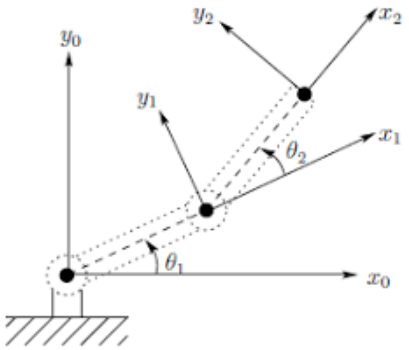
MEL3020: Kinematics and Dynamics of Machines (Practical Sessions)
Session: 4

1. Simulate the following dynamic equations for 2R using Matlab or Octave:



$$M = \begin{bmatrix} m_1 l_1^2 + m_2\left(l_1^2 + l_2^2\right) & m_2\left(l_1 l_2 \cos\theta_2 + l_2^2\right) \\ m_2\left(l_1 l_2 \cos\theta_2 + l_2^2\right) & m_2 l_2^2 \end{bmatrix}$$

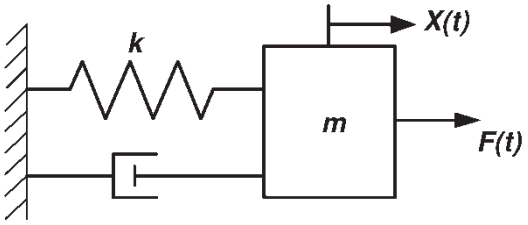
$$C = \begin{bmatrix} -2m_2 l_1 l_2 \sin\theta_2 \;\; \dot{\theta}_1\dot{\theta}_2 + \dot{\theta}_2^2 \\ m_2 l_1 l_2 \dot{\theta}_1^2 \sin\theta_2 \end{bmatrix}$$

$$G = \begin{bmatrix} (m_1 + m_2) l_1 g \cos\theta_1 + m_2 g l_2 \cos(\theta_1 + \theta_2) \\ m_2 g l_2 \cos(\theta_1 + \theta_2) \end{bmatrix}$$

$$\ddot{\theta} = M^{-1}(\tau - C - G) \qquad \text{Where} \quad \ddot{\theta} = \begin{bmatrix} \ddot{\theta}_1 \\ \ddot{\theta}_2 \end{bmatrix}$$

m 1=1 kg, m2=1kg, l 1= 1 m , l2= 0.75 m , g=9.8 m/s², τ=0 Nm, Simulate for 10 seconds with time step 0.05 s, with θ1 initial pi/3, θ2 initial pi/4. **initial** $\dot{\theta} = 0$

2. Simulate the spring mass damper system using Matlab or Octave using the governing dynamic equations.



$$m\ddot{X}(t) = F(t) - C\dot{X}(t) - kX(t)$$

K=10 N/m, m=1 kg, C= 1 kg/s , F(t)=0, initial disturbance for X(t)= 0.5m, length of spring= 2 m , Simulate for 10 seconds with time step 0.1 s