Lab 06: Multi-loop PID Control Simulation

CHEN4011: Advanced modeling and Control

Ranjeet Utikar

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1 Objectives

1. To develop a MATLAB Simulink model for multi-loop PID control simulation
2. To apply controller tuning methods.

2 Problem Statement

Consider a 2x2 MIMO process given as follows:

$$G(s) = \begin{bmatrix} \frac{22.89e^{-0.2s}}{4.572s+1} & \frac{-11.64e^{-0.4s}}{1.807s+1} \\ \frac{4.689e^{-0.2s}}{2.174s+1} & \frac{5.80e^{-0.4s}}{1.801s+1} \end{bmatrix} \tag{1}$$

3 Tasks

1. Determine suitable controller pairings for the MIMO process given above. Based on the results of the controller pairing analysis, next reduce the decentralized system above to a diagonal form with two effective open-loop transfer functions (EOTF). [2.5 marks]

2. Complete the multi-loop PI controller tuning using the aforementioned 2 different tuning methods stated in the objectives. Then, evaluate the multi-loop PI controller performances for sequential setpoint tracking to 1 unit step change in the setpoints of y_1 and y_2. Analysis the simulation results and identify which of the 2 tuning methods gives the best performance for this particular MIMO process. [2.5 marks]

3. Next, evaluate the multi-loop PI controller performance for disturbance rejection: consider 1 unit step changes in the output disturbances to y_1 and y_2. Again, based on your analysis of the simulation results identify the best multi-loop PI control system. [2.5 marks]

4. Suppose that there are modelling errors in the process model where the gain errors are 10% and deadtime errors are 20%. Under these modelling errors, run the simulation of the multi-loop PI control systems involved. Analyze the simulation results and summarize 2 key findings from the simulation. [2.5 marks]

4 Notes

- Show the Simulink model in the report
- Provide a few figures or plots to show your control system responses
- Use tables to summarize your results
- Maximum report is 5 pages excluding the cover page