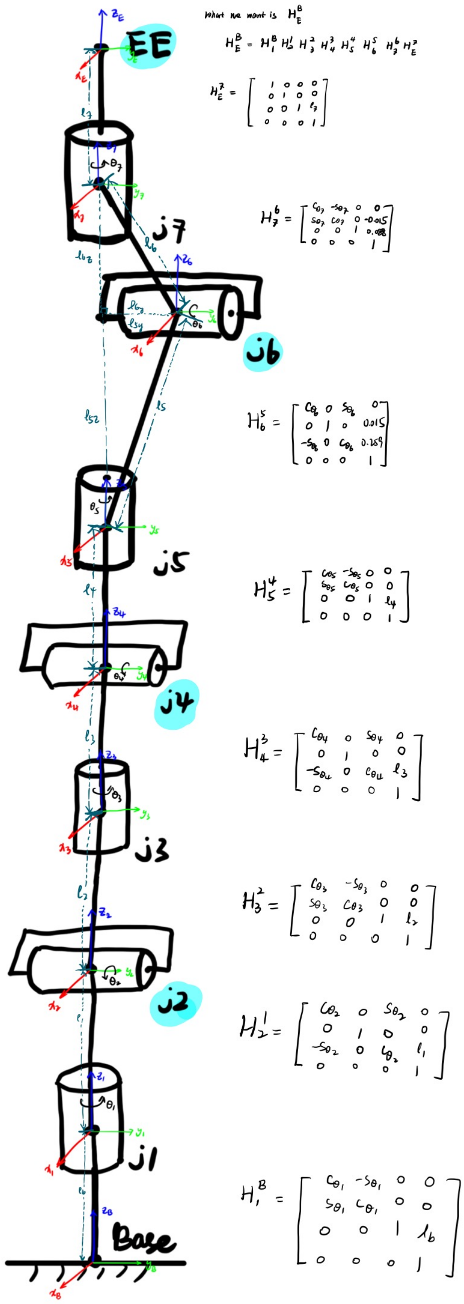
Lab 1 Report

Methods

Formulation

(TODO)



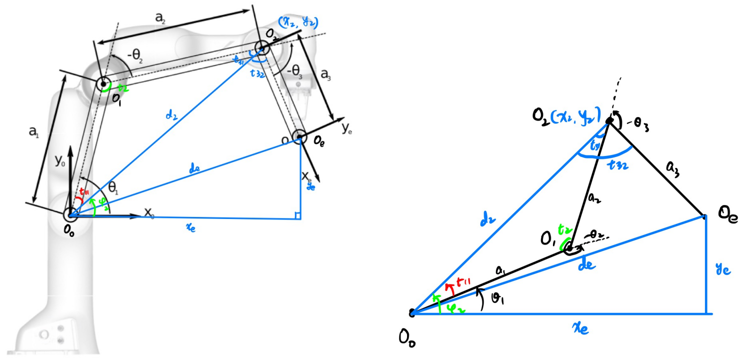
FK

(TODO)

IK

Use geometric approach:

- Draw the schematic of 2 solutions and define intermediate angles and edges as follow:



- Compute position of $O_2(x_2, y_2)$
- Compute d_2, d_e, ϕ_2
- Compute all the needed angles using law of cosine with known a_1, a_2, a_3, d_2, d_e
- Compute $\theta_1, \theta_2, \theta_3$ with the intermediate angles

