

$$\dot{h}_1 + 0.5 h_1 = 0.5 h_2 \rightarrow \dot{h}_1 = -0.5 h_1 + 0.5 h_2$$

$$\dot{h}_2 + 0.2 h_2 = 2u \quad \dot{h}_2 = -0.2 h_2 + 2u$$

$$G(s) = \frac{H_1(s)}{U(s)} = \frac{H_2(s)}{U(s)} \cdot \frac{H_1(s)}{H_2(s)}$$

$$= \frac{2}{s+0.2} \cdot \frac{0.5}{s+0.5}$$

$$= \frac{1}{s^2 + 0.7s + 0.1}$$

$$s^2 H_1(s) + 0.7s H_1(s) + 0.1 H_1(s) = U(s)$$

$$\ddot{h}_1(t) + 0.7 \dot{h}_1(t) + 0.1 h_1(t) = u(t)$$

$$\dot{x} = \begin{pmatrix} \dot{h}_1 \\ \dot{h}_2 \end{pmatrix} = \begin{pmatrix} -0.5 & 0.5 \\ 0 & -0.2 \end{pmatrix} \begin{pmatrix} h_1 \\ h_2 \end{pmatrix} + \begin{pmatrix} 0 \\ 2 \end{pmatrix} u$$

$$y = (1 \ 0) \begin{pmatrix} h_1 \\ h_2 \end{pmatrix}$$

$$\ddot{h}_1 + 0.7 \dot{h}_1 + 0.1 h_1 = u$$

$$\begin{cases} \dot{z}_1 + 0.7 z_1 + 0.1 z_2 = u \\ \dot{z}_2 = z_1 \end{cases}$$

$$z = \begin{pmatrix} h_1 \\ h_2 \end{pmatrix} = \begin{pmatrix} z_1 \\ z_2 \end{pmatrix}$$

$$\dot{z}_2 = h_1$$

$$y = h_1 = z_1$$

$$\begin{pmatrix} \dot{z}_1 \\ \dot{z}_2 \end{pmatrix} = \begin{pmatrix} -0.7 & -0.1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} z_1 \\ z_2 \end{pmatrix} + \begin{pmatrix} 1 \\ 0 \end{pmatrix} u$$

$$y = (0 \ 1) \begin{pmatrix} z_1 \\ z_2 \end{pmatrix}$$

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

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

$$T\dot{z} = ATz + Bu \quad / * T^{-1}$$

$$\dot{z} = \underbrace{T^{-1}AT}_{\tilde{A}} z + \underbrace{T^{-1}B}_{\tilde{B}} u$$

$$y = \underbrace{CT}_{\tilde{C}} z + \underbrace{D}_{\tilde{D}} u$$

$$\det(sI - A) \stackrel{?}{=} \det(sI - \underbrace{T^{-1}AT}_{T^{-1}T})$$

$$\det(T^{-1}(sI - A)T)$$

$$\cancel{\det(T^{-1})} \cdot \det(sI - A) \cdot \cancel{\det(T)} = \det(sI - A)$$

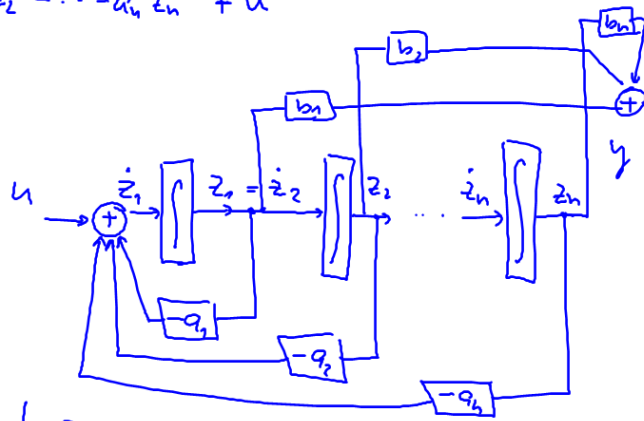
$$\dot{z}_1 = -a_1 z_1 - a_2 z_2 - \dots - a_n z_n + u$$

$$\dot{z}_2 = z_1$$

$$\dot{z}_3 = z_2$$

$$\dots$$

$$\dot{z}_n = z_{n-1}$$



$$y = b_1 z_1 + \dots + b_n z_n$$