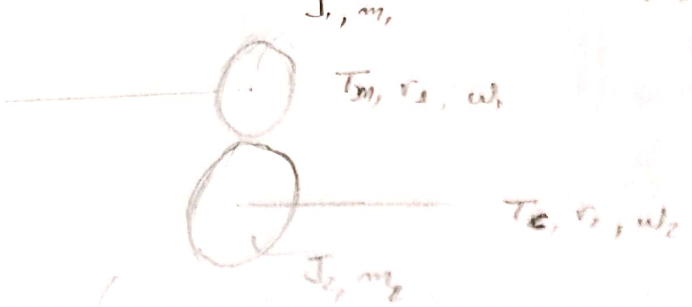
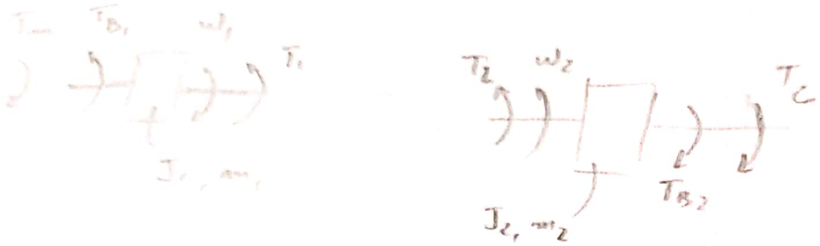
Caixa de transformação

$\hookrightarrow$ razão de transmissão : $\dfrac{\omega_1}{\omega_2} = \dfrac{r_2}{r_1} = \dfrac{N_2}{N_1} = \eta$





$$\Rightarrow \begin{cases} J_1 \dot{\omega}_1 = T_m - T_1 - B_1 \cdot \omega_1 \\ J_2 \dot{\omega}_2 = T_2 - T_c - B_2 \omega_2 \end{cases}$$

$\eta = 1 \Rightarrow T_1 \cdot \omega_1 = T_2 \cdot \omega_2$

$\therefore T_2 = \eta \cdot T_1$

$\therefore J_2 \dot{\omega}_2 = \eta \cdot T_1 - T_c - B_2 \omega_2$

$J_2 \dot{\omega}_2 = \eta \cdot (J_1 \dot{\omega}_1 - T_m + B_1 \omega_1) - T_c - B_2 \omega_2$ $\qquad$ * $\omega_1 = \eta \omega_2$, $\dot{\omega}_1 = \eta \dot{\omega}_2$

$(J_2 - \eta^2 J_1) \dot{\omega}_1 + (B_2 - \eta^2 B_1) \omega_1^2 = -T_c - \eta T_m$

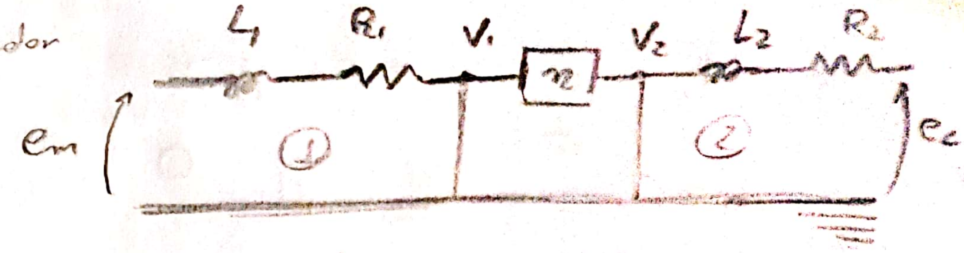
$(\eta^2 J_1 - J_2) \dot{\omega}_1 + (\eta^2 B_1 - B_2) \omega_1^2 - T_c = \eta T_m$

$$\left(J_1 - \frac{J_2}{\eta^2}\right) \dot{\omega}_1 + \left(B_1 - \frac{B_2}{\eta^2}\right) \omega_1^2 - \frac{T_c}{\eta} = T_m$$

com transformador

$\rightarrow \bar{M}_G \rightarrow i$

$\rightarrow \bar{\omega} \rightarrow V$



$$\eta = \frac{i_a}{i_b} = \frac{V_b}{V_a} = \frac{N_b}{N_a}$$

$$V_2 = \eta \cdot V_1$$
$$i_1 = \eta \cdot i_2$$

Malha 1:

$$e_m - V_1 = L_1 \cdot \frac{di_1}{dt} + R_1 i_1$$

Malha 2:

