ECED 4601 Digital Control Systems

Assignment #5

http://www.jasongu.org/4601/assignments.html

Due date: November 23, 2017. Late submission will not be accepted.

Assignment #5 contains the following problems:

1) Problem B-6-1: Consider the system defined by

$$x((k+1)) = Gx(k) + Hu(k)$$
$$y(k) = Cx(k)$$

Where $G = \begin{bmatrix} a & b \\ c & d \end{bmatrix}, H = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, C = \begin{bmatrix} 1 & 0 \end{bmatrix},$

Determine the conditions on a,b,c, and d for complete state controllability and complete observability.

2) B-6-8 consider the pulse transfer function system.

$$\frac{Y(z)}{U(z)} = \frac{z^{-1}\left(1+z^{-1}\right)}{\left(1+0.5z^{-1}\right)\left(1-0.5z^{-1}\right)}$$

Obtain the state-space representation of the system in the following forms

a) controllable canonical form
b) observable canonical form
c) diagonal canonical form

3) B-6-12 consider the system defined by

$$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \\ x_3(k+1) \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -0.16 & 0.84 & 0 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \\ x_3(k) \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} u(k)$$

Determine the state feedback gain matrix such that when the control signal is given by

$$u(k) = -Kx(k)$$

The closed loop system will exhibit the deadbeat response to any initial state $x(0)$

4) B-6-16 consider the system defined by:

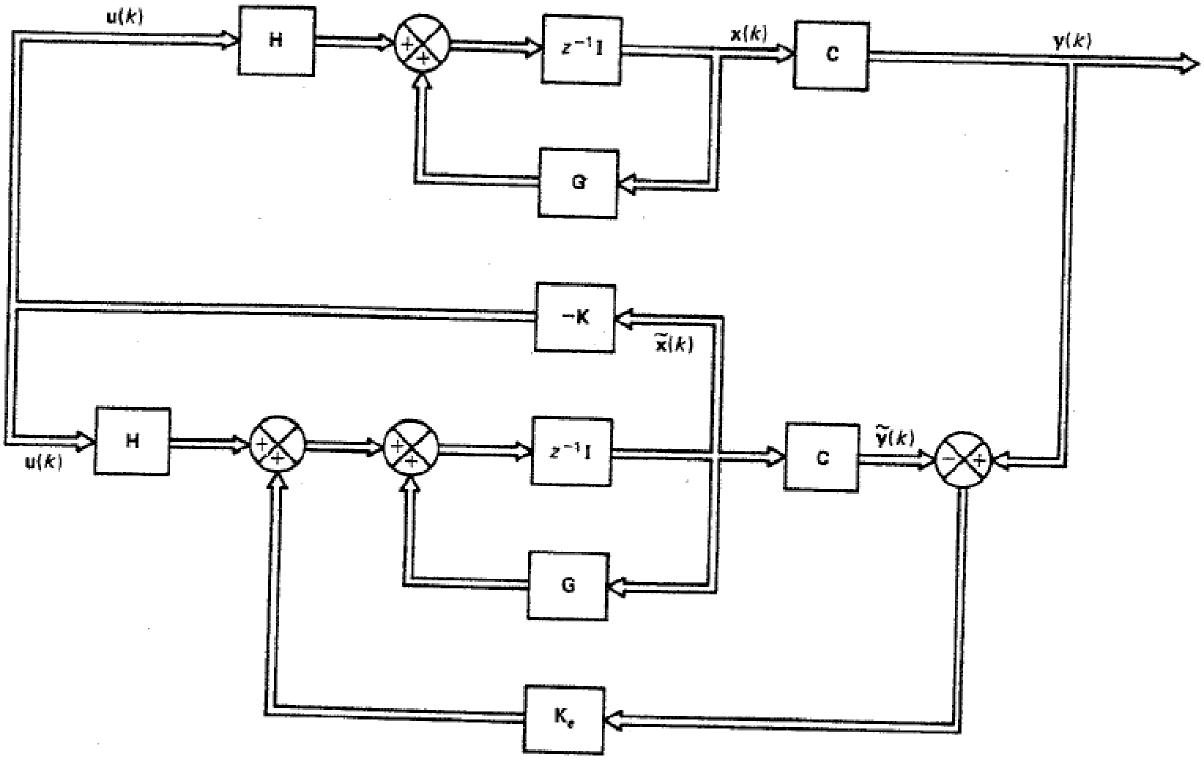
$$x((k+1)) = Gx(k) + Hu(k)$$
$$y(k) = Cx(k)$$

Where $G = \begin{bmatrix} 0 & -0.16 \\ 1 & -1 \end{bmatrix}$, $H = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$, $C = \begin{bmatrix} 0 & 1 \end{bmatrix}$,

Using MATLAB, determine the observer feedback gain matrix K_e such that the desired eigenvalues for the observer matrix are

$u_1 = 0.5 + j0.5$, $u_2 = 0.5 - j0.5$

Assume that the system configuration is identical to that shown in figure. Using Ackermann's formula, write a MATLAB program.



Observed state feedback control system