Chair of Automatic Control

FAU

Announcement for Master Thesis

Stochastic distributed model predictive control

Motivation

Stochastic Model predictive control (SMPC) presents a promising control strategy to cope with uncertain systems and constraints. The states of the system are hereby modeled as random variables and state constraints can be defined as chance constraints that should be fulfilled with a certain probability [1]. An interesting aspect of SMPC is how uncertainties behave and are propagated through large-scale, distributed systems in which every system possesses a local controller. That is why it shall be investigated how SMPC can be applied to this system class and what additional measures are necessary to implement a distributed stochastic MPC scheme.

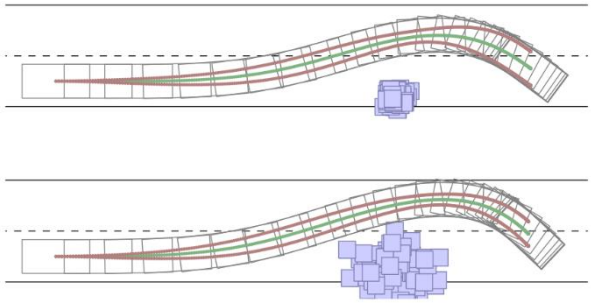

Abbildung 1: Collision avoidance with SMPC

Task description

The main goal of this thesis is to implement an existing stochastic MPC solver into the DMPC framework GRAMPC-D [2]. After a literature review, GRAMPC-D should be extended in a modular fashion to provide the needed functionality to support stochastic systems. The implementation should then be evaluated for different example scenarios with a focus on how uncertainties are propagated through distributed systems and their effect on computation time.

Requirements

Basic knowledge of optimal control and MPC is required, either by having attended the corresponding lecture or by familiarizing oneself with the topic at the beginning of the thesis as well as good knowledge in C++ programming.

References

[1] Völz, Andreas, and Knut Graichen. "Gradientenbasierte stochastische modellprädiktive Regelung unter Verwendung der Unscented-Transformation." at-Automatisierungstechnik 64.8 (2016): 658-670.

[2] Burk, Daniel, Andreas Völz, and Knut Graichen. "A modular framework for distributed model predictive control of nonlinear continuous-time systems (GRAMPC-D)." Optimization and Engineering (2021): 1-25.

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