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

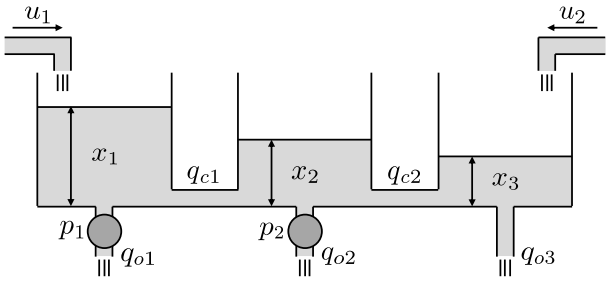
TECHNISCHE UNIVERSITÄT DARMSTADT

Master's Thesis

A Model Predictive Controller (MPC) excels in controlling processes with explicit constraints to ensure continuous operation and safety. By utilizing a mathematical model of the dynamical system, the MPC anticipates the future system evolution and solves an online optimization problem repeatedly to optimize control performance. However, non-smooth system dynamics, often occurring in processes with switching system behavior, can pose challenges during optimization. In such cases, specialized solution methods are needed to allow real-time MPC implementation.

Within the scope of this master's thesis, the objective is to develop and implement a real-time capable MPC for a three-tank process characterized by nonlinear and non-smooth system behavior, primarily governed by Torricelli's law. This task involves researching methods for simulating and optimizing non-smooth systems to develop a suitable structure for an MPC implementation. While initial work can be conducted using a simulation, the objective is to apply the MPC to a real three-tank system, emphasizing computational efficiency and real-time capability.

For this thesis, a strong fundamental understanding of control engineering is essential, particularly regarding optimization-based and model predictive control. Proficiency in system modeling and programming with Matlab/Simulink is also required. Knowledge of digital-analog-hybrid and real-time critical systems is advantageous but not mandatory.



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CCPS Control and Cyber-Physical Systems