16662 Robot Autonomy – Homework 1

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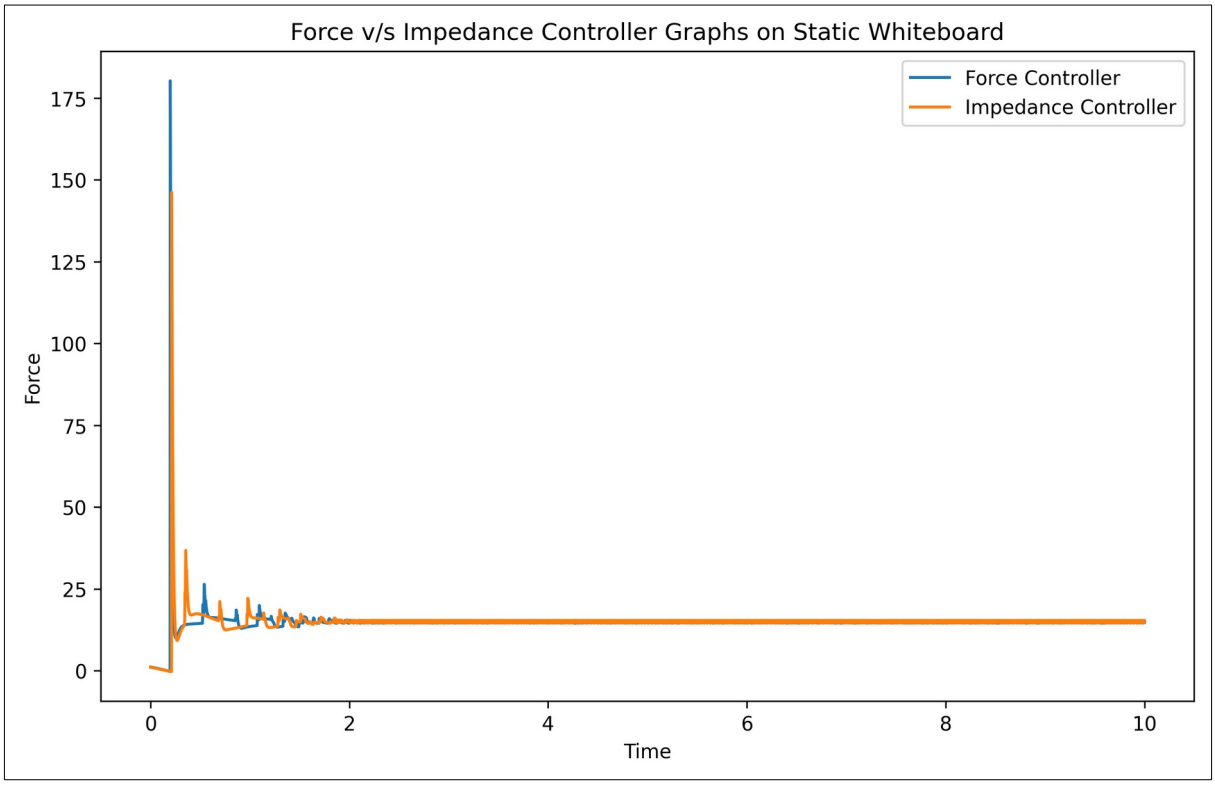
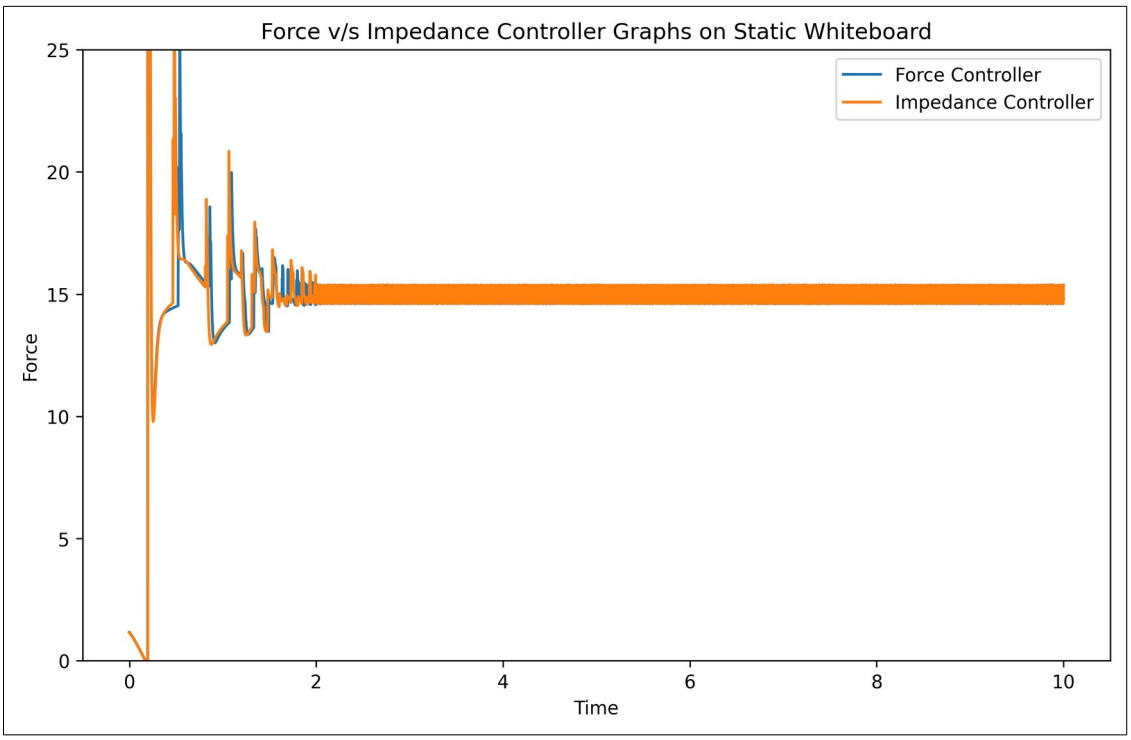
Submission for Q3

