

Sarvesh Patil

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EDUCATION

Carnegie Mellon University
PhD in Robotics

Pittsburgh
Aug 2023

Carnegie Mellon University
MS in Robotics

Pittsburgh
Aug 2021

VES Institute of Technology
BE in Electronics and Telecommunication

Mumbai
Aug 2015 – July 2019

RESEARCH AND TECHNICAL EXPERIENCE

Carnegie Mellon University
Graduate Researcher

Aug 2021 – Present
Pittsburgh, PA

Linear Delta Arrays for Distributed Dexterous Manipulation

- Designed and manufactured an array of 64 soft delta robots in an 8x8 grid from scratch, to push the limits of dexterous manipulation with non-anthropomorphic robots
- Developed an efficient TCP socket communication system over the entire array with a 10ms latency for fast closed-loop control through a central workstation
- Implemented Relative Entropy Policy Search to learn the weights of Dynamic Motion Primitives as robot trajectories and demonstrate how compliance aids learning efficiency for dexterous manipulation
- Collaborated with another PhD student to apply a novel MCTS-based algorithm to generate contact-rich manipulation plans using RRT within seconds, and successfully execute them on real robots in an open-loop manner to show how the versatility of the soft delta arrays
- Implemented a Soft Actor-Critic (SAC) algorithm to efficiently learn closed-loop manipulation skills (~1000 episodes) in IsaacGym and demonstrated the effectiveness of the learned policy using delta arrays in the real world
- Currently working to scale the SAC implementation for a multi-agent setting and employ causal discovery for efficient transfer of learned policies

DeltaZ

- Worked on an accessible 3D printed soft delta robot for research and education that costs less than \$50
- Reached out to various students and instructors from middle schools and high schools involved in FIRST robotics and shared easy-to-follow tutorials for getting students familiar with robotic manipulation

Class Projects

- Built a PyBullet simulation of a Franka robot with a knife for pushing chopped vegetables. Wrote a switched MPC controller with cross-entropy search to bring the vegetable particles to a goal configuration.
- Designed a chopstick end-effector tool for a Franka robot with a soft elastomer interface between the chopsticks and high-fidelity SMT force sensors. Trained a 3D ConvNet to learn preconditions from point cloud data to grasp 3D-printed chicken nuggets using a force-position controller in the real world.
- Conducted experiments to compare speed, accuracy, and transferability of Casual Discovery algorithms like PC, FCI, LiNGAM, and GES to obtain a directed acyclic graph representing delta robots near a wooden block.

HyperWorks Imaging

Aug 2019 – Feb 2021

Machine Learning Engineer

Bangalore, India

- Built a system for multi-modal Super-Resolution of optical microscope images to scanning electron microscope images by adding Spectral Normalization and Self Attention to Pix2Pix and ESRGAN models
- Implemented a particle sizing algorithm using an in-house object detection model for densely agglomerated microscopic particles from the super-resolved images, that achieved 0.989 D50 and 0.982 CV values compared to expert human annotators
- Developed a full-stack web application for AutoML using Django and Angular 8. The backend performed feature engineering and model selection using Bayesian Optimization for explainable model ensemble selection
- Built an annotation tool for object detection of microscopic particles with few-shot generalization using traditional methods like Hough transforms to augment self-supervised learning. Implemented an MLOps backend using MLFlow and Nginx for conveniently tracking and merging experiments across teams of up to 30 engineers.

- Implemented StyleGANv2 for data augmentation of small confidential data for an Ad Agency, improving the mean average precision (mAP value) of object detection with YOLOv5 by 20% over 19 classes
- Implemented an SFU server for WebRTC, socket connection for chatting, and Redis server for real-time geo-fencing to facilitate interactive audio-first communication on a cross-platform app using React Native

VES Institute of Technology
Undergraduate Capstone Project

June 2018 – Apr 2019
 Mumbai, India

Automatic Traffic Management System

- Used a pre-trained Mask-RCNN and developed a Gaussian Mixture Model to estimate traffic density at busy intersections to optimize traffic signal timers.
- Collected a dataset of 12k Indian vehicles across 60 categories to train a ResNet50 classifier for brand detection
- Collaborated with the Traffic Police Dept. in Navi Mumbai, and tested the system using real footage of a busy intersection captured using a PTZ camera

COURSES

Carnegie Mellon University

Aug 2021 – Present

- Math Fundamentals for Robotics
- Advanced Computer Vision
- Kinematics, Dynamics, and Control
- Optimal Control and Reinforcement Learning
- Learning for Manipulation
- Planning in Robotics
- Graduate Artificial Intelligence
- Causality and Machine Learning
- Advanced Machine Learning and Game Theory

TECHNICAL SKILLS

Languages: Python (Expert), C, C++, JavaScript (Intermediate), Julia, MATLAB (Beginner)

Frameworks: IsaacGym, PyBullet, Mujoco, PyTorch, Tensorflow/Keras, Scikit-Learn, OpenCV, Arduino, Django, React Native, OpenAI API, ROS

Softwares: Solidworks, Eagle PCB, Blender, PostgreSQL, Firebase, MongoDB, Jenkins, MLFlow

Hardware Skills: Franka Panda Robot, 3D printing (FDM and SLA), Silicon Elastomer Molding, Laser Cutting, SMD Soldering (up to 0201/12-LQFN), Basic Machining and Woodworking

PUBLICATIONS

- Cheng, X., Patil, S., Temel, F.Z., Kroemer, O., & Mason, M., "Enhancing Dexterity in Robotics Manipulation via Hierarchical Contact Exploration". (RAL 2023)
- Patil, S., Tao, T.S., Hellebrekers, T.L., Kroemer, O., & Temel, F.Z., "Linear Delta Arrays for Compliant Dexterous Distributed Manipulation". (ICRA 2023)
- Patil, S., Alvares, S.C., Mannam, P., Kroemer, O., & Temel, F.Z., "DeltaZ: An Accessible Compliant Delta Robot Manipulator for Research and Education". (IROS 2022)