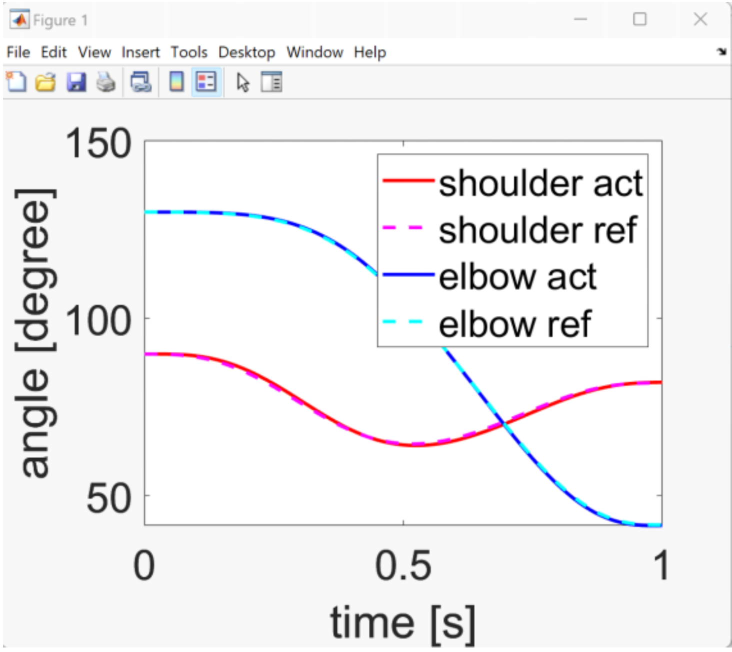
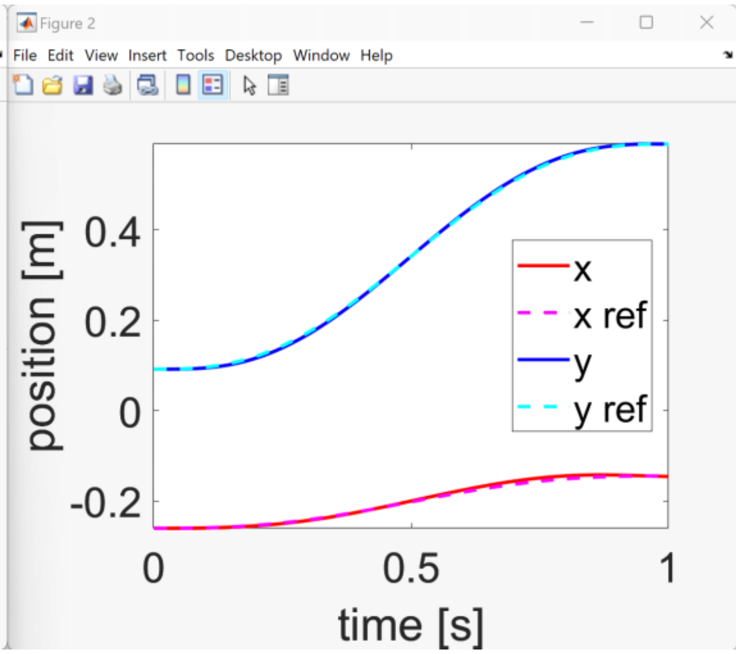
Q2

