

# Parsa Ghasemi

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## EXPERIENCE

### Vice President

Jul 2025 – Present

Pomona, CA

*Autonomous Vehicle Laboratory, Cal Poly Pomona*

- Undergraduate executive in DoE-funded graduate research lab with 50+ members, promoted based on technical contributions to CAN bus and embedded systems
- Administer \$84,000+ annual Department of Education research grant, overseeing budget allocation, procurement, and fiscal reporting
- Direct 15 researchers across 4 teams delivering 3 conference papers, 1 production AV platform, and \$30,000+ in documented cost savings
- Achieved 100% paper submission rate by guiding 4 concurrent research teams, with 2 papers accepted to peer-reviewed conferences
- Reduced new researcher onboarding time by 50% by establishing standardized protocols and technical documentation

### Research Assistant

Apr 2025 – Jul 2025

Pomona, CA

*Autonomous Vehicle Laboratory, Cal Poly Pomona*

- Identified 3 CAN bus attack vectors and developed defense framework, resulting in SCCUR oral presentation to 500+ attendees
- Engineered embedded control system achieving 100 Hz loops and centimeter-level positioning, deployed on production research vehicle
- Co-authored 2 research papers with graduate researchers, contributing experimental design and data analysis for peer review
- Promoted to Vice President within 3 months based on technical contributions and leadership capabilities

### Founder & President

Jan 2025 – Present

Pomona, CA

*Legged Robotics Lab*

- Founded student organization and 501(c)(3) robotics nonprofit focused on legged locomotion; secured \$10K+ in funding
- Designing bipedal robot platform with forward and inverse kinematics analysis for walking gait development
- Deliver workshops on embedded systems, control theory, kinematics, and robot locomotion

## EDUCATION

### California State Polytechnic University, Pomona

Pomona, CA

*Bachelor of Science in Computer Engineering; GPA: 3.5/4.0*

Expected May 2027

- Relevant Coursework: Data Structures, Embedded Systems, Digital Logic Design, Signals & Systems, Linear Algebra

## PROJECTS

### Autonomous Vehicle Navigation System | *Python, ROS2, OpenCV, NumPy, OSMnx* 2025 – 2026

- Architected autonomous navigation system enabling campus waypoint following validated over 50+ hours of field testing
- Achieved centimeter-level positioning by developing GPS/RTK/IMU fusion pipeline processing at 100 Hz with EKF and graceful degradation
- Built probabilistic occupancy grid achieving 0.2m resolution over 400m<sup>2</sup> coverage using Bayesian log-odds and Bresenham raycasting
- Implemented Dynamic Window Approach (DWA) with kinematic bicycle model and Pure Pursuit path-following for Ackermann-steering vehicles
- Integrated OpenStreetMap routing via OSMnx with Dijkstra's algorithm for GPS-based waypoint navigation on real road networks
- Implemented Pure Pursuit path-following controller with adaptive speed-dependent lookahead and linear waypoint interpolation

- Developed costmap with morphological obstacle inflation for C-space collision checking and thread-safe concurrent access
- Built PID velocity controller with anti-windup and HeadingPID with angle wrapping at  $\pm\pi$  discontinuity
- Integrated Velodyne VLP-16 LIDAR, Intel RealSense RGB-D, and Xsens MTi-680G IMU with unified sensor abstraction layer
- Designed thread-safe state containers with lock-protected snapshots for multi-threaded perception/control/visualization pipeline
- Integrated YOLOPv2 multi-task neural network for drivable area segmentation and lane line detection on RealSense RGB-D frames

**Distributed Embedded Vehicle Control System | C++, Teensy 4.1, CAN Bus, I2C, FlexCAN** 2025 – 2026

- Engineered distributed CAN bus system in C++ achieving 100 Hz deterministic control across 4 Teensy MCUs at 250 kbps
- Achieved zero safety incidents over 50+ hours by implementing 4-layer E-STOP architecture with <200ms emergency response
- Developed throttle control node with MCP4728 quad DAC over I2C for precise voltage output (0.3V–4.0V) and drive mode selection
- Built stepper motor steering controller with limit switch protection, analog encoder feedback, and non-blocking pulse generation
- Implemented closed-loop brake actuator control with linear actuator position feedback and stroke calibration
- Designed custom CAN message protocol (0x100/0x200/0x300) with JSON telemetry and ASCII command interface for remote monitoring
- Built 500ms hardware watchdog with automatic E-STOP failsafe across distributed CAN network

