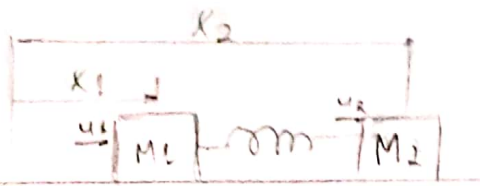


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$$\delta = x_1 - x_2$$

$$\ddot{x} = \frac{M_1 x_1 + M_2 x_2}{M_1 M_2} \rightarrow M_1 + M_2 = M$$

$$\ddot{\delta} = -\frac{KM}{M_1 M_2} \delta + \frac{u_1}{M_1} - \frac{u_2}{M_2}$$

$$\ddot{x} = \frac{u_1 + u_2}{M}$$

Espazo de Estados

$$\underbrace{\begin{bmatrix} \dot{x} \\ \dot{\delta} \\ x \\ \delta \end{bmatrix}}_Z = \underbrace{\begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & -\frac{KM}{M_1 M_2} & 0 & 0 \end{bmatrix}}_A \underbrace{\begin{bmatrix} x \\ \delta \\ x \\ \delta \end{bmatrix}}_Z + \underbrace{\begin{bmatrix} 0 & 0 \\ 0 & 0 \\ \frac{1}{M} & \frac{1}{M} \\ \frac{1}{M_1} & -\frac{1}{M_2} \end{bmatrix}}_B \underbrace{\begin{bmatrix} u_1 \\ u_2 \end{bmatrix}}_u$$

Com isso: $\dot{z} = Az + Bu$

$$\begin{bmatrix} \bar{x} \\ \delta \end{bmatrix} = \begin{bmatrix} M_1/M & M_2/M \\ L & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

$$y = \begin{bmatrix} x_1 \\ L x_2 \end{bmatrix} = \begin{bmatrix} 1 & \frac{M_2}{M} & 0 & 0 \\ 1 & -\frac{M_1}{M} & 0 & 0 \end{bmatrix} \begin{bmatrix} \bar{x} \\ \delta \\ \bar{x} \\ \delta \end{bmatrix}$$

Com isso, chega-se a:

$$y = Cz$$

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