ECTE471/871/971 MECH950
Advanced Robotics
Tutorial 2 on ARTE and Robotics Simulation

Question 1

Consider the ABB IRB 140 robot shown schematically in Figure 1.

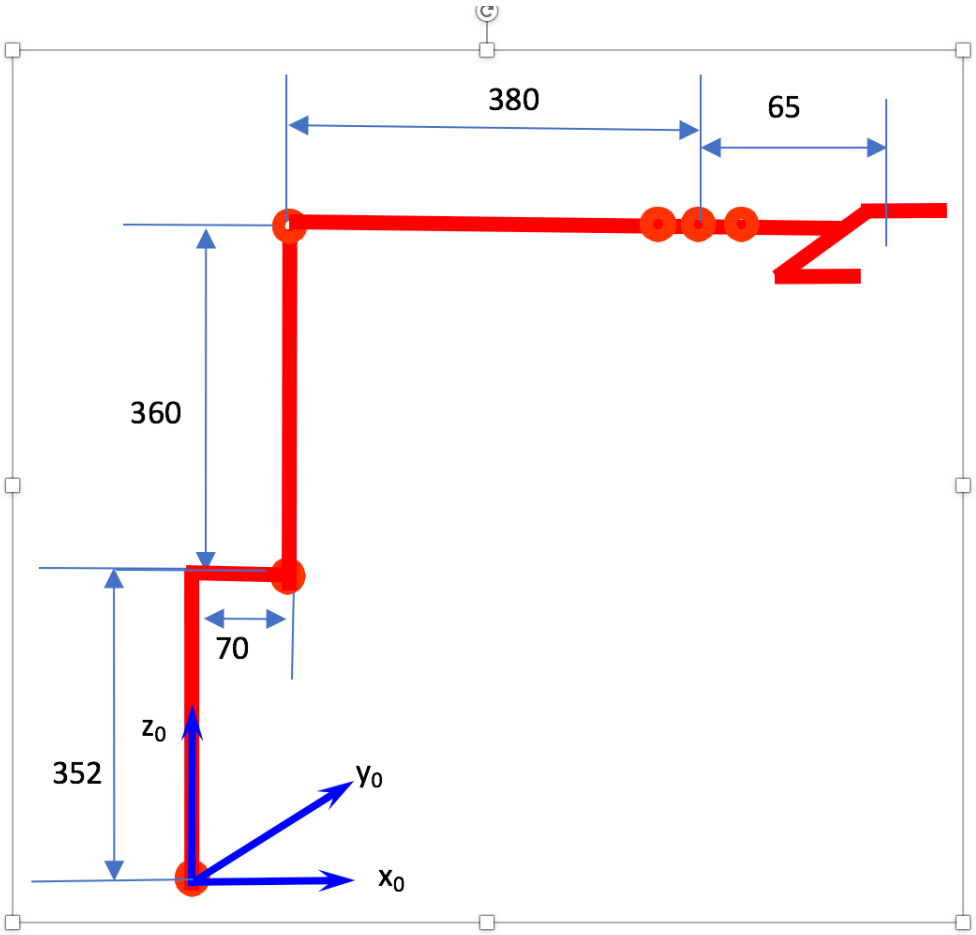

Figure 1 – Schematic diagram of ABB IRB 140 robot

a) Attach coordinate frames to the links of the robot.
b) Derive the kinematic parameters of the robot and present them in the DH table.
c) Express kinematic parameters using ARTE functions.
d) Calculate the kinematic parameters at home position q=[0 0 0 0 0 0].
e) Derive the homogenous transformation between every consecutive links of the robot at home position.
f) Derive the homogenous transformation between the tool and the base using composite transformation.
g) Calculate T06 for q2=[pi/2 pi/4 pi/4 0 0 0] and draw the configuration of the robot. We use drawrobot3d to draw it.

Question 2

Consider the ABB IRB140 robot arm. Derive the homogenous transformation of the tool relative to the base of the robot for q=[pi/4 pi/4 pi/4 0 0 pi/2] and draw the robot.

Question 3

Use RAPID programming to perform the following robotic manipulations.

a) Load ABB IRB140 robot.
b) Attach gripper parallel_0 to the robot.
c) Add "table_two_areas" to the model workspace.
d) Add cylinder_tiny to the workspace.
e) Transform the location of the cylinder to the top centre of the round box. coordinate $(0.5,-0.4, 0.2)^T$,
f) Move the robot tool 0.3 m above the cylinder configured to pick the cylinder. This means that the tool should have the same rotation matrix as the part but pointing down. Save this point as Approach1.
g) Open the gripper simulation_open_tool
h) Move the gripper down over the part. Save this point as Pick. Assume the length of the cylinder if 0.1 m.
i) Close the gripper using simulation_close_tool and grab the cylinder using simulation_gripp_piece.
j) Move along the z axis to the Approach
k) Move the tool with the cylinder to the centre of square box 0.3 m above it. Call this point approach2.
l) Move the tool to position the centre of the box while maintaining its orientation. Call this point deposit.
m) Release the cylinder using simulation.release. piece.
n) Move the tool to Approach2.
o) Return to home position