SWARAJ M RAO

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EDUCATION

UNIVERSITY OF MARYLAND, COLLEGE PARK | M. Eng. Robotics Engineering | GPA 3.88/4 — Aug 2023 – May 2025

Coursework – Perception, Artificial Intelligence, Reinforcement Learning, Aerial Robotics, Software Development, Robot Programming, Control Systems, Cloud Computing (AWS, Azure, GCP), Motion Planning

RAMAIAH INSTITUTE OF TECHNOLOGY | B. Eng. Mechanical Engineering | GPA 3.7/4 — Aug 2017 – July 2021

WORK EXPERIENCE

RESEARCH ASSISTANT at Tubaldi Lab | University of Maryland, College Park — Aug 2024 – Dec 2024

- Designed a low-dimensional, differentiable design space that parameterizes the shape and actuation of soft underwater swimmers using Wasserstein metric, significantly enhancing the stability and energy efficiency of underwater soft robotic platforms by 20%.
- Accelerated design and control optimization of soft underwater robots by 3x by developing an end-to-end differentiable simulation pipeline that integrates soft-body physics and gradient-based co-design of morphology and actuation policies.
- Increased hydrodynamic efficiency and trajectory tracking accuracy by 15% by applying multi-objective, physics-informed optimization to simultaneously refine robot shape, control inputs, and structural robustness.

PRODUCT DEVELOPMENT ENGINEER at Brahm Works Pvt. Ltd.(Startup) | Bengaluru, Karnataka, India — Dec 2022 – Mar 2023

- Increased crop yield by 25% by designing a perception-driven hydroponic automation system and implementing time-series ML models to optimize irrigation, nutrient delivery, and lighting using multi-modal sensor data (temperature, humidity, EC, pH).
- Accelerated automated product assembly and testing cycles by 40% by developing PLC-based control architectures with Siemens hardware, deploying robust data acquisition for real-time system monitoring and control in infrastructure testing.
- Improved machinery prototyping efficiency by 55% by leading CAD-driven product development (Fusion 360, SolidWorks), managing full-stack fabrication/assembly, and integrating DMAIC methodologies for rapid, iterative deployment.

SOFTWARE ENGINEER at Tata Technologies Limited | Pune, Maharashtra, India — Jun 2021 – Mar 2023

- Unified 50+ TB of data from 3 enterprise databases by designing and implementing automated TeamCenter PLM migration workflows, achieving 100% integration of SAP and CAD BOM data with zero data loss for Marelli Europe S.p.A.
- Reduced manual CAD data loading time by 70% by developing C++ tools to automate CATIA CADBOM migration for a leading automotive supplier, enabling the processing of 500,000+ records with minimal errors and on-time delivery.
- Cut post-migration data validation and analysis time by 85% by automating batch processes and software deployment using Shell scripts, accelerating production readiness and reducing human error rates.

PROJECTS (www.swarajmrao.com/projects)

3D Scene Reconstruction Using UAV with PX4, ROS2, and COLMAP — Spring 2025

- Developed an autonomous UAV pipeline by integrating PX4 odometry, VOXL2 camera feeds, and ROS2 perception nodes for synchronized data collection; implemented onboard ORB+FLANN feature matching with telemetry-triggered frame selection, reducing image storage by 75% and accelerating high-fidelity 3D reconstruction using COLMAP, Polycam, and Reality Capture.

Multi-Sensor Fusion and Perception Pipeline for Autonomous Vehicle Localization and Navigation — Fall 2024

- Developed a perception pipeline for autonomous vehicles by fusing LiDAR, radar, and camera streams with GPS/IMU-based localization for object detection, lane and horizon segmentation, dynamic obstacle tracking, and real-time navigation in complex, multi-lane environments.

Vision-Based SLAM and Marker-Guided Navigation on ROS2 — Spring 2024

- Engineered a real-time robotic navigation system for TurtleBot3 on ROS2, integrating SLAM-based mapping, ArUco marker detection for high-precision localization, and object recognition to enable autonomous waypoint following and dynamic obstacle avoidance in outdoor and indoor and spaces; validated across both simulation and hardware.

ASD Prediction Using Eye Tracking Data — Fall 2024

- Achieved 88.9% classification accuracy in predicting Autism Spectrum Disorder by developing deep learning models (CNN, LSTM, Transformers in PyTorch), deployed the pipeline on AWS with a web-based frontend for image upload and result output.

SKILLS

- **Technical Expertise :** ROS1, ROS2, Machine Learning (Supervised and Reinforcement) and Deep Learning (Feedforward, CNN, Transformers, RNN), NLP & LLMs, RAG, Multimodal and Generative AI, Computer Vision, Simulation, SLAM, 3D reconstruction, Sensor Fusion, Multi-threading & Parallel Programming, CUDA, Robot Modelling and Programming, Human Robot interaction, Could Computing, Data structures and Algorithms, Containerization, Version Control, Optimization, Control theory, Manufacturing, Rapid Prototyping, Industrial Robotics, PLC Programming
- **Programming Languages :** C++, Python, MATLAB, KRL (KUKA Robot Language), RAPID (ABB)
- **Libraries, Frameworks and Tools:** PyTorch, Cuda, Tensorflow, JAX, Keras, ONNX, Huggingface, Langchain, OpenCV, Open3D, PCL, YOLO, Cartographer, NumPy, pandas, scikit-learn, NLTK, Docker, AWS, Azure, GCP, Linux, GitHub.
- **Others :** MATLAB Simulink, SolidWorks, AutoCAD, Fusion 360, CATIA, Embedded and Edge hardware (NVIDIA Jetson, Raspberry Pi), CI/CD principle