

1 Examining a system

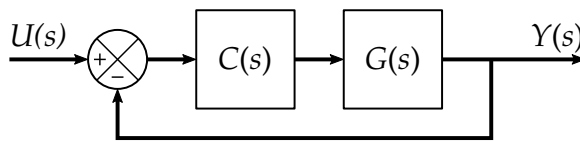
Given a system,

$$G(s) = \frac{1}{s^2 + 20s + 2}$$

1. Use Matlab to plot the step response.
2. What are the poles of this system?

2 Applying feedback

1. Now apply proportional feedback ($C(s) = k_P$), and compute the overall transfer function $H(s)$:



2. Use Matlab to plot the poles of the complete system as a function of the proportional gain, as k_P goes from 0 to ∞ .

3 Analyzing the feedback system

1. Draw a line on your graph where the damping ratio is $\zeta = 0.5$. What value of k_P produces $\zeta = 0.5$?
2. Is there a value of k_P that makes the system unstable?

4 Exploring further

1. What about proportional-derivative control? Recall that $C(s) = k_P + k_D s$. Since you can only plot one gain parameter, make this k_D and use a constant ratio of k_P/k_D .

2. What about the transfer function

$$G(s) = \frac{1}{s^2 + 2s - 20}$$

3. Try other transfer functions - can you pick gain values that cause the system to become unstable? Values which make an unstable system stable? What about PID control?