Brief Introduction of Master Thesis

Industrial robots are widely used in industrial manufacturing, replacing humans to perform monotonous, repetitive and laborious tasks. But the robot programming process is difficult and tedious. Learning from demonstration aims at simplifying the robot programming process and transferring the professional skill from human to robot.

How to teach the robot and how the robot learns from the human demonstration are two key issues of learning from demonstration. In this work, we utilize the observational teaching method and a one-shot learning method to achieve a fast and flexible teaching and learning system. In the teaching process, the human teacher makes demonstrations under a human motion capturing system. The human body parts are detected with a human-body-part detect algorithm, OpenPose, and the detected position is recorded through the stereo camera ZED. In the learning process, we use dynamic movement primitive (DMP) to get the motion model from the human demonstration. To increase the accuracy of the learned model, we propose a keypoint-finding algorithm and use the found keypoints to segment the obtained training trajectories. The learned models of all the training trajectory segments compose the total demonstrated motion model.

To evaluate the accuracy of the learned model, we calculate the deviation between the generated motion trajectory and the training trajectory. Compare to the standard DMP, the accuracy of the learned model is greatly increased after adding keypoints. The feasibility of our approach is validated with a handover task. The UR10 robot can successfully imitate human behaviour in the simulation environment.

The main targets of this work can be summarized as follows:

- Designing a flexible and safe teaching method
- Finding the keypoints of the training trajectory automatically
- Learning the model of demonstrated motion accurately
- Imitating the human behaviour in simulation