CMPSCI 403: Introduction to Robotics: Perception, Mechanics, Dynamics, and Control

HW 05

Due Online, Sunday, Oct. 10th, 11:50 PM

All questions refer to the robot arm sketched in the figure below. The robot is the same as the one used in homework 4. Answer the questions below with text, mathematical statements, and supporting sketches where appropriate. Include a commented copy of your MATLAB code.

1. Make a MATLAB function that computes a Jacobian matrix in global frame given joint positions.
2. Find the joint configuration that coincides with the following end-effector goal position and orientation (i.e EE SE(3)) and submit a screenshot of the robot's posture in the kinematic simulation you built in homework 4.

$$ {}_0\boldsymbol{T}_{goal} = \begin{pmatrix} 0 & -1 & 0 & 0.2 \\ 1 & 0 & 0 & 0.31 \\ 0 & 0 & 1 & 0.2 \\ 0 & 0 & 0 & 1 \end{pmatrix}, $$

Tip:
Use the Jacobian you found in question 1 together with Newton-Raphson method to find the joint configuration.

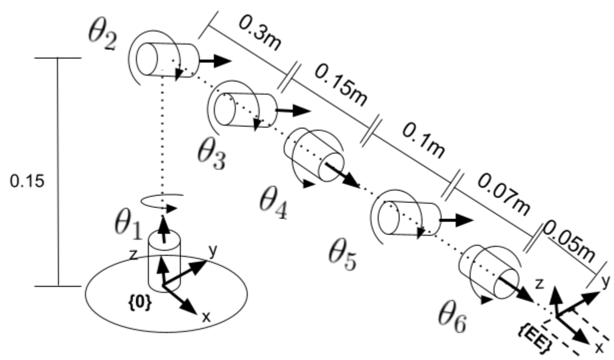

Figure 1: Six DOF arm in its home configuration (i.e $\theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = \theta_6 = 0$). Notice the local frame of the end-effector $\{\mathbf{EE}\}$ is aligned with the global frame $\{\mathbf{0}\}$. Each of the cylinders represent the joints of the robot and the arrows going through the cylinders represent the axes of rotation. Therefore, θ_1 is the rotation around z axis, $\theta_{2,3,5}$ are the rotation around y axis, and $\theta_{4,6}$ are the rotation around x axis.