Aashish Shaju

Blacksburg, VA | aashishshaju00@gmail.com | linkedin.com/in/aashishshaju **|** github.com/aashishshaju00 **|** aashishshaju00.github.io

SUMMARY

Controls engineer (Ph.D., Mechanical Engineering) specializing in autonomous and articulated vehicles, with experience in vehicle dynamics, controller development, real-time simulation, and vehicle testing. Developed longitudinal and lateral control systems in MATLAB/Simulink, generated deployable C code, and validated algorithms through high-fidelity simulation and autonomous vehicle testing

TECHNICAL SKILLS

Model-Based Design & Toolchain: MATLAB/Simulink, automatic code generation (Simulink/Embedded/MATLAB Coder), S-function integration, MiL/SiL workflows, fixed-step real-time execution, TruckSim, CarSim, Git
Controls & Estimation: PID (anti-windup, saturation), LQR, MPC, state-space modeling, system identification, Kalman filtering, EKF/UKF/particle filter, stability analysis, closed-loop validation
Motion Planning & Autonomy: Trajectory tracking, motion and path planning, curvature-continuous path generation (clothoid, Hermite spline), trajectory optimization, articulated vehicle control, vehicle platform characterization, redundant and fail-safe architectures
Embedded & Signal Processing: Embedded C++, real-time DAQ, deterministic timing, analog signal conditioning, frequency-domain analysis, feature extraction, sensor integration

PROFESSIONAL EXPERIENCE

Senior Research Associate | Center for Vehicle Systems & Safety, Virginia Tech **Jan 2025 – Present**

- Developing a real-time model predictive path-tracking controller for articulated vehicles with explicit limits on articulation angle, lateral acceleration, steering, and road boundaries; a validated geometric controller provides a predictable fallback if the optimizer becomes infeasible or exceeds its time limit.
- Implemented the controller in C++ and integrated the same compiled binary with Simulink through a MEX interface, running fixed-step at 100 Hz against a TruckSim plant model with per-cycle latency measurement
- Lead a sponsored MxV Rail program developing a portable ultrasonic wheel-defect screening system; designed the analog front end and FPGA-based acquisition hardware, completed field deployments at MxV Rail, and developed a two-indicator method that detected all defective wheelsets with one false alarm across independent datasets. Patent filing planned

Graduate Research Assistant | Center for Vehicle Systems & Safety, Virginia Tech **Aug 2021 – Dec 2024**

Ph.D. research: Adaptive longitudinal and lateral control for autonomous articulated trucks

- Developed a receding-horizon clothoid path-tracking controller in C++ and deployed it on Virginia Tech's instrumented Chevrolet Bolt, using 100 Hz GNSS/IMU pose estimates and steering commands over CAN; achieved approximately 0.2 m RMS lateral cross track error at speeds up to 30 mph
- Tuned the localization EKF using recorded test data and innovation-consistency checks, and identified speed-dependent steering maps from vehicle testing for controller design
- Extended the controller to tractor-semitrailer combinations, accounting for trailer off-tracking and allowing the tractor, hitch, or trailer to serve as the controlled point without changing the overall control structure
- Added high-speed transition logic (heading-continuity checks, curvature-dependent lookahead selection, adaptive lookahead rate limits) and validated in TruckSim and Simulink at 100 Hz on real highway geometry, holding under 0.1 m RMS error at the tracked point with lateral acceleration inside ±0.5 g at speeds to 55 mph

Research Assistant | Vibration Research Lab, IIT Delhi **Sep 2020 – Jul 2021**

- NVH analysis of military vehicle suspension and powertrain subsystems; extracted spectral and statistical features from accelerometer data and optimized sensor placement for diagnostic reliability

SELECTED PROJECTS

- **Discrete PID Controller in C++ with MEX and Simulink Harness:** Implemented a stateful PID controller with output saturation, conditional-integration anti-windup and filtered derivative in C++, integrated it with MATLAB/Simulink through a compiled MEX interface and validated it in a multirate test environment. github.com/aashishshaju00/cpp-pid-mex-for-control
- **Nonlinear State Estimation (EKF / UKF / Particle Filter):** Implemented and benchmarked multiple estimators for a nonlinear robotic platform; fused multi-station radar measurements for real-time localization
- **System Identification & Output Feedback:** Identified unknown plant dynamics via frequency-domain methods; designed an LQR plus Kalman estimator validated in both time and frequency domains

EDUCATION

Ph.D., Mechanical Engineering (Control Systems & Vehicle Dynamics), Virginia Tech -- GPA 4.0/4.0 **2024**
M.S., Mechanical Engineering (Vehicle Dynamics), IIT Hyderabad -- GPA 3.8/4.0 **2020**
B.S., Mechanical Engineering, Cochin University of Science and Technology -- GPA 3.6/4.0 **2017**

SELECTED PUBLICATIONS

- "Integrated Longitudinal and Lateral Control for High-Speed Platooning of Articulated Vehicles," Vehicle System Dynamics, in press.
- "Enhancing Autonomous Vehicle Navigation with a Clothoid-Based Lateral Controller," Applied Sciences, 2024.
- "Practical Application of Passive Air-Coupled Ultrasonic Acoustic Sensors for Wheel Crack Detection," Sensors, 2025.