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Assignment 6

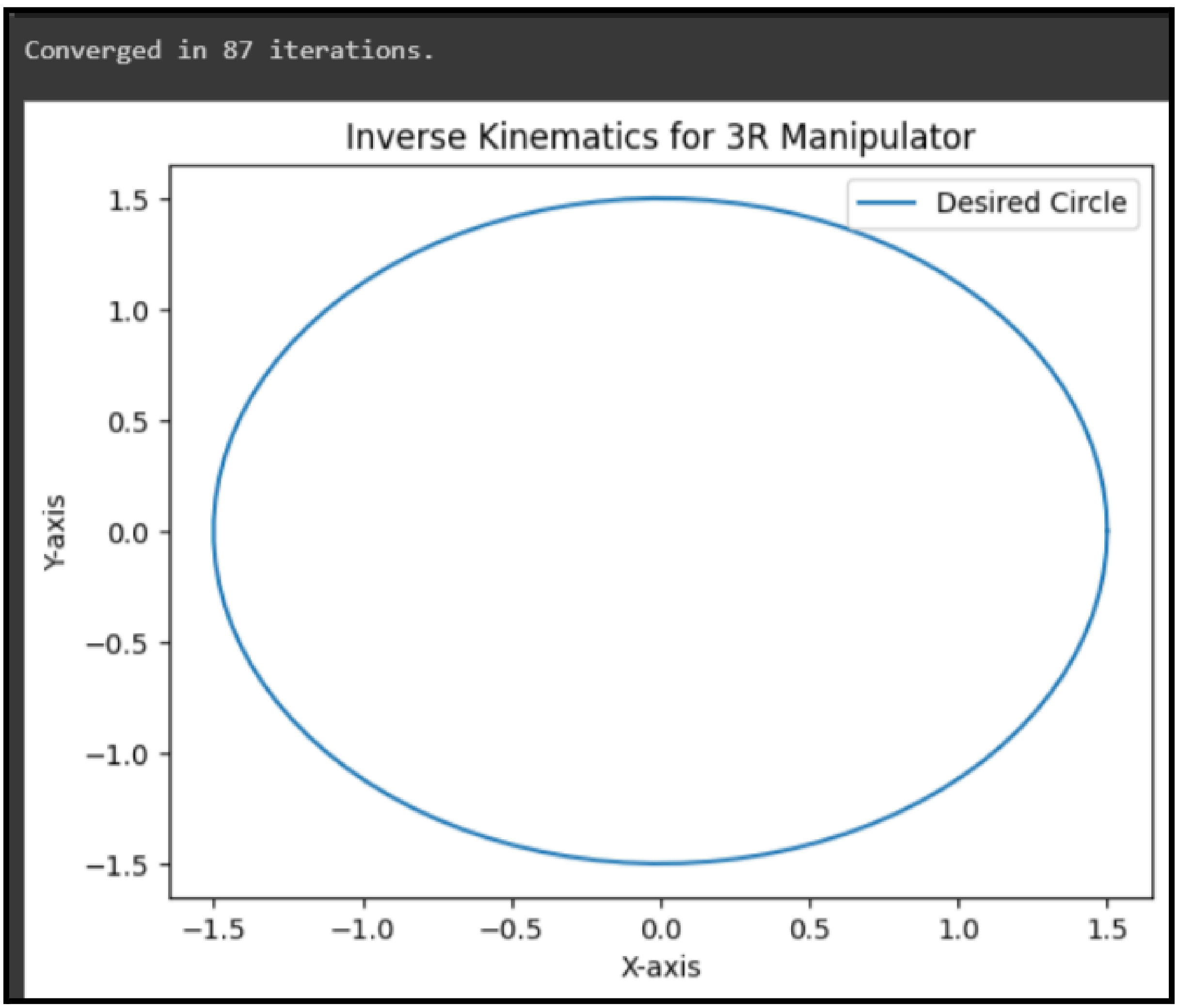
Q 1)

