PD** controller, with gains optimized via gradient-based optimization for accurate trajectory tracking.
- Developed an **NMPC** controller using **CasADi**, incorporating position, velocity, and orientation angle errors in the cost function.
- Performed **system identification** through model fitting and simulation-based parameter tuning.
- Achieved **86.7% ISE** and **92.6% ITAE** improvement with NMPC over PD, validated in MATLAB.
- Currently integrating Reinforcement Learning for adaptive, **learning-based MPC**.

Autonomous Rover Design **Sep 2024 – Dec 2024**
- Developed an autonomous rover using **C++, ROS 2**, and **Pixhawk** for GPS-based waypoint navigation.
- Implemented the **Pure Pursuit algorithm** to achieve smooth and accurate trajectory tracking.
- Used **QGroundControl** for mission planning, live telemetry, and real-time control.
- Enabled user-defined waypoint selection with automatic **path planning**, tested in simulation.

LQR-Based Control of Inverted Pendulum System **Sep 2023 – Dec 2023**
- Modeled and linearized a nonlinear inverted pendulum system and analyzed system states, **controllability**, and **observability**.
- Designed and simulated an **LQR** controller with a state estimator in MATLAB/Simulink to validate system stability.

Awards & Honors

Honorable Mention(3rd Place) – CSU Student Research Competition **April 2025**
California State University Systemwide Event, 2025
- Recognized for outstanding graduate research in Engineering and Computer Science at the 39th Annual CSU Student Research Competition, hosted by Cal Poly Humboldt.

Provost's Award for Research Excellence – 1st Place **March 2025**
California State University, Sacramento Spring Symposium, 2025