Thanikai Adhithiyan Shanmugam

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Education

MS **Worcester Polytechnic Insitute (WPI)**, Robotics GPA: 4.0/4.0 **Aug. 2023 - May 2025**
BTech **Indian Insitute of Technology, Indore (IIT)**, Mechanical GPA: 8.58/10.0

Technical Skills

Programming: Python, C/C++, MATLAB, Deep Neural Networks, Machine Learning,AWS, R, RasPi, SLURM, Chef
Software: ROS, Numpy, CI/CD, TensorFlow, Keras, Pytorch, Pandas, NLTK, CUDA, Git, Linux, SLAM/NERF, LLMs, Kalman Filter, VLM
Design/Simulation: Issac Gym, Gazebo, OMPL, AirSim, TrajOpt, Pybullet/AIgym, Mujoco, MoveIt

Experience

Robotic AI Algorithm Intern, Advanced Robotics Group, Magna RnD **May - Sept '24**
Mentor: Dr Mochan Shrestha - *Generative AI, LLMs, Imitation Learning, Pytorch, Reinforcement Learning, VLMs, Transfomers*

- Recreated a real environment in MuJoCo, replicating customized robot movements for accurate simulation-based movements.
- Customized **Action Chunking Transformers** and **Diffusion Policy** with calibration of 3 point cloud cameras, achieving **77%** sim-to-real success (ACT) and **82%** (Diffusion), optimized GPU usage by 0.2 via Nsight, and leveraged HPC clusters for computation.

Graduate Student Researcher at ELPIS Lab, Worcester Polytechnic Institute **Dec '23 - Present**
Research Guide: Dr Constantios Chamzas -*RL, Pybullet, Neural Volume Rendering, Structure from Motion, Representation Learning*

- Constructed learning pipeline with Residual Learning and Physics Informed Models on UR10 manipulator to perform precise tossing tasks using 3D reconstruction through monocular depth.Integrated **ROS2 Moveit servo control** with real-time OS and **Moveit**.
- Achieved **87.6% success** with on-head calibrated camera through optimal SfM in Pybullet and StableBaselines **A3C, PPO** policies.

Research Assistant Robot Healthcare Lab, Worcester Polytechnic Institute **Aug'24 - Present**
Research Guide: Dr Fengpei Yuan - *Deep Reinforcement Learning, Causality, LLMs, Generative AI*

- Benchmarked and Integrated **GPT-4**, **Llama**, **ViT** in enhancing language transitioning from MDP which uses PPO to free policy estimation, improving Robot Reminiscence Therapy.
- Enhanced Q-val convergence and **14%** favored conversations with **causal Direct Acyclic Graphs** and **Double Bayesian Network**.
- Embedded entire framework in **Pepper Humanoid Robot** and benchmarked performance with standard Therapy.(RA-L Draft)

Undergraduate Thesis at Autonomous Cyber-Physical Systems Lab, IIT Indore **Jan'22 - Mar'23**
Research Guide: Dr Gourinath Banda - *Reinforcement Learning, AirSim, Multi-agent control*

- Personal Aerial Vehicle Developed a heuristic approach to futuristic Air Traffic scenarios using **MTRL** for **ANCS PAVs** and system architecture integrating **LIDAR with ROS(PID Control), Extended Kalman Filter for state estimation, PX4, QGC, AirSim**. Created one of **first synthetics datasets** for PAV in various virtual environments

Publications

PAVeDS: A Synthetic dataset for developing Autonomous Personal Aerial Vehicles -IEEE Access' 23
Augmented Reality and Deep Learning based System for Assisting Assembly Process - ICRA'23
Comparing the accuracy of open-source pose estimation methods for measuring gait kinematics -Gait n Posture '22

Projects

Traffic Scene Understanding (Dashboard Simulation) Github - *Pytorch, Object detection, Optical Flow, OpenCV*

- Built real-time Tesla Autopilot dashboard with auto-calibration, Detic **(0.89)**, YOLO3D **(0.83)**, and Marigold **(0.94)**, rendered in Blender.
- Developed pipeline for optical flow(RAFT) with **.87** accuracy for static and dynamic objects and trajectory estimation.

IEEE Singapore Autonomous Underwater Vehicle Challenge (SAUVC) Github - *PD control, NERF, Homography, Motion Planning*

- Implemented obstacle avoidance based on **ORBSLAMv3**(NERF) with **CLAHE** for efficient underwater traversal.
- Led a team of 12 to Singapore and embedded a custom **5-DOF** robotic arm with precise **non-linear PD control**.

DRDO UAV Guided UGV Navigation Challenge, 10th Inter-IIT, IIT KGP Github

- Trained **D-Link** with **DeepGlobe** dataset to skeletonize roadmap and enforced non-linear **MPC** with **GQC** for tracking.
- Instated **RRT* (0.79SR)** algorithm in PX4 STIL for waypoints, spline interpolation for smoothness. Won **bronze** from 23 IITs.

Other Projects

- **Reachability-Guided RRT for Kinodynamic Planning using OMPL** Integrated planner on OMPL and outperformed RRT, KPIECE over success rate, planning time, path length.
- **ASR+LLM**- Integrated End-to-End(ASR) Natural Language Model and SayCan(LLM) for intent of speech on manipulator controlGithub
- **Visual Inertial Odometry** Designed a seminal VIO with MSCKF and also with LSTM and Convolutional Networks. **(Best Project)**
- **LQR,MPC for UAV Tracking** Improved tracking with NMPC(88.4 SR) over LQR(76.8 SR) with novel MPC cost. **Best Poster**