Explicit Model Predictive Control for Nonlinear Systems

**TECHNISCHE UNIVERSITÄT DARMSTADT**

Master's Thesis

Model Predictive Control (MPC) is an advanced control method that can naturally handle nonlinear systems subject to constraints. However, for MPC, we need to repeatedly solve a complex nonlinear programming problem (NLP) online. Consequently, MPC is often out of reach for real-time application. Explicit MPC tries to surmount this problem using multiparametric programming techniques to characterize the optimal control law offline. Instead of solving the optimization problem during online operation, the control action can then be determined by evaluating an explicit function of the current state. The goal of this thesis is to investigate and implement methods for nonlinear explicit MPC.

Requirements:

- Strong programming skills (Matlab or Python) are essential for this topic
- Knowledge in optimization and MPC
- English

Tasks:

- Literature review on explicit model predictive control
- Design of a nonlinear model predictive controller
- Implement approaches for explicit MPC of nonlinear systems
- Demonstrate the approaches on self-selected examples
- Approximation via (conventional) regression methods
- Evaluate, compare and present the results
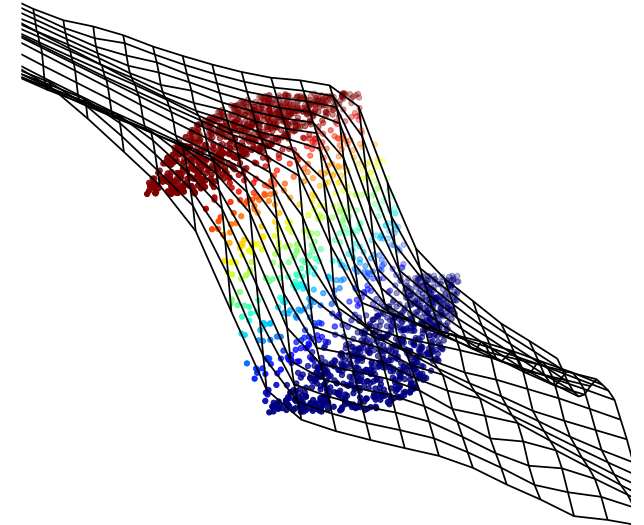
Resources:
[1] A. Alessio, A. Bemporad. A Survey on Explicit Model Predictive Control.
[2] A. Grancharova, T.A. Johansen. Explicit Nonlinear Model Predictive Control.
[3] Johansen, T.A.. Approximate explicit receding horizon control of constrained nonlinear systems.

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