Robotics [IIT-Jodhpur]
Practical 1: Introduction to MATLAB through Force Analysis (Inverse Dynamics) of 1-link robot

Part A: Demonstration of MATLAB

Brief Demonstration of features of MATAB

Part B: Force Analysis (Inverse Dynamics) of 1-link robot Using MATLAB

Equation of motion of the 1-link robot, shown in Fig. 1, is given by

$$I_{zz}\ddot{\theta} = \tau - mgl_c cos\,\theta \quad or$$

$$Inverse\ Dynamics: \ \tau = I_{zz}\ddot{\theta} + mgl_c cos\,\theta$$

(or Force Analysis) [**Inputs**: $\theta, \dot{\theta}, \ddot{\theta}$] [**Output**: τ]

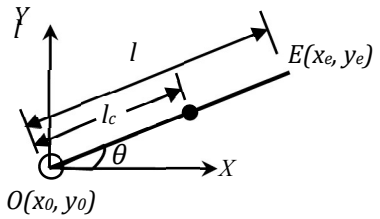

Figure 1: A 1-link robot

The robot is commanded to follow the cycloidal trajectory:

$$\theta_{des} = \theta\,(0) + \frac{\theta\,(T) - \theta\,(0)}{T}\left[t - \frac{T}{2\pi} sin\left(\frac{2\pi}{T}t\right)\right]$$

$$\dot{\theta}_{des} = \frac{\theta\,(T) - \theta\,(0)}{T}\left[1 - cos\left(\frac{2\pi}{T}t\right)\right]$$

$$\ddot{\theta}_{des} = \frac{\theta\,(T) - \theta\,(0)}{T}\left[\frac{2\pi}{T} sin\left(\frac{2\pi}{T}t\right)\right]$$

where $\theta\,(0) = 0°, \theta\,(T) = 120°$ and T = 3 sec.

Perform the following:

a. Plot the commanded joint position, velocity and acceleration vs. time for time period T = 3 s
b. Plot linear velocity and acceleration of the end-effector of the robot
c. Find joint torque (τ) required to follow the above trajectory and plot joint torque vs time
d. Animate the system for the commanded trajectories.

Assume m = 1kg, l = 1m, l_c = 0.5m, $I_{zz} = \frac{1}{3}ml^2$ and g = 9.81 m/s^2.