With Jacobian Matrix

For, L1, L2, L3 = 1, 1, 1

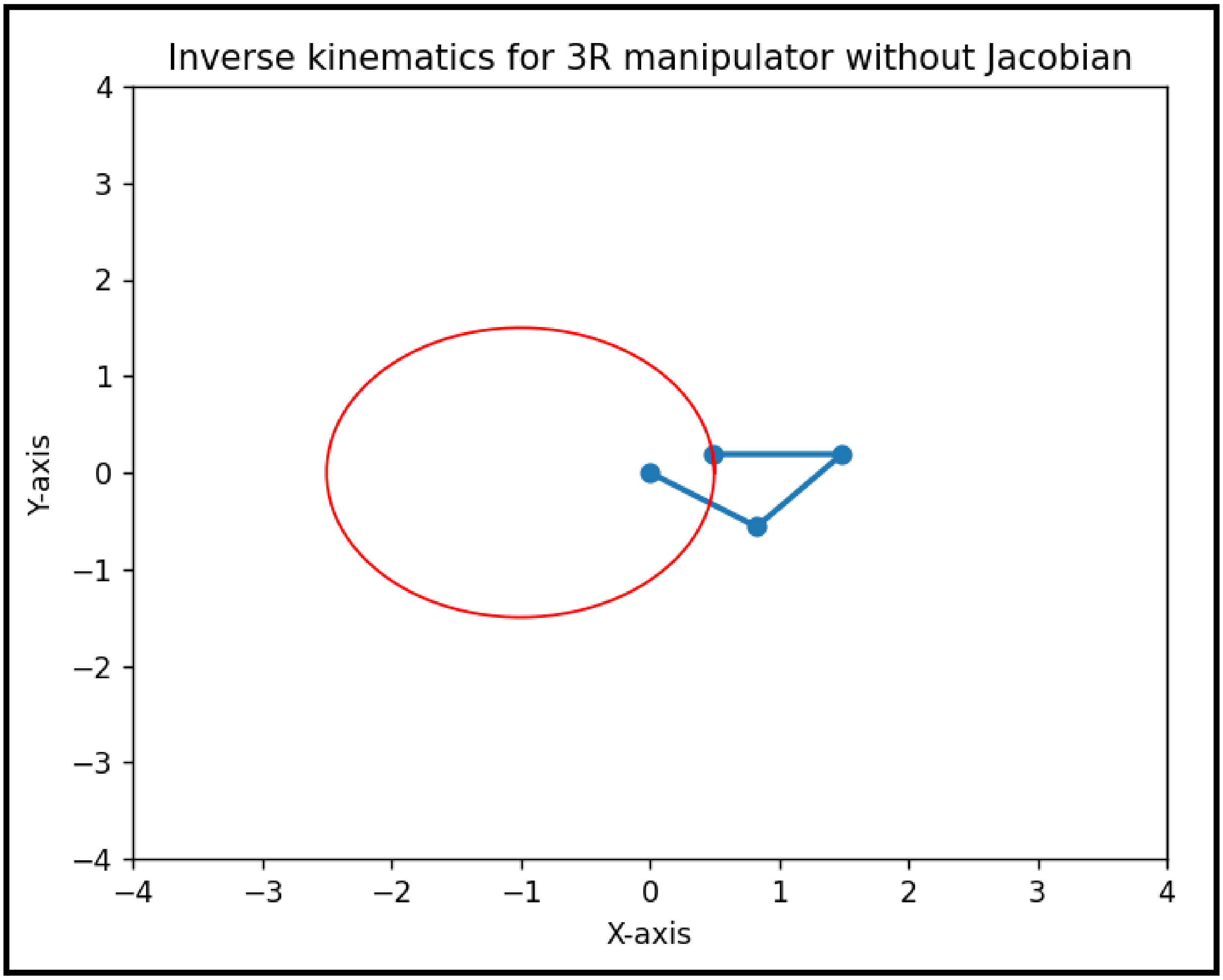
Initial theta values = [0.5, 0.25, 0.25]

Result

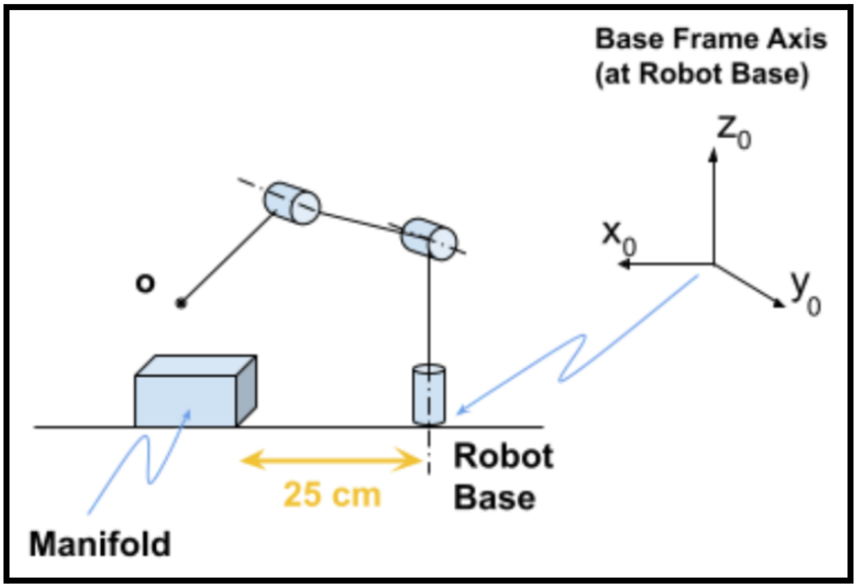


Withot Jacobian Matrix

Result



Q 2)



Assume that the z-coordinate on the top surface of the manifold block is always **0.1.**

a)

