Homework 1

(Due on: Wed, October 10 by 8:00PM via e-mail)

The aim of this homework is to introduce you to feedback control systems and for you to use your MATLAB and SIMULINK skills in the context of a simulation of a feedback control system. The control system in Fig. 1. is in detail covered in the class and presented in my lecture notes with all the parameters.

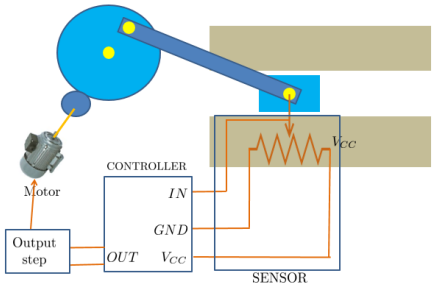

Figure 1:

a) Explain why in the feedback loop presented in the lecture notes we cannot use negative values for K_p and what the benefit of a large positive K_p value is.

b) Run the simulation **CE141IntroModel1.mdl** for input values 1, 2, 3,... and find the highest integer value u_{max} (for which the motor does not work). Can you explain (in words) the trend in the frequency of x_2 plots and check if the maximal and minimal values of x_2 correspond to those in the lecture notes?

c) The simulink model **CE141IntroModel2.mdl** includes both the system and the proportional controller K_p. The reference for the controller changes as a square pulse from 4 to 5.4 with a period of 10s and a duty cycle of 50%. Find the largest value of the gain K_p for which the control u value does not exceed u_{max} from (b). How does the limit on u impact the performance of the feedback control loop?

d) Use K_p from (c) and adjust the model in such a way that the reference changes from 4.2 to 4.8. Include the figures in your report.

e) The simulink model **CE141IntroModel3.mdl** models the system controlled by a digital proportional controller. Go back and forth between the simulation results of this model and of the one in **CE141IntroModel2.mdl** until you find the value of K_p that in both simulations results in a similar position (x_2) and control (u) signals. Include the figures in your report.

Note : You are free to use any part of the code provided with this homework. Please try to understand the code.