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Advanced Process Control - Tutorial 7   **WS 10/11**

Model Predictive Control

Quickies

1. Explain briefly the idea behind a model predictive control (MPC) scheme.

2. In commercial applications, why is the MPC scheme more popular than the classical control methods?

Exercises

Consider the original CSTR of tutorial one equipped with a measurement only for the concentration c_B. Your task is to design a model predictive controller using the MPC-toolbox from MATLAB. Use the constants $k_{AB} = 1, k_{BC} = 3, k_{CB} = 2, \dot{v} = 1, V_R = 10$.

Please download the simulation material from the website, unzip it and save it.

1. MPC Model

   Open `stepresponsemodel.m`.

   Decide on a sampling time t_s and create a step response model for the MPC-toolbox. Compare the step response model with the step response of the original system.

   Hint: Generally t_s should be smaller than the smallest time constant in the system. For simplicity, use the same sampling time for the uncontrolled plant and the controlled plant.

   Change only t_s in line 24 of the m-file `stepresponsemodel.m`. Then run this file.

   A step response model is needed for the MPC toolbox of Matlab.

2. Controller Design

   Open `MPC_play.m`. Design a controller for unbounded inputs u. Try different weights and horizons for the input horizon h_M and the prediction horizon h_P (see line 32-37). Please change t_s to 0.2 in line 24. Simulate the controlled system by running this file. What happens when input and prediction horizon are identical and why?

3. Bounded Inputs

   Open `MPC_constraint.m`. Include a reasonable lower bound u_{min} and a reasonable upper bound of $u_{max}0$ in the simulation (line 52, 53). What is the effect?

4. Plant Model Mismatch

   Open `MPC_plant_model_mismatch.m`. Change e.g. the Volume of the model (line 31). Simulate the behaviour of the controller in order to verify the robustness. What happens when the volume becomes smaller? Can you explain it?