

# Mitigating the impact of MPC calculation time using NLP sensitivities.

## Preliminary task description – Master thesis

When using model predictive control, the computation time of the optimization is almost always neglected. Before each iteration of the optimization, the system state is acquired and considered in the constraints as initial state. Up to the computation of the optimum is finalized, the true initial state changed however again.

A pure look-ahead is not sufficient due to varying calculation times and disturbances. Therefore, approaches have been developed [1] which, in addition to solving the optimization problem, also determine its sensitivity with respect to the initial conditions. This allows the solution to the true problem to be approximated retrospectively.

In this master thesis, this approach shall be investigated and implemented using an example from the field of Automated Driving.

Further topics of interest could be:

- How to ensure that the computation of the sensitivities is successful, which conditions have to be fulfilled, when do problems occur.
- Can the chosen approach prevent discontinuities in the input variables that would occur in systems with additional linear feedback?
- Even if a simulative consideration should be done first, an evaluation on real hardware (e.g. hamster) could be done later.

The findings obtained are to be documented by preparing a written thesis and subsequently presented in a talk. Particular attention must be paid to the appropriate choice of sources and correct citation. Plagiarism will be treated as attempted cheating according to §38 of the APB of the Technische Universität Darmstadt.

[1] Zavala, V.M. and Biegler, L.T. (2009). The advanced-step NMPC controller: Optimality, stability and robustness. *Automatica*, 45, 86–93.

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