Question 1) Work out problem 2.11 from Parallel Robots: Mechanics and Control Book.

Question 2) Consider the pure rotation of a rigid body that is represented by the screw axis parameters $\{\theta, \hat{s} = [s_x, s_y, s_z]^T\}$. Show that the corresponding rotation matrix can be evaluated by the following matrix exponential function.

$$_B^A R = e^{\hat{s}_\times \theta}$$

in which the matrix $\hat{s}_\times$ is defined as

$$\hat{s}_\times = \begin{bmatrix} 0 & -s_z & s_y \\ s_z & 0 & -s_x \\ -s_y & s_x & 0 \end{bmatrix}$$

Question 3) The coordinates of point 1 in A and B coordinate systems are $\begin{bmatrix}10\\10\\4\end{bmatrix}$ and $\begin{bmatrix}8\\20\\-2\end{bmatrix}$, respectively. The B coordinate system can be obtained by translating A coordinate system to a point and then rotating it 30 degrees about Y-axis.

a) Determine the coordinate of the origin of the B coordinate system measured in the A coordinate system.
b) Determine the coordinate of the origin of the A coordinate system measured in the B coordinate system.

Question 4) A three degree of freedom robot is shown in Figure 1. The angle between the second and third link is 40 degrees. By assigning appropriate intermediate coordinate systems on the robot, determine the coordinate of the end effector (point A) and its direction $\boldsymbol{v}$ regarding the XYZ fixed coordinate system.

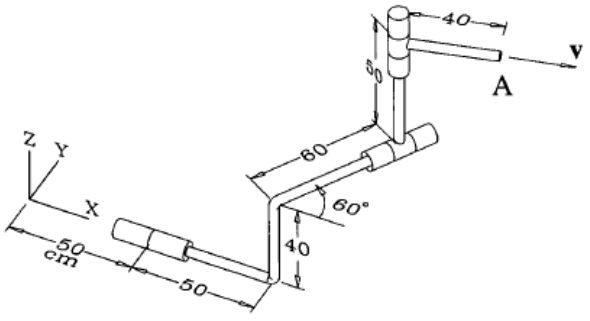

Figure 1: The 3DoF robot manipulator

Question 5) For the rotation matrix given below

$$R = \begin{bmatrix} 0.8333 & -0.1869 & 0.5202 \\ 0.5202 & 0.5833 & -0.6237 \\ -0.1868 & 0.7904 & 0.5833 \end{bmatrix}$$

a) Compute the screw axis of rotation and the angle of rotation.
b) Determine the unit quaternion that could represent this rotation.
c) What are the Z-Y-Z Euler angles of this rotation?

Late homework policy: Please submit your assignments on time, in case you run out of time, You can still send it as late submission only by one day with the expense to lose some marks depending on the time you submit your work.

Collaboration policy: Collaboration with humans is very beneficial but restricted to the "whiteboard level", meaning that we recommend you to discuss approaches and solutions with your peers, but write your code, reports, and analytical derivations by yourself.

How to submit: Zip your files within the format of HW#_Name_StudentID, and submit them to the LMS website.

Contact us through Email: ta.robotics.1399@gmail.com
