

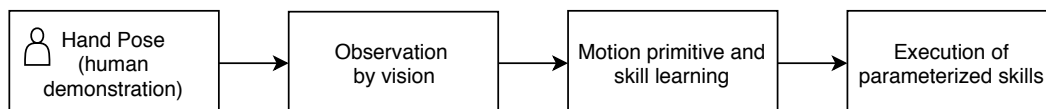
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BACHELOR THESIS

Hand-pose-based Learning from Demonstration of Manipulation Tasks

Problem description:

Learning from Demonstration (LfD) is a popular technique to transfer task knowledge to a robot. In this thesis work, we consider teaching manipulation skills [2], e.g. pick and place (, more specifically, using a pinch grasp), to a robot. In combination with recent hand-pose estimation algorithms [1], a human could directly (without using any specific hardware, but using his/her own body) demonstrate manipulation skills to a robot and the robot can observe the human demonstration using vision. These skills can be parametrized by the measurements coming from the hand-pose estimation and by visual tracking of objects in the workspace. By using a pinch grasp during demonstration, a mapping between human fingers and robotic gripper fingers has to be identified in order to reproduce the task.



Tasks:

- Observing human demonstration: Track the human hand pose and object poses in the workspace using ros packages and a Kinect sensor
- Extracting Movement Primitives (MP) from human demonstration: Segment the demonstration data by identifying if an object has been grasped or released
- Learning Task Parameterized Movement Primitives (TP-MP): Define and parameterize your robot skills using the segmented data
- Retargeting from human to robot: Define a mapping between finger poses (i.e. the finger positions when grasping the object) and robot gripper fingers in order to grasp different objects with the robot
- Execution of learned MPs: Reproduce your demonstrated task within a robot simulator (V-REP)

Bibliography:

- [1] Shile Li and Dongheui Lee. Point-to-pose voting based hand pose estimation using residual permutation equivariant layer. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, pages 11927–11936, 2019.
- [2] Mikkel Rath Pedersen, Lazaros Nalpantidis, Rasmus Skovgaard Andersen, Casper Schou, Simon Bøgh, Volker Krüger, and Ole Madsen. Robot skills for manufacturing: From concept to industrial deployment. *Robotics and Computer-Integrated Manufacturing*, 37:282–291, 2016.

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