Chair of
Automatic Control

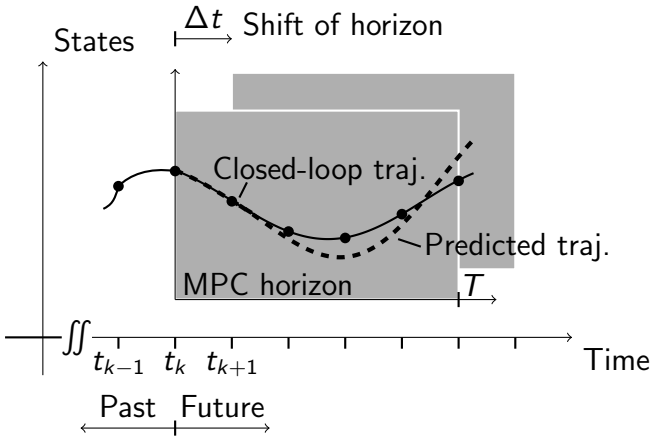
FAU

Research Project

Realizability of advanced control concepts on FPGA hardware

Motivation

Nonlinear Model Predictive Control (NMPC) is a highly effective control strategy for managing complex and constrained systems but faces challenges in real-time embedded applications, such as solving non-convex optimization problems within strict sample times and limited resources [1]. Linearizing the optimization problem at each sampling time significantly improves feasibility and efficiency for real-time implementation [2].



Task Description

The work focuses on implementing NMPC on FPGA hardware from scratch. Key objectives include not only implementing but also improving the computational efficiency of NMPC to meet real-time application demands by linearizing the optimization problem at each sample time and optimizing application-specific operations. Benchmarking implementation approaches is crucial to assess efficiency and feasibility for embedded systems.

Requirements

Candidates should have completed the "Numerical Optimization and Model Predictive Control" lecture and possess strong programming skills in C/C++. A general understanding of embedded processors is considered an advantage.

References

[1] Tobias Englert, Andreas Völz, Felix Mesmer, Sönke Rhein, and Knut Graichen. A software framework for embedded nonlinear model predictive control using a gradient-based augmented lagrangian approach (grampc). *Optimization and Engineering*, 20:769–809, 2019.

[2] Vaishali Patne, Deepak Ingole, and Dayaram Sonawane. Towards fast nonlinear model predictive control for embedded applications. *IFAC-PapersOnLine*, 55(22):304–309, 2022.

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