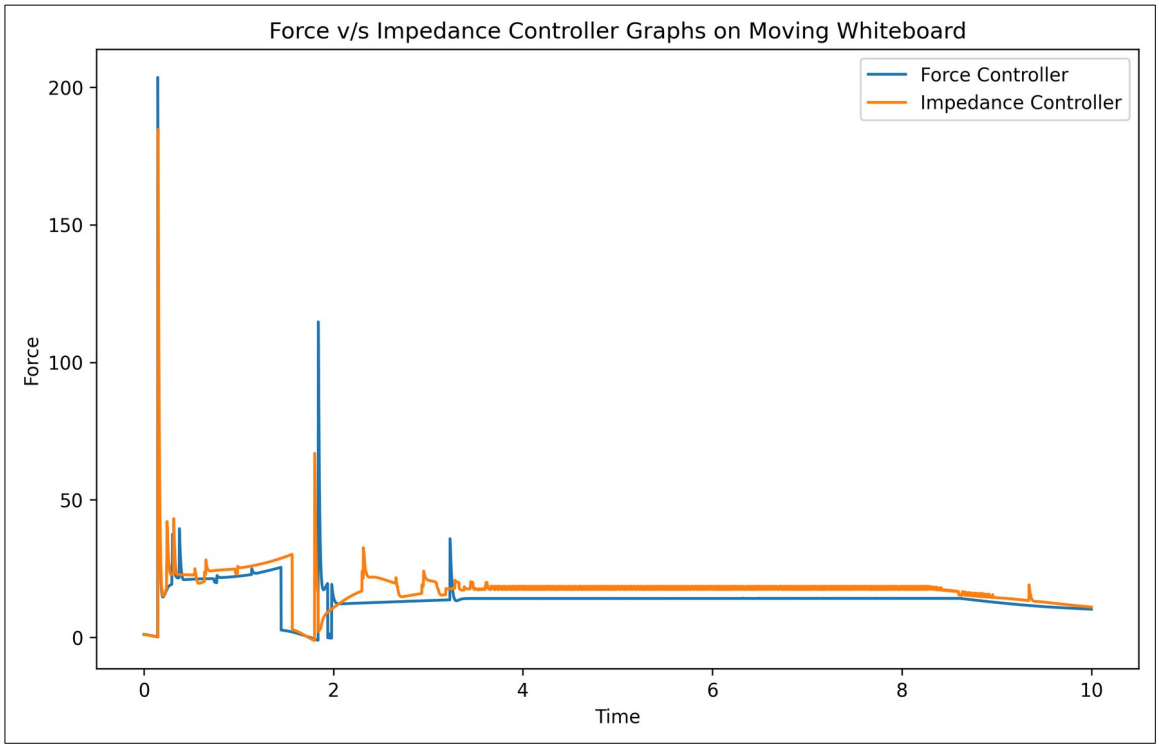
Plot for Static Whiteboard



