Sarvesh Bipin Patil

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EDUCATION

MS in Robotics (MSR) Expected: **August 2023**
The Robotics Institute, Carnegie Mellon University GPA: **4.17/4**
Pittsburgh, PA

BE in Electronics and Telecommunication Year of Passing: **2019**
V.E.S. Institute of Technology, Mumbai University, GPA: **8.89/10**
Mumbai, India

PUBLICATIONS

Research Papers

- Patil, S., Tao, T.S., Hellebrekers, T.L., Kroemer, O., & Temel, F.Z., *"Linear Delta Arrays for Compliant Dexterous Distributed Manipulation"*. (ICRA) 2023 (Submitted)
- 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

Workshop Presentation

- Patil, S., Tao, T.S., Hellebrekers, T.L., Kroemer, O., & Temel, F.Z., *"Linear Delta Arrays for Dexterous Distributed Manipulation"*. (ICRA) 2022

MSR EXPERIENCE

The Robotics Institute, CMU **Aug 2021 - Present**

Graduate Researcher

- Implemented Relative Entropy Policy Search (REPS) on a 3D-printed educational DeltaZ robot to demonstrate sample efficient reinforcement learning benchmarking afforded due to compliance in the real world without any simulation, that converged to the goal configuration within 150 policy rollouts
- Designed and assembled an array of 64 linear delta robots in an 8x8 hexagonal tesselating grid to study multi-agent prehensile and non-prehensile manipulation strategies while training an undergraduate student
- Created a half-duplex communication system based on TCP sockets using ESP-01S boards that communicated at 100ms latency across the entire array of 64 robots
- Implemented REPS to learn weights of dynamic motion primitives (DMPs) to generate trajectories for dexterous manipulation of a wooden block using compliant fingers attached to the delta robots within 200 real-world policy rollouts.
- Currently working on SMD assembly of millimeter-scale electronics and soft silicon-based elastomer molds for an omnidirectional magnetic tactile sensor for force characterization of soft delta robots while costing less than $20

Class Projects Aug 2021 - Present

- Built a PyBullet simulation of a Franka Panda robot with a custom end-effector for pushing chopped vegetables to a target configuration. A control scheme employed a model-predictive control via cross-entropy as the cost-to-go function to bring the environment to a goal configuration emulating the equilibrium.
- Designed a novel chopstick end-effector tool for a Franka Panda robot with a soft elastomer interface between the chopsticks and high-fidelity SMT force sensors. Implemented a pipeline to learn preconditions from point cloud data to grasp chicken nuggets using a hybrid force-velocity controller.

WORK EXPERIENCE

HyperWorks Imaging, Bengaluru **Aug 2019 – February 2021**

Data Scientist

- Built a system for multi-modal Super-Resolution of optical microscope images to scanning electron microscope images using highly modified Pix2Pix and ESRGAN models, for accurate particle size analysis
- Improved upon a particle sizing algorithm using an in-house object detection model for highly agglomerated microscopic particles, that achieved 0.989 D50 and 0.982 CV values compared to expert human annotators
- Developed a full-stack web application for an AutoML product using Django and Angular 8. The AutoML backend performed feature engineering and model selection using Bayesian Optimization for explainable model ensemble selection
- Built an annotation tool to enable high-quality object detection of particles with few-shot generalization using traditional methods to supercharge self-supervised learning. Implemented an MLOps backend using MLFlow and Nginx for conveniently tracking and merging experiments across large teams of up to 30 members.
- Implemented StyleGANv2 for domain randomization of small confidential data for an Ad Agency, improving the mean average precision (mAP value) of object detection 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

UNDERGRADUATE EXPERIENCE

Automatic Traffic Management System **June 2018 – April 2019**

- Used Mask-RCNN to compute the rolling mean of the traffic density to manipulate traffic signal timers
- Collected a dataset of about 11,500 Indian vehicles and trained a ResNet50 model using contrastive loss for brand detection in a low-data environment
- Used a Single Shot Detector model to track vehicles across zebra crossing lines illegally with about an 85% success rate, and stored the brand detection data from the ResNet50 model in a database
- The project was placed among the top 5 in the final year and was selected for exhibition in Avishkar, a state-level project competition

Image Generation From Textual Input **August 2018 - January 2019**

- Implemented a conditional GAN to generate images using captions. Used sentence-level embeddings on the captions and trained the GAN to generate flowers matching the description

Emergency Distress Relief App **January 2018 - May 2018**

- Created an Android Emergency App in my third year, linked with the Dial-100 response of the Police Department of Navi Mumbai, using Android Studio with a FireBase backend for storage and authentication

CERTIFICATIONS AND PROFESSIONAL DEVELOPMENT

- **Reinforcement Learning Specialization (Coursera)** — **July 2021**
- **Data Structures and Algorithms Nanodegree (Udacity)** — **June 2018**
- **Deep Learning Specialization (Coursera)** — **April 2018**
- **Deep Learning Nanodegree (Udacity)** — **October 2017**

TECHNICAL SKILLS

- **Programming Languages:** Python(Expert), C, C++(Expert), JavaScript(Intermediate), Julia (Beginner)
- **Frameworks:** IsaacGym, PyBullet, PyTorch, Tensorflow/Keras, Scikit-Learn, OpenCV, Arduino, Django, React Native, ROS (Melodic and Noetic)
- **Software:** Solidworks, Fiji (ImageJ), Eagle PCB, PostgreSQL, Firebase, MongoDB, Jenkins, MLFlow, MATLAB
- **Hardware Skills:** Franka Panda Robot, 3D Printing (FDM and SLA), Laser Cutting (CO_2, LPKF), SMD Soldering (up to 0201 / 12-LQFN), Common Machining

OUTREACH AND SERVICE

During MSR

- Mentored two undergraduate students from CMU and helped them conduct experiments and get started with manipulation research using the delta robot arrays
- Organized three townhalls, one each semester, as the MSR representative for the grad student organization *RoboOrg* and acted as the liaison between students and the department for issues related to finances, coursework, and logistics
- Volunteered for RoboOrg activities like post-seminar receptions and other events for existing and incoming students
- Volunteered to spread awareness about soft robot research among high school students at the *First Robotics Competition* in Pennsylvania and shared the DeltaZ design files and control code with teachers present at the event

During Undergrad

- Worked as the technical coordinator for the IEEE Student Chapter and designed three technical events to increase student participation. Also, led a team of 10 to organize the annual symposium - *Melange*
- Volunteered as the operational head for *Praxis* to help the organizing committee plan and create 7 technical events, 4 non-technical events, and an inter-city treasure hunt to help students relax after finals