Robot Autonomy - Homework 1

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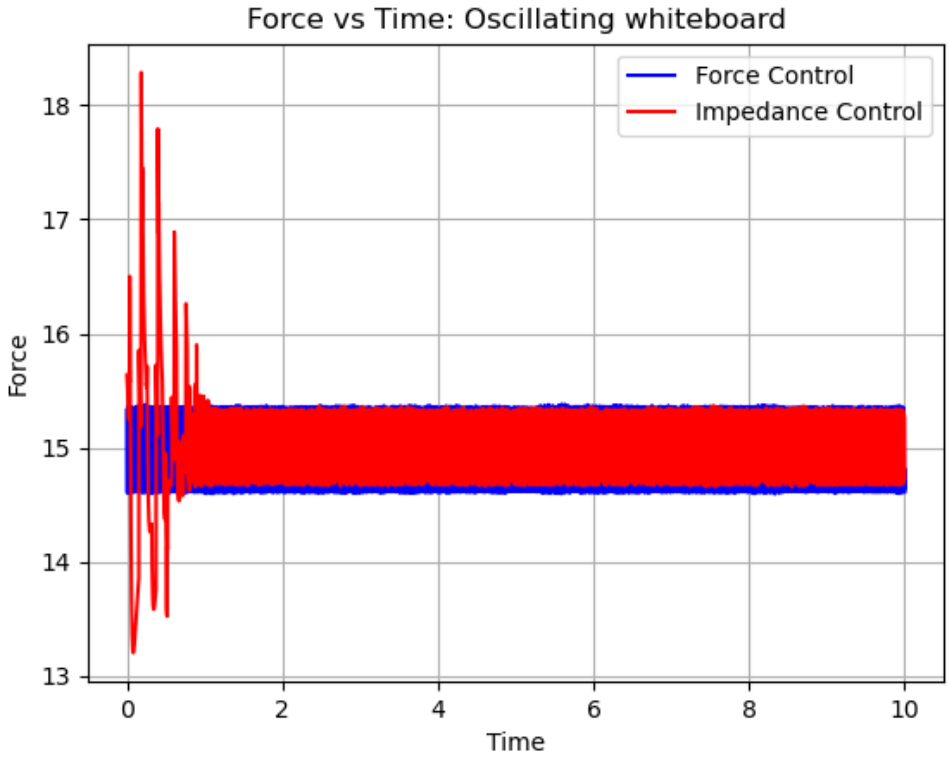
