State-dependent Dimensionality Reduction in Model Predictive Control

TECHNISCHE UNIVERSITÄT DARMSTADT

Project Seminar (2-3 students)

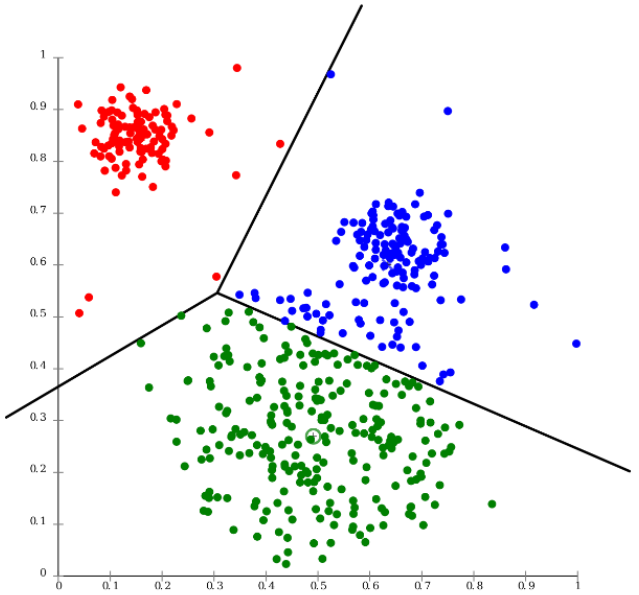
Model predictive control (MPC) offers remarkable potential for the optimal management of dynamical systems. However, the necessity for an online solution to an optimal control problem often renders it impractical. To address this issue, specialized dimensionality reduction techniques designed for optimal control problems have been proposed.

In this project, you will focus on a method that approximates the solution to the optimal control problem in a lower-dimensional space. In [1], such a space is designed from sampled data. One of the remaining challenges is to capture the dependence of the optimal solution on the system state.

This project aims at combining the method from [1] with the clustering approach from [2], in order to design **state-dependent** spaces. Your tasks include:

- Understanding the main ideas in [1] and [2]. Choice of two linear illustrative example systems.
- Development of a sampling and training strategy for the clustering.
- Closed-loop simulations and comparison of the results, with a special focus on suboptimality and computation times.

Knowledge of control theory and optimization is required. Creativity is desirable. Please do not hesitate to contact me if you have any further questions!



https://de.wikipedia.org/wiki/Clusteranalyse

[1] R. Schurig, A. Himmel, and R. Findeisen, „Towards Dimensionality Reduction on the Grassmann Manifold in Model Predictive Control“, submitted to the Conference on Decision and Control, 2023

[2] A. Bemporad and G. Cimini, „Reduction of the number of variables in parametric constrained least-square problems“, *arXiv preprint arXiv:2012.10423*, 2020

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