EECS 16B Designing Information Devices and Systems II Spring 2016 Anant Sahai and Michel Maharbiz Discussion 10B

1. Controllable Canonical Form - Eigenvalues Placement

Consider the following linear discrete time system

$$\vec{x}(t+1) = \begin{bmatrix} 2 & -3 & 4 \\ 0 & 0 & 4 \\ 3 & 4 & 7 \end{bmatrix} \vec{x}(t) + \begin{bmatrix} 2 \\ -3 \\ 6 \end{bmatrix} u(t)$$

- (a) Is this system controllable?
- (b) Is the linear discrete time system stable?
- (c) Bring the system in a controllable canonical form as

$$\vec{z}(t+1) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -a_1 & -a_2 & -a_3 \end{bmatrix} \vec{z}(t) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$$

using transformation $\vec{z}(t) = T\vec{x}(t)$

- (d) Using state feedback $u(t) = -\begin{bmatrix} f_1 & f_2 & f_3 \end{bmatrix} \vec{z}(t)$ place the eigenvalues at 0, 1/2, -1/2.
- (e) Is the system now stable?

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