Hands-On Lab: Robot Control and Learning with Isaac Sim and Isaac Lab

General Information

This document provides a high-level description of the lab exercises and their learning objectives.

Detailed, step-by-step instructions (including setup and execution) are available at:

`https://github.com/matijamavsar/isaaclab-exercise`

Participants are encouraged to follow the instructions in the repository when working through the exercises. This document is intended as an overview of the tasks and concepts rather than a technical manual.

Overview

This lab introduces participants to robot control and learning using **Isaac Sim** and **Isaac Lab**. Through two hands-on exercises, participants will work with simulated robots and deformable objects (cloth) and gain practical experience with both model-based control and learning-based approaches.

The exercises are designed to progressively build understanding, starting from direct robot control and moving toward reward design for reinforcement learning.

Exercise 1: Dual-Arm Cloth Grasping

In the first exercise, participants will work with **two robotic arms** that must cooperatively pick up a piece of cloth.

The goal of this exercise is to learn how to:

- Control robot manipulators in simulation using Isaac Sim
- Use Isaac Lab to send target commands to robot end-effectors
- Coordinate multiple robots acting on the same object
- Reason about coordinate frames and relative poses

Participants will modify a provided code template to implement the missing control logic. By the end of this exercise, both robots should successfully grasp the cloth at the same time and lift it in a controlled manner.

This exercise focuses on *classical robot control concepts* implemented within a modern simulation framework.

Exercise 2: Learning to Fling a Cloth

The second exercise introduces **reinforcement learning** concepts within Isaac Lab.

Here, the task is to train robots to **fling a cloth away from themselves** by learning an appropriate motion strategy. Rather than directly specifying the motion, participants will design a *reward function* that encourages the desired behavior.

In this exercise, participants will learn how to:

- Design reward functions for deformable object manipulation
- Encode task objectives such as distance, direction, and motion quality
- Understand how reward shaping influences learned behavior
- Iterate on reward design to improve learning outcomes

The focus is not on achieving a perfect policy, but on understanding how reward definitions guide learning and how small changes in rewards can lead to significantly different behaviors.

Learning Outcomes

After completing this lab, participants should:

- Be comfortable controlling robots in Isaac Sim using Isaac Lab
- Understand how to coordinate multiple robots in a shared task
- Have hands-on experience designing reward functions for learning
- Gain intuition for deformable object manipulation in simulation

These skills are broadly applicable to research and development in robotics, especially in areas involving manipulation, learning, and simulation-based experimentation.