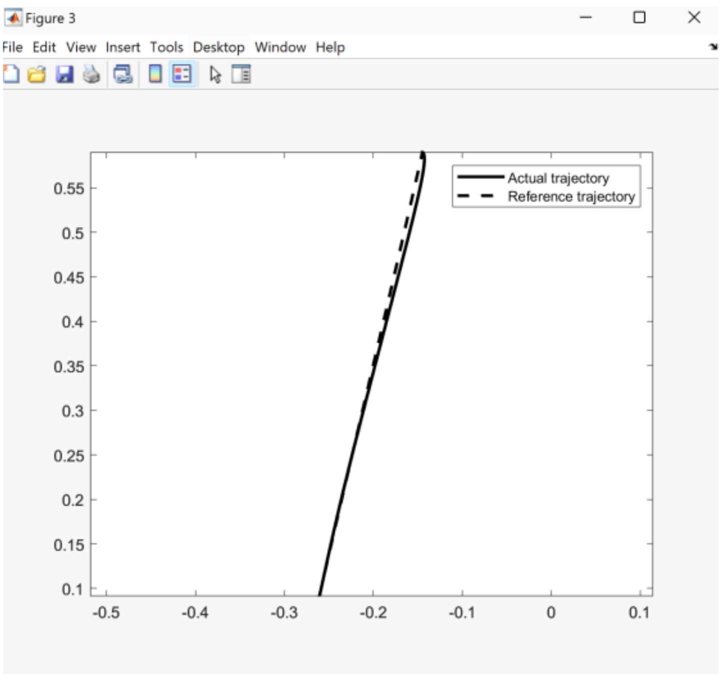
22 February 2023 18:27

1b)

