QArm Recommended Assessment

Workspace Identification

1. Provide the completed DH Table for the QArm manipulator.

i	a_i	α_i	d_i	θ_i
1				
2				
3				
4				

2. From the completed DH table and the general transformation matrix ${}^{i-1}T_i$,, derive the matrices ${}^0T_1$, ${}^1T_2$, ${}^2T_3$, and ${}^3T_4$.

3. Derive the matrices ${}^0T_2$, ${}^0T_3$, and ${}^0T_4$.

4. Provide expressions for the position and orientation of the end-effector frame with respect to the base frame.

5. Can you provide an example of the joint states $\vec{\Theta}$ where the task space position of the end-effector is ${}^0p_4 = [0\ 0\ 0.5]^T$. The end-effector in this configuration is directly above the base, hence the x and y positions being 0. Are there other solutions for this position?

6. Open MATLAB and load the data you saved by double-clicking on myData.mat in the Folder Browser. What is the maximum reach of the manipulator r_{max} in your case? You can calculate this by running the following command in the Command Window.

   ```
   >> r_max = max(sqrt(x.^2 + y.^2 + z.^2))
   ```

   Note the dot between the variable and the power symbol to denote an element-wise exponent. What is the theoretical length of the manipulator when completely stretched out? Compare the theoretical result to your r_max value.

7. Comment on any discrepancy between the theoretical workspace volume and the one you measured in this lab.