TECHNISCHE UNIVERSITÄT MÜNCHEN
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ORDINARIA: UNIV.-PROF. DR.-ING. SANDRA HIRCHE

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

Learning Control for Robotic Manipulators

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, many approaches separate the learning phase (data measuring and model training) and the control phase [3].
Learning control techniques allow to improve the model during the execution of the control law [1]. However, this comes with various theoretical and practical challenges e.g. stability analysis of hybrid systems or high demand on processing and storing the constantly growing data set.
The goal of this thesis is to investigate how data-driven learning control can be transferred to practical applications. More specifically we aim to implement and evaluate event-triggered adaptive control using Gaussian processes on a three degree of freedom robotic system. The performance and the scalability will be analyzed.

Tasks:

- Literature research on Gaussian processes and learning control
- Implementation in Matlab / Simulink
- Evaluation on the robotic system

Bibliography:

[1] Girish Chowdhary, Hassan A. Kingravi, Jonathan. P. How, and Patricio A. Vela. Bayesian non-parametric adaptive control using Gaussian processes. *IEEE Transactions on Neural Networks and Learning Systems*, 26(3):537–550, March 2015.
[2] Carl E. Rasmussen and Christopher KI Williams. *Gaussian Processes for Machine Learning*. MIT Press, Cambridge, MA, USA, January 2006.
[3] Jonas Umlauft, Thomas Beckers, Melanie Kimmel, and Sandra Hirche. Feedback linearization using Gaussian processes. In *Conference on Decision and Control (CDC)*, pages 5249–5255. IEEE, Dec 2017.

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