Niranjan Kumar Ilampooranan

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Education

Worcester Polytechnic Institute | M.S. in Robotics Engineering | **CGPA:** 4.0/4.0 **Aug 2023 – May 2025**
Anna University | B.E. in Electronics and Communication | **CGPA:** 8.46/10.0 **Jul 2017 – Aug 2021**

Technical Skills

Programming Languages: Python, C++17, MATLAB, Bash, LaTeX
Frameworks/Libraries: ROS, ROS2, MoveIt, Open Motion Planning Library (OMPL), PyTorch, Tensorflow, OpenAI gym, Shapely, MeshLib, CGAL, Ardupilot, Blender, Fusion 360, Git, Docker
Simulators: Genesis (Embodied AI), Gazebo 11, PyBullet, CoppeliaSim, SUMo, URSim
Hardware Platforms: Universal Robots 5e/10e, Arduino Uno, Raspberry Pi, Nvidia Jetson Xavier

Experience

Efficient Learning and Planning for Intelligent Systems Laboratory **Jan 2024 – Present**
Research Assistant | Advisor: Prof. Constantinos Chamzas Worcester, Massachusetts

- Engineered general framework for any robot to compute roadmaps that provides strong guarantees on valid path existence for any arrangement of obstacles in semi-static environments; also performed extensive benchmarking for object-grasping tasks (manipulators) and for navigation tasks (planar robots) in various simulated environments (Genesis).
- Pioneered roadmap quality (problem-space coverage) assessment tool based on proportion of possible obstacle arrangements for which valid paths are admitted; we achieved higher problem-space coverage (ranging from $2-20\%$ in all environments) for heterogenous obstacle settings than prior works.
- Accelerated the framework ($\geq 100\times$ speedup) by transforming expensive collision checking process to rapid graph cut-finding and sparse matrix multiplications through binary encodings.
- Served as Grader and Teaching Assistant for RBE550 - Motion Planning (graduate course) in Fall '24 and Spring '25.

Indian Institute of Technology, Madras **May 2022 – Jun 2023**
Project Associate & Lead | Advisor: Prof. Prabhu Rajagopal Chennai, India

- Spearheaded a five-member team to develop a mobile manipulator prototype for customer assistance in retail stores; collaborated with multiple teams and startups toward integration and demonstration of the robot's capabilities in a structured environment
- Engineered the object manipulation pipeline using ROS2 packages, utilizing a state-machine architecture for high-level task control; integrated EfficientDet for object pose estimation with our manipulation pipeline (vacuum gripper-equipped UR5)
- Designed and fabricated the chassis focused on ease of manufacturing and assembly; validated final robot structural integrity via simulation with a safety factor of 2.39 and capability to withstand nudges upto 400N.

Solarillion Foundation **Dec 2019 – Mar 2022**
Research Assistant & Teaching Assistant | Mentor: Mr. Vineeth Vijayaraghavan Chennai, India

- Conducted research on relative importance of select states in decision-making of RL agents. Developed three white-box frameworks to detect these critical states - statistical analysis of action probabilities, advantage estimation, short-horizon simulation-based.
- Achieved performance reduction of 40% (simulation-based) through gradient-based adversarial attacks on critical states (1% of total input states) on an A3C-LSTM network trained on ATARI games. Culminated in a conference presentation (IEEE ICMLA 2021).
- Mentored 5 project interns in Machine Learning fundamentals and collaborative programming for research.

Projects

Benchmarking Antipodal Grasping Pipelines for Grocery Store Applications **Oct 2024 – Dec 2024**

- Evaluated two generative grasping pipelines - CAPGrasp and GGCNN - on lateral-access constrained tasks (grasping objects in shelves). Task pipeline designed as state-machine and ROS2 packages and demonstrated grasping pipelines on simulated environments in Gazebo. We recorded 85% success rate with CAPGrasp compared to GGCNN pipeline (35%) for multiple object arrangements.
- Fine-tuned YOLOv11 using Roboflow for robust pose estimation in variable illumination.

Benchmarking Kinodynamic Motion Planners for Car-like Systems **Oct 2024**

- Implemented reachability-guided RRT (modification to RRT where controls are sampled based on reachable states instead of random states) for robot modeled as a Dubin's car in OMPL C++.
- Benchmarked its performance against RRT, KPIECE on OMPL's PlannerArena with respect to path length, solution time, success rate and graph states. We recorded noticeable improvements in graph states, solution time compared to RRT due to the modified control sampling at the cost of memory (KPIECE recorded better results in terms of success rate).

Traffic Control using Reinforcement Learning | Winning product in Hackerspace (intercollegiate competition) **Mar 2020**

- Fine-tuned a Deep Q-Network (DQN) policy for adaptive road traffic control and showcased our traffic congestion solution through SUMo (simulation of urban mobility); achieved 70% traffic flow reduction vs. static timer methods.
- Integrated YOLOv3 to traffic control pipeline to obtain vehicle lane densities from footage to emulate realistic initial states for our traffic controller.

Publications & Patents

- **Niranjan Kumar Ilampooranan**, Constantinos Chamzas," COVER: COverage-VErified Roadmaps for Fixed-time Motion Planning in Continuous Semi-Static Environments", IEEE International Conference on Robotics and Automation (ICRA), Vienna, Austria, June 2026 (submitted)
- **Niranjan Kumar Ilampooranan** et al., "An Autonomous Mobile Robotic System and Method for Store Operations and Customer Engagement". IN Patent 202341074278, filed October 31,2023. Patent pending.
- Praveen Kumar Ramesh, **Niranjan Kumar Ilampooranan** et al., "Critical State Detection for Adversarial Attacks in Deep Reinforcement Learning", IEEE International Conference on Machine Learning and Applications (ICMLA), Pasadena, California, USA, December 2021