

Machine Dynamics - Assignment 3

Student ID: D08522005

Student Name: 張元

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 .

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

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

$$F_{34} + F_g + F_{14} = 0$$

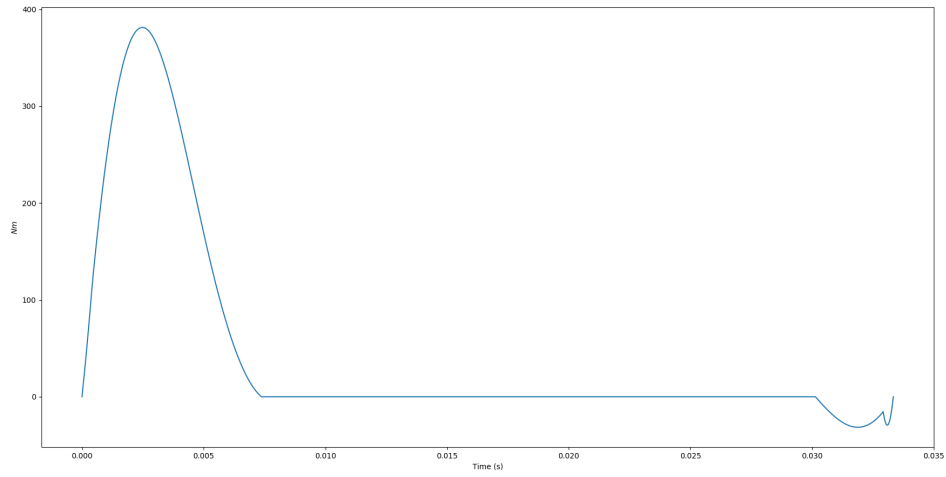
$$F_{23} = F_{34}$$

$$T_{21} = -x \times F_{41} = 0$$

$$x = r \cos \omega_2 t + l \sqrt{1 - \left(\frac{r}{l} \sin \omega_2 t\right)^2}$$

Torque on pin 2:

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



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.

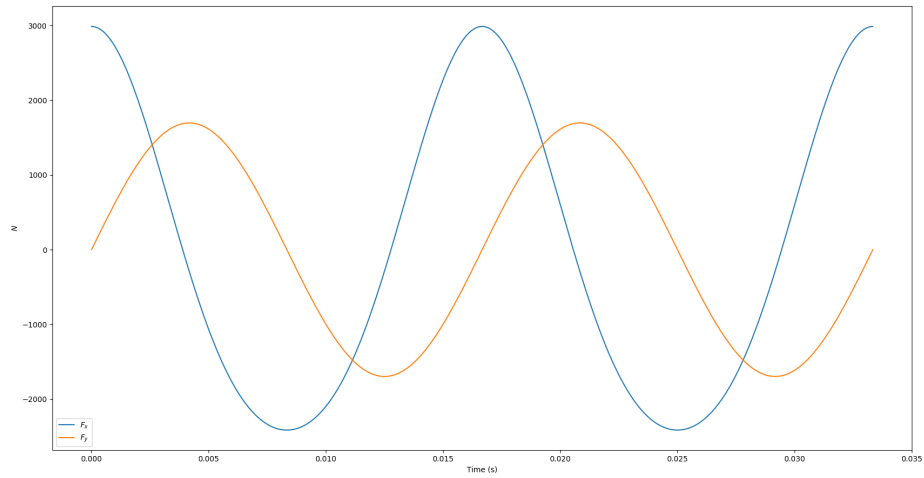
$$\begin{cases} m_a + m_b &= m_3 \\ m_a l_a &= m_b l_b \\ m_a l_a^2 + m_b l_b^2 &= I_{G3} \\ l_b &= l - r_{G3} = 0.64l \\ l_a &= r_{G3} = 0.36l \end{cases}$$

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:

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

