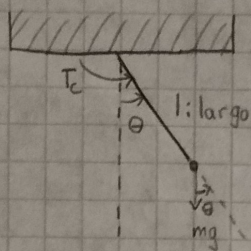


Ejercicio pendulo simple



$$I = ml^2$$

$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$|\tau| = |\vec{r}| |\vec{F}| \sin \theta$$

$$|\tau| = l mg \sin \theta$$

$$T_c - mg \sin \theta = I \ddot{\theta} \quad T_c - mg \sin \theta = ml^2 \ddot{\theta} \quad \ddot{\theta} = \frac{T_c}{ml^2} - \frac{g}{l} \sin \theta$$

Linealización ángulos pequeños $\sin \theta \approx \theta$ y $\cos \theta \approx 1$ $\ddot{\theta} = \frac{T_c}{ml^2} - \frac{g}{l} \theta$

Tenemos $q_1 = \theta$ $q_2 = \dot{q}_1 = \dot{\theta}$ $y = \theta = q_1$
 $\dot{q}_2 = \ddot{\theta}$

Reemplazando $\dot{q}_2 = \frac{T_c}{ml^2} - \frac{g}{l} q_1$

Representación espacio de estados

$$\begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -g/l & 0 \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1/ml^2 \end{bmatrix} T_c \quad y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \end{bmatrix}$$