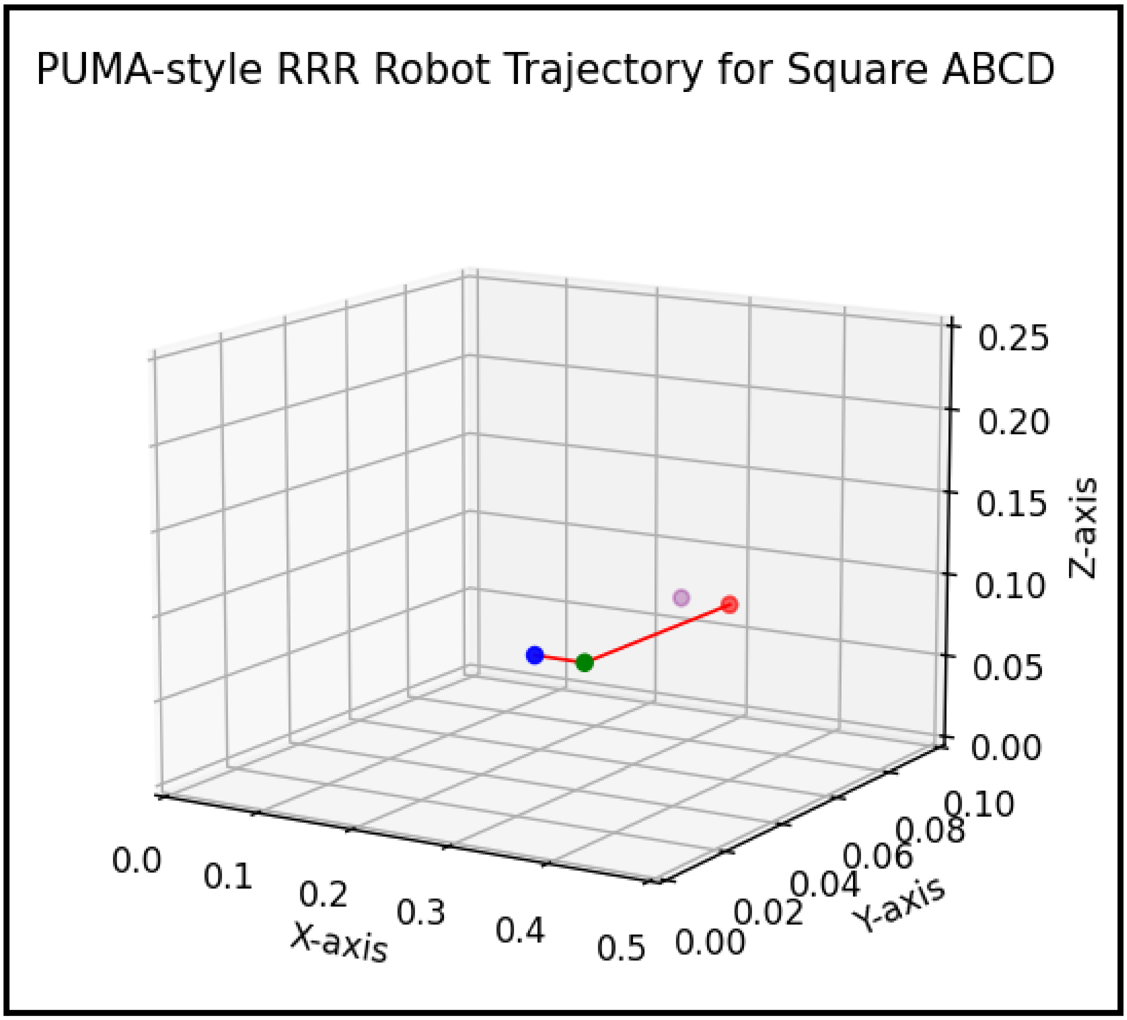
Entire top surface of the manifold lies within the robot workspace by ensuring that all four corners lie within its workspace. Below is the computed joint angles and end effector position for all four corners.

```
Point A:
Joint Angles: [0.1651, 0.5642, 2.1706]
End Effector Position: [-0.2834, 0.162, 0.4564]

Point B:
Joint Angles: [-0.1651, 0.5642, 2.1706]
End Effector Position: [-0.2156, 0.2451, 0.4564]

Point C:
Joint Angles: [-0.2915, 1.8494, 3.0171]
End Effector Position: [-0.156, 0.0792, 0.281]

Point D:
Joint Angles: [0.2915, 1.8494, 3.0171]
End Effector Position: [-0.1738, -0.0197, 0.281]
```

b)

```
# coordinates for points A, B, C, D
A = (0.40, 0.06, 0.1)
B = (0.40, 0.01, 0.1)
C = (0.35, 0.01, 0.1)
D = (0.35, 0.06, 0.1)
```

Result



Note:- Waypoints A, B, C, and D are represented by colored markers (red, green, blue, purple) in the 3D plot. Further, the line connects these waypoints to visualize the trajectory.

Here,

- Forward_kinematics computes the end effector position in Cartesian coordinates (x, y, z) based on the joint angles (theta1, theta2, theta3) using the forward kinematics equations.
- Inverse_kinematics calculates the joint angles (theta1, theta2, theta3) for a given end effector position (x, y, z) using inverse kinematics.
- FuncAnimation is used to create an animation by calling the update function for each frame.
- The animation progresses through each frame, updating the positions of waypoints and the connecting line.
- The movement follows the specified trajectory, forming a square in 3D space.