Control Theory Homework 3

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Exercise 3.

$$W = \frac{s+2}{2s^2+7}$$

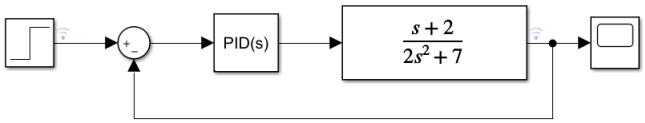

Figure 1: Simulink Schema

I decided to start with $k_p = 1$ *and* $k_d = k_i = 0$

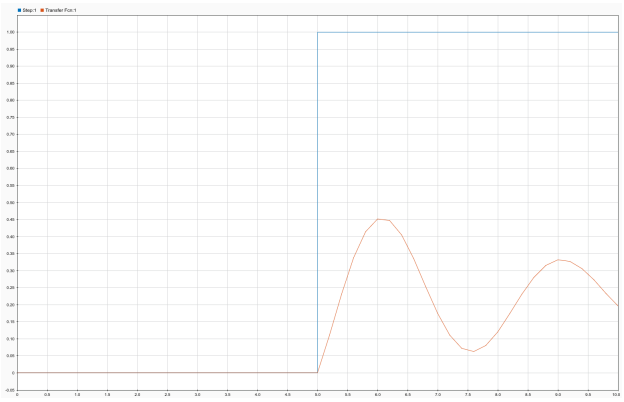

Figure 2: $k_p = 1$ *and* $k_d = k_i = 0$

As we can see, the system is far from the desired control.
To solve this problem, I adjusted the the coefficients using PID Tuner.

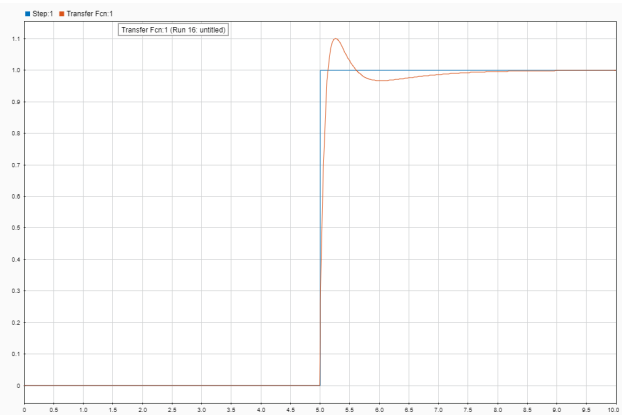

Figure 3: Overshoot with $k_p = 35,\ k_d = 0.4,\ k_i = 61$

The controller above stabilize the system pretty fast. However, it overshoots.

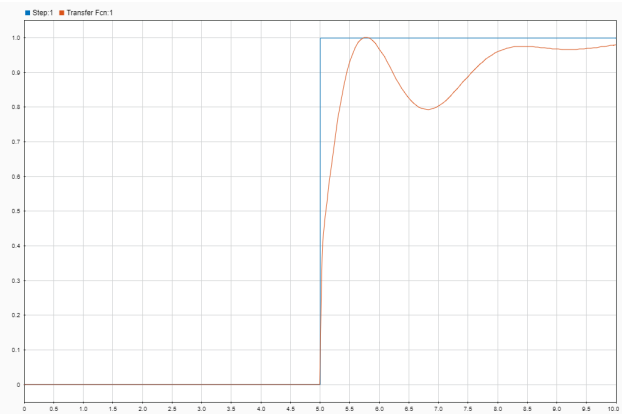

Figure 4: No overshoot with $k_p = 5.33,\ k_d = 0.99,\ k_i = 6.75$

The controller above doesn't overshoot. However, its stabilization time is greater than the one that the previous controller had.

As a result, we need to make choice between overshooting and minimizing the stabilization time.

