TECHNISCHE UNIVERSITÄT WIEN
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Autonomous Systems
UNIV.-PROF. DR.-ING. DONGHEUI LEE
AUTONOMOUS SYSTEMS

BACHELOR THESIS

Generating and Executing Reactive Movements in Human-Robot Interaction

Problem description:

Human-robot interaction (HRI) is a rapidly growing field in robotics and artificial intelligence and is especially important in social robotics. The robot's motions should be human-like for a better user experience. The motions generated by an optimization algorithm may seem mechanistic to a human, thus decreasing the familiarity and overall interaction experience. This problem can be solved by learning motions from human demonstrations. One of the tools that can be used to collect the data is a motion capture system.
The goal is to implement a similar solution to the one presented in [1] for HRI. Simple actions like "fist bumping" and object handover are considered. The student will use a Motion Capture system to interact with the robot. The action of the human can be classified by using deep learning models [2]. The responses can be learned by using any of the numerous robot learning algorithms [3]. Finally, both steps need to be combined into one pipeline and assessed in user experiments.

Tasks:

- Task1. Familiarize with the proposed literature and additional research on the topic of human-robot interaction and human pose classification.
- Task2. Set up the motion capture system.
- Task3. Collect robot response trajectory data.
- Task4. Learn the responses from the data.
- Task5. Implement a controller that tracks the learned movements.
- Task6. Test the controller in a simulation environment and on a Franka Emika Panda robot.
- Task7. Develop an action recognition algorithm.
- Task8. Combine the human action recognition and robot motion generation and execution algorithms into one pipeline
- Task9. Design a test scenario (fist bump and handover) and verify it in user experiments.

Bibliography:

[1] Dongheui Lee, Christian Ott, and Yoshihiko Nakamura. Mimetic communication model with compliant physical contact in human—humanoid interaction. *The International Journal of Robotics Research*, 29(13):1684–1704, 2010.
[2] Srijan Das, Saurav Sharma, Rui Dai, and Monique Thonnat. *VPN: Learning Video-Pose Embedding for Activities of Daily Living*, pages 72–90. 11 2020.
[3] Sylvain Calinon and Dongheui Lee. *Learning Control*, pages 1261–1312. 01 2019.

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