Evaluation

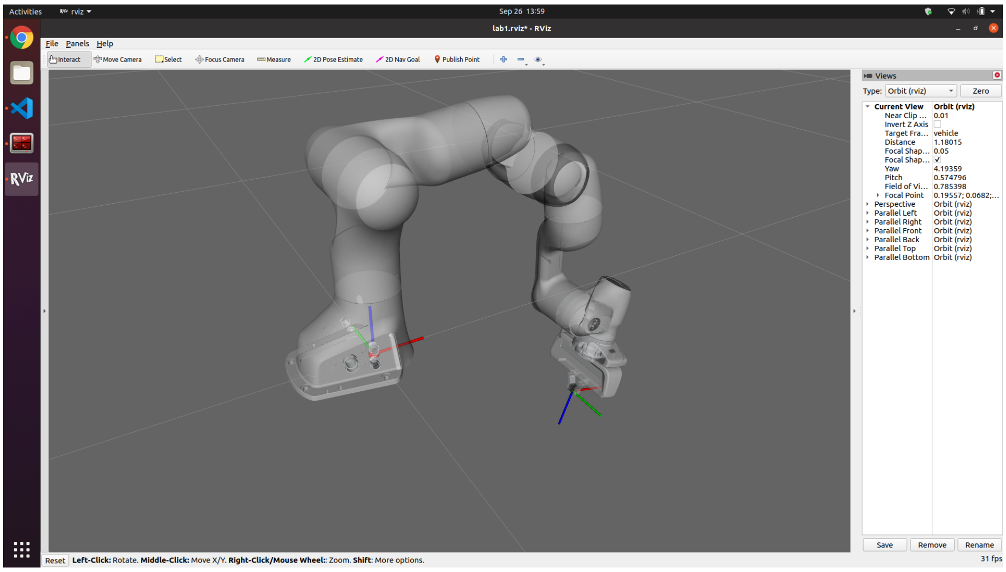
FK

(TODO)

IK

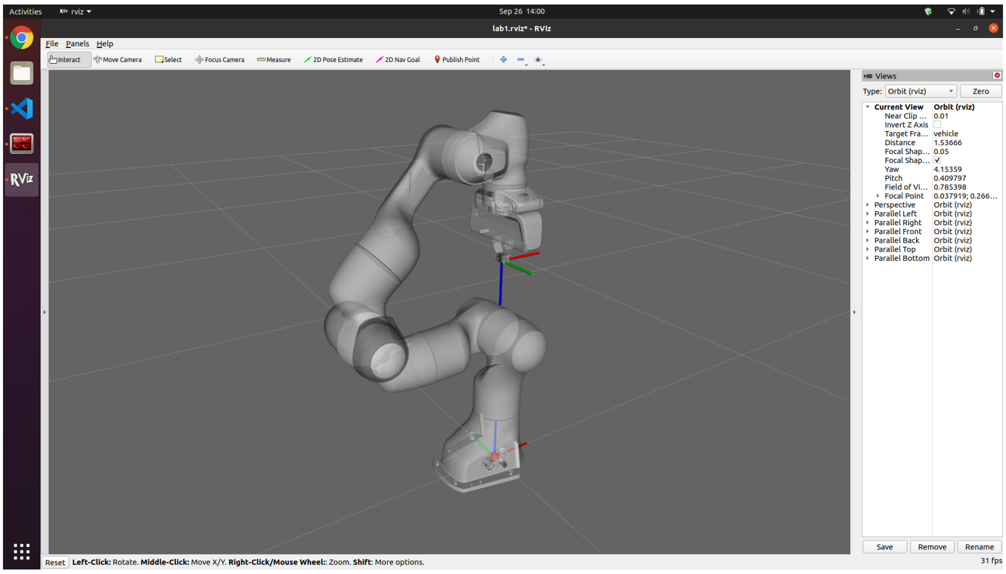
Target 1

```
{ # IK target 1
    'o': np.array([0.5, -0.3]),
    'theta': pi/2+0.3
}
```



