

# Machine Dynamics - Assignment 1

Student ID: D08522005

Student Name: 張元

## Part I

### Q2 Statics

Calculate the reaction forces at all joints and the required torque on Link 2 to achieve static balance when  $\theta_2$  is equal to 90 degree. List all the data in a table.

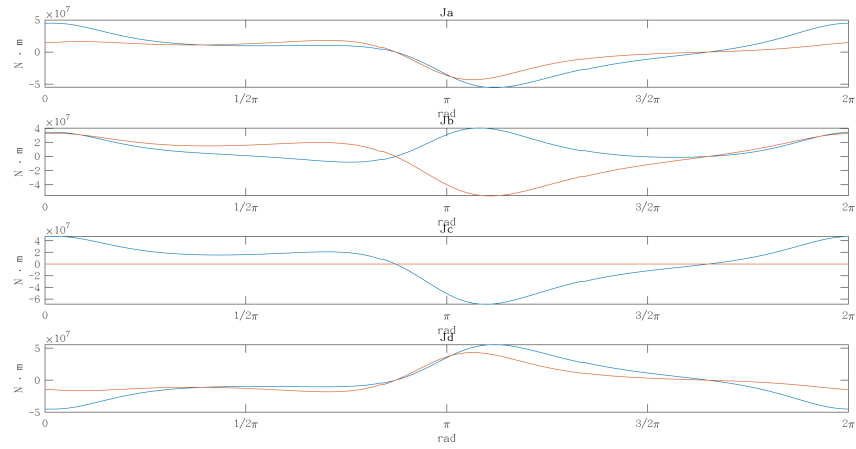
Joint	Reaction Force ( $N$ )	Required Torque ( $N \cdot m$ )
A	1035.4742	0
B	1036.2480	0
C	1036.5765	0
D	1044.4153	0

## Part II

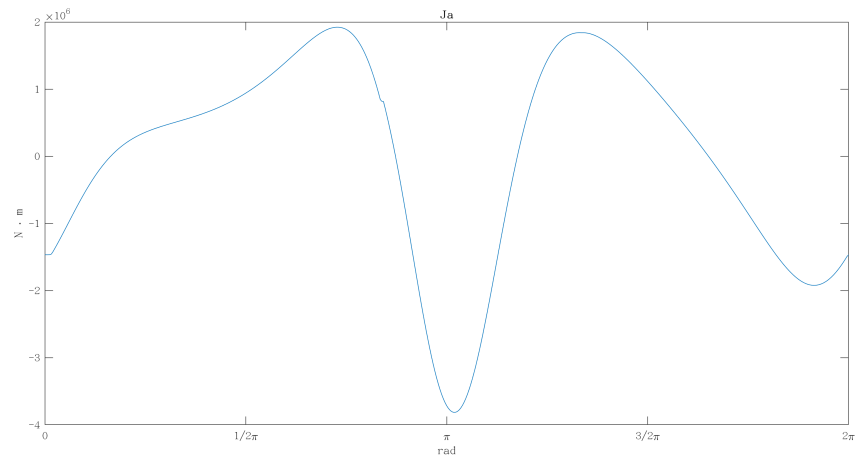
### Q3 Kinetostatics

Calculate the reaction force at all joints and the required torque on Link 2 when  $\theta_2$  varies from  $\theta$  to 360 degree (interval  $\leq 1$  degree). Take the angle of Link 2 ( $\theta_2$ ) as the horizontal axis to draw plots for these variables.

The reaction forces of each joint splitted with x and y axis: (Ja ~ Jd)



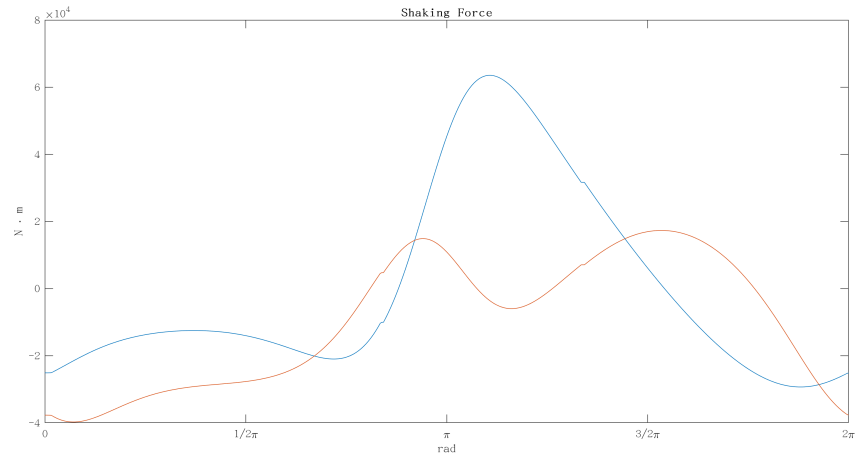
The required torque on Joint A:



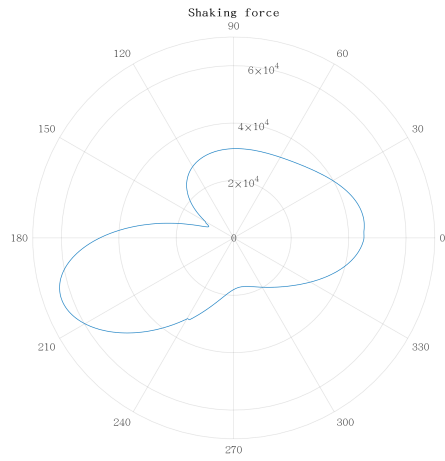
**Q4**

Continued from 3, draw (a) the plots of the x and y components of the shaking force with  $\theta_2$  as the horizontal axis, and (b) the polar plots of the shaking force and shaking moment.

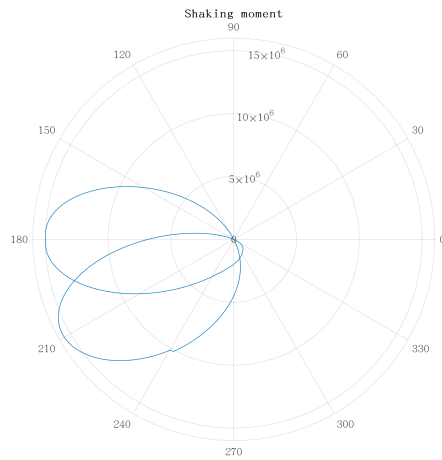
The shaking force is composed by Joint A and Joint D based on the frame.



The polar plot of shaking force. (Composed)



The shaking moment can be obtained by  $M_S = \overrightarrow{R_1} \times \overrightarrow{F_{41}} + \overrightarrow{T_{21}}$ .



**a. What is the maximum input torque? When does it happen? Use degree as the unit and be accurate to 2 decimal places.**

According to the torque of Joint A, the extremum of input torque is  $3.8172 \times 10^6 \text{ N} \cdot \text{m}$  at  $\theta_2 = 183.9195 \text{ deg}$ .

**b. What are the maximum shaking force and shaking moment? When do they happen? Use degree as the unit and be accurate to 3 decimal places.**

According to the polar plot, the maximum shaking force is  $57694.7620 \text{ N}$  at  $\theta_2 = 199.6040 \text{ deg}$ ; the maximum shaking moment is  $1556.5653 \times 10^4 \text{ N} \cdot \text{m}$  at  $\theta_2 = 209.5842 \text{ deg}$ .