EE402 Mini Project 3

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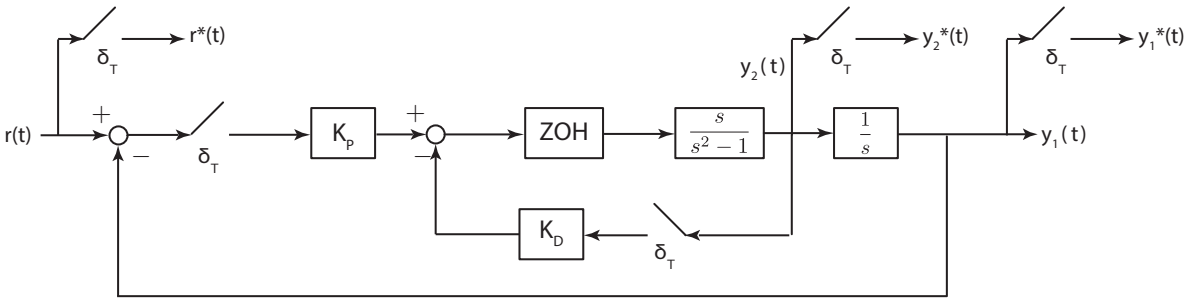
Due: 23-Nov-2018, @16:40 PM (There will be a box to drop the Mini Projects in front of D-226. The box will be removed after 16:40 PM.)

Important: In this mini project, you are supposed to perform some computations in MATLAB, perform simulations in Simulink, and plot some results both using MATLAB and Simulink. You should provide all of your source codes, Simulink models, and graphical results with your submission. For Simulink models a snapshot figure of the model is satisfactory.

1. Consider the discrete-time control system topology which is given in the Figure below. Let's assume that $T = 0.5$s.



   (a) Let $K_D = 0$ (i.e., no D action), then compute the pulese transfer functions $\frac{Y_1(z)}{R(z)}$ and $\frac{Y_2(z)}{R(z)}$.

   (b) For $K_D = 0$, find a range of K_P such that closed-loop system is stable (if possible).

   (c) Let $K_D = 0$ and $K_P = 2$, then find a closed form expression for the step responses of the closed-loop discrete system, i.e. $y_1[k]$ and $y_2[k]$.

   (d) For the same K_P value, using MATLAB find and plot the step-responses of the closed loop discrete system. Compare this result with the ones found in the previous part (e.g. you can plot both results on the same figure).

   (e) Now, you will analyze the general PD action. Let $K_P = 2$, then compute the pulse transfer functions $\frac{Y_1(z)}{R(z)}$ and $\frac{Y_2(z)}{R(z)}$.

   (f) For $K_P = 2$, find a range for the K_D values such that closed-loop system is stable.

   (g) For $K_P = 2$, choose a K_D value that can can stabilize the system, then find a closed from expression for the step responses of the closed-loop discrete system, i.e. $y_1[k]$ and $y_2[k]$.

   (h) For the same (K_P, K_D) pair, using MATLAB find and plot the step-responses of the closed loop discrete system. Compare these results with the ones found in the previous part, (g).

   (i) Realize the block diagram topology in Simulink, and simulate the system with the same (K_P, K_D) pair to find the unit-step responses of the closed-loop system. Compare this result with the ones found in parts (g) and (h).