With Kp=100 and Kd=10



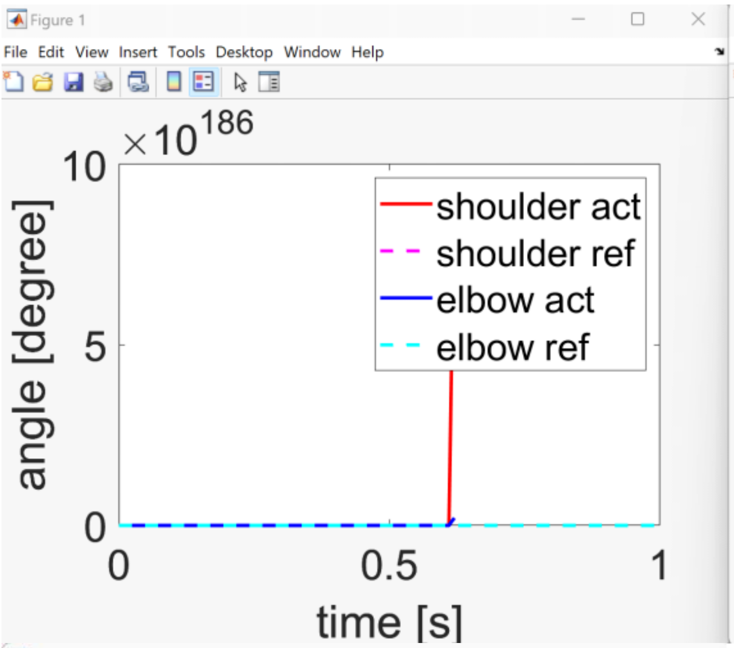


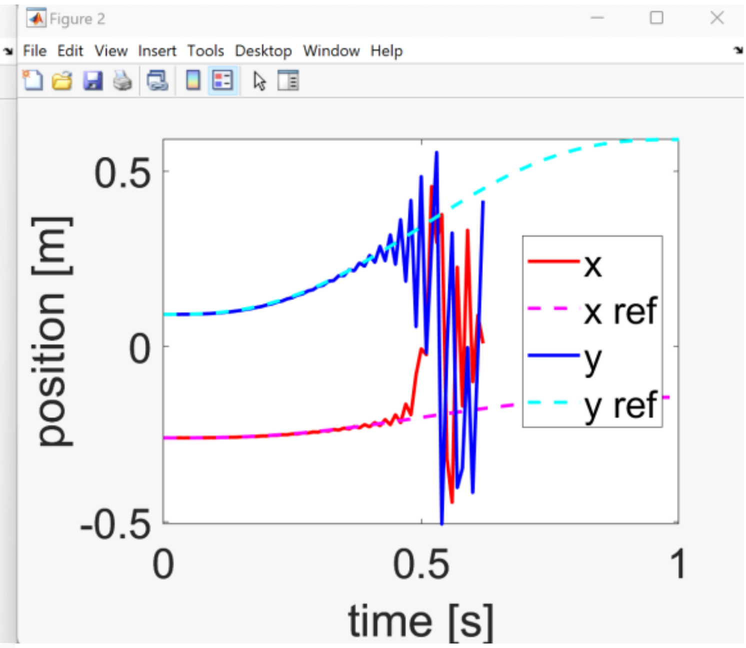


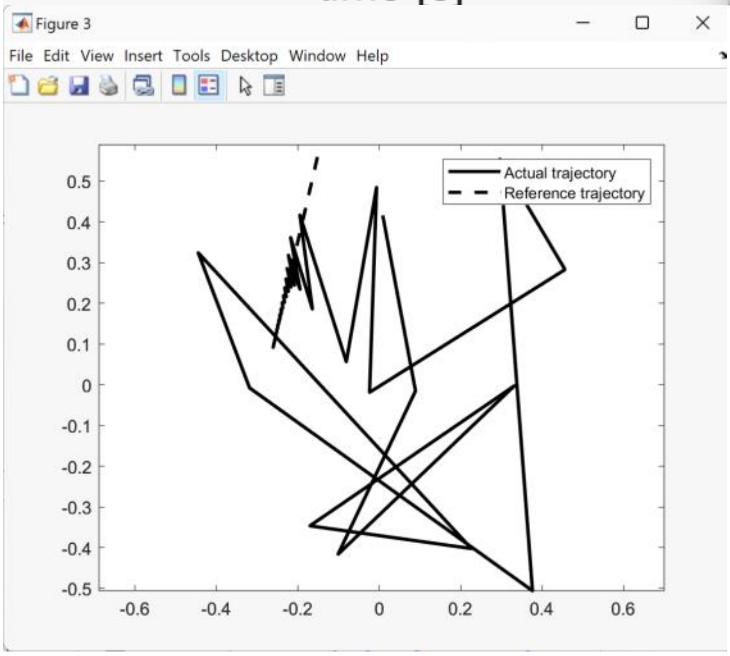
Small change in Kd: Kp=100 and Kd=20

- $Ke + D\dot{e}$

- By increasing Kd, we increase the priority of e-dot.
- The rise time is longer, because Kd damps the system.
- Over-damped shows a slow response.
- We have a high viscosity constant (Kd) meaning the muscle is highly viscose.
    - So its high viscosity means it dampens quicker.
    - This is because it dissipates elastic energy quicker.
    - This means the muscle has too many cross-bridges.
    - It's dissipating energy so quickly, that it finishes the movement before completing the trajectory.
-







Large change in Kd: Kp=100 and Kd=10000

- Here, Kd has been increased so much that the trajectory is now instable.
- On the position vs time graph, we see the hand overshooting for both x and y.
- Velocity in x is in the opposite direction to velocity in y.

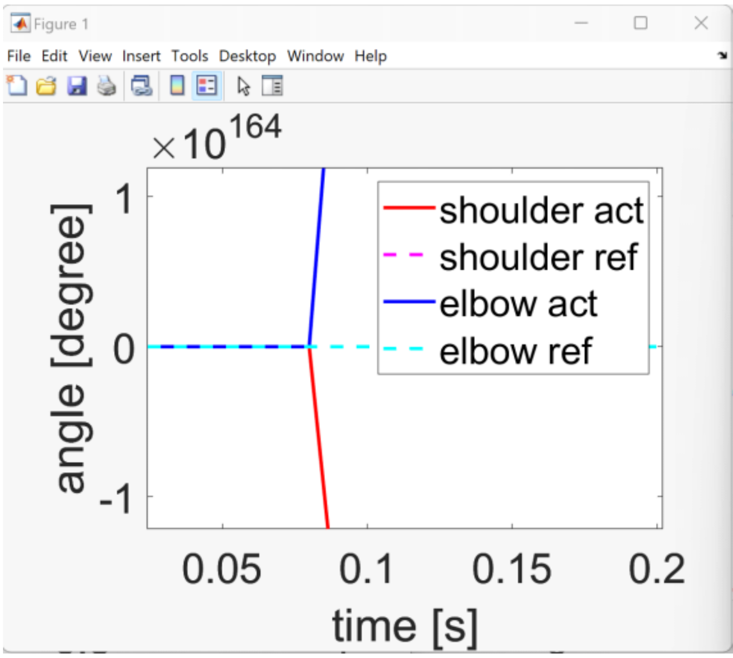


Figure 1
File Edit View Insert Tools Desktop Window Help
×10^164
1
0
-1
angle [degree]
shoulder act
shoulder ref
elbow act
elbow ref
0.05
0.1
0.15
0.2
time [s]

