RBE 521: Homework 3

Submitted by: Prasham Patel

Problem 1:

For both Euler angles ('zyz' and 'xyz'), end effector pose is same, that is:

P = [10.0000 20.0000 150.0000 -0.0000 0.0035 0.0070]

This is because the end effector rotation in all axes is 0. Which means that Rx = Ry = Rz. Thus, the sequence of multiplication want matter, Rzyz = Rxyz.

Problem 2:

Step1:

The boundary layer equations are as shown below:

$$(x-u1_x)^2+(y-u1_y)^2+(z-u1_z)^2 = lmax^2$$

$$(x-u2_x)^2+(y-u2_y)^2+(z-u2_z)^2 = lmax^2$$

$$(x-u3_x)^2+(y-u3_y)^2+(z-u3_z)^2 = lmax^2$$

$$(x-u4_x)^2+(y-u4_y)^2+(z-u4_z)^2 = lmax^2$$

$$(x-u5_x)^2+(y-u5_y)^2+(z-u5_z)^2 = lmax^2$$

$$(x-u6_x)^2+(y-u6_y)^2+(z-u6_z)^2 = lmax^2$$

$$(x-u1_x)^2+(y-u1_y)^2+(z-u1_z)^2 = lmin^2$$

$$(x-u2_x)^2+(y-u2_y)^2+(z-u2_z)^2 = lmin^2$$

$$(x-u3_x)^2+(y-u3_y)^2+(z-u3_z)^2 = lmin^2$$

$$(x-u4_x)^2+(y-u4_y)^2+(z-u4_z)^2 = lmin^2$$

$$(x-u5_x)^2+(y-u5_y)^2+(z-u5_z)^2 = lmin^2$$

$$(x-u6_x)^2+(y-u6_y)^2+(z-u6_z)^2 = lmin^2$$

This equation are implemented in is_within_bound() function. It checks if the given point is within the boundary curves or not, or in other words if the point is within the workspace or not.

