TECHNISCHE UNIVERSITÄT MÜNCHEN
LEHRSTUHL FÜR INFORMATIONSTECHNISCHE REGELUNG
ORDINARIA: UNIV.-PROF. DR.-ING. SANDRA HIRCHE

9. März 2016

A D V A N C E D   S E M I N A R

Gaussian Processes for Model Predictive Control

Problem description:

Gaussian Processes (GPs) are a great tool for learning unknown non-linear dynamics from observations [3] [2] and have been applied in control [1]. GPs are considered as a Bayesian non-parametric framework, thus they are capable of representing arbitrarily complex continuous functions. Therefore, they are a very powerful tool is system identification.
A commonly used approach for the control of non-linear dynamical systems is model predictive control (MPC) [4]. MPC is based on a forward simulation of the dynamical system over a finite time horizon and requires therefore accurate models. Its application in practice is wide spread as it allows to take constraints into account and works successfully for many classes of systems.
Both, MPC (due to the forward simulation) and GP (due to a large matrix inversion) are considered computational relatively slow. Thus, the combination of both comes with the challenge of a high computational burden, but at the same time is also very promising.
This Advanced Seminar aims to investigate different adaptations of GPs which allow the application of GP in MPC and summarize the corresponding literature.

- Literature research for GPs and MPC
- Summary and comparison for different options of reducing computational burden of GP predictions
- Documentation of the results

Literatur

[1] Marc Deisenroth and Carl E Rasmussen. PILCO: A model-based and data-efficient approach to policy search. In *Proceedings of the 28th International Conference on machine learning (ICML-11)*, pages 465–472, 2011.
[2] Juš Kocijan, Agathe Girard, Blaž Banko, and Roderick Murray-Smith. Dynamic systems identification with Gaussian processes. *Mathematical and Computer Modelling of Dynamical Systems*, 11(4):411–424, 2005.
[3] CE. Rasmussen and CKI. Williams. *Gaussian Processes for Machine Learning*. Adaptive Computation and Machine Learning. MIT Press, Cambridge, MA, USA, January 2006.
[4] James Blake Rawlings and David Q. Mayne. *Model predictive control : theory and design*. Madison, Wis. Nob Hill Pub. cop., 2009.

Supervisor: M. Sc. Jonas Umlauft

(S. Hirche)
Univ.-Professor