7.7. Design a Kalman filter for the aircraft lateral dynamics given by Eq. (4.97) in Exercise 4.3 using $\mathbf{F} = \mathbf{I}$, $\mathbf{Z} = \mathbf{C}\mathbf{C}^{\mathbf{T}}$, $\Psi = \mathbf{0}$, and $\mathbf{V} = 0.001\mathbf{F}^{\mathbf{T}}\mathbf{F}$. Where are the poles of the Kalman filter in the s-plane?

7.8. Design a Kalman filter for the turbo-generator of Example 3.14, using $\mathbf{F} = \mathbf{B}$, $\mathbf{Z} = \mathbf{C}\mathbf{C}^{\mathbf{T}}$, $\Psi = \mathbf{0}$, and $\mathbf{V} = 0.0001\mathbf{B}^{\mathbf{T}}\mathbf{B}$. Where are the poles of the Kalman filter in the s-plane?

7.9. Design a linear Kalman filter to estimate the *nonlinear* state of wing-rock model described in Example 4.13, and programmed in the M-file *wrock.m* which is listed in Table 4.8. Plot the elements of the estimation error vector as functions of time, if the initial condition is $\mathbf{x}(0) = [0.2; 0; 0; 0; 0]^T$. Which state variables have the largest estimation error, and what are the magnitudes of the largest estimation errors?

7.10. Re-design a Kalman filter for the distillation column (Exercise 7.6), such that the LQG optimal compensator formed by including the optimal regulator deigned in Exercise 6.2 has loop-transfer recovery at the plant's input in the frequency range 0.01–10 rad/s. What are the largest control input magnitudes required for the resulting LQG/LTR compensator if the initial condition is $\mathbf{x}(0) = [1; 0; 0; 0]^T$?

7.11. Re-design a Kalman filter for the aircraft lateral dynamics (Exercise 7.7), such that the LQG optimal compensator formed by including the optimal regulator deigned in Exercise 6.3 has loop-transfer recovery at the plant's input in the frequency range 0.1–100 rad/s. What are the largest control input magnitudes required for the resulting LQG/LTR compensator if the initial condition is $\mathbf{x}(0) = [0.5; 0; 0; 0]^T$? Repeat the simulation of the closed-loop initial response using a measurement noise of ± 0.01 rad/s in the roll-rate, $p(t)$, channel.

7.12. Re-design a Kalman filter for the turbo-generator (Exercise 7.8), such that the LQG optimal compensator formed by including the optimal regulator designed in Exercise 6.5 has loop-transfer recovery at the plant's input in the frequency range 0–10 rad/s. What are the largest control input magnitudes required for the resulting LQG/LTR compensator if the initial condition is $\mathbf{x}(0) = [0.1; 0; 0; 0; 0; 0]^T$?

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