ELEC 7500 Project 2

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1   Linear System Stability

2   Stable and Unstable Subspaces

3   Analysis of Nonlinear System Stability

4   Controllable and Stabilizable Properties

Consider the model $\dot{x} = \mathbf{A}x + \mathbf{B}u$, where

$$\mathbf{A} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -2 & 0 & 0 \\ 0 & 0 & 3 & 0 \\ 0 & 0 & 0-4 \end{bmatrix}$$

5   State Feedback

Consider the model from the previous section. Design a state feedback controller $u = -\mathbf{K}x$ so the closed loop system is asymptotically stable. Can the closed loop eigenvalues be freely selected? Describe the constraints on the choice of eigenvalues and the impact on the gain matrix $\mathbf{K}$.

6   Controllability, revisited

Consider the model $\dot{x} = \mathbf{A}x + \mathbf{B}u$, where

$$\mathbf{A} = \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$\mathbf{B} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

$$x(0) = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

Find an input function $u(t)$ that drives the state from $x(0)$ to the origin at $t = 1$. Verify the solution either analytically or by simulation.