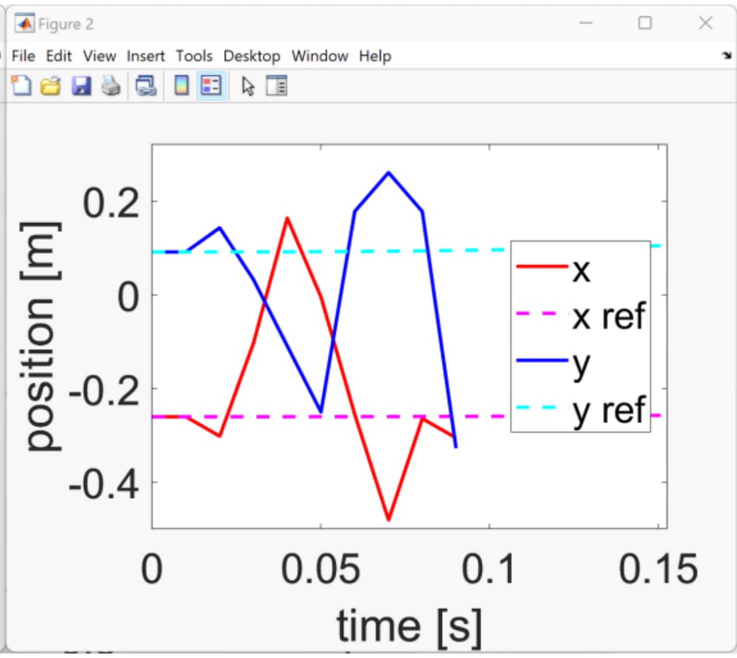


Figure 2
File Edit View Insert Tools Desktop Window Help
0.2
0
-0.2
-0.4
position [m]
x
x ref
y
y ref
0
0.05
0.1
0.15
time [s]

