Anoushka Alavilli

1 Hilltop Drive, Hanover, NH 03755
603-667-5708 anoushka.alavilli@gmail.com

Research Interests: Field robotics, autonomous off-road navigation, reinforcement learning, model predictive control, sim-to-real transfer, dynamics modeling, and continual learning on hardware.

Education

Carnegie Mellon University **Pittsburgh, PA**
Ph.D. student at the Robotics Institute, School of Computer Science *August 2024 – current*
Coursework: Deep Reinforcement Learning, Introduction to Robot Learning, Integrated Planning & Learning, Kinematics, Dynamics & Control, and Math Fundamentals for Robotics

Carnegie Mellon University **Pittsburgh, PA**
M.S. in Electrical & Computer Engineering *August 2022 – December 2023*
GPA – 3.89/4.0
Coursework: Optimal Control & Reinforcement Learning, Intro. to Machine Learning for Engineers, Robot Dynamics & Analysis, Applied Stochastic Processes, Computer Vision, Digital Signal Processing.

Tufts University **Medford, MA**
B.S. in Electrical Engineering *September 2018 – May 2022*
GPA – 3.91/4.0, graduated *summa cum laude*
Relevant Coursework: Convex Optimization, Linear Systems, Feedback Control Systems, Probabilistic Systems Analysis, Distributed Machine Learning and Control, Computational Geometry, Mathematical Aspects of Data Analysis, Data Structures.

Experience

Robotics Institute, Carnegie Mellon University **Pittsburgh, PA**
PhD Student, Co-advised by Prof. Jeff Schneider and Prof. Guanya Shi *August 2024 – current*

- Conducting research in **learning-based planning and control for autonomous off-road driving**, with emphasis on reinforcement learning, model predictive control, and sim-to-real transfer.
- Developed a hierarchical **RL–MPPI framework for high-speed off-road navigation** that uses an RL value function as an execution-aware planning cost, enabling bidirectional feedback between planning and control without explicit and expensive terrain cost maps.
- Demonstrated **86% navigation success vs. 55% for baseline MPPI** across unseen off-road evaluation tasks, while substantially reducing vehicle jerk, acceleration, pitch, and roll; introduced online value-function adaptation to learn from real-world driving experience.
- Integrated and deployed the hybrid RL–MPPI algorithm on a **full-scale Yamaha Viking ATV**.
- Published this work as a **full paper with oral presentation at IEEE IROS 2026**. (see Publications [1]).
- Investigating **vision-based sim-to-real transfer for off-road driving**, combining simulation pre-training with online adaptation to incorporate real-world visual terrain information at deployment.
- Co-leading a weekly CMU graduate student reading group on dynamics modeling, reinforcement learning, and control.

FieldAI **Irvine, CA**
Robotics Research Intern, Federal Off-road Driving Team *May – August 2026*

- Developed a **semi-structured dynamics learning** framework for skid-steer mobile robots, combining a physics-based Lagrangian prior with structured learned residual dynamics basis to model tire-terrain

interactions and other unmodeled forces.
- Designed a low-dimensional **online adaptation** method that re-estimates environment-dependent dynamics parameters from recent robot observations using closed-form ridge regression, enabling rapid adaptation to changing operating conditions.
- Performed numerical simulation evaluations based on **real deployment challenges**, including **strong stream currents with reduced traction, unknown payload masses, and sliding payloads**; demonstrated improved multi-step prediction accuracy over baselines.
- Integrated the learned adaptive dynamics model into a 60 Hz **closed-loop Model Predictive Path Integral (MPPI)** controller.
- **Work accepted as poster** to IROS 2026 workshop *Bridging Perspectives in Navigation* (see Publications [2]).

NASA Jet Propulsion Laboratory **Pasadena, CA**
Intern, Aerial Mobility Robotics Group (347T) *February – August 2024*

- Performed research in dynamics modeling for off-road driving as part of the controls & planning team on the DARPA RACER project.
- Designed and implemented a **hybrid terradynamics model** for the offroad vehicle. Incorporated DINOv2 visual foundation model (VFM) feature information from the terrain to enable vision-based learned adaptation of the terradynamics model.
- Integrated the dynamics modeling and visual feature mapping into the team's **ROS autonomy stack**. Wrote all code using Python, C++, and ROS.
- Published and presented resulting research at **IEEE ICRA 2025** (see Publications [3]).

