trans.exe Exercises for Chapter trans

Exercise trans.apiarian

A control system has dominant closed-loop poles at $-8 \pm j3$. Under the second-order assumption, what is its settling time?

Exercise trans.pericentral

Consider the block diagram of Fig. exe.1. Let the plant G have transfer function

$$G(s) = \frac{9}{(s+4)(s^2+3s+9)}, \tag{1}$$

the feedback transfer function $H(s) = 1$, and the controller C have transfer function

$$C(s) = K \tag{2}$$

where $K \in \mathbb{R}$ is some gain.

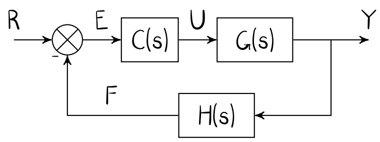

Figure exe.1: a block diagram with a controller $C(s)$.

1. Determine the closed loop transfer function $Y(s)/R(s)$.
2. For $K = 4$ and a unit step input to the closed-loop system, what are the second-order approximations of the peak time T_p, rise time T_r, settling time T_s, and percent overshoot $\%OS$?
3. For $K = 4$ and a unit step input to the closed-loop system, simulate to estimate peak time T_p, rise time T_r, settling time T_s, and percent overshoot $\%OS$.
4. Compare the second-order approximations with the simulated results. Explain the differences and similarities.

Steady-state response performance

After the transient response has settled–that is, reached steady-state–the system may or may not be in a desirable state. If the response asymptotically approaches any state other than that commanded, it is said to have **steady-state error**. These arise from three primary sources:

steady-state error

1. nonlinearities, like backlash in gears–we won't explore this one;
2. disturbances, like those from the environment; and
3. input (command) type and the plant dynamics.

We will focus our attention on item 3; item 2 is similar.