$$V_2 - e_c = L_2 \frac{di_2}{dt} + R_2 i_2$$

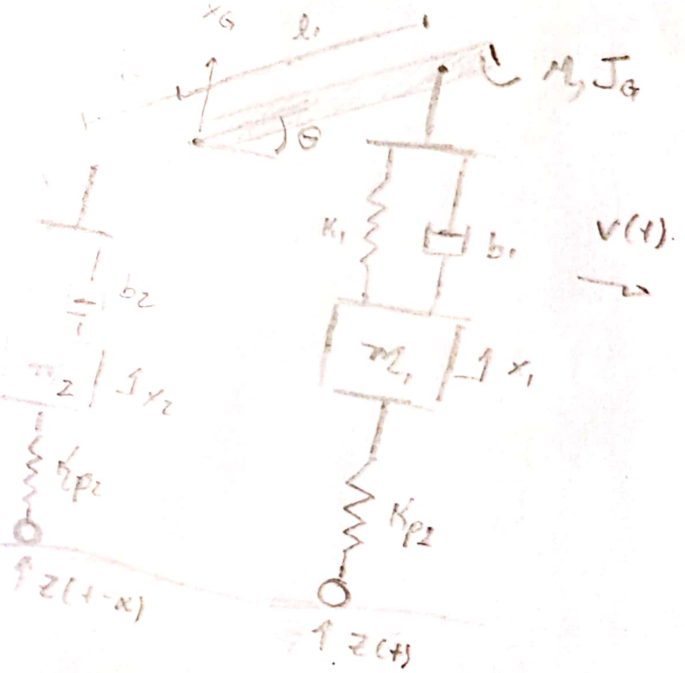
$$\eta \cdot V_1 - e_c = \frac{L_2}{\eta} \frac{di_1}{dt} + \frac{R_2}{\eta} i_1$$

$$\begin{cases} R_1 \cdot i_1 + L_1 \dfrac{di_1}{dt} = e_m - V_1 \\ \dfrac{R_2}{\eta} \cdot i_1 + \dfrac{L_2}{\eta} \dfrac{di_1}{dt} = \eta V_1 - e_c \end{cases}$$

$$\left(L_1 + \frac{L_2}{\eta}\right) \cdot \frac{di_1}{dt} + \left(R_1 + \frac{R_2}{\eta}\right) i_1 = e_m - e_c + V_1(\eta - 1)$$

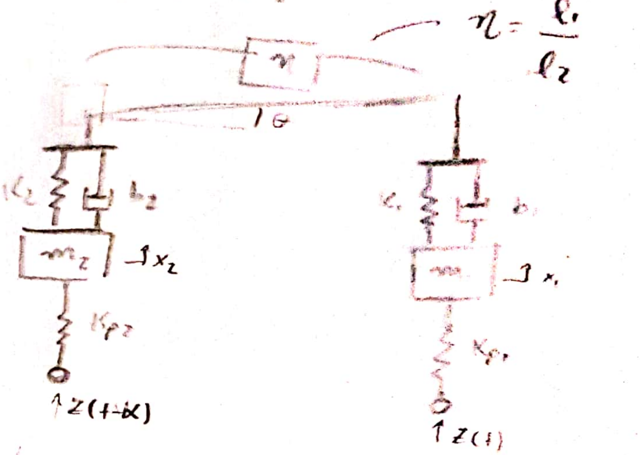
$$\left(J_1 + \frac{J_2}{\eta}\right) \cdot \dot{\omega}_1 + \left(B_1 + \frac{B_2}{\eta}\right) \omega_1 = T_m - T_c + T_1(\eta - 1)$$

$l_2 + l_1 = L$

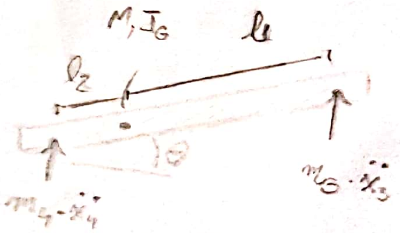


• Para modelar o efeito da suspensão no corpo, infere-se: m_{i+2} e x_{i+2}

$\eta = \frac{l_1}{l_2}$



Análise do corpo:



$$J_G \ddot{\theta} = m_3 \ddot{x}_3 \cdot l_1 \cdot \cos\theta - m_4 \ddot{x}_4 \, l_2 \cos\theta$$

↳ transformador: $\eta = \frac{l_1}{l_2}$

$$J_G \ddot{\theta} = \left(m_3 \ddot{x}_3 \cdot l_1 - m_4 \ddot{x}_4 \frac{l_1}{\eta}\right) \cos\theta$$

$$J_G \ddot{\theta} = \left(m_3 \ddot{x}_3 - \frac{m_4 \ddot{x}_4}{\eta}\right) \cdot l_1 \cos\theta$$

Para cada $\frac{1}{4}$:

$$m_3 \ddot{x}_3 = K_1 (x_3 - x_1) + b_1 (\dot{x}_3 - \dot{x}_1)$$

$$m_1 \ddot{x}_1 = K_1 (x_1 - x_3) + b_1 (\dot{x}_1 - \dot{x}_3) + K_{p1}(x_1 - z(t))$$

$$m_3 \ddot{x}_3 = - m_1 \ddot{x}_1 + K_{p1}(x_1 - z(t))$$

$$\therefore J_G \ddot{\theta} = \left[\left(\frac{m_2 \ddot{x}_2 - K_{p2}(x_2 - z(t-x))}{\eta}\right) - \left(m_1 \ddot{x}_1 - K_{p1}(x_1 - z(t))\right)\right] l_1 \cos\theta$$