

Day 23

Observers (nonlinear sensor models)

AE 353

Spring 2022

Bretl

$$\dot{m} = f(m, n)$$

$$\ddot{q}_1 = \tau$$

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

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

$$A = \left. \frac{\partial f}{\partial m} \right|_{(m_e, n_e)} \quad B = \left. \frac{\partial f}{\partial n} \right|_{(m_e, n_e)}$$

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

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

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

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

$$y = Cx + Du$$

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

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

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

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

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

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

$$o = [\sin q]$$

$$\underbrace{}_{g}([\theta], [\tau])$$

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

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

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