Announcement for Research Project

Learning-based Stochastic Model Predictive Control for Truck-Trailer Systems in Off-road Environments

Motivation

Heavy-duty vehicles, as used in industries like agriculture or mining, are frequently operated under harsh environmental conditions. As such, the vehicles are often subject to dynamic disturbances, deteriorating the tracking accuracy. One approach to address this issue is by learning the disturbance behavior via Gaussian Processes. This probabilistic framework appears particularly useful as it provides a measure of uncertainty regarding its prediction. The predicted uncertainty

IPG TruckMaker

can then be incorporated into the motion planning and control setup by means of a stochastic model predictive controller, increasing the safety of the system.

Task description

First, literature on stochastic model predictive control as well as on learning-based predictive controllers for vehicles is to be studied. After familiarization with an existing learning-based control setup, a stochastic model predictive controller is to be developed in the framework GRAMPC-S [1]. The controller is evaluated in the simulation environment TruckMaker.

Requirements

-   Experience in Matlab and C++ programming
-   Experience with Gaussian Process Regression
-   The lecture Numerical Optimization and Model Predictive Control is beneficial

References

[1]   Landgraf, D., Völz, A., & Graichen, K. (2024). A software framework for stochastic model predictive control of nonlinear continuous-time systems (GRAMPC-S). arXiv preprint arXiv:2407.09261.

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