

Thanikai Adhithiyan Shanmugam

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📁 Portfolio

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Education

MS Worcester Polytechnic Institute (WPI), Robotics GPA: 4.0/4.0

Aug. 2023 - May 2025

- **Coursework:** Motion Planning, Reinforcement Learning, Generative AI, Robot Control

BTech Indian Institute of Technology, Indore (IIT), Mechanical GPA: 8.58/10.0

- **Coursework:** Computer Vision, Deep Learning, Data Structures

Technical Skills

Programming: Python, C/C++, MATLAB, Deep Neural Networks, Regresions, Bazel, AWS, R, RasPi, SLURM(multi-processing), MLFlow

Software: ROS, ROS2, 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/Algym, Mujoco, Moveit, TCP

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, Transformers

- 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, SfM, Representation Learning, Guassian Splatting

- 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, StableBaselines and achieving **84.21% success** real-time. Will submit in **IROS'24**.

Research Assistant Robot Healthcare Lab, Worcester Polytechnic Institute

Aug'24 - Present

Research Guide: Dr Fengpei Yuan - Deep Reinforcement Learning, Causality, LLMs, Generative AI, Embodied A

- Benchmarked and Integrated **GPT-4, Llama, ViT** in enhancing language transitioning from MDP which uses Proximal Policy Optimization (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. Drafting a research paper for **RA-L**.

Undergraduate Thesis at Autonomous Cyber-Physical Systems Lab, IIT Indore

Jan'22 - Mar'23

Research Guide: Dr Gourinath Banda - Reinforcement Learning, Unreal Enigne, 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 sensor fusion**, **PX4, QGC, AirSim**. Created one of **first synthetics datasets** for PAV in various virtual environments using NoSQL database systems.

Research Intern at I3D Lab, Indian Institute of Science, Bangalore

May'22 - Nov'22

Research Guide: Dr Pradipta Biswas - (Funded by Spatics Society of India) -Mixed Reality, C++, Unity, DL

- **MR for Assisted Assembly:** Developed interface for visual instruction for pneumatic cylinder assembly using MRTK-Unity(MR) in C++ to increase tangibility. Achieved RMS error of **2.03cm** and **0.96mAP**
- **Eye-Gaze Controlled Robots for SSMI:** Designed **3D printed COTS controller**(Eye-Gaze, Head and Iris control) for SSMI and integrated in MR and AR and benchmarked with tactile sensing manipulation. Collected Work featured in UNESCO magazine.

Research Intern at NeuRRo Lab, University of Michigan, Ann Arbor

Apr'21 - Feb'22

Research Guide: Dr Chandramouli Krishnan - Pose Estimation, GANs, LLMs

- Developed a novel **C++** pipeline for gait-kinematics estimation for occlusion and uncertainty in open-source pose models.
- Improved **0.26mAP** and reduced size by **16%** using **Foundation Models, Fusion Blocks** with depth maps for 6D pose.

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 **CLAHF** for efficient underwater traversal.
- Developed goal-state estimation using **acoustic beamforming** and ultrasonic DSP enabling precise localization in noisy environments
- Led a team of 12 to Singapore and embedded a custom **5-DOF** robotic arm with precise **non-linear PD control**.

DRDO UAV Guided L4 UGV Navigation Challenge, 10th Inter-IIT, IIT KGP [Github](#) - ADAS, L4 AV, Segmentation, Mapping, Localisation

- 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.

POMDP for Needle Steering in C++ - C++, RL, Kinodynamic motion planning, OMPL

- Formulated 2D-Dubin's car with valid transitions and observations as POMDP and simulated with Gaussian noise.
- Analysed the performance in **DESPOT-C++** and **POMCP-C++** for elapsed time and path (**DESPOT 60x faster**)

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) module and SayCan(LLM) for intent of speech on manipulator control [Github](#)
- **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](#)
- **EEG for MultiModal Interfaces** Benchmarked Electroencephalography(EEG) for AR, MR and VR interfaces during teleoperation for pick and place task.

Talks and Workshops

Hackathon IIT Madras: Eye-Gaze Interface for SSMI users

Indian Society of New Era Engineers: Presented the novel electric Go-Kart for GKDC competition.

Mechanical symposium, IIT Indore: Novel Parachute Module - Best Project Abstract award

IVDC, IIT Indore: Introduction to Intelligent Vehicles - 2 day workshop

MOWITO(Startup): IVDC - Future and Beyond

Achievements

INMO One out of 30 students in India to qualify for INMO(pre-final IMO) consecutively for 2 years

JEE Among 0.2%(3744) of 15 million candidates in Joint Engineering Exam(JEE)

Amazon ML Summer School One in 2500 in India to attend the ML summer school by Amazon

MCM Received MCM Scholarship (top 10 percent in IIT Indore) for academic excellence.

Glenn Yee Tution Award Received tuition fee waiver for academic and research excellence for the 2 consecutive semesters