

EE380K: Linear Systems Theory—Fall 2008

PROBLEM SET 6

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Due **Wednesday**, October 29, 2008.

This problem set focuses on the ideas of reachability/controllability, and observability. Starred exercises are bonus/optional.

1. Consider the LTI continuous time state space representation

$$\dot{x} = Ax + Bu,$$

where

$$A = \begin{pmatrix} 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 2 & -1 & 0 \\ 0 & -1 & 1 & 1 \end{pmatrix}, \quad B = \begin{pmatrix} 1 & 1 \\ 1 & 0 \\ 1 & 0 \\ 0 & 0 \end{pmatrix}.$$

Find a change of basis so that the resulting system is in controllability form, that is:

$$\tilde{A} = \begin{pmatrix} \tilde{A}_{11} & \tilde{A}_{12} \\ 0 & \tilde{A}_{22} \end{pmatrix}, \quad \tilde{B} = \begin{pmatrix} \tilde{B}_1 \\ 0 \end{pmatrix},$$

where the pair $(\tilde{A}_{11}, \tilde{B}_1)$ is controllable.

2. Exercise 22.1 from the course notes.
3. Exercise 22.2 from the course notes, but you do not need to do the part about drawing a block diagram.
4. Exercise 22.3 from the course notes.
5. Exercise 23.3 from the course notes.
6. Exercise 23.4 from the course notes.
7. * Exercise 23.5 from the course notes.