12.4 tf.exe Exercises for Chapter 12 tf

Exercise 12.1 scallywag

Use a computer to solve this problem. Consider the transfer function

$$H(s) = \frac{10(s+3)}{(s+2)(s^2+8s+41)}.$$

a. What are poles and zeros of H?
b. Comment on the stability of the system described by H (justify your comment).
c. Construct a pole-zero plot.
d. Use a function like Matlab's `lsim` or `step` to find the unit step response of the system and plot it for $t \in [0, 3]$ seconds.

Exercise 12.2 swashbuckling

Consider a system with linear state-space model matrices

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$$A = \begin{bmatrix} -1 & 4 \\ 0 & -3 \end{bmatrix} \qquad B = \begin{bmatrix} 1 \\ -1 \end{bmatrix} \tag{1a}$$

$$C = \begin{bmatrix} 1 & 0 \end{bmatrix} \qquad D = \begin{bmatrix} 0 \end{bmatrix}. \tag{1b}$$

1. Derive the transfer function $H(s)$ for the system. Express it as a single ratio in s.
2. What are the poles and zeros?
3. Compare the poles to the eigenvalues of A.
4. Draw or sketch a pole-zero plot.
5. With reference to the pole-zero plot, comment on the stability and transient free response characteristics of the system.
6. Use the inverse Laplace transform $\mathcal{L}^{-1}$ to find the system's forced response $y(t)$ to step input $u(t) = 9\,u_s(t)$.

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