

EEL 4612 Homework # 5 – Due Tu March 31

1. Consider the following state-space model:

$$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{pmatrix} = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -5 & -6 & 0 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} u$$
$$y = (1 \quad 0 \quad 0) \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

Design a full-order state observer to place the observer poles at -10, -10, -15. Complete the design procedure using each of the 3 methods taught in class.

2. Consider the following state-space model:

$$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} + \begin{pmatrix} 0 \\ 1 \end{pmatrix} u$$
$$y = (1 \quad 0) \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$$

Design an observer controller to place closed-loop poles at $s = -2 \pm j2\sqrt{3}$ and use a minimum-order observer to place the desired observer pole at $s = -5$. Then, implement the observer controller in SIMULINK. Attach the plot of the output response when the system starts with initial condition $\begin{pmatrix} x_1(0) \\ x_2(0) \end{pmatrix} = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$.