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

January 25, 2019

F O R S C H U N G S P R A X I S
for
N.N.
Student ID XXXXXXX, Degree XX-XX

Efficient Exploration of Dynamical Systems

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 [3]. 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 structure of the dynamics, of which the details are learned through the exploration. Starting with a literature review on related work [2], an optimal exploration strategy should be formulated. A theoretic analysis and an evaluation in simulation should be a performed.

Work schedule:

- Literature research on covering and exploration algorithms
- Design of an efficient exploration strategy which considers the dynamical structure
- 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] Andreas Krause, Ajit Singh, and Carlos Guestrin. Near-optimal sensor placements in Gaussian processes: Theory, efficient algorithms and empirical studies. *Journal of Machine Learning Research*, 9(Feb):235–284, 2008.
[3] Carl Edward Rasmussen and Christopher KI Williams. *Gaussian Processes for Machine Learning*. MIT Press, Cambridge, MA, USA, January 2006.

Supervisor:	M. Sc. Jonas Umlauft
Start:	xx.xx.xxxx
Delivery:	xx.xx.xxxx

(S. Hirche)
Univ.-Professor