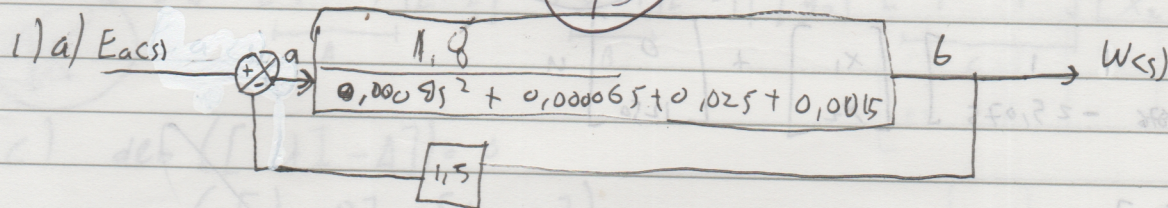


Gebirni S.A. Makongga
0041 17104

10/05/04
79

No. Stb. : 0041171014
Mata Pelajaran : Sistem Kendali 1
Semester : 5
Strata : S1
Tgl. Ujian : 20 Desember 2019



$$a = Eacs) - 1,5b$$

$$b = Wcs) = a \cdot \frac{1,8}{0,0009s^2 + 0,020065 + 0,0015}$$

$$= (Eacs) - 1,5b \cdot \frac{1,8}{0,0009s^2 + 0,020065 + 0,0015} \rightarrow \text{misalkan} = j$$

$$b \left(1 + \frac{2,7}{j} \right) = \frac{Eacs) \cdot 1,8}{j}$$

$$Wcs) \left(\frac{j + 2,7}{j} \right) = \frac{Eacs) \cdot 1,8}{j}$$

$$\frac{Wcs)}{Eacs)} = \frac{1,8}{0,0009s^2 + 0,020065 + 0,0015 + 2,7}$$

$$\frac{Wcs)}{Eacs)} = \frac{1,8}{0,0009s^2 + 0,020065 + 2,7015}$$

$\begin{matrix} 60 \\ \uparrow \\ 1,8 \\ \downarrow \\ a_0 \quad a_1 \quad a_2 \end{matrix}$

10

b. $a_0 = 2,7015$ $b_0 = 1,8$
 $a_1 = 0,02006$
 $a_2 = 0,0009$

$$\therefore A = \begin{bmatrix} 0 & 1 \\ \frac{a_0}{a_2} & \frac{a_1}{a_2} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ \frac{2,7015}{0,0009} & \frac{0,02006}{0,0009} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -3376,875 & -25,075 \end{bmatrix}$$

$$\therefore B = \begin{bmatrix} 0 \\ \frac{1}{a_2} \end{bmatrix} = \begin{bmatrix} 0 \\ \frac{1}{0,0009} \end{bmatrix} = \begin{bmatrix} 0 \\ 1250 \end{bmatrix}$$

$$C = [60 \ 6] = [1,9 \ 0]$$

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = A \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + B u$$

$$= \begin{bmatrix} 0 & 1 \\ 3376,876 & -25,075 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1250 \end{bmatrix} u$$

$$y = [1,9 \ 0] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

10

2/a) $m=2$, $n=2$, $h=2$ sehingga:

$$A = [h \times n] = [2 \times 2]$$

$$B = [h \times m] = [2 \times 2]$$

$$C = [h \times n] = [2 \times 2]$$

$$D = [h \times m] = [2 \times 2]$$

10

b) $\dot{x}_1 = x_1 + u_1$
 $\dot{x}_2 = x_1 - x_2 + u_2$

$y_1 = 2u_1 + x_1 + x_1 \rightarrow = 2u_1 + 2x_1$
 $y_2 = x_1 + x_2$

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \underbrace{\begin{bmatrix} 1 & 0 \\ 1 & -1 \end{bmatrix}}_A \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \underbrace{\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}}_B \begin{bmatrix} u_1 \\ u_2 \end{bmatrix} \quad \begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \underbrace{\begin{bmatrix} 2 & 0 \\ 1 & 1 \end{bmatrix}}_C \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \underbrace{\begin{bmatrix} 2 & 0 \\ 0 & 0 \end{bmatrix}}_D \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

c) $\det([\lambda I - A]) = 0$

$\det\left(\begin{bmatrix} \lambda & 0 \\ 0 & \lambda \end{bmatrix} - \begin{bmatrix} 1 & 0 \\ 1 & -1 \end{bmatrix}\right) = 0$

$\det\left(\begin{bmatrix} \lambda-1 & 0 \\ -1 & \lambda+1 \end{bmatrix}\right) = 0 \rightarrow (\lambda-1)(\lambda+1) = 0$