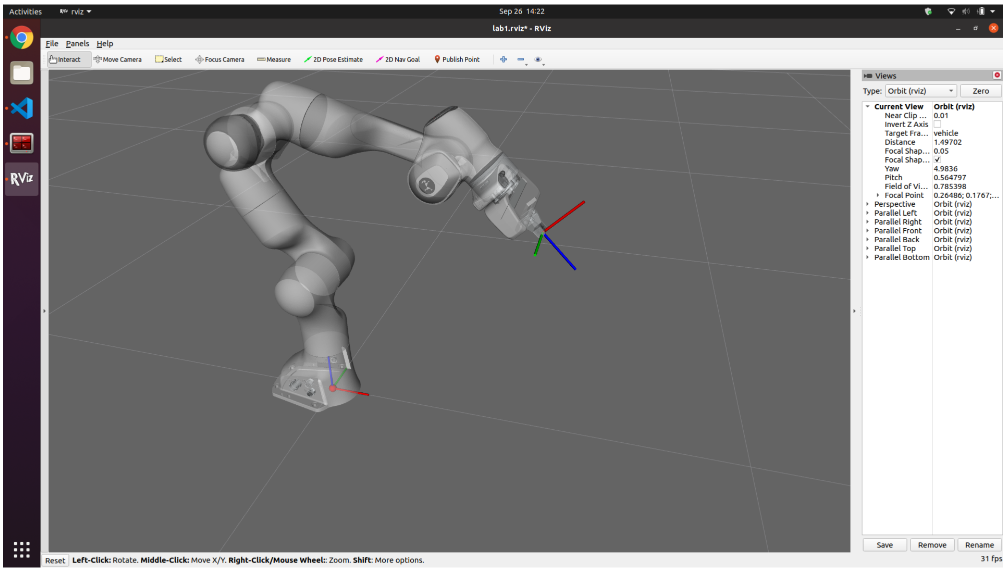
Target 2

```
{ # IK target 2
    'o': np.array([0, 0.5]),
    'theta': pi/2
}
```



Target 3

```
{ # IK target 3
    'o': np.array([0.5, 0.5]),
    theta': 1/4 * pi
}
```



Analysis

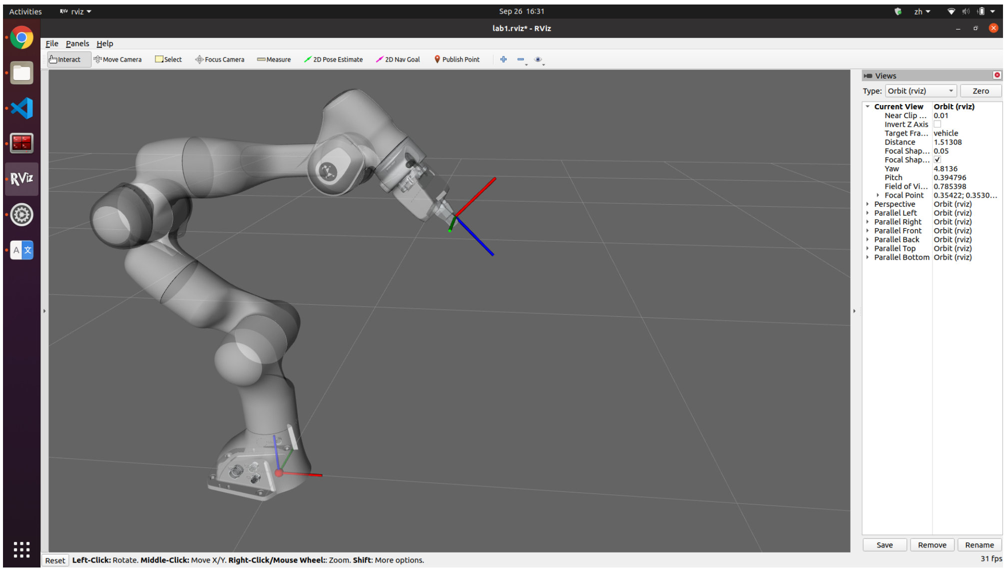
Gravity

FK

(TODO)

IK

With gravity, the manipulator tends to move faster and will have a little shake when reaching the target. The final posiiton of the end effector might be a little below the target.



The reason might be with gravity, the joints cannot reach the exact computed values because of the external gravity force.

Reachable workspace

(TODO)

Extending Inverse Kinematics to 3D

Panda does have a spherical wrist. However, kinematic decoupling does not work on the full Panda robot because it has 7 dofs, and you have to solve the first 4 joint variables with only 3 equations (the position of the wrist center). The appropriate way I can think of is to use geometric approach to solve the first 4 joint variables, and then the 3 joint variables of the wrist can be solved using Euler angles.