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BACHELOR THESIS / MASTER THESIS

Human-Human Cooperation Analysis using Uncertainty Models

Problem description:

Humans very successfully cooperate in teams when given a common goal, e.g., the cooperative manipulation of a heavy or bulky object. They are also capable of dealing with uncertain information regarding their individual role in the task and asymmetric or contradicting trajectory information. Such behaviour is very desirable in robot-robot cooperation but remains an unsolved challenge in robotics [3]. Therefore, understanding the underlying control mechanism in human-human cooperative behaviour would represent a core contribution for tackling this problem.

As robots are nowadays increasingly employed in human-assisting tasks, it is also important for them to act intuitively as human-like partners in physical Human-Robot Interaction [1]. This also requires an understanding of the human's interaction model [2].

Therefore, the goal of this thesis is to investigate human behaviour in cooperative tasks considering asymmetric or uncertain information about the task. In order to enable these investigations, an experiment using two interconnected 2 DoF linear axis devices will be designed and implemented.

Tasks:

- Literature research on human-human cooperation schemes
- Design and implementation of human-centred experiment
- Collection of experimental data for human behaviour analysis.
- Model identification based on experimental data

Bibliography:

- [1] Agostino De Santis, Bruno Siciliano, Alessandro De Luca, and Antonio Bicchi. An atlas of physical humanrobot interaction. *Mechanism and Machine Theory*, 43(3):253–270, 2008.
- [2] J Grau-Moya, E Hez, G Pezzulo, and DA Braun. The effect of model uncertainty on cooperation in sensorimotor interactions. *Journal of the Royal Society Interface*, 10(87), 2013.
- [3] Jérôme Szewczyk, Frédéric Plumet, and Philippe Bidaud. Planning and controlling cooperating robots through distributed impedance. *Journal of Robotic Systems*, 19(6):283–297, 2002.

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