ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

CRL
Computational Robotics Lab

Master Thesis

Learning Dexterous Robotic Manipulation from Human Demonstrations

Introduction

The goal of this project is to endow a robotic arm-hand system with the ability to complete everyday-life tasks like using tools, opening doors, or assembling equipment. This skill will have important implications across a range of domains, including personal robotics, manufacturing, and fulfillment.

Combining human-robot interaction and machine learning, this project will investigate a framework for learning robot dexterity from human demonstrations (LfD). This will involve the design of a human-to-robot telemanipulation interface that will enable a human user to seamlessly provide demonstrations of

Figure 1: This thesis will explore a learning from demonstration framework to enable a endow a dexterous robot arm-hand system with fine manipulation capabilities.

manipulation skills. Using this interface, we will collect a dataset of human demonstrations, and leverage it to train a robot policy to tackle fine-manipulation tasks.

Tasks

- Develop a human-to-robot telemanipulation interface that will enable intuitive and scalable collection of manipulation demonstrations from human users.

- Define a benchmark involving challenging, everyday-life manipulation tasks.

- Use the telemanipulation interface to collect a dataset of human demonstrations.

- Extract a manipulation policy by learning from human demonstrations.

- Integrate the learned policy into a real-world dexterous arm-hand system.

- Characterize the efficiency, generalization, and robustness of the policy on the benchmark.

Requirements

- Strong interest in machine learning, imitation learning, or reinforcement learning.

- Proficiency in Python and experience with learning technologies (e.g., PyTorch).

- Experience working with real robots and using related technologies (e.g., ROS).

Remarks

This thesis is overseen by Prof. Dr. Stelian Coros and supervised by visiting Prof. Dr. Christoforos Mavrogiannis.

Contact

For further information or application for the thesis project, please contact Christoforos Mavrogiannis (cmavro@umich.edu).