Exercise Sheet 13: Feedforward Control

Problem 27:

We again consider the magnetic suspension system with the transfer function $G(s) = \dfrac{0.01}{0.001\,s^2 - 1}$. Starting from the position $y = 0$ in the air gap of the suspension system, we want to move the sphere to the position $y = d/2$, whereby $d = 0.04\,\mathrm{m}$.

a. Determine an appropriate function $f(t)$ for the desired trajectory $y_d(t)$ such that the transition from $y = 0$ to $y = d/2$ happens between time $t = 0$ and $t = 2$.

b. Compute the required input function $u(t)$ such that the plant output follows the desired trajectory: $y(t) = y_d(t)$.

c. Simulate the magnetic suspension system with the feedforward controller you designed. What do you observe and why?

Hint: The Simulink model on the course webpage already provides the input generator. You only need to enter the coefficients of $f(t)$.

d. We want to combine feedforward and feedback control. Use the controller

$$C(s) = \frac{1000 + 4\,400\,s + 160\,s^2}{s\,(40 + s)}$$

from Problem 16 to close the loop. Perform the same simulation as in **c**.

e. Now simulate a disturbance step response of $d = 0.05\,\mathrm{N}$. Record the plant output and the controller output of your feedback controller. What do you observe?