Day 25

Observers (implementation)

AE353

Spring 2022

Bretl

$$\dot{m} = f(m, n) \qquad \ddot{q}_1 = \tau$$

$$0 = f(m_e, n_e)$$

$$x = m - m_e \qquad u = n - n_e$$

$$A = \frac{\partial f}{\partial m}\Big|_{(m_e, n_e)} \qquad B = \frac{\partial f}{\partial n}\Big|_{(m_e, n_e)}$$

$$0 = g(m, n)$$

$$y = 0 - g(m_e, n_e)$$

$$C = \frac{\partial g}{\partial m}\Big|_{(m_e, n_e)} \qquad D = \frac{\partial g}{\partial n}\Big|_{(m_e, n_e)}$$

$$\dot{x} = Ax + Bu$$

$$y = Cx + Du$$

$\leftarrow$

$$\begin{cases} \dot{m} = f(m, n) \\ 0 = f(m_e, n_e) \\ x = m - m_e \qquad u = n - n_e \\ A = \left.\frac{\partial f}{\partial m}\right|_{(m_e, n_e)} \qquad B = \left.\frac{\partial f}{\partial n}\right|_{(m_e, n_e)} \end{cases}$$

$$o = g(m, n)$$

$$y = o - g(m_e, n_e)$$

$$C = \left.\frac{\partial g}{\partial m}\right|_{(m_e, n_e)} \qquad D = \left.\frac{\partial g}{\partial n}\right|_{(m_e, n_e)}$$

$$x = \begin{bmatrix} q - q_e \\ v - v_e \end{bmatrix} \qquad u = [\tau - \tau_e]$$

$$o = [\sin q]$$

$$g\left(\begin{bmatrix} q \\ v \end{bmatrix}, [\tau]\right)$$

$$y = [\sin q] - [\sin q_e] = [\sin q - \sin q_e]$$

$$C = \left.\frac{\partial [\sin q]}{\partial \begin{bmatrix} q \\ v \end{bmatrix}}\right|_{\left(\begin{bmatrix} q_e \\ v_e \end{bmatrix}, [\tau_e]\right)} = \begin{bmatrix} \cos q_e & 0 \end{bmatrix}$$

$$D = \left.\frac{\partial [\sin q]}{\partial [\tau]}\right|_{(\,\cdot\,)} = [0]$$

$$\hat{x}(0) = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$u(0) = -K\,\hat{x}(0)$$

$$y(0) = \begin{bmatrix} \sin(q_1(0)) - \sin(q_{1e}) \\ v_2(0) - v_{2e} \end{bmatrix}$$

$$\hat{x}(0+\Delta t) = \hat{x}(0) + \Delta t\left(A\,\hat{x}(0) + B\,u(0) - L\left(C\,\hat{x}(0) - y(0)\right)\right.$$

$$u(\Delta t) = -K\,\hat{x}(\Delta t)$$

$$y(\Delta t) = \begin{bmatrix} \qquad\qquad \end{bmatrix}$$

$$\hat{x}(\Delta t + \Delta t) = \hat{x}(\Delta t) + \Delta t(\ \cdots\ )$$