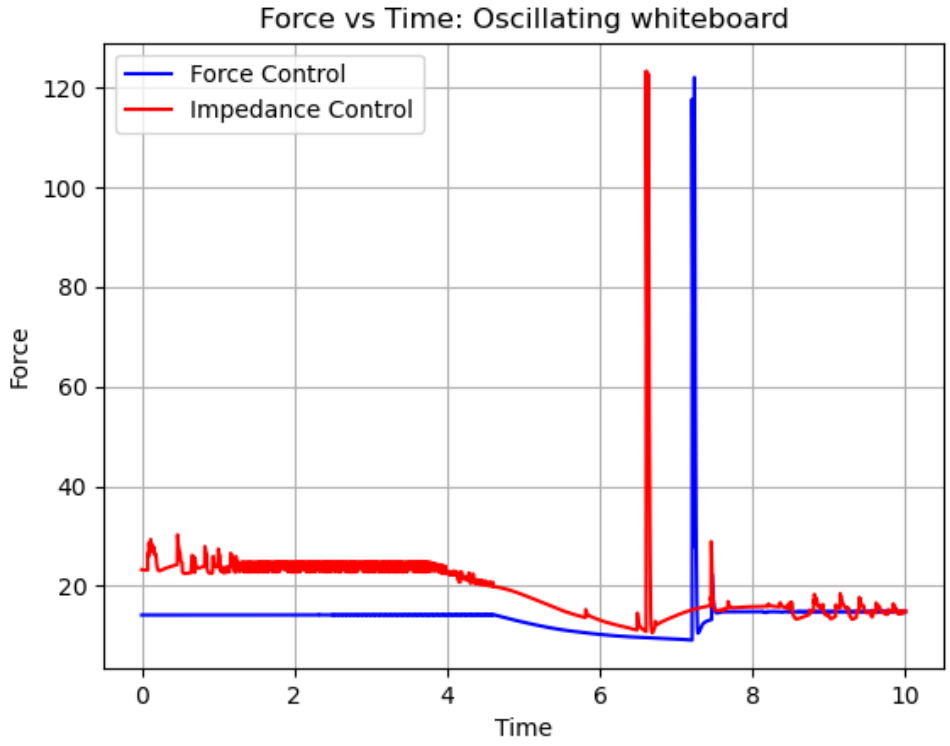
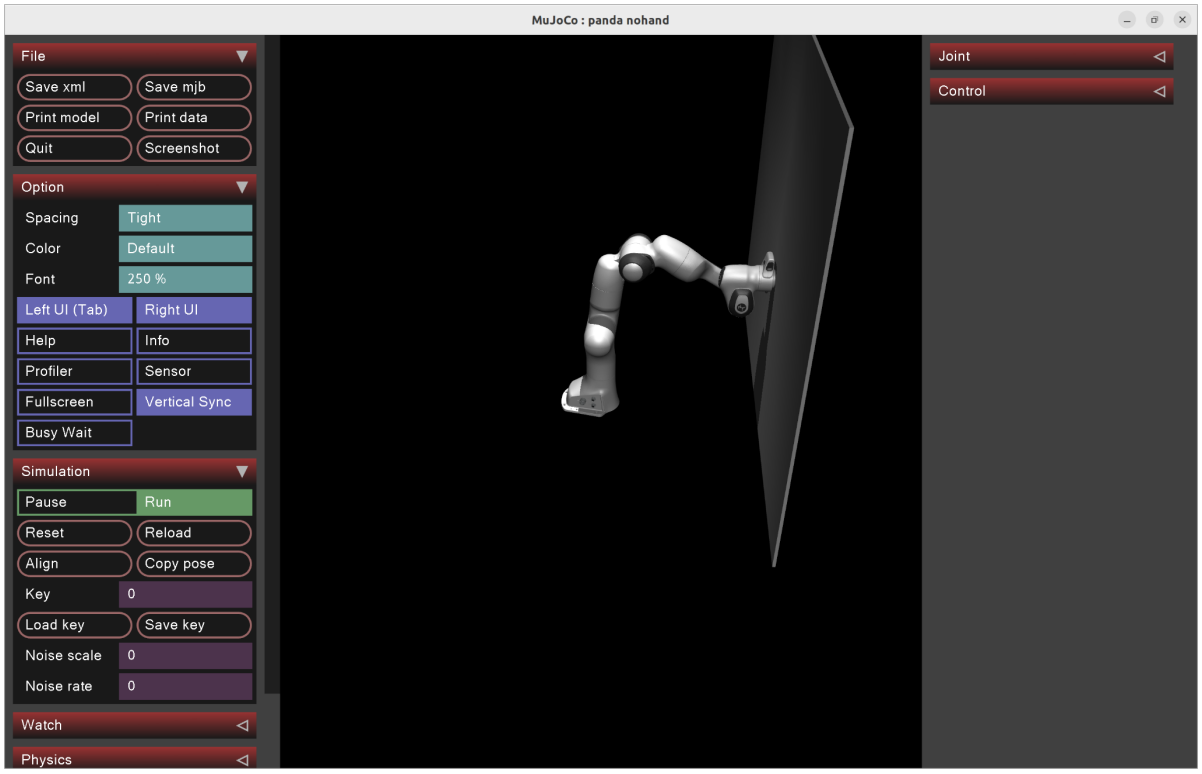
3.1 Part 1

