Neelkumar Ahir

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Summary

Robotics Engineer specializing in motion planning and controls, robot learning for autonomous systems, with expertise in C++, Python, ROS2, NMPC, and trajectory optimization in translating complex problems into efficient solutions for real-world deployment.

Education

California State University, Sacramento, CA   **Aug 2023 – Dec 2025**
Master of Science in Mechanical Engineering   *GPA: 3.8/4*
Awards:
- **Provost's Award (1st Place)** – Sacramento State Spring Symposium, 2025
- **Honorable Mention (3rd Place)** – The 39th Annual CSU Student Research Competition, hosted by Cal Poly Humboldt, *2025*

Gujarat Technological University, Gujarat, India   **July 2019 – May 2023**
Bachelor of Engineering in Mechanical Engineering   *GPA: 3.1/4*

Technical Skills

Programming Languages:	C++, Python, MATLAB/Simulink
Frameworks/Tools:	ROS2, Gazebo, Issac Sim/lab, CasADi, Pytorch, Git/GitHub
Simulation & CAD:	SolidWorks, CATIA, Ansys, FEA
Hardware Platforms:	Jetson AGX Thor, Jetson Orin Nano, Pixhawk(PX4), IMU, Encoders, GPS, Linux, HITL/SITL, SO-101 arm

Projects

LeSandwitch – Embodied AI Hackathon by Seeed Studio, NVIDIA Robotics, Hugging Face (link)Sep 2025 – Oct 2025
- Built a mobile manipulator with dual **LeRobot SO-101** arms and a modular kitchen setup for sandwich preparation and delivery
- Teleop data collection via **leader–follower** control; expanded datasets with simulation in **IsaacSim/IsaacLab**
- Trained **GR00T-N1.5** and **ACT** policies on cloud GPUs using **Runpod, Vast.ai, Brev, and PhosphoBot**
- Deployed real-time inference on **NVIDIA Jetson AGX Thor** (prototyped on **Jetson Orin Nano Super**).

Thesis: Nonlinear Model Predictive Control of a Quadrotor   **Jan 2024 - Present**
- Derived a complete nonlinear quadrotor model using **MATLAB** and Simulink, including motion and actuator constraints.
- Designed a **cascaded-loop PD** controller and optimized gains 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.
- Achieved **86.7% ISE** and **92.6% ITAE** improvement with NMPC over PD, validated in MATLAB.
- Performed experimental flight tests on **DJI Phantom 4 Pro V2.0** across 3 trajectories to validate controller performance.
- 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.
- Implemented **EKF** fusing dual IMUs + encoders at **30** Hz; reduced yaw drift by **55**%.

Experience

Robotics Software Engineer – Planning and Control   **Dec 2024 – Present**
Competitive Robotics Club – Firefighter Project   *California State University, Sacramento*
- Developed motion planning algorithms and **PID** controllers in **C++** for autonomous rover navigation.
- Built a real-time **sensor fusion** system integrating dual IMUs to enhance localization and state estimation.
- Conducted **system-level debugging** for hardware-software integration issues during field testing.
- Collaborated in version-controlled team setup using **Git/GitHub**, designed behavior tests in simulation before deployment.

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 using **EKF**, enhancing control stability under load variation.
- 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.

Publications

- Garima Bhandari, **Neelkumar Ahir**, Atefeh Mohammadpour. "Enhancing Drone Trajectory Tracking in Construction via Proportional–Derivative Control Optimization" submitted to the 62nd ASC International Conference, 2026, Accepted.
- **Neelkumar Ahir**, Jesus Betancourt and Garima Bhandari. "Non-Linear Model Predictive Control of Quadrotor for Trajectory Tracking" under review for IEEE Robotics and Automation Letters.