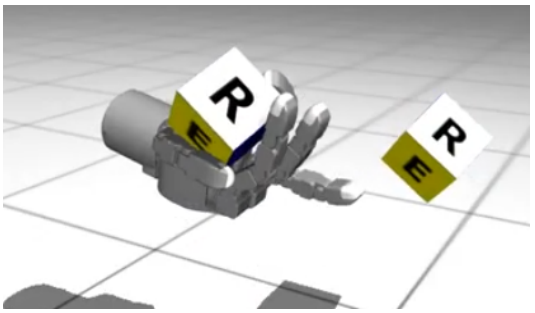
Masters Thesis: Learning manipulation from human priors

Motivation:
Dexterous manipulation is a challenging problem partially due to the high dimensional space of the robot hand, and partially due to the complex robot-object interactions. One example for this is cube reorientation using a dextrous hand. Current approaches to in hand reorientation are usually also relatively imprecise, and do not actually hold the cube at the goal orientation.



However, when training this skill from scratch in simulation, relatively conservative behaviours are learned, such as rotating the cube in hand, compared to what a human would do: rotating it by pinch grasping it with the fingertips. More complex, possibly 'more risky' behaviours are usually not learned, such as pinch grasping the cube and rotating it with other fingers, therefore motivating how we could learn from human data in a manipulation setting, compared to requiring complex reward engineering in order to achieve the desired behaviours.

In this work, we want to explore using human motions as prior for learning manipulation behaviours. The cube orientation task is just one of the possible specific tasks that we could tackle. Others include e.g., functional grasping of everyday objects.

Goal:
We want to start with data collection from human motions. For this, we have motion capture gloves to capture the human hand motion, and working pose estimation for tracking the object(s) that we are manipulating.

Since the robot hand is kinematically different, and there are possibly errors in the object and in the finger pose estimation, we need to develop an approach to use this data for learning with the robot hand. A promising approach for this is [1].

Interested?
Ideally, you already have strong experience with Python (and possibly with C++), and have experience with robot learning.

For further information or to apply for this project, please contact Valentin Noah Hartmann (*valentin.hartmann@inf.ethz.ch*) with your CV and transcripts.

[1] DexMachina: Functional Retargeting for Bimanual Dexterous Manipulation, https://arxiv.org/pdf/2505.24853