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M A S T E R T H E S I S
for
N.N.
Student ID XXXXXXX, Degree XX-XX

Identification and Control for Input-Output Systems based on Gaussian Processes

Problem description:

Research at the intersection of machine learning and control made impressive advances over the past years. Data-driven identification using Gaussian processes (GPs) have been successfully employed in various control tasks [3]. However, many approaches consider only the state-space representation of the dynamics. This implicitly assumes knowledge on the order of the system, which is a very strong limitation [2]. Furthermore, many classical system identification approaches are well-suited to estimate systems, for which only an output but not the entire state is measurable. For such settings, the performance of data-driven approaches is not well understood.
The goal of this thesis is to investigate how data-driven identification and control can be realized for dynamical systems without any knowledge of the state-space or its order. More specifically we aim, for a Gaussian process based regression model, to represent the input-output dynamics of an unknown system. The proposed control law should make use of the uncertainty measure provided by the GP [1] and include a theoretical analysis of the closed-loop behavior.

Tasks:

- Literature research on Gaussian processes and system identification
- Design of an identification and control scheme
- Theoretical analysis and evaluation in simulation of the proposed approach

Bibliography:

[1] Gregor Gregorcic and Gordon Lightbody. Internal model control based on a Gaussian process prior model. In *American Control Conference (ACC)*, volume 6, pages 4981–4986 vol.6, June 2003.
[2] Jus Kocijan. *Modelling and Control of Dynamic Systems Using Gaussian Process Models*. Springer, 2016.
[3] Carl E. Rasmussen and Christopher KI Williams. *Gaussian Processes for Machine Learning*. MIT Press, Cambridge, MA, USA, January 2006.

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