Antareep Singha

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RESEARCH EXPERIENCE

Nanyang Technological University(NTU), Singapore **Jul, 2025 – present**
Graduate Research Assistant @ Algorithmic Robotics Group(ARG) Computer Vision
Advisors: **Prof. Yoonchang Sung**

- Working on Occlusion-Aware Motion Planning for Manipulators using 3D scene hallucinations.
- Planning discrete actions in unordered and occluded 3D scenes using POMDP, to fetch a target object.

International Institute of Information Technology, Hyderabad (IIITH) **Jan, 2024 – Oct, 2025**
Research Associate @ RRC-(Autonomous Wheelchair) Deep Learning, Optimal Control
Advisors: **Prof. K. Madhava Krishna, Prof. Arun Kumar Singh**

- Built a novel local-planning algorithm for generating human-like trajectories in crowded scenes using Conditional Flow Matching(CFM). This work has been submitted to **IEEE ICRA 2026.**
- Built a local planner to function in dense crowds using VQ-VAE **(CrowdSurfer)**, conditioned on perception inputs. This work was **published at IEEE ICRA 2025.** An extension of this work, **Multi-CrowdSurfer** has been accepted to **AAAI WoMAPF 2026**.
- Built a novel **MPC pipeline using CasADi** integrating polygonal SDF for dynamic actors, and deployed it IRL.
- Migrated the entire wheelchair stack from ROS Noetic to ROS2, including the open-source Voronoi Global Planner.

Indian Institute of Technology, Madras (IITM) **May 2023 – July 2023**
Summer Fellow - (SFP 2023) FPGAs, RTL and Digital Design
Advisors: **Prof. Anil Prabhakar, Prof. Nitin Chandrachoodan**

- Developed and implemented a **novel Verilog based Data Acquisition(DAQ)** module on a **RedPitaya STEMlab 125-10** that reads 10-bit ADC data, runs a peak detection algorithm, and stores the output on its Block RAM.
- Generated Gaussian peaks using **PYNQ** Overlay on Zynq-7010 SoC to simulate the Verilog based DAQ module.

EDUCATION

Nanyang Technological University, Singapore **Aug 2025 – May 2027(expected)**
MSc. in EEE(Computer Control and Automation)
*(**Relevant Coursework:** Machine Vision, Multi-variable Control, Probability)*

Puducherry Technological University, Puducherry **Aug 2020 – May 2024**
B.Tech in Mechatronics Engineering — First Class with Distinction *CGPA: 9.08/10*
*(**Relevant Coursework:** Industrial Robotics, Control Systems)*

PUBLICATIONS

Crowd-FM: Learned Optimal Selection of Conditional Flow Matching-generated Trajectories for Crowd Navigation
Antareep Singha, Laksh Nanwani, Mathai Mathew Pulicken, Samkit Jain, Phani Teja S., Arun Kumar Singh, K. Madhava Krishna
*Under Review - **IEEE International Conference on Robotics and Automation(ICRA), 2026***

Multi-CrowdSurfer: A Position Paper on Applying Single-Agent Generative Priors to Decentralized MAPF
Antareep Singha, Laksh Nanwani, Arun Kumar Singh, K. Madhava Krishna
7^{th} International Workshop on Multi-Agent Path Finding, AAAI 2026

CrowdSurfer: Sampling Optimization Augmented with Vector-Quantized Variational AutoEncoder for Dense Crowd Navigation
Naman Kumar*, **Antareep Singha***, Laksh Nanwani*, Dhruv Potdar, Tarun R, Fatemeh Rastgar, Simon Idoko, Arun Kumar Singh, K. Madhava Krishna
IEEE International Conference on Robotics and Automation(ICRA), 2025

An FPGA based Real-Time Video Processing system on Zynq 7010

Antareep Singha
IEEE Second International Conference on Advances in Computational Intelligence and Communication (ICACIC), 2023

PROJECTS

Occlusion-Aware prehensile motion planning via Scene Hallucinations(in-progress) **Source Code**

- Given a single RGB-D image of an occluded/partially occluded scene, plan a discrete set of actions to fetch a target object via Partially Observable Markov Decision Process(POMDP).
- Given the partial view of a given environment in the form of an RGB image, leveraging SOTA 3D reconstruction models to mitigate the uncertainty in the case of total occlusion of the target object. Maintaining a belief space over the 3D scene to roll out actions like "grasp", "relocate objects", "next-best-view", etc.

Social Navigation on an Autonomous Wheelchair **Source Code**

- Built a novel local planning algorithm to generate scene-specific trajectories using Conditional Flow Matching(**Crowd-FM**). Improved success rates above CrowdSurfer, and other SoTA methods like CoHAN 2.0, and DRL-VO by at least **20%.**
- Built a novel local planning algorithm for generating multi-modal trajectories in **dense crowds** using generative modeling and Sampling Optimization(**CrowdSurfer**). A VQ-VAE is used to generate a trajectory distribution to be used for warm-starting a sampling optimizer. Improved success rates by **40%** against SOTA DRL-VO planner.
- Developed a custom **MPC** pipeline using **CasADi**. Constraints to the MPC are dynamic agent velocities, and static obstacle positions as an SDF function.

Costmap-Diffusion(in-progress) **Source Code**

- Learning to generate **scene-specific top-down local costmap representations** using Diffusion, to model social behavior from ego-demonstrations.
- The core idea is to modify the local costmap based on visual perception inputs to model social behavior. The generated costmaps can be used by any off-the-shelf planner.

Torch-MPPI **Source Code**

- Built and open-sourced a Model Predictive Path Integral(MPPI)-based 2D path planner completely using PyTorch.
- This pipeline was used to benchmark and perform ablations on the Flow Matching-based path planner.

Temporal-RRT Path Planner **Source Code**

- Implemented a 3D temporal RRT planner to determine multiple simultaneous shortest paths and checked for collision avoidance to ensure that no two independently computed paths occupy the same grid point at any given time step.

TECHNICAL SKILLS

Languages: Python, C/C++, MATLAB
Frameworks and Tools: PyTorch, ROS/ROS2, Jax, CasADi, Git, Docker
Areas of Interest: Computer Vision, Motion Planning, Reinforcement Learning, Optimal Control

HONOURS & AWARDS

- Acting as a Reviewer for **IEEE ICRA 2026** submissions.
- ***A*warded ICRA 2025 Travel Grant** by IEE Robotics and Automation Society to present my work at IEEE ICRA 2025 in Atlanta, Georgia.
- ***ICRA 2025 paper*** got showcased in a local newspaper and drew a crowd of over 300 people during IIIT Hyderabad's annual RnD Showcase.
- Awarded **Best Paper Award** at PTU Genesis 2023, a National Level Technical Symposium. Presented my research ***An FPGA based Real-Time Video Processing System on Zynq 7010*** to jury of 5 members.