Robotic Exploration Lab, Carnegie Mellon University **Pittsburgh, PA**
Master's student researcher under Professor Zachary Manchester

TinyMPC *January – December 2023*

- Developed a fast and memory-efficient **model predictive control (MPC) solver for embedded applications** with trajectory tracking and real-time obstacle avoidance. Showcased functionality on a Crazyflie drone.
- Formulated and implemented the Alternating Direct Method of Multipliers (ADMM) to solve the underlying MPC problem.
- Published this work as a conference paper to **IEEE ICRA 2024** within a student group (see Publications [4]) and won award for **Best Paper in Automation**.

NASA Jet Propulsion Laboratory **Pasadena, CA**
Summer Intern, Mars 2020 Instrument Data Systems Operations *May – July 2023*

- Designed a variation of Gaussian mixture models with probabilistic uncertainty quantification (exceeding initial assignment) to predict data pipeline outputs for Mars 2020 mission downlink operations. Model circumvents the prior dependence on image content, instead only using instrument metadata from Mars, to make output predictions.

Publications

[1] **Alavilli, A.**, Song, R., Shi, G., & Schneider, J. (2026). Paper link. Value Function-Guided MPPI for Hierarchical Planning and Control in Off-Road Autonomous Navigation (*Accepted as full paper with oral presentation* to IEEE IROS 2026.)
[2] **Alavilli, A.**, Noren, C., Gibson, J., Shi, G., Schneider, J., & Khattak, S. (2026). Model Learning and Online Adaptation for Environmental Disturbances in Autonomous Off-Road Driving. Submitted paper link. (*Accepted as a poster* to the IEEE IROS 2026 Workshop on Bridging Perspectives in Navigation.)
[3] Gibson, J.*, **Alavilli, A.***, Tevere, E., Evangelos, T., & Spieler, P. (2024). Dynamics Modeling using

Visual Terrain Features for High-Speed Autonomous Off-Road Driving. Arxiv link. (Published in IEEE ICRA 2025 Conference Proceedings.) * These authors contributed equally
[4] **Alavilli, A.***, Nguyen, K.*, Schoedel, S.*, Plancher, B., & Manchester, Z. (2023). TinyMPC: Model-Predictive Control on Resource-Constrained Microcontrollers. arXiv preprint arXiv:2310.16985. Arxiv link. (Published in IEEE ICRA 2024 Conference Proceedings.) * These authors contributed equally.
[5] **Anoushka Alavilli** and Mai Vu. 2022. PLAN: a leafcutter ant colony optimization algorithm for ride-hailing services. In Proceedings of the Genetic and Evolutionary Computation Conference (GECCO '22). Association for Computing Machinery, New York, NY, USA, 4–12. Publication link.

Awards

- **ICRA 2024 Best Paper Award in Automation** for TinyMPC
- **Harry Poole Burden Prize in Electrical Engineering**, Tufts University, Spring 2022 (Awarded for the best design or research project done by electrical engineering undergraduate students)
- **Morris and Sid Heyman Prize Scholarship**, Tufts University, Spring 2021 (Awarded for academic achievement and future promise)

Talks and Presentations

- First-author paper presentation at ICRA 2025 for "Dynamics Modeling using Visual Terrain Features for High-Speed Autonomous Off-Road Driving."
- Guest lecture on autonomous off-road driving and MPPI for the course *Optimal Control and Reinforcement Learning* at Carnegie Mellon University in Spring 2026.
- Guest lecture on convolutional neural networks for the course *Fundamentals and Engineering Applications of AI* at Carnegie Mellon University in Spring 2023.
- First-author paper presentation at ACM GECCO 2022 conference for undergraduate research.

Skills

Programming languages: Python, Julia, MATLAB, C++

Computational tools: Linux, ROS2, Docker, IsaacLab, JAX, PyTorch, MeshCat, CVX/CONVEX.jl, Git, LaTeX,.