Sunny Nitin Deshpande

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EDUCATION

University of Illinois Urbana-Champaign (UIUC) — Aug 2025 - Sep 2026

Master of Engineering in **Autonomy and Robotics** (GPA: 3.75/4.00)

- Current Coursework: **Reinforcement Learning, Advanced Computer Vision, Autonomous Vehicle Safe Autonomy**, Humanoid Robotics

Singapore University of Technology and Design (SUTD) — Sep 2021 - May 2025

- B.Eng. (**Eng. Product Development**), **Robotics Focus**, **Minor in CS** | SHARP Honours, Global Distinguished Scholarship

TECHNICAL SKILLS

SLAM & Localization: GMapping, AMCL, SLAM Toolbox, ORB-SLAM3, DROID-SLAM, Visual Odometry, Point Cloud Registration (ICP, NDT), Extrinsic Calibration

Planning & Navigation: Motion Planning, Path Planning (**A***, **RRT/RRT***), **Trajectory Smoothing (Bezier)**, Behavior Prediction, Costmap Generation, **Nav2**, **Frontier Exploration**, Occupancy Grids

Control & Estimation: PID, Stanley Controller, Pure Pursuit, Admittance Control, Kalman Filter, Sensor Fusion (LiDAR + RGB-D), State-Space Control, Bicycle/Ackermann Models

Languages & Libraries: Python, C++, MATLAB | PyTorch, OpenCV, TensorFlow, Nav2, MoveIt, Pinocchio

Platforms & Tools: ROS/ROS2, Gazebo, Isaac Lab, Docker, CMake, Git, GitHub Actions CI, Linux/Bash, CAN, DDS, MQTT

Hardware: Polaris GEM e4, **Ouster OS1-128 LiDAR**, OAK-D Stereo, Jetson Orin Nano/Xavier, Hokuyo UTM-30LX, Pioneer P3-DX.

WORK EXPERIENCES

Hyundai Motor Group Innovation Centre Singapore — May 2024 - Sep 2024

Robotics Fleet Software Engineer Intern - Robotics Centre | Singapore

- Overhauled fleet communication from REST to event-driven MQTT (QoS-1), cutting latency from **332ms to 151ms**; successfully deployed and actively running on **200+ production AMRs**.
- Replaced stop-and-wait intersection coordination with velocity-profiled trajectory blending (Bezier smoothing, adaptive-lookahead pure pursuit), increasing multi-robot intersection throughput **by 40%** via staged rollout to **200-AMR fleet**.
- Designed traffic-aware **fleet path planner** with **corridor congestion scoring**, **ETA-based rerouting**, and **kinematic feasibility validation** for constrained factory aisles; increased completed missions **by 10%** via staged canary deployments.
- Created custom node-based path planning emulator to evaluate traffic-based planning algorithms using C++.
- Performed fleet failure analysis via internal simulator log replay of failed missions, diagnosing trajectory tracking and coordination faults; findings fed directly into planner parameter tuning and intersection logic refinements.

Venti Technologies — Sep 2023 - Dec 2023

AV Simulation Engineer Intern - Planning & Control | Singapore

- Built physics-based simulation in VTD modeling port-specific dynamics (trailer articulation, wet-surface friction, restricted turning radii); authored 200 procedurally generated test scenarios from 50 parameterized templates, exposing MPC payload oscillation during high-speed turns.
- Supported on-site AV trial runs at port: performed system bring-up, observed live operations, and logged edge cases; pipeline adopted for regression testing.

Agency for Science, Technology and Research — May 2019 - Aug 2019

Robotics & AI Research Intern - Perception Team | Singapore (Solo Project)

- Built end-to-end CNN-based visual navigation on Pioneer P3-DX: automated data collection via random waypoint patrol (saving ~40 hrs), custom ROS synchronization across RGB-D/odometry/planner streams (36K+ samples), and 80x costmap acceleration (0.125 to 10 Hz); 95% avoidance across 50 real-world trials.

PUBLICATIONS

Evaluating Visual Odometry Methods for Autonomous Driving in Rain – Published at CASE 2023 — May 2023 - Aug 2023

- Benchmarked classical and learned VO/SLAM across **15+ rain sequences**; proposed **DROID-SLAM** heuristic with map priors for **robust long-horizon stereo localization** under **adverse weather**.

Characterization of Focal EEG Signals: A Review - Elsevier Future Generation Computer Systems, 2019 — May 2018 - Feb 2019

SELECTED PROJECTS

AutoShield - Safety-Filtered Autonomous Driving on Polaris GEM e4 — Oct 2025 - Dec 2025

- Developed modular ROS2 autonomy stack (perception/fusion/prediction/decision/control) on Polaris GEM e4 with **GNSS/INS localization**, PACMod drive-by-wire, and lifecycle-managed launch configs (4-person team; owned prediction/tracking).
- Built LiDAR pipeline (voxelization, ground filtering, **DBSCAN**, **EMA tracking**) and RGB-D pipeline (YOLOv11, depth, extrinsic-calibrated pixel-to-ego with ICP); fused via weighted averaging with 0.1 s time sync and 2.0 m Euclidean association.
- Implemented **TTC-based trajectory prediction** with simulated ego rollout, gating **3-state safety FSM** with **Stanley lateral and PID longitudinal control**; achieved **91% success** across diverse pedestrian scenarios in field tests

Maze Frontier Exploration Simultaneous Exploration and Mapping (SLAM) with Object Tracking — Sep 2024 - Dec 2024

- Implemented a **Frontier-Based exploration** algorithm integrated with **GMapping SLAM** to autonomously map and explore unknown maze environments.
- Developed custom object tracking and memory algorithm for robot to remember unseen key landmark objects in maze
- Engineered a global path planner using **A* search** to navigate to detected frontiers while performing simultaneous object detection and tracking.

Curved Glass Cleaning Robot - Changi Airport Group — Aug 2024 - May 2025

- Led 7-person team: designed force-current-based admittance controller with Kalman-filtered FSR and ACS712 current sensing, maintaining brush-to-glass contact pressure (< 150 N) for cleaning curved surfaces (3 cm depth over 60 cm).
- Architected full ROS2 autonomy stack on Jetson Orin Nano: **SMACH-based FSM** coordinating AGV navigation, 3-stage cascade lift (15 kg to 2 m in 5 s), and dual Arduino controllers with closed-loop encoder feedback; validated in live airport deployment.

Autonomous Underwater Vehicle Navigation - SUTD SOAR, Software Lead — Sep 2022 - Apr 2024

- Architected cascaded PID control loop for 6-DOF underwater stability, fusing depth sensor and IMU via state-space control on embedded system; led integration of real-time CV nodes for autonomous target acquisition under low-visibility conditions; Enabled AUV to perform **vison-object based navigation underwater**.

Hierarchical Multi-Agent RL for Humanoid Robot Interaction — Oct 2025 - Dec 2025

- Designed hierarchical PPO for dual **Unitree G1 humanoids** in **Isaac Lab**: 29-DOF locomotion via 7-phase curriculum (30M steps, 512 envs) with 25+ shaped reward terms and domain randomization across friction, mass, terrain, and actuator parameters; **Two agents converge** from **10 m to 0.5 m target separation** with **95% success** across randomized spawns.