Exercício da aula 01/10/2020

→ Equação: $\bar{x} = (M_1x_1 + M_2x_2)\frac{1}{M}$; $\ddot{\bar{x}} = (U_1+U_2)\frac{1}{M}$; $\delta = x_1 - x_2$

$\ddot{\delta} = -\frac{KM}{M_1M_2}\delta + \frac{U_1}{M_1} - \frac{U_2}{M_2}$; $z = [\bar{x}\ \delta\ \dot{\bar{x}}\ \dot{\delta}]^T$; $\dot{z} = [\dot{\bar{x}}\ \dot{\delta}\ \ddot{\bar{x}}\ \ddot{\delta}]^T$

→ Reescrevendo

- $\dot{\bar{x}} = 0\cdot\bar{x} + 0\cdot\delta + 1\cdot\dot{\bar{x}} + 0\cdot\dot{\delta} + 0U_1 + 0U_2$
- $\dot{\delta} = 0\cdot\bar{x} + 0\cdot\delta + 0\cdot\dot{\bar{x}} + 1\dot{\delta} + 0U_1 + 0U_2$
- $\ddot{\bar{x}} = 0\cdot\bar{x} + 0\cdot\delta + 0\cdot\dot{\bar{x}} + 0\dot{\delta} + \frac{1}{M}U_1 + \frac{1}{M}U_2$
- $\ddot{\delta} = 0\cdot\bar{x} - \frac{KM}{M_1M_2}\delta + 0\cdot\dot{\bar{x}} + 0\dot{\delta} + \frac{1}{M_1}U_1 - \frac{1}{M_2}U_2$

→ Encontrando x_1 e x_2 em função de $\bar{x}$ e δ:

- $\bar{x} = (M_1x_1 + M_2(x_1-\delta))\frac{1}{M} = (Mx_1 - M_2\delta)\frac{1}{M} \Rightarrow \bar{x} = x_1 - \frac{M_2}{M}\delta \Rightarrow \boxed{x_1 = \bar{x} + \frac{M_2}{M}\delta}$
- $\bar{x} = (M_1(\delta + x_2) + M_2x_2)\frac{1}{M} = (M_1\delta + Mx_2)\frac{1}{M} = \bar{x} \Rightarrow \bar{x} = x_2 + \frac{M_1}{M}\delta \Rightarrow \boxed{x_2 = \bar{x} + \frac{M_2}{M}\delta}$

→ Na forma matricial:

$$\begin{vmatrix} \dot{\bar{x}} \\ \dot{\delta} \\ \ddot{\bar{x}} \\ \ddot{\delta} \end{vmatrix} = \begin{vmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & -\frac{KM}{M_1M_2} & 0 & 0 \end{vmatrix} \cdot \begin{vmatrix} \bar{x} \\ \bar{\delta} \\ \dot{\bar{x}} \\ \dot{\delta} \end{vmatrix} + \begin{vmatrix} 0 & 0 \\ 0 & 0 \\ \frac{1}{M} & \frac{1}{M} \\ \frac{1}{M_1} & -\frac{1}{M_1} \end{vmatrix} \cdot \begin{vmatrix} U_1 \\ U_2 \end{vmatrix}$$

$$\begin{vmatrix} y_1 \\ y_2 \end{vmatrix} = \begin{vmatrix} 1 & \frac{M_2}{M} & 0 & 0 \\ 1 & -\frac{M_1}{M} & 0 & 0 \end{vmatrix} \cdot \begin{vmatrix} \bar{x} \\ \delta \\ \dot{\bar{x}} \\ \dot{\delta} \end{vmatrix}$$