Appendix

A. Coordinates set-up

1. (**Forward Kinematics**) Consider the robot shown in Fig. 1, where the system has six degrees as $\boldsymbol{q} = [q_1\ q_2\ q_3\ q_4\ q_5\ q_6]^T$.

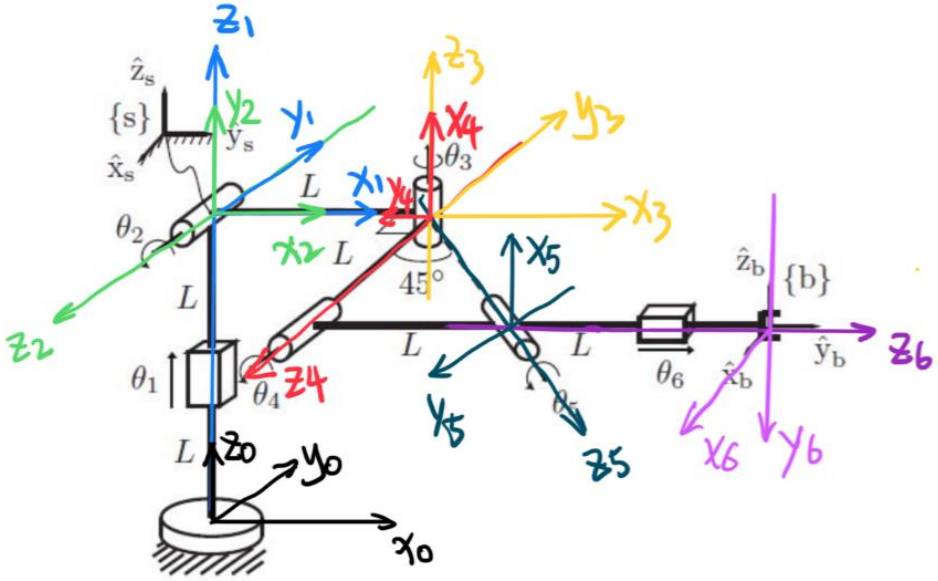

Figure 1: A PRRRRP robot

B. Some corner cases to verify DH table and the implementation of Matlab code/script.

If qc = [0 0 0 0 0 0], the manipulator should be the same as the configuration shown in Figrue. 1 in the question sheet. The frame of end effector is

-0.0000	1.0000	0.0000	1.5000
-1.0000	-0.0000	0.0000	-0.5000
0.0000	-0.0000	1.0000	1.0000
0	0	0	1.0000

, which is right.

If qc=[0 90° 0 0 0 0], The frame of end effector is

-0.0000	0.0000	-1.0000	0.0000
-1.0000	-0.0000	0.0000	-0.5000
-0.0000	1.0000	0.0000	2.5000
0	0	0	1.0000

, which is also right.

If qc=[0 0 90° 0 0 0], The frame of end effector is

1.0000	0.0000	-0.0000	1.0000
-0.0000	1.0000	0.0000	1.0000
0.0000	-0.0000	1.0000	1.0000
0	0	0	1.0000

, which is also right.

If qc=[0 0 0 90° 0 0], The frame of end effector is

-0.0000	0.0000	-1.0000	0.5000
-1.0000	-0.0000	0.0000	-0.5000
-0.0000	1.0000	0.0000	2.0000
0	0	0	1.0000

, which is also right.

In all, the DH params should be correct.

C. Simulate the forward kinematics for 5 seconds with a 1 Hz sinusoid movement for joint 2 and joint 5 (Amp = 45° , Phase = 0) and a 1 Hz sinusoid movement at joint 1 and joint 6 (Amp = 0.2 meters, Phase = 0). Joint 3 keeps 45° and Joint 4 keeps at 60°. (I just attach the result or figure here and please check the MATLAB code for detail.)