Screenshot of the force plots for the case where the whiteboard is static



3.2 Part 2


Force vs Time: Oscillating whiteboard
Force Control
Impedance Control
Force
Time
120
100
80
60
40
20
0
2
4
6
8
10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Watch
Physics
Joint
Control

The force control does not have any kind of feedback. If the board was fragile, it will constantly apply 15N of force in the x direction and break the board. Whereas the impedance control, has feedback and will adapt to the dynamic environment.

In the static board case, we see that the force is always 15N for the force controller and it slowly converse to 15N in the impedance control case.

In the oscillating board case, the force reading in the force controller is mostly always 15N, except when the board moves and applies force to franka. On the other hand for the impedance controller, as the board moves closer to the robot, the force becomes larger and as it moves away from the robot, the force becomes lower. This is natural as F = Kp (X) + Kd (X') and the X decreases as the board moves further away from the robot.

4.1 Forward Kinematics

Q1

$$t = \begin{pmatrix} 0.088 \\ 0 \\ 0.926 \end{pmatrix}$$
$$R = \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{pmatrix}$$

Q2

$$t = \begin{pmatrix} 0.157 \\ -0.103 \\ 0.936 \end{pmatrix}$$
$$R = \begin{pmatrix} 0.649 & 0.759 & 0.052 \\ 0.755 & -0.651 & 0.073 \\ 0.089 & -0.008 & -0.996 \end{pmatrix}$$

