Varshith Sreeramdass

Aim: PhD, Fall 2024 Focus: CS / Robotics

CV: PDF

SOP:

PDF (Please use this if you prefer to have a glance and give general comments)

Google Doc (Please use this if you prefer to comment at specific lines)

Earliest Deadline: 1st Dec, 2023 (UMich, UPenn)

Kindly use this table to keep track of the submissions:

University	Deadline	LOR Submission Link Sent?	LOR Submitted?
UPenn	Dec 1		
UMich	Dec 1		
Stanford	Dec 5		
CMU	Dec 13		
GeorgiaTech	Dec 15		
UTAustin	Dec 15		
Princeton	Dec 15		
USC	Dec 15		
UCSD	Dec 20		
UMass / Yale / Cornell / ASU			

Excerpt from SOP related to work at Honda:

Real-World Robotics: Joining Honda Robotics R&D in Tokyo, Japan helped me discover my passion for robotics. One of my main projects was deploying RL for real-world dexterous in-hand manipulation. Our focus was on algorithms capable of leveraging offline RL datasets and fine-tuning through online interactions. We successfully achieved robustness to noisy initializations of object poses in the real world. However, as we attempted to extend to more tasks, problems with deployed learning systems became more difficult to address. In-hand object pose estimation proved to be unreliable due to finger occlusions. Sparse reward specification made the RL optimization difficult. The process of reward shaping to attain favorable behaviors was an iterative cumbersome process. Consequently, my interest grew in investigating the incorporation of systematic biases into policy learning, to make it feasible for real-world applications.

Inductive Biases in Policy Learning: Applying insights gained from my experience in deploying real-world RL, I subsequently led two projects. In the first project, my focus was on integrating parameterizable low-level controllers, such as Dynamic Motion Primitives (DMPs) into policies for long-horizon in-hand manipulation. On the whole, the hierarchical policy structure proved useful in accelerating learning but hindered learning in scenarios requiring quick and reactive behaviors. In the second project, our objective was to enhance the robustness of a scripted base controller in a coke-can opening task. We employed residual actions to adjust commands from the base controller to accommodate for environment and initialization noise. While simulation results showed a significant improvement over the base controller and a policy learned without a base controller, real-world performance was limited by discrepancies between the simulation and reality. Factors such as noisy perception, intricate contact dynamics, and approximate resistance models for the pop-tab of the coke-can contributed to the limited performance. Nevertheless, through both projects, I understood the necessity of careful policy design for real-world robotics, emphasizing that the right inductive bias can make all the difference

Summary of work at Honda: (Reverse chronological order)

Oct 21 - June 22: Residual RL for Can-opening

- Implementation of Python bindings for TaskController class for Multi-fingered hand control
- Simulation setup and residual policy learning for pull-tab task
- Development and tuning of resistance models for the tab of Red Bull can to reduce real and sim gap
- Coordination of real robot deployment efforts for evaluation of developed model involving perception setup (Yoshihira-san, Morihira-san), Perception Jib/Jig design (Waita-san), Real Robot Testing (Morihira-san)
- Experimented with Hybrid-RL (discrete and continuous action spaces for controlling state machine in TaskController)
- Partial setup of a Mujoco simulation for dexterous hand for better sim-to-real transfer

Feb 22 - April 22: Skill Discovery for System Identification

- Survey and brainstorming with Osa-sensei for research topics
- Development of a theoretical framework for discovering behaviors that effectively identify parameters of the system
- Preliminary experiments with LunarLander and LSTM-based system identification policy

Feb ‘20 - Sept ‘21: Hierarchical RL of Motor Primitive based Robotic Manipulation Control

- Deep RL framework for gating policies that operate Dynamic Motion Primitives with inferable goal, duration

- Investigated variants involving primitive interruption heuristics, duration inference mechanisms, optimization of inference costs, local planning, utilization of sub primitive trajectory information for frequent network updates.
- Evaluated exploration efficiency, trajectory smoothness with Maze Navigation, Box Pushing, InHand Manipulation.

Dec ‘20 - Aug ‘21: Offline RL for Screwdriver Reorientation Task

- Took a bigger role in real robot experiments
- Designed way-point based scripted controller to collect demonstrations of the task
- Iterated on reward function to achieve desirable behaviors
- Tested AWAC code in simulation and on the real robot system

Feb ‘20 - Nov ‘20: Offline RL for Remote-Control Reorientation Task

- Assisted in the deployment of DAPG on the real robot
- Designed way-point-based scripted controller to collect demonstrations of the task
- Tested and setup AWAC code-base for simulation and real robot

Nov ‘19 - Jan ‘20: Implementation of vision component of the network in the following paper:
Levine, S., Finn, C., Darrell, T., & Abbeel, P. (2016). End-to-end training of deep visuomotor policies. *The Journal of Machine Learning Research*, *17*(1), 1334-1373.