$\lambda_1 - 1 = 0 \vee \lambda_2 + 1 = 0$

$\lambda_1 = 1$

$\lambda_2 = -1$

Jadi, karena terdapat nilai eigen yang positif, maka sistem tidak stabil

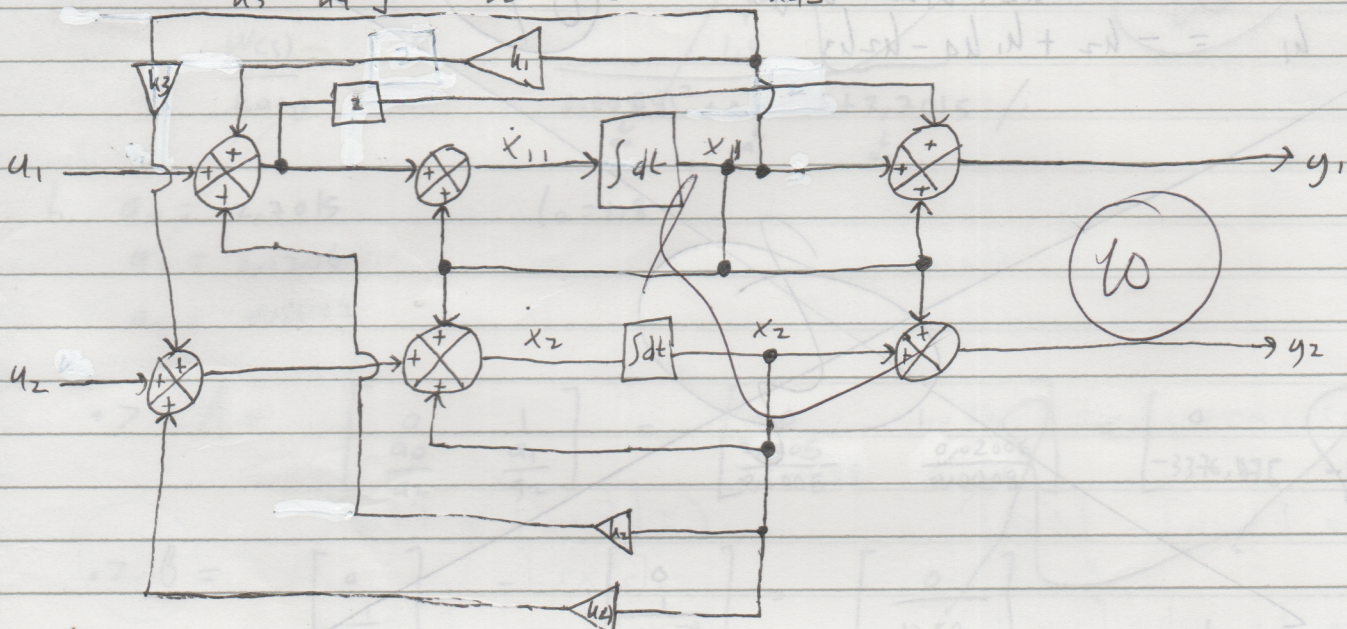
d) Kita ketahui bahwa dimensi matriks B ialah $[m \times n]$, sehingga agar dapat ~~dihakikan~~ dihalikan dengan B, maka dimensi k harus:

$k = [m \times n] \rightarrow m=2, n=2$

$k = [2 \times 2]$

e) Karena dimensi k ialah $[2 \times 2]$, maka dibutuhkan 4 buah penguat, yaitu:

$k = \begin{bmatrix} k_1 & k_2 \\ k_3 & k_4 \end{bmatrix} \rightarrow k_1 = 1 \times 1 \quad k_3 = 2 \times 1$
 $k_2 = 1 \times 2 \quad k_4 = 2 \times 2$



$$p) \bar{A} = [A + BK]$$

$$= \begin{bmatrix} 1 & 0 \\ 1 & -1 \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} k_1 & k_2 \\ k_3 & k_4 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 \\ 1 & -1 \end{bmatrix} + \begin{bmatrix} k_1 & k_2 \\ k_3 & k_4 \end{bmatrix}$$

$$\bar{A} = \begin{bmatrix} 1+k_1 & k_2 \\ 1+k_3 & k_4-1 \end{bmatrix}$$

$$\det([sI - \bar{A}]) = 0$$

$$= 0$$

$$\rightarrow \lambda_1 = \lambda_2 = -1, \text{ sehingga:}$$

$$\det \left(\begin{bmatrix} s & 0 \\ 0 & s \end{bmatrix} - \begin{bmatrix} 1+k_1 & k_2 \\ 1+k_3 & k_4-1 \end{bmatrix} \right) = 0$$

$$\det \left(\begin{bmatrix} s-(1+k_1) & -k_2 \\ -(1+k_3) & s-(k_4-1) \end{bmatrix} \right) = s^2 + 2s + 1$$

$$\frac{(s-\lambda_1)(s-\lambda_2)}{s^2 + 2s + 1} = 0$$

$$(s-(1+k_1))(s-(k_4-1)) - (-k_2)(-(1+k_3)) = s^2 + 2s + 1$$

$$s^2 - s(k_4-1) - s(1+k_1) + (1+k_1)(k_4-1) - k_2(1+k_3) = s^2 + 2s + 1$$

$$-s(k_4-1) + s(1+k_1) + (1+k_1)(k_4-1) - (k_2 + k_2k_3) = 2s + 1$$

$$\begin{aligned} \bullet \rightarrow -s(k_4-1) + s(1+k_1) &= 2s \\ k_4 + k_1 &= 2 \end{aligned}$$

$$\begin{aligned} \bullet \rightarrow (1+k_1)(k_4-1) - (k_2 + k_2k_3) &= 1 \\ k_4 - 1 + k_1k_4 - k_1 - k_2 + k_2k_3 &= 1 \\ k_4 - k_2 + k_1k_4 - k_2k_3 &= 2 \end{aligned}$$

$$k_4 + k_1 = k_4 - k_2 + k_1k_4 - k_2k_3$$

$$k_1 = -k_2 + k_1k_4 - k_2k_3$$

54