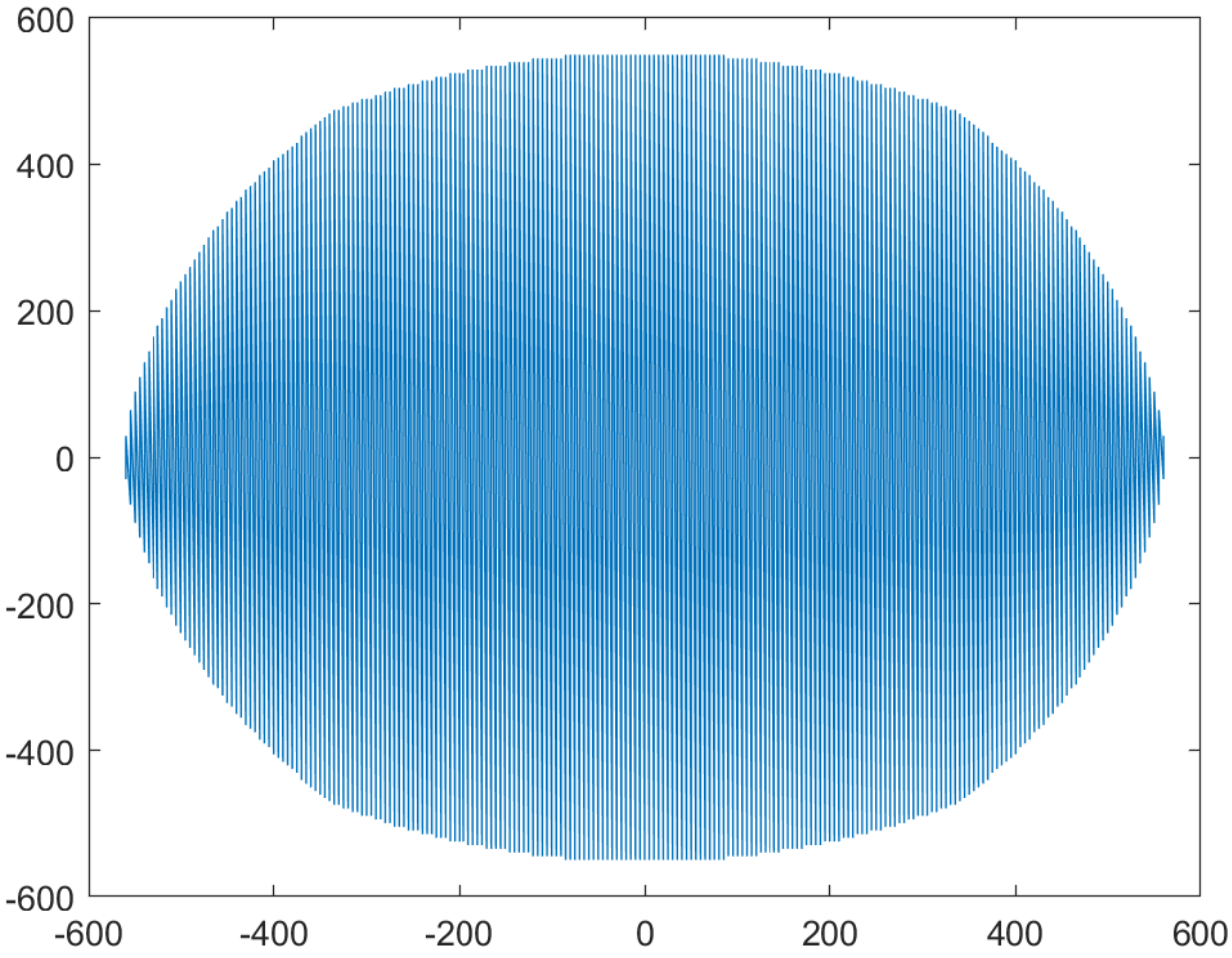

Fig 1. Workspace at z = 800mm

Step2:

Points from -1000 mm to 1000 mm are sampled with a step size of 5mm in both x and y axis using the is_wihtin_bound() function.

Step3:

Position error is illustrated as 3d scatter plot as shown in Fig 2. X and Y axis show the position in X and Y direction. Z axis shows the RSS position error. Here, Z axis of the end effector is considered to have a constant Z of 800 mm.

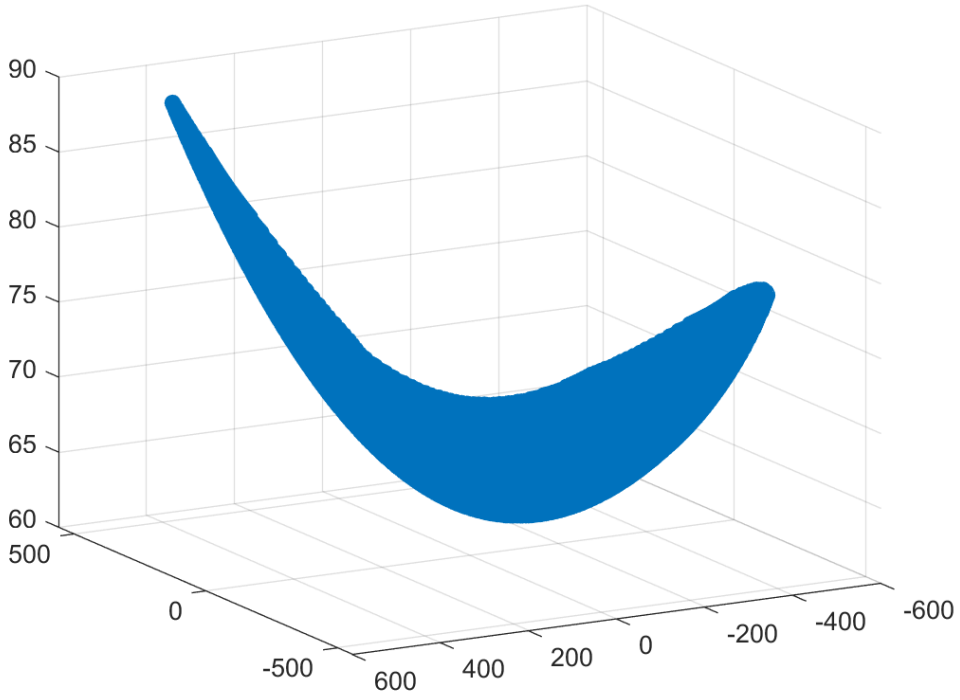

Fig 2. RSS End Effector Pose Error