TECHNISCHE UNIVERSITÄT MÜNCHEN
Human-centered Assistive Robotics
UNIV.-PROF. DR.-ING. DONGHEUI LEE

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I N G E N I E U R P R A X I S
for
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Student ID , Degree EI

Classification of physical robot contacts with the environment

Problem description:

Programming a robot to execute physical interactions with the environment can be a time consuming task, where expert knowledge is if such behaviors are implemented manually. To allow non-experts to model the robot behaviors for contact tasks, they can use the more intuitive way of demonstrating the desired behavior to the robot. As a demonstration might not always lead to an efficient behavior, the intent of the user can be classified based on the demonstration data, which includes the motion and interaction forces.
The goal of the classification is to extract the real intent of the user in order to parameterize predefined robot skills for an efficient execution in an adaptive environment. Possible interactions can be touching, pressing, sliding along a surface or inserting an object into a constrained location.
A prerequisite for this project is to implement a force compensation of the robot and tool dynamics.

The detailed work schedule is attached at the following page.

Work schedule:

Plan	*Work Packet Description*
1st week	**Induction into topic** • Independent incorporation in the topic of human robot collaboration and learning from demonstration • Learn how to setup our KUKA LWR robot with external force sensor and the according software to control it
2nd ... 3rd week	**Wrench compensation for tool and object** • Get familiar with current state of the software to read force signals from the force-torque sensor. • Extend the C++ software by tool and object compensation: – Compensate tool gravity force – Compensate tool dynamics based on robot acceleration • Define interfaces to control and connect your module (e.g. ROS service, configuration parameters, GUI) • Evaluate your module with different objects and display your results in a visualization (Rviz or Gazebo)
4th ... 7th week	**Classification of contact type based on user demonstration** • Record a labeled interaction dataset in several contact situations with the KUKA LWR and external force-torque sensor • Pre-process the data such that we obtain the pure contact force at the end effector • Collect a dataset of robot contact demonstrations • Define features over the collected demonstrations (duration, forces, torques, motion) • Test a classifier (e.g. logistic regression, SVM) on your dataset and report the results
8th week	**Discussion of achieved goals and revision of project work**
9th week	**Documentation and Presentation of Results**

Supervisor: M. Sc. Thomas Eiband
Start: XX.XX.2019
Delivery: XX.XX.2019

(D. Lee)
Univ.-Professor