MCEN90028 Robotics Systems
Assignment 1 (10 Marks)

Due date: 31 March, 2020, 5pm

1 Description of Task

This assignment will focus on the forward and inverse kinematics of your robot.

In this assignment, you are required to:

1.1 Forward Kinematics

1. produce the kinematic definition of your robot through a schematic appropriately sketched (with robot in "zero position") and labelled with appropriate coordinate frames. (0.5 marks)

2. produce the DH table containing the parameters. (0.5 marks)

3. derive and produce the transformation matrix of Frame E attached at the end effector with respect to Frame 0 at the base of the manipulator to (1.5 marks)

4. provide support that your forward kinematics solution is correct by displaying at least two configurations (other than your robot's zero position) that can be easily verified by observation. (0.5 marks)

5. evaluation the workspace of your robot by plotting the reachable workspace on the sagittal plane, superimposed on the outline of the space (the outline) occupied by the expected Jenga Tower. (2 marks)

6. use the plot produced in Point 5 above to adjust the DH parameters and the joint limits (the upper and lower limits of the angular displacements of each joint) of your robot that results in the reachable workspace suitable for the construction of the Jenga Tower. Produce a table of summary of these parameters and provide a brief justification of why these are selected (1 mark).

1.2 Inverse Kinematics

In the second part of the assignment, you are required to:

1. produce the derivation and the final expressions (symbolic expressions) of the explicit inverse kinematics solutions for the robot you designed. Include the consideration of the parallelogram design selected for this subject. (2.5 marks)

2. show that your inverse kinematics solution is correct by calculating the joint angles for at least two configurations (other than your robot's home position) that can be easily verified by observation. (0.5 marks)

3. select the 8 vertices of the Jenga Tower, use their numerical values, and perform Inverse Kinematics to arrive at their joint displacements. (1 mark)
    - Indicate which of the multiple solutions is valid and selected.
    - Indicate if the solution fits within the joint limits of your designed robot.

2 Submission

You need to submit one report and one set of Matlab code per assignment group (of 3 students max).

The report should be in an **appropriate engineering report format** and submitted as a PDF. The report should be **no more than 15 pages** (everything included) with **12pt font size**.

The title of your report should be "Assignment1 Report_AG[#]" and the title of the main MATLAB file should be "Assignment1 Matlab_AG[#]" (put your AG group number in "[#]", eg. AG07).

Compress your report and all your relevant MATLAB files as a .zip file and submit them on Canvas. Note: only the last submission will be assessed.

Submission checklist:

- ☐ Report is no more than 15 pages
- ☐ Report has 12pt font size
- ☐ Report saved as PDF
- ☐ Titles of files are in the right format
- ☐ Compressed as a .zip file

3 Academic Integrity

We take academic integrity seriously. Please note that while the two assignment groups within one project group may discuss and share the robot design details, they should work on their assignments separately.

Details about academic integrity can be found on MCEN90028 Canvas page (under Subject Overview) or at `http://academicintegrity.unimelb.edu.au/`. Please check with the tutors or the lecturer if you are in doubt. Ignorance is not a valid reason for academic misconducts.