# DARSHIT PATEL

Natick, MA | dapatel2198@gmail.com | +15408240814 | www.darshp.info


## SUMMARY


Software Engineer with 3+ years of C++ development and research experience spanning production simulation software and autonomous-vehicle motion planning. Skilled in MATLAB/Simulink, MPC, trajectory optimization, vehicle dynamics, and closed-loop simulation. Published researcher integrating prediction, planning, and control for autonomous systems.


## SKILLS & INTERESTS

**Programming:** Modern C++, Python 3, MATLAB, JavaScript

**Planning & Control:** MPC/NMPC, trajectory optimization, pRRT/RRT*, A*, vehicle dynamics, nonlinear control

**Optimization:** Nonlinear optimization, cost and constraint formulation, solver tuning, numerical methods

**Tools & Systems:** Simulink, Simscape, GoogleTest, ROS2, Git, CI, Stateflow, CARLA, V2V communication

## WORK EXPERIENCE

**MathWorks Inc. | Software Engineer in Test** | *Simulink* *Dec 2025 – present*

- Develop and maintain automated tests in **C++/GoogleTest, JavaScript, and MATLAB** for Simulink instrumentation, data logging, live streaming, and visualization workflows.
- Design unit-, integration-, and system-level validation across production C++ backends and desktop/web interfaces
- Review developer-authored production C++ source and GoogleTest code daily for correctness, design quality, maintainability, performance, test coverage, and backward compatibility
- Debug failures, validate fixes, and expand regression coverage through continuous-integration workflows.

**MathWorks Inc. | Software Engineer** | *Engineering Development* *July 2023 – Dec 2025*

- Developed nonlinear spring-damper force-modeling capabilities for 3D rigid-body joints within the production **C++/Simscape Multibody codebase**, including unit and system validation.
- Contributed to development of the **Extremum Seeking Control block** in C++, implementing GoogleTest and system-level validation and creating a battery state-of-charge estimation demonstration.
- Integrated bag-of-words-based loop-closure functionality into a **C++ VSLAM workflow** for Automated Driving Toolbox.

## RESEARCH & PROJECTS

**Motion Planning for autonomous vehicles (MS Thesis) |** *Prof. Azim Eskandarian* *Aug 2021 – June 2023*

- Developed and benchmarked a pRRT-based online motion planner against closed-loop RRT and RRT* for unsignalized intersections, incorporating GPR-based prediction of dynamic obstacle vehicles and testing 14 maneuvers across one-, two-, and three-lane environments.
- Demonstrated that pRRT required **15× fewer floating-point operations than RRT**, achieved comparable path optimality to RRT*, and converged approximately **100× faster than RRT***.
- Proposed a pRRT-Connect planner using intermediate-goal selection, Bézier path smoothing, and MPC/Stanley tracking; reduced average sampling iterations by **55% versus pRRT and 69% versus RRT** across 100 trials.
- **Patel, Darshit** & Eskandarian, Azim. (2023). "Probabilistic RRT Connect with Intermediate Goal Selection for Online Planning of Autonomous Vehicles," *IFAC-PapersOnLine*, 56(3), 373–378, 2023.
- **Patel, Darshit** & Eskandarian, Azim, "Sampling-Based Planning Algorithms at Non-Signalized Intersections with Traffic for Autonomous Vehicles," manuscript under revision for *IEEE Transactions on Intelligent Transportation Systems*.

**Trajectory optimization for autonomous racing using NMPC** | *Prof. Azim Eskandarian* *Mar 2021 – May 2022*

- Developed a high-level NMPC motion planner using a **nine-state nonlinear bicycle model and Pacejka tire dynamics** to generate time-optimal racing trajectories.
- Formulated the lap-time objective and enforced nonlinear dynamics, track-boundary, acceleration, steering-angle, steering-rate, and velocity constraints over the prediction horizon.
- Evaluated the planner in MATLAB across **COTA, Spa, and Monza** for F1, LMP1, and LMGTE vehicles, generating dynamically feasible trajectories consistent with professional racing lines.
- Sivashangaran, S**., Patel, D., and** Eskandarian, A., "Nonlinear Model Predictive Control for Optimal Motion Planning in Autonomous Race Cars," *IFAC-PapersOnLine*, 55(37), 645–650, 2022.

**Full-Scale and Scaled AV Development (Ford Fusion, F1tenth) |** *Prof. Azim Eskandarian* *Aug 2021 – May 2023*

- Contributed to development and experimental testing of **X-CAR**, a full-scale Ford Fusion connected-autonomy platform integrating CARMA3, ROS/C++, perception sensors, drive-by-wire actuation, and DSRC/V2X communication.
- Developed the **C++ motion-planning stack** for deployment on scaled autonomous vehicles, integrating planning and control components and performing closed-loop experimental validation.
- Implemented and tested vehicle-control and V2V communication workflows across full-scale and scaled platforms for autonomous-navigation experiments.
- Mehr, G., Ghorai, P., Zhang, C., Nayak, A., **Patel, D.**, et al., "X-CAR: An Experimental Vehicle Platform for Connected Autonomy Research Powered by CARMA," *IEEE Intelligent Transportation Systems Magazine, 15(2), 41–57, 2023.*

**National Champion — Go-Kart Design Challenge 2019 | Steering System Lead** *Aug 2019 – May 2020*

- Led design, CAD modeling, fabrication, and implementation of an Ackermann/Pitman-arm steering system, including steering geometry, effort, load-transfer, and component-sizing calculations.
- Validated the knuckle, kingpin, steering linkage, and steering shaft through ANSYS structural analysis before manufacturing and track testing.

## ACADEMICS

**Master of Science in Mechanical Engineering | Virginia Tech, VA | 3.95/4.0** **Aug 2023**

**Bachelor of Technology in Mechanical Engineering | SVNIT Surat | 9.37/10** **May 2020**