TECHNISCHE UNIVERSITÄT MÜNCHEN
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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

Indirect Adaptive Control based on Gaussian Processes

Problem description:

Data-driven approaches from machine learning provide powerful tools to identify dynamical systems with limited prior knowledge of the model structure. Gaussian Processes (GPs) have been successfully employed to such identification task due to their Bayesian non-parametric nature [2].
This work aims to employ Gaussian Processes to learn control affine system in order to perform feedback linearizing control [1]. The GP offers beneficial properties, which we aim to incorporate in the controller design: It provides an estimate of the model fidelity (the variance functions) based on the distribution of training data and it allows (from the Bayesian nature) to inject prior knowledge regarding the estimated function.
Taking these advantages, the goal is to achieve simultaneous identification and control. Therefore, the work focuses on designing an online model-based adaptive control scheme using GPs and feedback linearization. In addition to the design, a theoretical analysis and a simulation should verfiy the proposed method.

Tasks:

- Literature review in Gaussian Processes and feedback linearization
- Design of an adaptive control scheme for control-affine systems
- Analyze theoretical properties and practical implications of the approach based on simulation

Bibliography:

[1] H. K. Khalil and J. Grizzle. *Nonlinear systems*, volume 3. Prentice hall New Jersey, 1996.
[2] C. E. Rasmussen and C. K. Williams. *Gaussian Processes for Machine Learning*. MIT Press, Cambridge, MA, USA, Jan. 2006.
[3] A. Yesildirak and F. L. Lewis. Feedback linearization using neural networks. *Automatica*, 31(11):1659–1664, 1995.

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