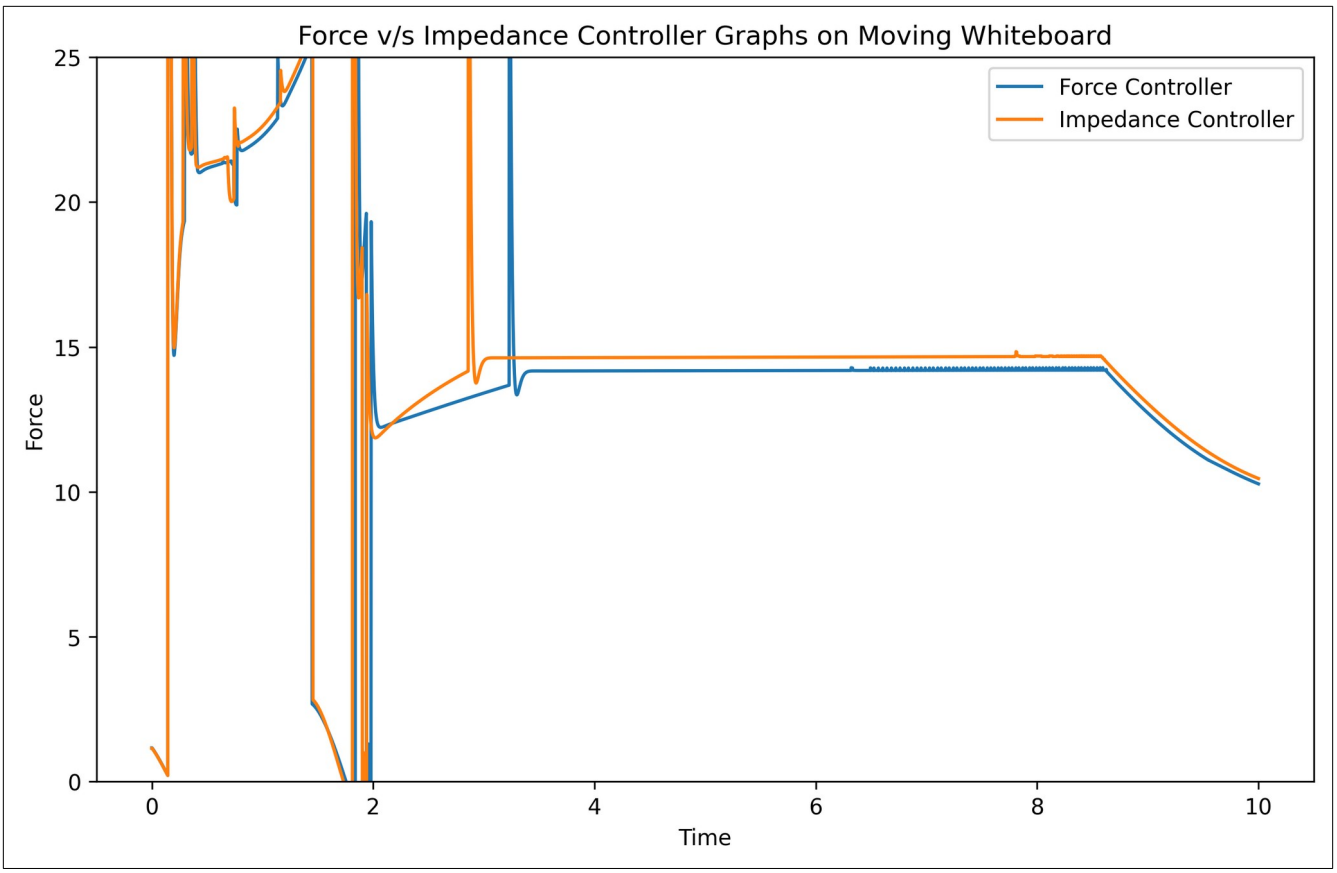
Zoomed in:



