

October 18, 2018

B A C H E L O R T H E S I S
 for
 N.N.
 Student ID XXXXXXXX, Degree XX-XX

Efficient Exploration for Gaussian Process Models

Problem description:

Research at the intersection of machine learning and control made impressive advances over the past years. Data-driven identification using Gaussian processes have been successfully employed in various control tasks [2]. However, the performance is highly sensitive to the available data, which leads to the question how high quality dataset are obtained.

In this thesis, we aim to design a control approach to efficiently explore the state space of an unknown dynamical system. While many of the existing approaches simply explore the points with the highest uncertainty [1], we want to achieve an efficient covering and a time efficient collection of valuable training points.

The goal is to design an efficient approach for the exploration of the state space, based on a Gaussian process model. It must consider the dynamics of the system, which should be learned, in the planning of the trajectory [3]. Starting with a literature review on related work, an optimal exploration strategy should be formulated. A theoretic analysis and an evaluation in simulation should be a performed.

Tasks:

- Literature research on covering and the traveling salesman problem
- Design of an exploration strategy with optimality guarantees
- Implementation and evaluation of the proposed concept.

Bibliography:

- [1] Felix Berkenkamp, Riccardo Moriconi, Angela Schoellig, and Andreas Krause. Safe learning of regions of attraction for uncertain, nonlinear systems with Gaussian processes. *arXiv preprint arXiv:1603.04915*, 2016.
- [2] Carl Edward Rasmussen and Christopher KI Williams. *Gaussian Processes for Machine Learning*. MIT Press, Cambridge, MA, USA, January 2006.
- [3] K. Savla, F. Bullo, and E. Frazzoli. Traveling salesperson problems for a double integrator. *IEEE Transactions on Automatic Control*, 54(4):788–793, April 2009.

Supervisor:	M. Sc. Jonas Umlauft, M. Sc. Armin Lederer
Start:	xx.xx.xxxx
Intermediate Report:	xx.xx.xxxx
Delivery:	xx.xx.xxxx

(S. Hirche)
 Univ.-Professor