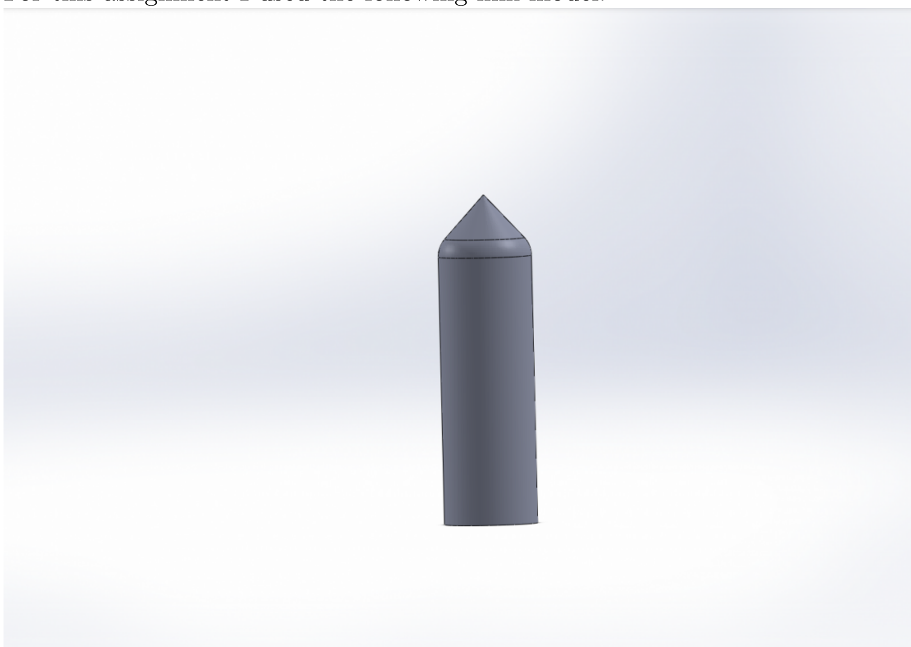
Task 1

Derive dynamic model for your robot model using the Euler-Lagrange approach

For this assignment I used the following link model:



It has mass equal to 111.83 g and inertia tensor $\begin{pmatrix} 127315.49 & 0 & 0 \\ 0 & 17300.01 & 0 \\ 0 & 0 & 127315.49 \end{pmatrix}$ given in $\frac{g}{m^2}$

I took one third of the length of this link as a center of mass.

1. I found inertial matrix using the formula

$$M(q) = \sum_{i=1}^{n} m_i J_{v_i}^T J_{v_i} + J_{\omega_i}^T R_i I R_i^T J_{\omega_i}$$

2. Then coriolis matrix:

$$C(q, \dot{q}) = \sum_{k=1}^{n} c_{ijk} \dot{q}_k$$

where $c_{ijk} = \frac{1}{2}(\frac{\partial m_{ij}}{\partial q_k} + \frac{\partial m_{ik}}{\partial q_j} - \frac{\partial m_{jk}}{\partial q_i})$, where m_{ij} are elements of matrix M

3. Gravity vector:

$$g(q) = \sum_{k=1}^{n} (J_{v_i}^k)^T m_k g_0$$

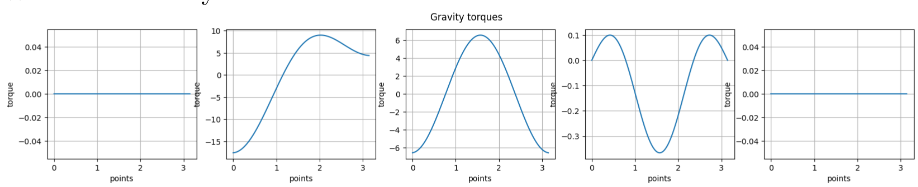
Using matrices from above, I got dynamic model for the robot:

$$M(q)\ddot{q} + C(q, \dot{q})\dot{q} + g(q) = \tau$$

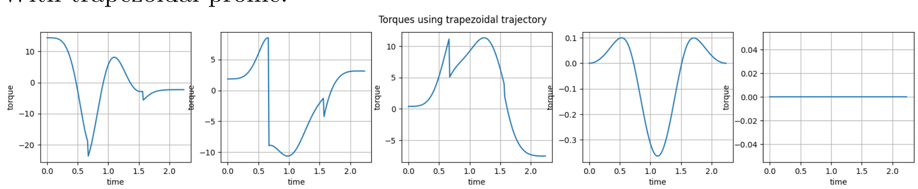
Task 2

Drive the robot joints between $[0, \pi]$

With zero velocity and acceleration:



With trapezoidal profile:



With polynomial profile: