Implementation of a Model Predictive Controller for a Three-Tank-System with Non-Smooth Dynamics

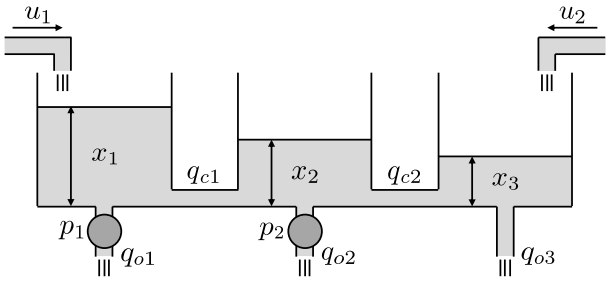
TECHNISCHE UNIVERSITÄT DARMSTADT

Project Seminar (3-4 People)

Model Predictive Controllers (MPCs) excel in areas, in which explicit constraints need to be considered for continued process operation and safety. To achieve this, an MPC must solve an online optimization problem. An essential aspect of this optimization entails incorporating a system model in the optimization to enable the MPC to anticipate the future evolution of the controlled system. In some cases, this model can pose significant problems during optimization. One such case, that often results from switches or near-instantaneous changes in system behavior is the case of non-smooth dynamics. In these instances, specialized solutions need to be found to implement the MPC and realize its real-time capability.

Over the course of this project, your objective is to develop and apply an MPC controller for a three-tank system. The system's dynamics are characterized by their non-smooth, non-linear behavior resulting directly from first principles, specifically Torricelli's law. To efficiently implement such a model, you will have to research methods for non-smooth simulation and optimization to devise a suitable structure. This implementation should also facilitate a real-time solution of the optimization with the end goal of controlling the three-tank system in real time. Fulfilling this additional constraint will require you to implement the MPC in a real-time and online executable manner while satisfying the necessary demands for optimization speed.

For this project, a firm grasp of control engineering, especially with optimization-based and model predictive control is required. Furthermore, knowledge of system modeling and programming with Matlab/Simulink is compulsory. Knowledge of digital-analog-hybrid and real-time critical systems will help in this project but is not required.



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