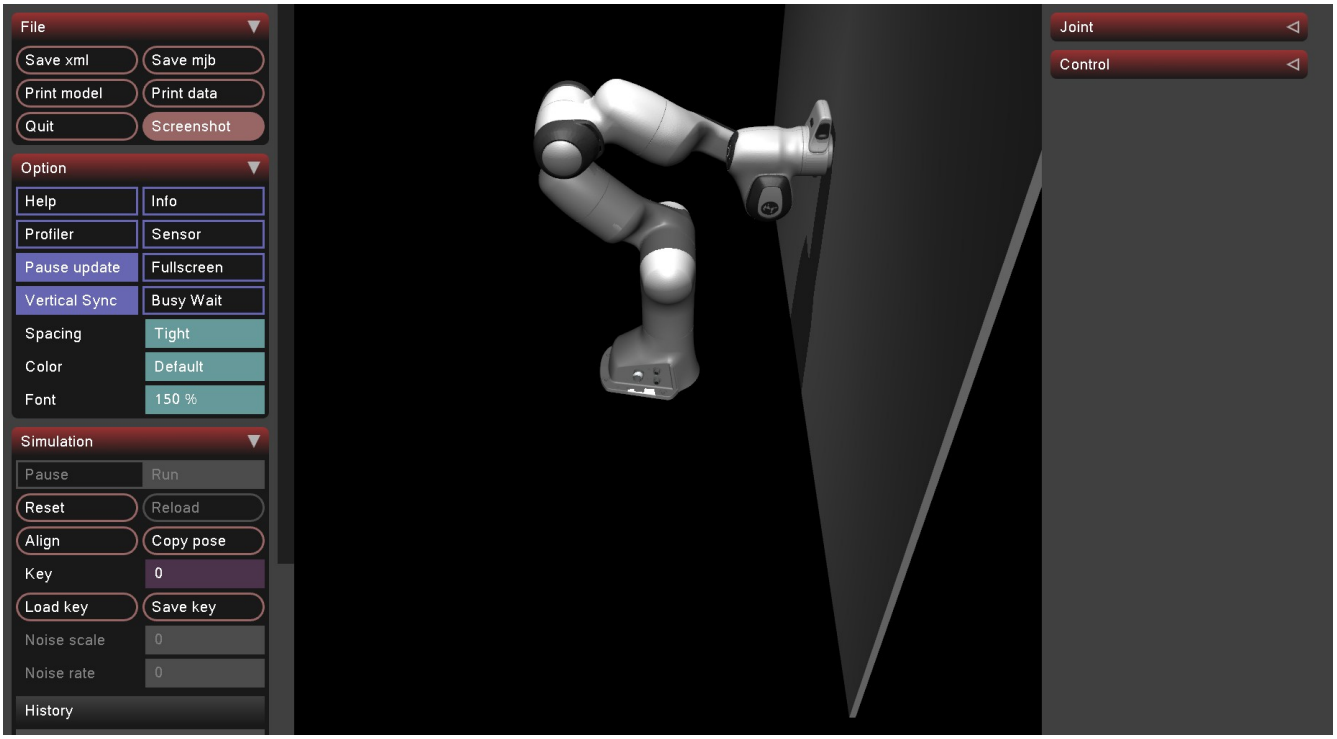
Plot for Moving Whiteboard



Zoomed in:



Screenshot of Robot at Maximum Amplitude



Explanation for difference in behavior of the force and impedance controllers

Impedance controllers resist sudden spikes/drops in force to help smooth out motion and eliminate jerks.

Submission for Q4

End Effector Poses

Q1

Joints:
[0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0]
computed FK ee position
[8.80000000e-02 -8.93992163e-18 9.26000000e-01]
computed FK ee rotation
[[1.0000000e+00 0.0000000e+00 0.0000000e+00]
 [0.0000000e+00 -1.0000000e+00 -1.2246468e-16]
 [0.0000000e+00 1.2246468e-16 -1.0000000e+00]]

Q2

Joints:
[0, 0, -0.7853981633974483, -0.2617993877991494, 0.3490658503988659, 0.2617993877991494, -1.3089969389957472]
computed FK ee position
[0.15710277 -0.10259332 0.93602711]
computed FK ee rotation
[[0.64935398 0.75871099 0.05193309]
 [0.7552124 -0.65137389 0.07325497]
 [0.08940721 -0.00834789 -0.99596017]]

Q3

Joints:
[0, 0, 0.5235987755982988, -1.0471975511965976, -1.1344640137963142, 0.7853981633974483, 0.0]
computed FK ee position
[0.40136375 0.08742801 0.85526363]
computed FK ee rotation
[[0.98015816 -0.18113365 -0.08050201]
 [-0.17410263 -0.5925751 -0.78647507]

[0.09475362 0.78488557 -0.61235316]]

Final Joint Angles for moving the end effector to R_g and t_g

Iterations for Convergence: 469
Error 9.284698282135374e-07 0.0001057796731105533 2
Computed IK angles [-1.381117 0.50327976 1.52171772 -1.88583765 -2.85264866 2.71926329 -0.77118883]

To verify, I computed H using the FK function

H_computed: [[-9.69874012e-06 8.45002582e-07 1.00000000e+00 6.00000067e-01]
 [-2.95517988e-06 1.00000000e+00 -8.45031243e-07 1.44289493e-09]
 [-1.00000000e+00 -2.95518807e-06 -9.69873762e-06 5.00000010e-01]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 1.00000000e+00]]

Screenshot Corresponding to the computed Joint Positions