Roue support

(Q1) (Q2) $\vec{\Omega}_{3/1} = \dot{\varphi}\,\vec{y}_2 + \dot{\theta}\,\vec{x}_2$ $\qquad \dot{\theta} = -\frac{L}{R}\dot{\varphi}$

(Q3) $E_c(2/1) = \frac{1}{2} C_2 . \dot{\varphi}^2$

(Q4) $E_c(3/1) = \frac{1}{2} \{\mathcal{V}_{3/1}\}_G \otimes \{\mathcal{C}_{3/1}\}_G$

$E_c(3/1) = \frac{1}{2}\left(m_3 . \vec{v}^2(G\in 3/1) + \vec{T}(G, 3/1) . \vec{\Omega}_{3/1}\right)$

$\vec{v}(G\in 3/1) = L.\dot{\varphi}.\vec{y}_2$

$\vec{\Omega}_{3/1} = -\frac{L}{R}\dot{\varphi}\,\vec{x}_2 + \dot{\varphi}.\vec{y}_2$

$$\vec{T}(G, 3/1) = \begin{bmatrix} A_3 & & \\ & B_3 & \\ & & B_3 \end{bmatrix} \begin{bmatrix} -\frac{L}{R}\dot{\varphi} \\ 0 \\ \dot{\varphi} \end{bmatrix} = -\frac{L}{R}\dot{\varphi} A_3 \vec{x}_2 + B_3 \dot{\varphi}\,\vec{y}_2$$

$E_c(3/1) = \frac{1}{2}\left(m_3 L^2 \dot{\varphi}^2 + B_3 \dot{\varphi}^2 + A_3 \left(\frac{L}{R}\right)^2 \dot{\varphi}^2\right)$

(Q5) $E_c(3/1) = \frac{1}{2}\left(m_3 L^2 + B_3 + A_3\left(\frac{L}{R}\right)^2\right)\dot{\varphi}^2 = \frac{1}{2} . J_{eq} . \dot{\varphi}^2$

(Q6) $P_{ent} = C_m . \dot{\varphi}$

(Q7) TEC $\Rightarrow$ $J_{eq}\,\dot{\varphi}\,\ddot{\varphi} = C_m\,\dot{\varphi} \Rightarrow \ddot{\varphi} = \frac{C_m}{J_{eq}}$

(Q8) $P_{int} = \mathcal{C}.\mathcal{V} = -\lambda\dot{\theta}^2 = -\lambda\left(\frac{L}{R}\right)^2\dot{\varphi}^2$

TEC $\Rightarrow$ $J_{eq}\,\dot{\varphi}\,\ddot{\varphi} = C_m\,\dot{\varphi} - \lambda\left(\frac{L}{R}\right)^2\dot{\varphi}^2$

$\Rightarrow$ $J_{eq}\,\ddot{\varphi} + \lambda\left(\frac{L}{R}\right)^2\dot{\varphi} = C_m$

$\Rightarrow$ $J_{eq}\,\dot{\omega} + \lambda\left(\frac{L}{R}\right)^2\omega = C_m$

$J_{eq}\, p\, \Omega(p) + \lambda\left(\frac{L}{R}\right)^2\Omega(p) = C_m(p)$

$$\frac{\Omega(p)}{C_m(p)} = \frac{1}{J_{eq}\, p + \lambda\left(\frac{L}{R}\right)^2} = \frac{\left(\frac{R}{L}\right)^2 \times \frac{1}{\lambda}}{\frac{J_{eq}}{\lambda\left(\frac{L}{R}\right)^2} p + 1}$$