**Multimodal Imitation Learning for Day-Night Driving | Python, PyTorch, OpenCV** 2025

- Built multi-sensor data pipeline (RGB 30Hz, thermal 30Hz, CAN 20Hz) capturing 50,000+ training frames for imitation learning
- Implemented multimodal perception pipeline fusing RGB and thermal cameras for robust day-night operation
- Achieved autonomous navigation with only 3 manual interventions over 0.3-mile campus route; presented at SCAIR symposium

**Real-Time Vehicle WebUI with Voice Control | Python, FastAPI, WebSocket, Whisper** 2025 – 2026

- Developed real-time web interface with WebSocket bridge to Teensy CAN master for remote vehicle control from mobile devices
- Integrated OpenAI Whisper speech-to-text for voice commands (E-STOP, throttle, steering, mode selection) over HTTPS
- Implemented joystick-to-control mapping, concurrent client management, and JSON state streaming at 50ms update rate

**Reinforcement Learning Environment for Autonomous Driving | Python, Gymnasium, CARLA, NumPy**

- Designed modular Gymnasium environment for CARLA simulator achieving 100 steps/sec training throughput with <10ms multi-sensor latency
- Architected manager-based system (7 modules) with factory pattern sensors, JSON-configurable scenarios, and dual-queue event handling
- Trained PPO agent to achieve stable lane-following behavior within 50,000 steps, validated over 10,000 episodes with no memory leaks

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## RESEARCH & PUBLICATIONS

**Defense-in-Depth Security Architecture for CAN-Based AV Control Systems** Nov 2025

- *Oral Presentation* at Southern California Conference for Undergraduate Research (SCCUR), CSU Channel Islands
- Developed multi-layered cybersecurity framework to harden CAN bus networks against injection attacks, replay attacks, and unauthorized access
- Proposed practical security mechanisms for real-world deployment on production autonomous vehicles

**Simplified Multimodal Imitation Learning for Day-Night Autonomous Driving** 2025

- *Poster Presentation* at Southern California AI and Robotics Symposium (SCAIR)
- Researched imitation learning techniques enabling autonomous vehicles to generalize driving behavior across varying lighting conditions

## DRIVE: Development Research Infrastructure for Vehicle Education

2026

- Conference Paper accepted to ASEE Zone IV Conference 2026
- Authored technical paper documenting affordable AV education platform (\$30,000 vs \$200,000+ commercial systems)
- Presented replicable drive-by-wire architecture for converting commodity UTVs into research testbeds with custom CAN bus control

## TECHNICAL SKILLS

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**Programming:** Python, C++, C, MATLAB

**Robotics & Autonomy:** ROS2, Nav2, OpenCV, Open3D, PyTorch, CARLA, Gymnasium, robot\_localization, tf2, URDF

**Embedded Systems:** Teensy 4.1, RP2040, Arduino, PlatformIO (cross-compilation), Real-time Control Systems

**Protocols:** CAN Bus (FlexCAN), I2C, SPI, UART, Serial, Ethernet/UDP, NTRIP

**Sensors:** LIDAR (Velodyne VLP-16), RGB-D (Intel RealSense), GPS/RTK/IMU (Xsens MTi-680G), Encoders

**Libraries:** NumPy, OSMnx, NetworkX, PyProj, Shapely, FastAPI, Adafruit\_MCP4728

**Tools:** Git, Linux, Sphinx, VS Code

**Concepts:** Multithreading, Sensor Fusion, Path Planning, Control Theory, Occupancy Grids, Kinematics, EKF, Reinforcement Learning

**Languages:** English (Fluent), Farsi/Persian (Native)

## VOLUNTEER EXPERIENCE

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### NSTI Program Volunteer Assistant

Jul 2025

*Caltrans*

Pomona, CA

- Supported Caltrans National Summer Transportation Institute (NSTI) STEM outreach program for underrepresented high school students
- Assisted professors with hands-on STEM lessons, student engagement activities, and field trip logistics

### SCAIR 2025 Symposium Student Volunteer

Oct 2025

*California State Polytechnic University, Pomona*

Pomona, CA

- Assisted with organization, A/V setup, and session coordination for Southern California AI & Robotics Symposium

### SCCUR 2025 Conference Volunteer

Nov 2025

*California State University Channel Islands*

Camarillo, CA

- Facilitated smooth experience for 500+ student presenters and faculty attendees across multiple concurrent sessions