Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

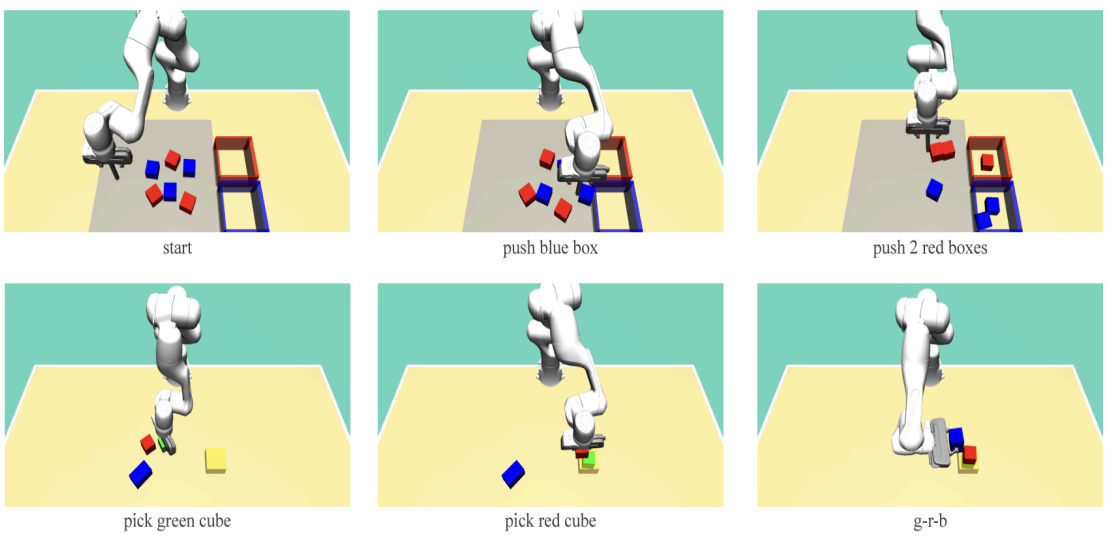
Karlsruher Institut für Technologie

Autonomous Learning Robots Lab

Robotic Systems Lab

Learning Diverse Behaviors: Diffusion Meets RL

Master Thesis



D3IL robot manipulation tasks[1]

Supervisors

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Description

This thesis will tackle the challenge of multi-modality in robot learning by integrating diffusion models into reinforcement learning (RL). We will transfer selected tasks from the D3IL [1] benchmark to the Isaac Lab [2] simulation environment and apply state-of-the-art RL algorithms enhanced with diffusion [3] models. The goal is to better capture and generalize diverse behaviors in complex, multi-modal tasks. The research will involve adapting D3IL tasks to Isaac Lab, implementing diffusion-augmented RL models, and developing metrics to evaluate their performance. The outcome of this thesis would advance the capability of RL to handle multi-modal behavior in sophisticated simulation environments.

References:

[1] Jia, Xiaogang, et al., "Towards diverse behaviors: A benchmark for imitation learning with human demonstrations." ICLR 2024.
[2] Mittal, Mayank et al., “Orbit: A Unified Simulation Framework for Interactive Robot Learning Environments”, IEEE RA-L 2023
[3] Ho, Jonathan et al., “Denoising Diffusion Probabilistic Models”, NeurIPS 2020

Work packages

- Literature research on diffusion policies
- Designing simulation environments in Isaac Lab and generating data
- Training and improving diffusion policy architecture for multi-modality in interaction data
- Performing ablations and comparisons to alternate methods

Requirements

- Highly motivated and autonomous student
- Experience with machine learning and controls
- Excellent knowledge of Python and PyTorch
- Experience with simulators and robot hardware is a bonus