YASH PURSWANI

+49 15129673151 • yashpurswani2004@gmail.com • yash-purswani.github.io

Education

Indian Institute of Technology Madras Jul 2022 - Jul 2027
B.Tech. in Mechanical Engineering and Inter-Disciplinary M.Tech. in Data Science ***9.24/10.00***

Research Interests

Autonomous Driving · Reinforcement Learning · Learning-based Control · Robot Perception · Multi-Agent Systems

Research Outputs

- **Feasibility-Aware Adversarial Scenario Generation for Autonomous Driving** — Manuscript in preparation
  Yash Purswani, *Yueshan Li, Matteo Penlington, Lorenzo Fiaschi, Emilio Frazzoli*
- **Finite-Time Tracking of Arbitrary Swarm Formations with Safety and Connectivity Certificates** — Manuscript in preparation
  Yash Purswani, *Shivansh Agrawal, Anuj Tiwari*

Honors & Awards

- RobotX 2026 Fellow, ETH Zürich, selected for competitive robotics research fellowship
- DAAD KOSPIE 2026 Scholar, selected for master's thesis exchange at Universität Stuttgart
- IROS RoboRacer 2026, 7th Overall among 30+ qualified teams
- IGVC 2024, 7th Overall among 30+ international teams and 6th in Design Challenge
- Inter-IIT Tech Meet 2024, Silver Medal for designing an efficient air-conditioning system

Research Experience

Uncertainty-Aware Zebra Reconstruction and Viewpoint Planning
DAAD KOSPIE Scholar, *Prof. Aamir Ahmad, IFR, University of Stuttgart* (*Sept 2026 - Present*)
- Developing a synthetic zebra database from 2D imagery for accurate individual re-identification using 3D models and texture
- Investigating multi-view UV texture mapping and uncertainty representation to quantify incomplete surface coverage
- Exploring uncertainty-guided viewpoint selection and database querying to inform policies for completing 3D zebra models
- Investigating viewpoint-planning policies for coordinated viewpoint planning and uncertainty-aware 3D model completion

Feasibility-Aware Adversarial Scenario Generation **Project Page**
RobotX 2026 Fellow, *Prof. Emilio Frazzoli, IDSC, ETH Zürich* (*Jul 2026 - Aug 2026*)
- Reformulated adversarial scenario generation with rule-constrained non-ego agents using feasibility-aware learning
- Extended FREA with feasibility-guided RL to encode pre-defined traffic rules while preserving adversarial behaviour
- Demonstrated that feasibility learning can serve as a reliable surrogate for learning and encouraging rule compliance
- Evaluated the framework in CARLA simulation to assess the trade-off between rule compliance and adversarial effectiveness

Finite-Time Tracking of Arbitrary Swarm Formations **Project Page**
Guide: Prof. Anuj Tiwari, ME Dept., IIT Madras (*Sept 2025 - Present*)
- Developed decentralized graph-based dynamics for finite-time tracking of asymmetric, time-varying formations
- Proved distributed finite-time convergence of station errors, swarm centroid, and relative formation geometry
- Derived formation-distortion bounds and station-geometry conditions for connectivity preservation and collision avoidance
- Numerically validated theoretical bounds, conditions, and parameter-selection criteria across various formations

Selected Projects and Engineering Experience

MLOps Pipeline for 3D Scene Reconstruction **Project Page**
Guide: Dr. Sudarsun Santhiappan, DSAI Dept., IIT Madras (*Mar 2026 - May 2026*)
- Built an automated MLOps pipeline orchestrating distributed 3D reconstruction and dense point cloud generation workflows
- Containerized multi-stage SfM workflows using Docker to ensure reproducible, isolated, and scalable deployment
- Integrated automated data versioning, experiment tracking, and artifact pipelines across all reconstruction execution stages
- Benchmarked inference throughput and optimized resource utilization across heterogeneous computing environments

Autonomous Road Dust Collector
Guide: Prof. Sivanagendra SM, CE Dept., IIT Madras (*Nov 2025 - Mar 2026*)
- Developed an Autonomous Road Dust Collection Robot for unmanned operations in sub-urban environments
- Implemented 3D LiDAR-based odometry, and mapping using FAST-LIO2 and NDT-based localization for pose estimation
- Incorporated Lanelet-based semantic road modelling for path planning and enable context-aware autonomous navigation
- Performed system performance evaluation and failure-mode analysis using time-series sensor data and simulation logs

Optimal Rendezvous Trajectory for Unmanned Aerial-Ground Vehicles
Guide: Prof. Rachel Kalpana Kalaimani, EE Dept., IIT Madras (*Mar 2025 - May 2025*)
- Designed an optimal control framework for UAV–UGV rendezvous and in-motion refuelling under non-linear dynamics
- Developed a trajectory-tracking and aggressiveness-index-based control strategy enabling tunable rendezvous behaviour
- Validated the method through numerical simulations in PRONTO, demonstrating robust convergence and adaptability

Professional Experience

Team Abhiyaan — IIT Madras (*Apr 2023 - May 2026*)
Team Lead / Software Module Lead / Robotics Engineer

BOLT — Driverless Institute Shuttle
Guide: Prof. Sathyan Subbiah, ME Dept., IIT Madras
- Developed and fully deployed a ROS-based software on an electric golf cart, turning it into a Driverless Institute Shuttle
- Achieved high accuracy using 3D LiDAR–camera sensor fusion for precise object classification and distance estimation
- Leveraged realistic CARLA and Gazebo simulations to conduct comprehensive testing of the software subsystem for BOLT

Project Vidyut
Intelligent Ground Vehicle Competition (*IGVC*), *Michigan, USA*
- Developed a ROS2-based navigation stack integrating Nav2, SLAM, and sensor fusion for autonomous navigation
- Implemented ORB-SLAM3, SLAM Toolbox, CUDA-accelerated perception, and EKF-based sensor fusion for localization
- Led software development and system integration for reliable autonomous vehicle deployment at IGVC 2024
- Secured **6th position** in the Design Challenge and an overall **7th position** among 30+ international teams at IGVC 2024

Team Leadership
- Led a 30+ member robotics team, coordinating software development and system integration while building academic collaborations and industry partnerships with Harman and Caterpillar

Technical Skills

- **Programming Languages:** Python, C++, MATLAB, Bash
- **Robotics:** ROS2, Gazebo, MuJoCo, CARLA, NVIDIA Isaac Lab/Omniverse
- **Perception:** OpenCV, Open3D, FAST-LIO2, FAST-LIVO2, ORB-SLAM3
- **ML/RL Libraries:** PyTorch, TensorFlow, JAX, scikit-learn, Gymnasium
- **Systems and Infrastructure:** Linux, CUDA, CMake, Docker, Git

Relevant Courses

- **Robotics, Dynamics & Control:** Network Dynamics & Controls · Optimal Control · Control Systems · Motion Planning for Self-Driving Cars*
- **Learning:** Reinforcement Learning · Foundations of Machine Learning · Machine Learning Operations
- **Others:** Parallel Scientific Computing · Multi-Variable Calculus · Linear Algebra · Data Structures & Algorithms

* - *Audited/informal coursework, not on official transcript*