

Final Project - Non-Prehensile Manipulation using MPPI with Parallelized simulation

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1 Project Overview

This project focuses on implementing non-prehensile manipulation using Model Predictive Path Integral (MPPI) control, leveraging a parallelized physics-based simulator for trajectory generation instead of relying on a dynamic model. By using a simulator to generate forward trajectories, the system can capture the complex dynamics and interactions involved in non-prehensile manipulation tasks, such as pushing or sliding objects.

2 Progress

- Integrated PyBullet as the backend simulation environment for non-prehensile manipulation tasks.
- Successfully created and tested multiple instances for simultaneous forward propagation using the Husky robot model.
- Simulated a 7-DOF manipulator with both position and velocity-based control to validate control performance
- Generated 100 sample trajectories over a time horizon of 10 timesteps to test the performance and successfully executed the sequence in 0.6 seconds.

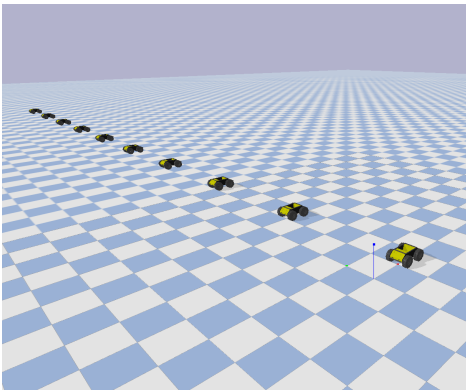


Figure 1: Husky - Multiple Instances

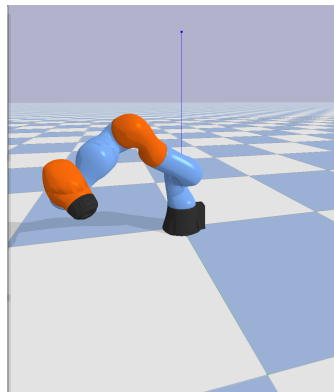


Figure 2: 7 DoF Manipulator

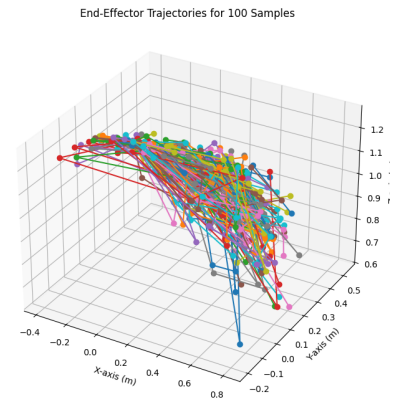


Figure 3: Sampled Trajectories of Manipulator

3 Future Work

- Parallelize the simulation using multiple instances to evaluate the maximum number of instances that can be run efficiently while minimizing compute time.
- Configure the environment with the robot and the object to be manipulated.
- Execute the complete MPPI framework to successfully perform the manipulation task.

4 GitHub Repo

<https://github.com/rohith-poola/MR/tree/main>