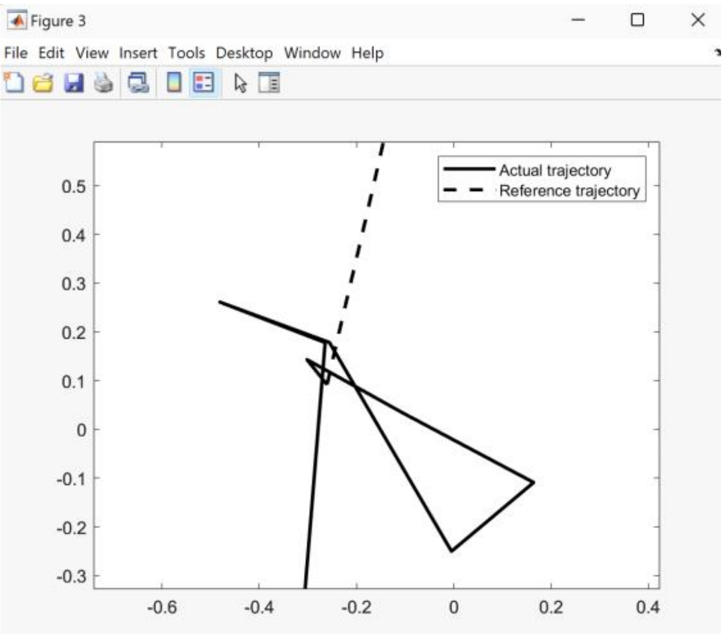
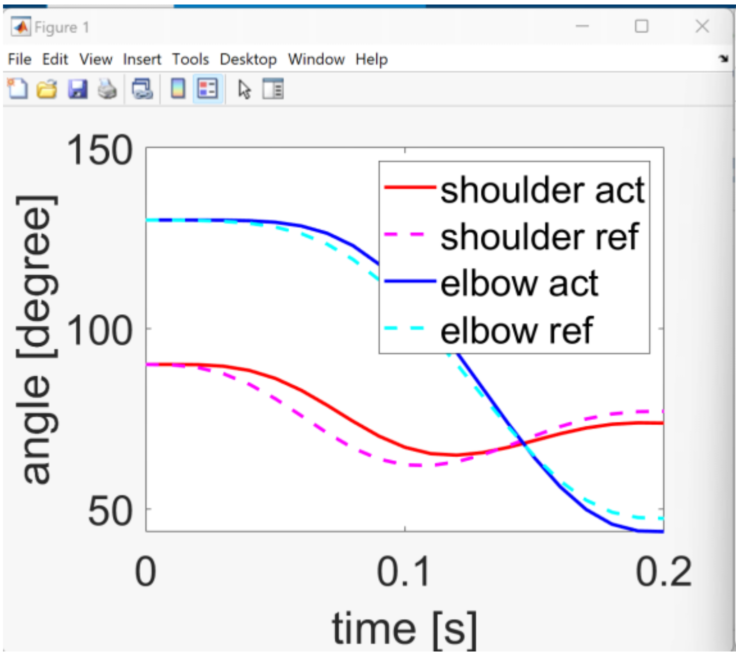
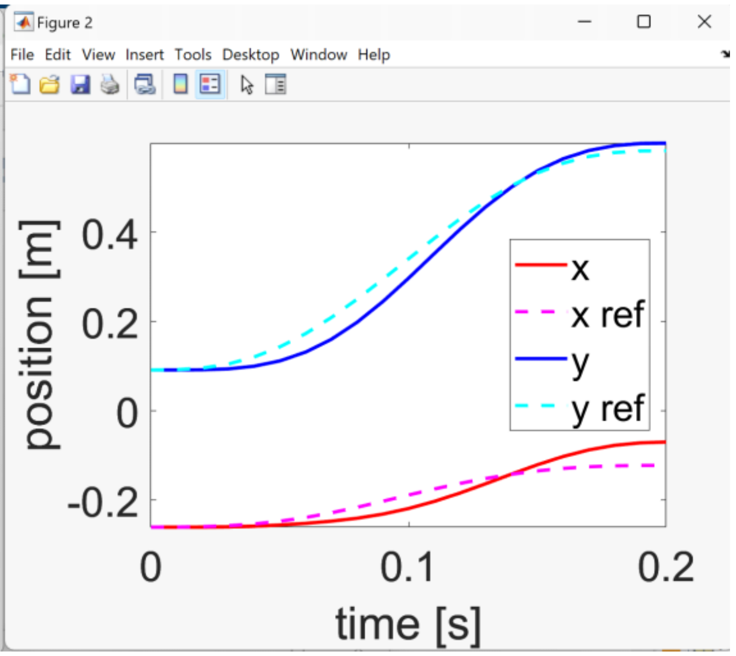
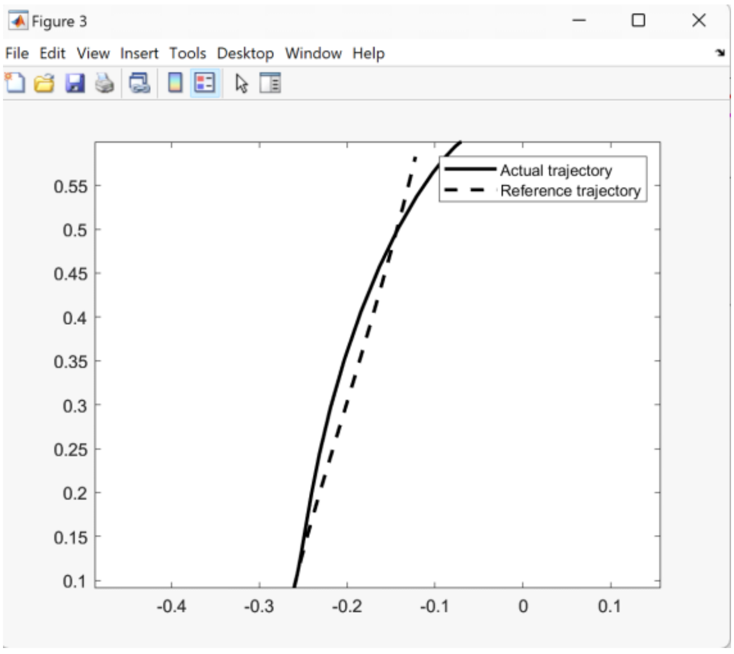


Figure 3
File Edit View Insert Tools Desktop Window Help
Actual trajectory
Reference trajectory
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.6
-0.4
-0.2
0
0.2
0.4

1c)







- When the arm moves five times as fast, there is a slight delay between the actual and reference trajectory.
- The delay reduces when you increase Kp (e.g Kp=1600) since the muscle is less bouncy.