

③ a $A = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ $B = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$ $C = (1 \ 0)$ $D = 0$

b $\gg [L, S, E] = \text{lqr}(P, [1, 0; 0, 0], .1) \Rightarrow L = (2.3166 \ 2.1525)$

c $E: -1.0762 \pm 1.4691i$

d $R_w = .01$ $R_v = B B^T = \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}$

e $\gg [K, R, F] = \text{lqe}(A, \text{eye}(2), C, R_v, R_w)$

$\Rightarrow K = \begin{pmatrix} 4.2544 \\ 9.0499 \end{pmatrix}$ $F: -2.1272 \pm 2.3505i$

g $\text{Cont} = \frac{29.3356 * (s + .4025)}{(s + 3.2034 + j3.3559)(s + 3.2034 - j3.559)}$

h The closed loop system will be stable.

④ a $A_d = \begin{bmatrix} .9801 & .1987 \\ -.1987 & .9801 \end{bmatrix}$ $B_d = \begin{bmatrix} .0199 \\ .1987 \end{bmatrix}$ $C_d = \begin{bmatrix} 1 & 0 \end{bmatrix}$ $D_d = 0$
 $y = x_1$

b $\gg [L_d, S_d, E_d] = \text{dlqr}(A_d, B_d, [1, 0; 0, 0], .1)$
 $\Rightarrow L_d = [1.6764 \ 1.9240]$

c $E_d: .7722 \pm j.2341$

d $R_{wd} = R_w = .01$ $R_{vd} = B_d B_d^T = \begin{bmatrix} .0004 & .004 \\ .0040 & .0395 \end{bmatrix}$

e $[K_d, R_d, F_d] = \text{dlqe}(A_d, \text{eye}(2), C_d, R_{vd}, R_{wd})$

$\Rightarrow K^* = \begin{bmatrix} .5697 \\ .1794 \end{bmatrix} \Rightarrow K_d = A_d K^* = \begin{bmatrix} .7926 \\ 1.0428 \end{bmatrix}$

f ~~Ed~~ $F_d: .5838 \pm j.2993$

g $\text{Contd} = \frac{3.3350 * (z - .9668)}{(z - .3759 + j.4507)(z - .3759 - j.4507)}$

h The closed loop system will be stable.