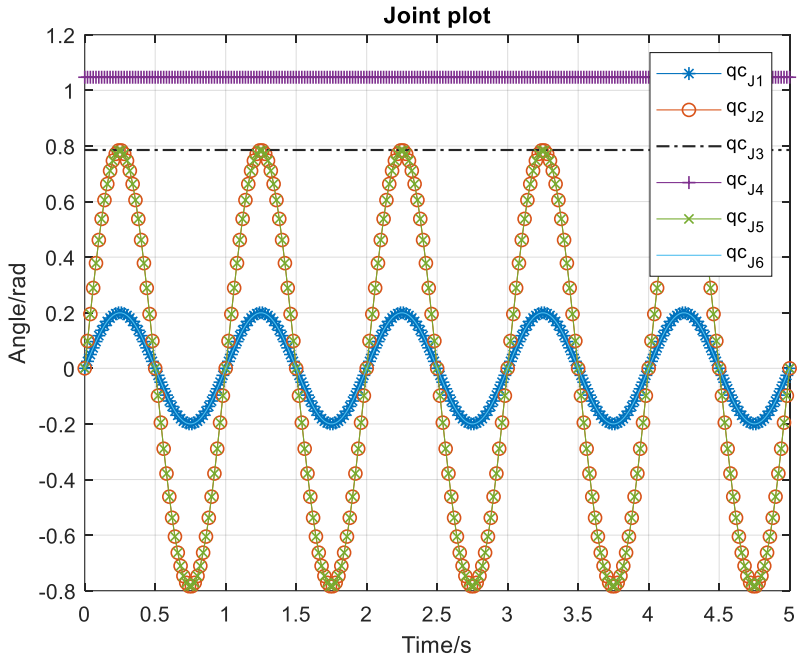

Fig. 1 Joint angles

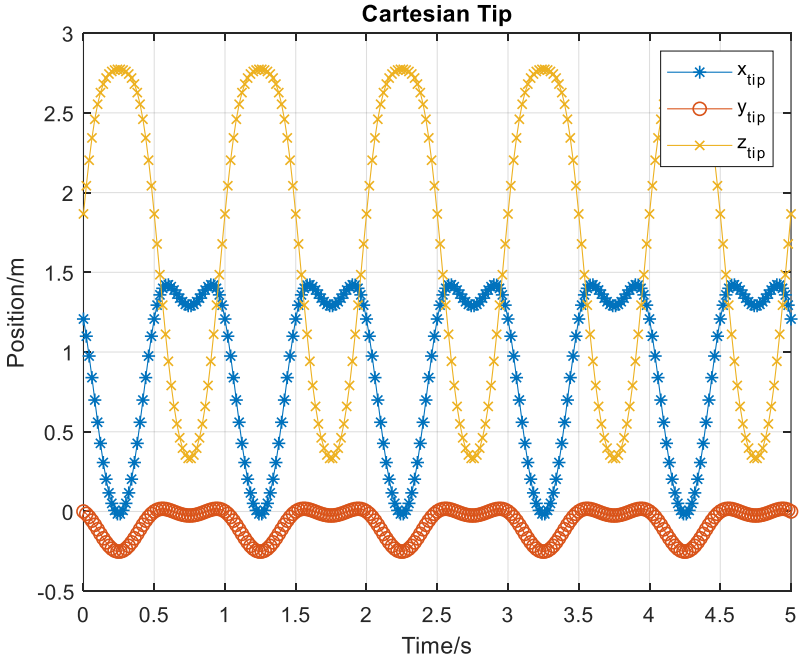

Fig. 2 Cartesian Trajectory

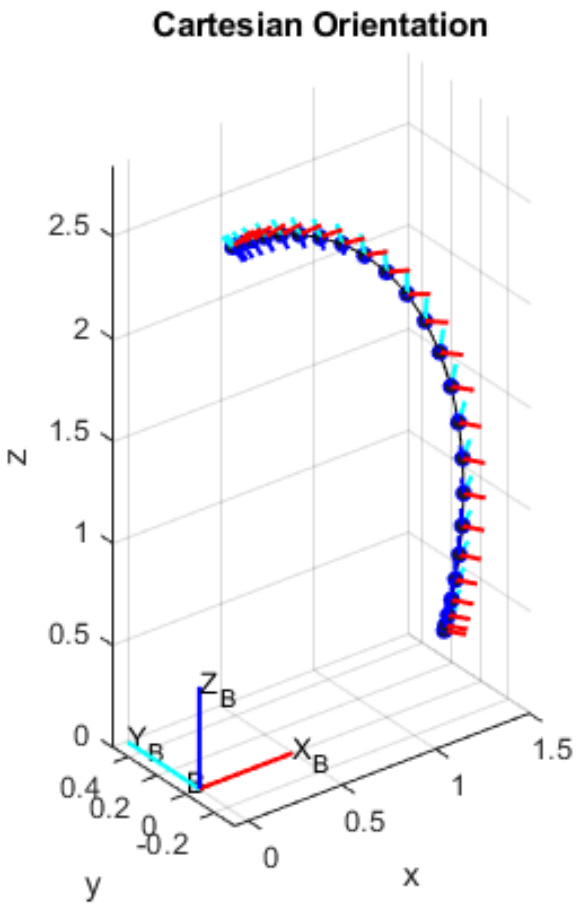

Fig. 3 Cartesian Orientation