Exercise 4.

$$W(s) = \frac{s+4}{s^2+3s+15}$$

Afer openning the Matlab Control System Designer, we see the following picture:

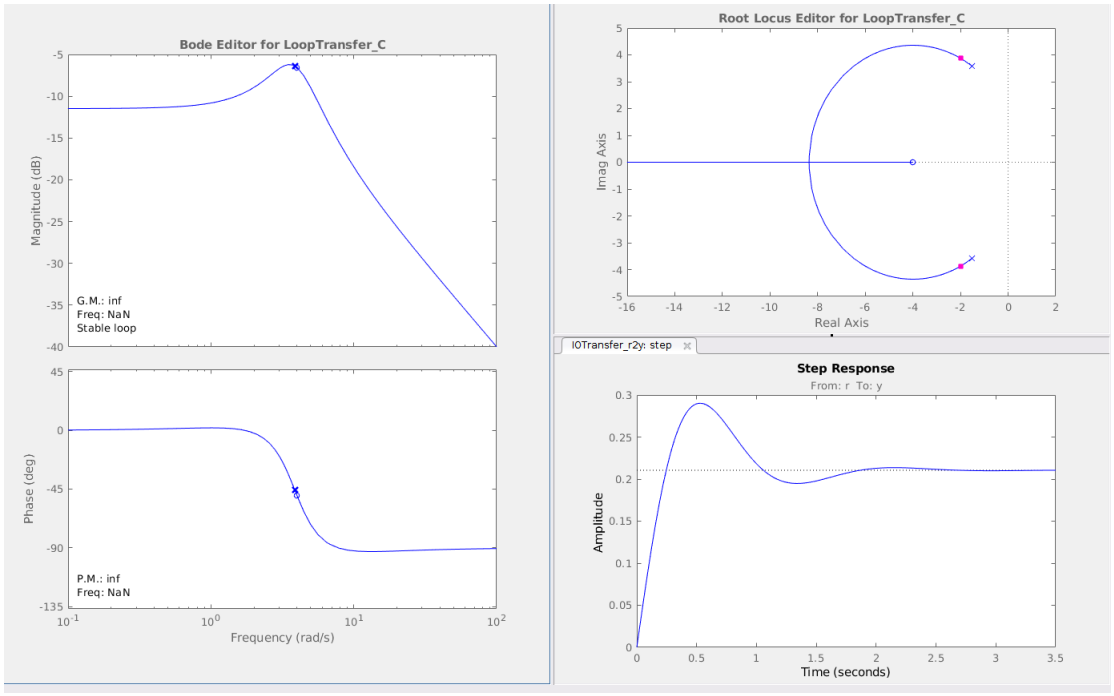

Figure 5: Original System

To make orientation easier the following design requirements were set: rise_time=1, settle_time=3, overshoot=20%

Then, in order to make it rise to 1, I added integrator (real pole in zero) and, to decrease the rise time, adjusted the bode magnitude plot

After the described manipulations I obtained the following:

