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M A S T E R ' S T H E S I S
for
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Student ID -, Degree EI

Probabilistic methods for human-robot cooperation in flexible manufacturing environments

Problem description:

An important objective of research in modern robotics is to achieve an effective cooperation between humans and robots in flexible manufacturing environments. In order to introduce robot co-workers in industrial environments, the classical control methods adopted in articulated robotics are not sufficient. A promising solution is the combination of feedback control methods with modern machine learning approaches, that have the potential to deal with uncertainties of the environment in a more effective and straightforward fashion. In particular, the main objective of the thesis is to investigate techniques based on Bayesian theory to identify and predict human behavior while performing cooperative tasks with a robot co-worker. In literature, approaches based on Hidden Markov Models (HMM) [1] have been proposed to predict human trajectories. To extend the state of the art, the student will investigate methods based on state space models (SSM) and Gaussian Processes (GP) to aim at an increased flexibility in both local prediction and global understanding of the trajectories. To prove the effectiveness of the developed techniques, a human-robot cooperative task will be executed with a KUKA lightweight robot.

Tasks:

- Developing an algorithm to learn and predict human behavior in human-robot collaboration tasks
- Implementing the developed algorithm on a KUKA lightweight robot
- Evaluating the performance of the algorithm in a cooperative human-robot task. The task can consist in a human user guiding the robot end-effector or in a cooperative pick and place task.

Supervisor:	Dr. Pietro Falco
Start:	07.2015
Intermediate Report:	09.2015
Delivery:	01.2016

(D. Lee)
Univ.-Professor

Bibliography:

[1] José Ramón Medina, Martin Lawitzky, Alexander Mörtl, Dongheui Lee, and Sandra Hirche. An experience-driven robotic assistant acquiring human knowledge to improve haptic cooperation. In *Intelligent Robots and Systems (IROS), 2011 IEEE/RSJ International Conference on*, pages 2416–2422. IEEE, 2011.