EXERCÍCIOS DE 01 E 06/10

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(2) $x = [x \; y \; \dot{x} \; \dot{y}]^t \Rightarrow \dot{x} = [\dot{x} \; \dot{y} \; \ddot{x} \; \ddot{y}]$

$M\ddot{x} + k_1(x-y) + b(\dot{x}-\dot{y}) = 0$

$m\ddot{x} - k_1(x-y) - b(\dot{x}-\dot{y}) + k_2(y-z) = 0$

$$\dot{x} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -k_1/M & k_1/M & -b/M & b/M \\ -k_1/m & -k_1-k_2/m & -b/m & -b/m \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 0 \\ k_2/m \end{bmatrix} z$$

(3) $x = [x \; y \; \dot{x} \; \dot{y}]^t \Rightarrow \dot{x} = [\dot{x} \; \dot{y} \; \ddot{x} \; \ddot{y}]^t$

$m\ddot{y} + k(y-x) + b(\dot{y}-\dot{x}) = 0$

$M\ddot{x} - k(y-x) - b(\dot{y}-\dot{x}) = u$

$$\dot{x} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -k/M & k/M & -b/M & b/M \\ k/m & -k/m & b/m & -b/m \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1/M \\ 0 \end{bmatrix} u$$

(4) $x = [x_1 \; x_2 \; x_G \; \theta \; \dot{x}_1 \; \dot{x}_2 \; \dot{x}_G \; \dot{\theta}] \Rightarrow \dot{x} = Ax + Bu$

$m_1\ddot{x}_1 + k(x_1 - z) - k_1(x_G - x_1 + l\theta) - b_1(\dot{x}_G - \dot{x}_1 - l\dot{\theta}) = 0$

$m_2\ddot{x}_2 + k(x_2 - z) - k_2(x_G - x_2 - l\theta) - b_2(\dot{x}_G - \dot{x}_2 - l\dot{\theta}) = 0$

$M\ddot{x}_G + k_1(x_G - x_1 - l\theta) + k_2(x_G - x_2 - l\theta) + b_1(\dot{x}_G - x_1 + l\dot{\theta}) + b_2(\dot{x}_G + z) = 0$

$J_G\theta + k_1 l(x_G - x_1 + l\dot{\theta}) - k_2 l(x_G - x_2 - l\dot{\theta}) + b_1 l(\dot{x}_G - \dot{x}_1 + l\dot{\theta}) + b_2 l(\dot{x}_G - \dot{x}_2 + l\dot{\theta}) = 0$

⑤ $x = [x\ \theta\ \dot{x}\ \dot{\theta}]^t$

$(M+m)\ddot{x} + ml\ddot{\theta} = 0$

$J\ddot{\theta} + ml\ddot{x} - mlg\theta = 0$

$$\begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & \frac{-m^2l^2}{J(M+m)-m^2l^2} & 0 & 0 \\ 0 & \frac{gml(M+m)}{J(M+m)-m^2l^2} & 0 & 0 \end{bmatrix} \quad \begin{bmatrix} 0 \\ 0 \\ \frac{1}{M+m+m^2l^2/J} \\ \frac{-gml}{J(M+m)-m^2l^2} \end{bmatrix}$$

⑥ $x = [x\ \dot{x}\ I]$

$$A = \begin{bmatrix} 0 & 1 & 0 \\ \frac{2kI_0^2}{mx_0^3} & 0 & -\frac{2kI_0}{mx_0^2} \\ 0 & 0 & -R/L \end{bmatrix} \qquad B = \begin{bmatrix} 0 \\ 0 \\ 1/L \end{bmatrix}$$

$\dot{x} = Ax + Bu$