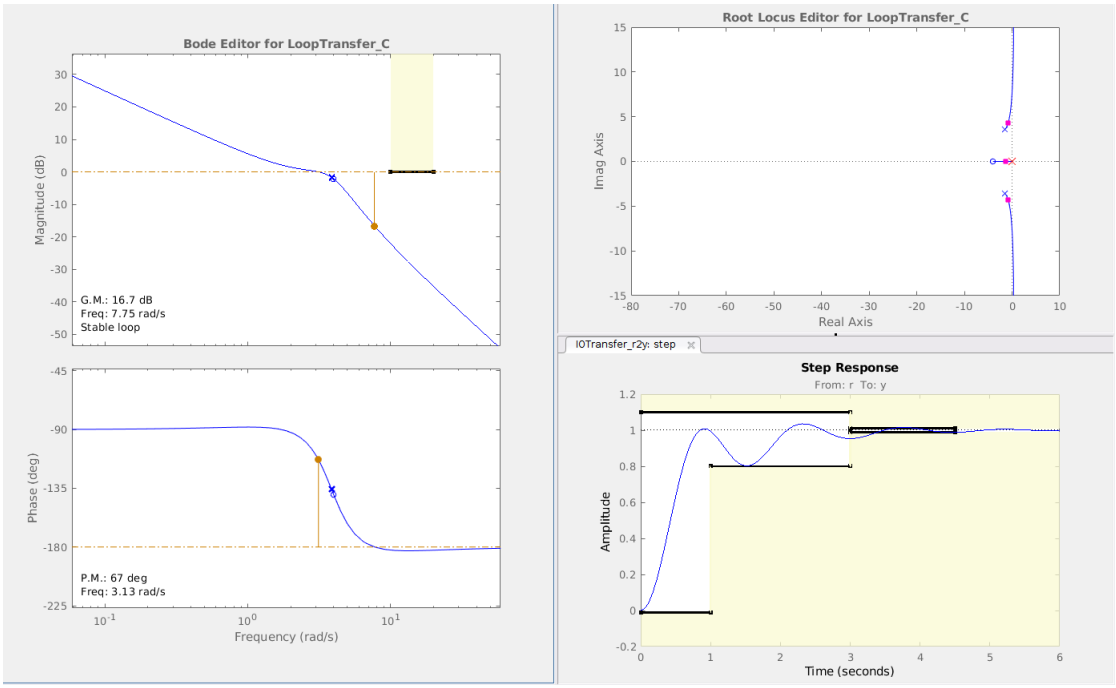

Figure 6: System with integrator and adjusted bode plot

To get rid of overshoot and decrease the stabilization time, I added several real zeroes and symmetric complex pole

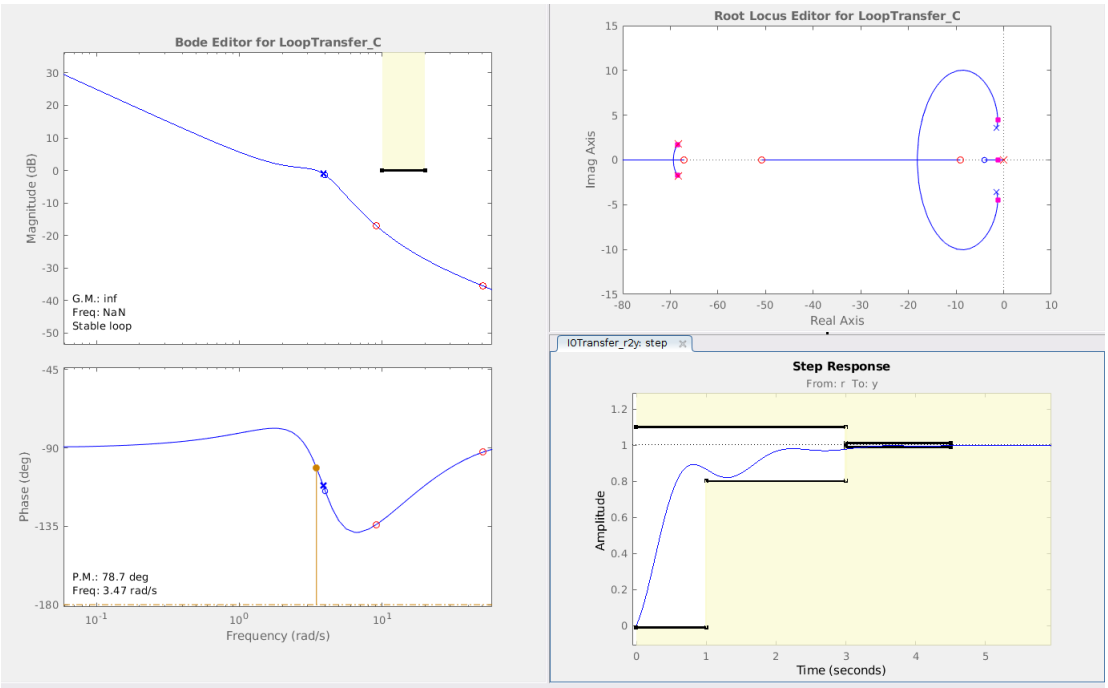

Figure 7: System with integrator and adjusted bode plot