

March 9, 2016

BACHELOR THESIS / MASTER THESIS

Enhancing Variance-Dependent Cooperative Dynamic Movement Primitives

Problem description:

Cooperative Dynamic Movement Primitives (DMPs) provide a flexible encoding for goal-directed and periodic movements demonstrated by humans. They can therefore be applied in various tasks like human-robot or robot-robot cooperative object manipulation [2].

Gaussian Processes (GPs) are a non-parametric regression model which recently gained high attention in the Machine Learning community as well as in robotics. When learning a trajectory for a robotic movement from multiple demonstrations, the GP provides during execution not only a desired position but also a level of confidence [1].

In cooperative manipulations tasks, this uncertainty measure can be used for determining the individual contribution of each agent to the common goal: More knowledgeable team members dominate in the decision-making process and contribute more than uncertain and less confident team members.

Goal of this thesis is to improve an existing approach for Variance-Dependent Cooperative DMPs towards more human-like behaviour for the application in robot-robot and human-robot cooperation. It also investigates optimal control approaches for joint trajectory reproduction in manipulation tasks.

Tasks:

- Familiarization with concepts of Variance-Dependent Cooperative DMPs
- Literature research on human-human cooperation schemes
- Implementation of human-like behaviour for experimental validation
- Investigate optimal control approaches for proposed cooperation

Bibliography:

- [1] CE. Rasmussen and CKI. Williams. *Gaussian Processes for Machine Learning*. Adaptive Computation and Machine Learning. MIT Press, Cambridge, MA, USA, January 2006.
- [2] Jonas Umlauft, Dominik Sieber, and Sandra Hirche. Dynamic movement primitives for cooperative manipulation and synchronized motions. In *IEEE International Conference on Robotics and Automation (ICRA)*, pages 766–771. IEEE, May 2014.

Supervisor: M. Sc. Jonas Umlauft
Start: XX.XX.XXXX
Intermediate Report: XX.XX.XXXX
Delivery: XX.XX.XXXX

(S. Hirche)
Univ.-Professor