ECE 6320 HWK 14

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December 2023

Problem 1

a)
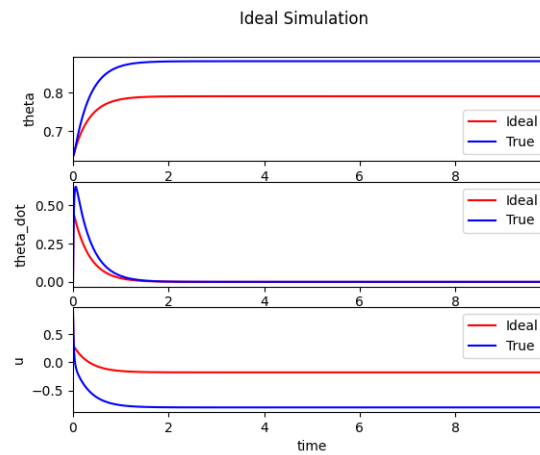
Matrices

$$Q = \begin{bmatrix} \frac{1}{0.15^2} & 0 \\ 0 & \frac{1}{.5^2} \end{bmatrix} \tag{1}$$

$$R = 1 \tag{2}$$

$$K = \begin{bmatrix} 6.845 & 1.2555 \end{bmatrix} \tag{3}$$

$$u_{ff} = -0.1388 \tag{4}$$

Plots

We see that the error in the dynamics causes the pendulum to have error in the state. Causing the pendulum to not converge to pi/4

b)

Matrices

$$A = \begin{bmatrix} 0 & 1 & 0 \\ \frac{\sqrt{2}g}{2l} & -\frac{b}{ml^2} & 0 \\ 1 & 0 & 0 \end{bmatrix} \tag{5}$$

$$B = \begin{bmatrix} 0 \\ \frac{1}{ml^2} \\ 0 \end{bmatrix} \tag{6}$$

$$Q = \begin{bmatrix} \frac{1}{0.15^2} & 0 & 0 \\ 0 & \frac{1}{.5^2} & 0 \\ 0 & 0 & \frac{1}{.2^2} \end{bmatrix} \tag{7}$$

$$R = 1 \tag{8}$$

$$K = \begin{bmatrix} 8.3666 & 1.2598 & 5 \end{bmatrix} \tag{9}$$

With a control law of,

$$u = u_{ff} - K \left(\begin{bmatrix} x_1 \\ x_2 \\ \sigma_1 \end{bmatrix} - \begin{bmatrix} x_{1,d} \\ x_{2,d} \\ 0 \end{bmatrix} \right) \tag{10}$$

Plots