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Disciplina: Modelagem de Sistemas Dinâmicos

2)
$$\begin{cases} M\ddot{x} + K_1(x-y) + b(\dot{x}-\dot{y}) = 0 \\ m\ddot{y} - K_1(x-y) - b(\dot{x}-\dot{y}) + K_2(y-z) = 0 \end{cases}$$

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \ddot{x} \\ \ddot{y} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -K_1/m & K_1/m & \frac{-b}{m} & b/m \\ K_1/m & \frac{-K_1-K_2}{m} & \frac{b}{m} & -b/m \end{bmatrix} \begin{bmatrix} x \\ y \\ \dot{x} \\ \dot{y} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ \frac{K_2}{m} \end{bmatrix} z(t)$$

$$\dot{u} = Au + Bz$$

3)
$$\begin{cases} m\ddot{y} + K(y-x) + b(\dot{y}-\dot{x}) = 0 \\ M\ddot{x} - K(y-x) - b(\dot{y}-\dot{x}) = u \end{cases}$$

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \ddot{x} \\ \ddot{y} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -K_1/M & K_1/M & -b/M & b/M \\ K_1/M & \frac{-K_1-K_2}{M} & b/M & -b/M \end{bmatrix} \begin{bmatrix} x \\ y \\ \dot{x} \\ \dot{y} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1/M \\ 0 \end{bmatrix} u(t)$$

$$\dot{z} = Az + Bu$$

4)

- $x = [x_1\ x_2\ x_G\ \theta\ \dot{x}_1\ \dot{x}_2\ \dot{x}_G\ \dot{\theta}]^T$
- $\dot{x} = [\dot{x}_1\ \dot{x}_2\ \dot{x}_G\ \dot{\theta}\ \ddot{x}_1\ \ddot{x}_2\ \ddot{x}_G\ \ddot{\theta}]^T$
- $\dot{x} = Ax + Bu$
- $$A = \begin{bmatrix} 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ -\frac{(k+k_2)}{m_1} & 0 & \frac{k_1}{m_1} & +\frac{k_1 l}{m_1} & -\frac{k_1}{m_1} & 0 & \frac{b_1}{m_1} & \frac{b_1 l}{m_2} \\ 0 & -\frac{(k_1+k)}{m_2} & k_2/m_2 & -\frac{k_2 l}{m_2} & 0 & -\frac{b_2}{m_2} & \frac{b_2}{m_2} & -\frac{b_2 l}{m_2} \\ k_1/M & k_2/m & -\frac{(k_1+k_2)}{m} & \frac{(k_2-k_1)l}{m} & \frac{b_1}{m} & \frac{b_2}{m_2} & -\frac{(b_1+b_2)}{M} & \frac{b_2 \cdot b_1 l}{m} \\ \frac{k_1 l}{J} & -\frac{k_2 l}{J} & \frac{(k_2-k_1)l}{J} & -\frac{l^2(k_2+k_1)}{J} & \frac{b_1 l}{J} & \frac{b_1 l}{J} & -\frac{b_2 l}{J} & \frac{l\, b_2 \cdot b}{J} \end{bmatrix}$$

5) $x = [x\ \theta\ \dot{x}\ \dot{\theta}]^T$
$\dot{x} = [\dot{x}\ \dot{\theta}\ \ddot{x}\ \ddot{\theta}]^T$

$$\begin{cases} (M+m)\ddot{x} + ml\ddot{\theta} = M \\ J\ddot{\theta} + ml\ddot{x} - mgl\theta = 0 \end{cases}$$

$$A = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & \frac{-m^2 l^2}{J(M+m)m^2 l^2} & 0 & 0 \\ 0 & \frac{mgl(M+m)}{J(M+m)^2 - m^2 l^2} & 0 & 0 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 0 \\ \frac{1}{M+m - \frac{m^2 l^2}{J}} \\ \frac{-mgl}{J(M+m) - m^2 l^2} \end{bmatrix}$$

6) $X = [x \dot{x} I]^T$

$\dot{X} = [\dot{x} \ddot{x} \dot{I}]^T$

$$A = \begin{bmatrix} 0 & 1 & 0 \\ \frac{2KI_0^2}{mx_0^2} & 0 & \frac{-2KI_0}{mx_0^2} \\ 0 & 0 & -R/L \end{bmatrix}$$

$$B = \begin{bmatrix} 0 \\ 0 \\ 1/L \end{bmatrix}$$

$$\dot{X} = A\dot{X} + Bu$$