THE DEPARTMENT OF AUTOMOTIVE ENGINEERING

CLEMSON UNIVERSITY

AuE 8220: Autonomy Mobility and Manipulation, Fall 2022

Homework #5: 3RRR Modeling in CoppeliaSim

Assigned on: Oct 25th 2022 Due: Nov 1st 2021, 1:00 PM

Instructions:

You will attempt all subsequent homework problems and software project together with your selected team-member for the rest of the course. Submit your scanned/printed work as a single PDF on Canvas by the due date/time noted above. **See also:** https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9492613&tag=1

Problem 1

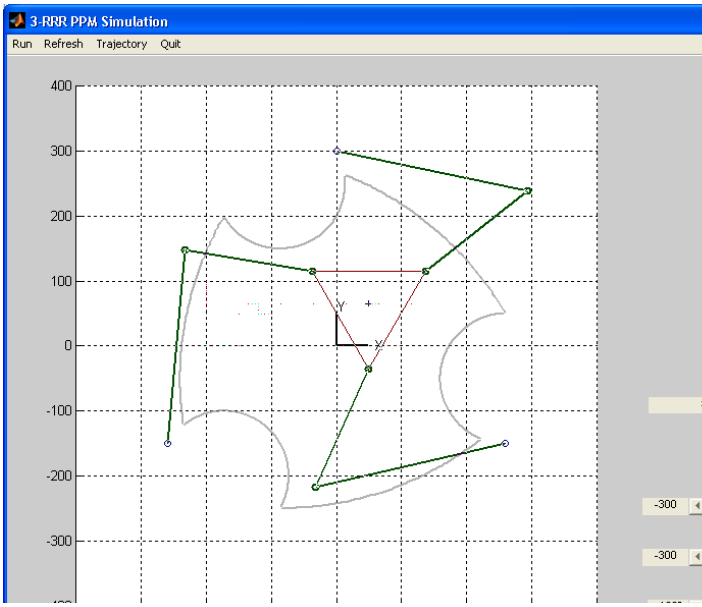

Figure 1 depicts the 3RRR Planar Parallel Manipulator at its initial position – in this problem we will perform the inverse (reverse) displacement analysis of this robot.

- The base joints lie on a circle of radius 300 (@angles of 90^0, 210^0 and 330^0) and are the vertices of an equilateral triangle.
- The platform forms another equilateral triangle with vertices at (136.6025,115.0000), (-36.6025,115.0000), (50.0000, -35.0000) as shown in the figure above.
- A moving reference frame is assumed to be attached at the centroid of the platform (50, 65) with the moving X axis at -60^0 w.r.t the horizontal.
- Each of the three legs is assumed to be symmetric with a proximal link length of 300 and a distal link length of 250.
- *In case some of these dimensions/initial conditions prove inadequate – please make some assumptions, document them as such and proceed to develop the results*

For this manipulator:

(i) Develop a CoppeliaSim Model using CoppeliaSim (or alternately import a SolidWorks assembly for the same.)

(ii) Test this for an end effector trajectory traverse from (X_{EE} , Y_{EE} , φ_{EE}) = (50, 65, -60) to (0, 65, -60).

(iii) Plot the various joint angles, joint velocities and joint accelerations for the centroid of moving platform (end-effector) X_{EE} and Y_{EE} to trace a circle of a radius 50 centered around (0,0) and φ_{EE} = 0