Machine Dynamics - Assignment 3

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Q1

Determine L and R according to the required stroke.

$$\begin{cases} l + r - (l - r) & = 76\text{mm} \\ \frac{l}{r} & = 3.5 \end{cases}$$

Obtains:

$$\begin{cases} r & = 38\text{mm} \\ l & = 133\text{mm} \end{cases}$$

Q2

Consider the gas force only, determine the corresponding shaking force, the shaking moment based on the point O, and the output torque T_2.

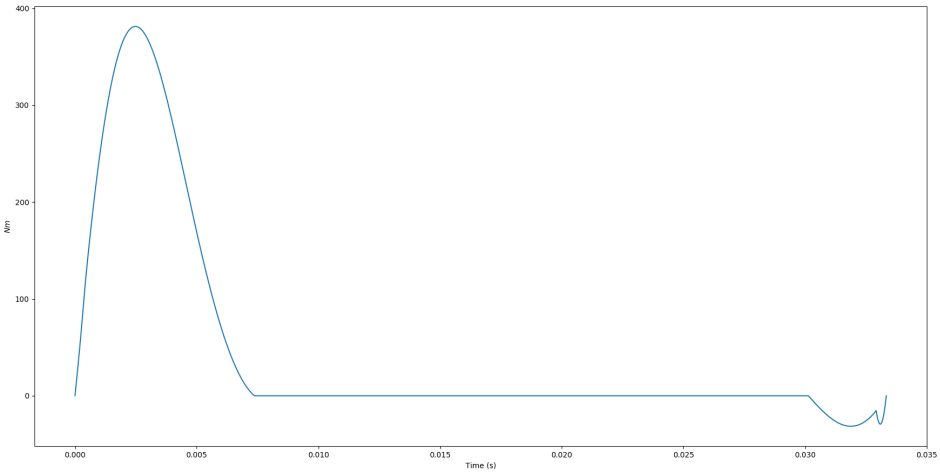
$$\begin{cases} \omega_2 & = 120\pi\text{rad/s} \\ \alpha_2 & = 0 \end{cases}$$

$$\begin{cases} F & = F_g + F_i \\ T & = T_g + T_i \end{cases}$$

$$
\begin{aligned}
F_{34} + F_g + F_{14} &= 0 \\
F_{23} &= F_{34} \\
T_{21} &= -x \times F_{41} = 0 \\
x &= r\cos\omega_2 t + l\sqrt{1 - (\frac{r}{l}\sin\omega_2 t)^2}
\end{aligned}
$$

Torque on pin 2:

$$
T_{21} = F_g \frac{r}{l}\sin\omega_2 t(1 + \frac{r^2}{2l^2}\sin^2\omega_2 t)r\cos\omega_2 t + F_g r\sin\omega_2 t
$$



Shaking force F_S:

$$
F_S = F_{12} + F_{14}
$$

Q3

Consider the inertial force only, determine the corresponding shaking force, the shaking moment based on the point O, and the output torque T_2.

Link3 masses:

- Assuming that m_3 is composed by two masses, $m_a + m_b = m_3$.
- m_a and m_b is distance l_a and l_b correspondly.

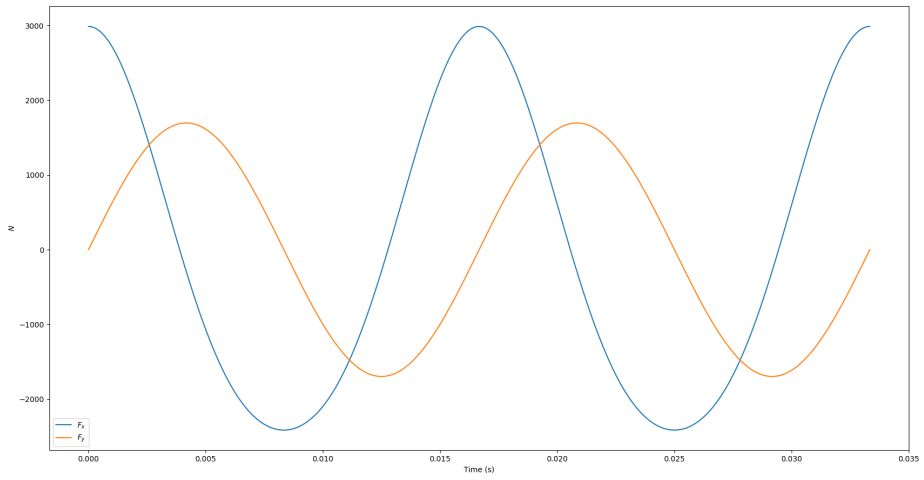
$$\begin{cases} m_a + m_b & = m_3 \\ m_a l_a & = m_b l_b \\ m_a l_a^2 + m_b l_b^2 & = I_{G3} \\ l_b & = l - r_{G3} = 0.64l \\ l_a & = r_{G3} = 0.36l \end{cases}$$

Obtains:

$$\begin{cases} l_b & = 0.08512 \\ l_a & = 0.04788 \\ m_a & = 0.3140683789674688 \\ m_b & = 0.1859316210325312 \end{cases}$$

Shaking force:

$$F_S = F_i = \begin{cases} F_x & = m_a r\omega_2^2 \cos\omega_2 t + m_b r\omega_2^2(\cos\omega_2 t + \frac{r}{l}\cos 2\omega_2 t) \\ F_y & = -m_a(-r\omega_2^2 \sin\omega_2 t) \end{cases}$$



Torque on pin 2:

$$T_{21} = \frac{1}{2} m_b r^2 \omega_2^2 \left(\frac{r}{2l} \sin \omega_2 t - \sin 2\omega_2 t - \frac{3r}{2l} \sin 3\omega_2 t \right)$$