Assignment 2: Control design

Introduction

Use the same system as in Assignment 1, $G_o(s) = \begin{bmatrix} G_{11}(s) & G_{12}(s) \\ G_{21}(s) & G_{22}(s) \end{bmatrix}$, where the outputs are air temperature, y_1, and humidity, y_2, that can be controlled by the flow to the heater, u_1 and the flow to the humidifier, u_2.

Pairing

Use *Relative Gain Array*, *RGA,* to pair the input and output. (In this case it should be obvious, but it is a good exercise to do it). The closed loop cross-over frequency shall be 1/10. Show how you did the pairing.

Decoupling

In this part you will try two different cases for the decoupling; one (i) steady-state decoupling and one (ii) dynamic decoupling. Create a decoupling for each of the cases where W_2=I for both cases and W_1=G^{-1}(s) for $s = 0$ for case (i) and $s = i\omega_c$ *for case* (ii). Since the latter matrix will be complex valued, use the real valued matrix.

A. Compare three different cases. The reference will be a feedback without decoupling (from assignment 1) and the other two cases are the two decoupling matrixes. In all cases use a unit feedback matrix. $F_y = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$. There might be a matrix F_r that normalizes the static gain to be one, but we do not take that into account in this assignment. Plot the three cases and compare the results.

B. Let the controller be a PI-controller $\frac{1+10s}{10s}\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$. That is, the integration time is T_i=10.

In the report I would like you to compare the three different cases. Moreover, analyze the results from the PI-controller.

LQG

Use the command matlab-command lqr to design a LQG controller. Try different penalty matrixes, plot the step response, evaluate and compare the results with earlier results. I would like to have three different penalty matrixes that clearly show the impact from the settings. Do not forget to comment your results.

Report

Hand in a written report on how you solved the problem. It should contain a short
(i) background/introduction, (ii) method, (iii) results with plots and diagrams,
(iv) conclusion/discussion. Place your Matlab-script as an appendix. Put your name and the name of your file on the front page. Hand in the report by using Blackboard