Analysis and design of an explicit model predictive controller via neural networks

TECHNISCHE UNIVERSITÄT DARMSTADT

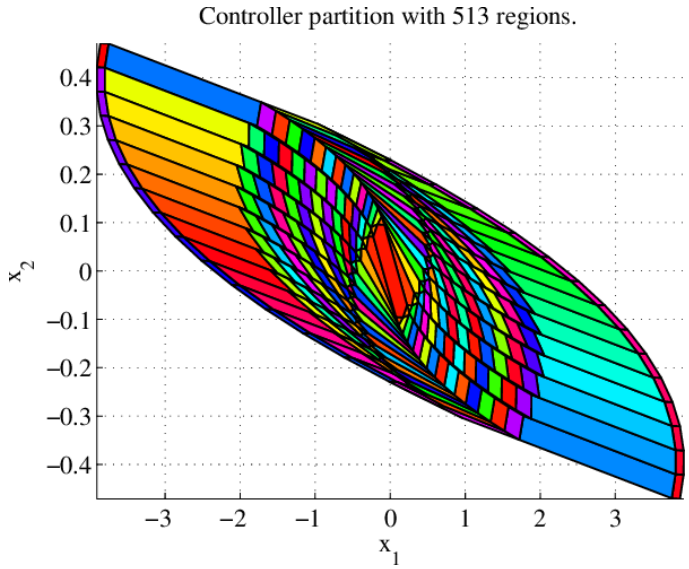
Bachelor‘s Thesis

Model predictive control (MPC) is a popular and successful control technique, where an optimal control problem has to be solved at every sampling instance. The control input is given implicitly by the solution to this problem as a function of the system state. Since the exact optimal solution is too complicated to compute in many cases, the MPC control low is often replaced by an explicit, learned controller. Artificial neural networks are particularly popular for this task [1].
This thesis should first analyze the properties of explicit and approximative controllers. Especially performance criteria for the closed-loop are to be investigated, designed and tested in simulations.
In particular, the regions in the state space in which a small approximation error is inevitable for good closed performance should be identified.
The gained insights can be used to design a sampling strategy for the training data for the explicit controller. Finally, the obtained controller is to be evaluated and compared with respect to its closed-loop performance.

The thesis thus contains the following steps:

- Literature review on MPC and closed-loop performance criteria
- Literature review on neuronal networks and their training
- Creation of a simulation environment to assess explicit controllers
- Development of a sampling strategy for training data
- Evaluation of the results

Basic knowledge of control theory is required.



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[1] B. Karg and S. Lucia, "Efficient Representation and Approximation of Model Predictive Control Laws via Deep Learning," in *IEEE Transactions on Cybernetics*, vol. 50, no. 9, pp. 3866-3878, 2020

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