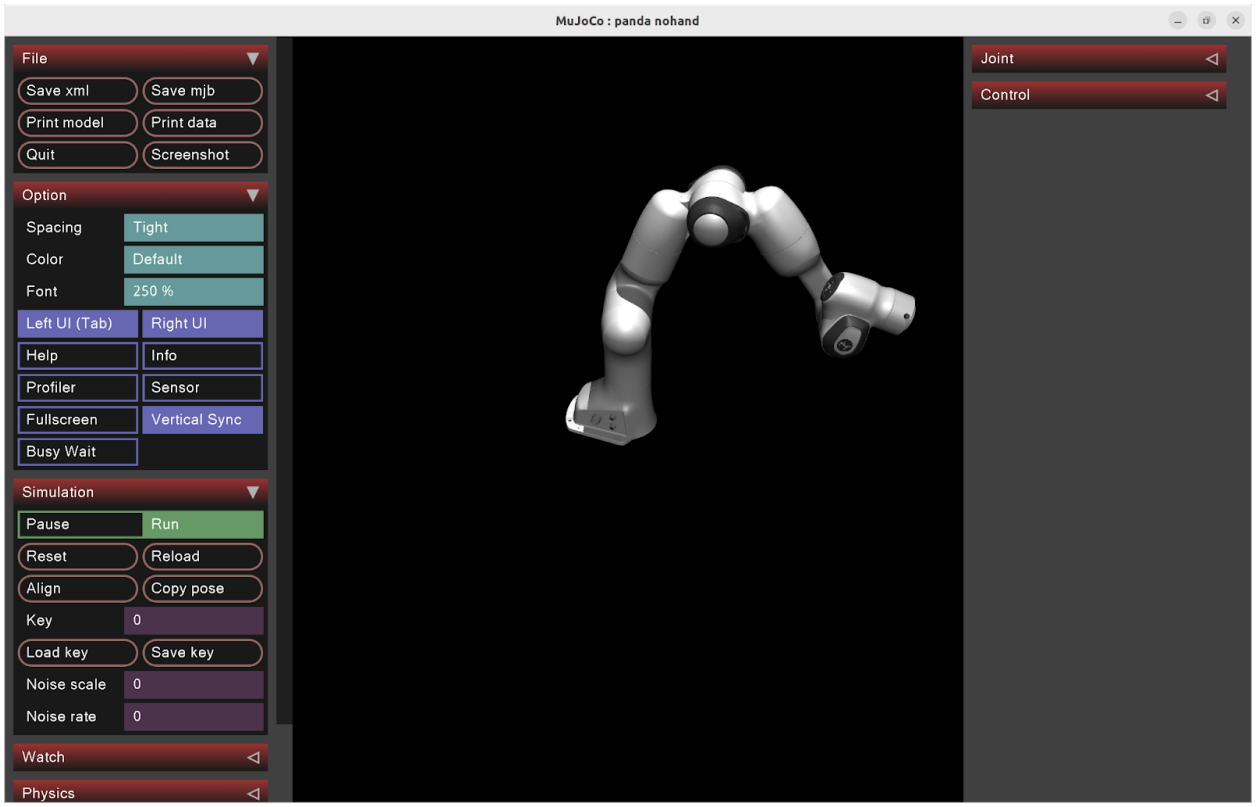
Q3

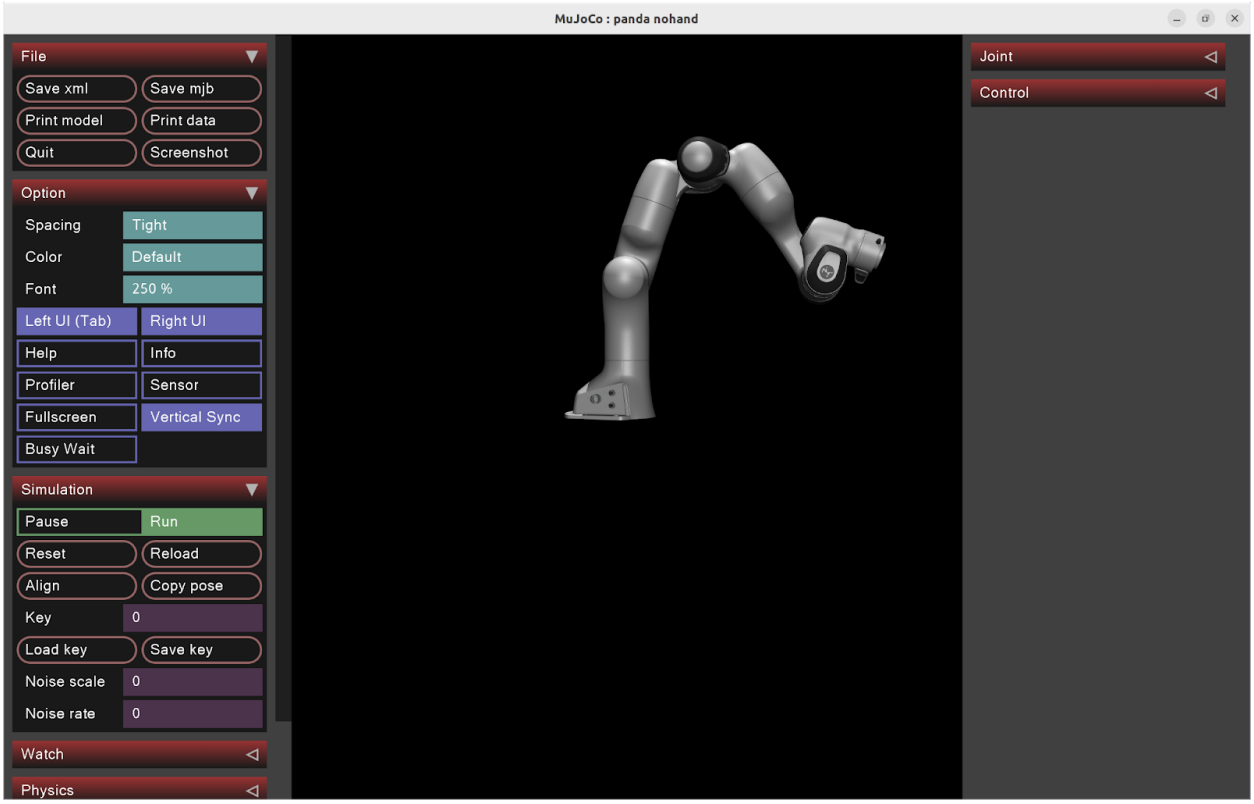
$$t = \begin{pmatrix} 0.401 \\ 0.087 \\ 0.855 \end{pmatrix}$$
$$R = \begin{pmatrix} 0.98 & -0.181 & -0.081 \\ -0.174 & -0.593 & -0.786 \\ 0.095 & 0.785 & -0.612 \end{pmatrix}$$

4.2 Inverse Kinematics

$$q = \begin{pmatrix} 0.577 \\ 0.312 \\ -0.683 \\ -2.079 \\ -0.116 \\ 3.914 \\ -2.863 \end{pmatrix}$$

Image of Robot

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