Exercise Sheet 8: Extended Pole Placement

Problem 16:

We again consider the magnetic suspension system with the transfer function $G(s) = \dfrac{0.01}{0.001\, s^2 - 1}$. It is now desired to achieve a closed-loop behavior with real poles at $s = -10$ and zero steady-state error.

a. What is the required controller order if the pole placement method is used? What is the expected controller type?

b. Apply pole placement to design an appropriate controller $C(s)$. Also use a pre-filter $F(s)$ if required.

c. Realize the feedback loop computed in Problem **b.** without the pre-filter and simulate a reference step response of $r = 1\,\mathrm{cm}$ and a disturbance step response of $F_L = 0.05\,\mathrm{N}$. Also record the plant input u.

d. Realize the feedback loop for **b.** including the pre-filter and perform the same experiments as in **c.** Compare the results.

Problem 17:

a. We consider the plant transfer function $G(s) = \dfrac{1}{s + 100}$. Design a controller $C(s)$ such that the closed-loop poles are located at $s = -1000$ and the steady-state error for step responses is zero. In addition we want to suppress sinusoidal disturbance signals with a frequency of 300 rad/sec.

b. Simulate the feedback loop with $G(s)$ and your controller $C(s)$ with an output disturbance $d(t) = 5\, \sin(300\, t)$.

c. Now apply a reference signal of $r(t) = 10\, cos(300\, t)$. What do you observe?