Question 2

Hover Performance [10]: Using the linearized feedback control policy developed in class, implement a PD feedback controller to enable the robot to hover at a desired location (e.g., z = 0.5 m). Create a simulation scenario where the robot transitions between multiple waypoints along the x-axis by specifying goals that increment by 10 cm in the x direction. Plot the error between the desired pose (position and orientation) and the actual pose. Indicate when new waypoints are sent to the system. Examine the convergence of the robot to each waypoint. Does the system oscillate about the waypoint? What happens when modifying the gains associated with the position control (outer loop) and attitude control (inner loop)? Plot the response for multiple gains and discuss qualitatively the change in performance.

Hover Performance

1.1 Below are the figures showing the actual/desired position, as well as the position error (**using the normal gains**):

Kp	17	17	20
Kv	6.6	6.6	9
Kr	190	198	80
Kw	30	30	17.88

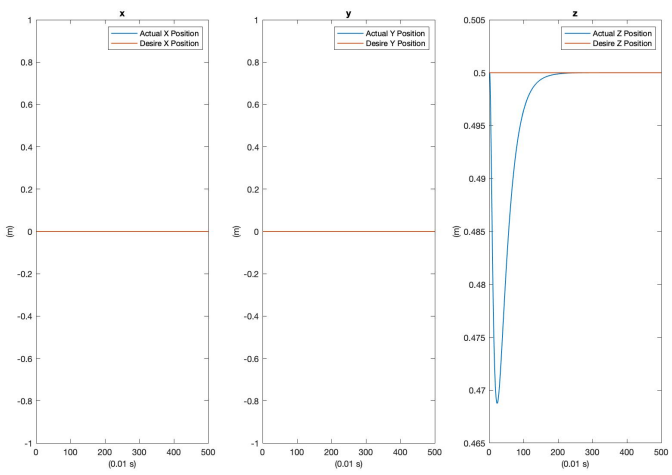

Figure 1. actual position vs desired position

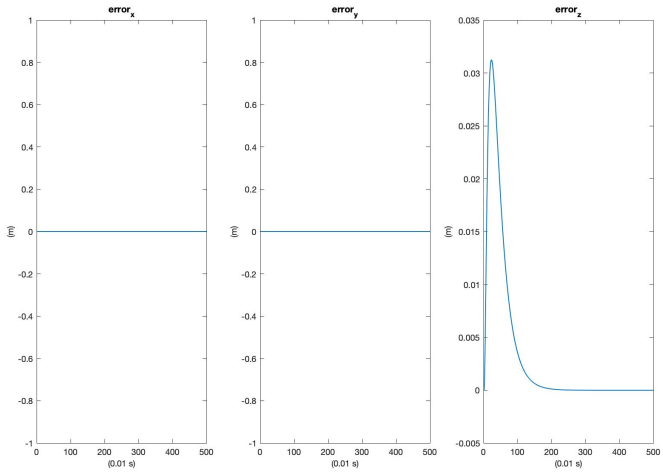

Figure 2. Position Errors

(Note that the unit for x-axis is 0.01s, and all figures in this report uses same units)

1.2 Below are the figures showing the actual/desired position, as well as the position error (**using bigger Kp**):

Kp	17	17	**40**
Kv	6.6	6.6	9
Kr	190	198	80
Kw	30	30	17.88

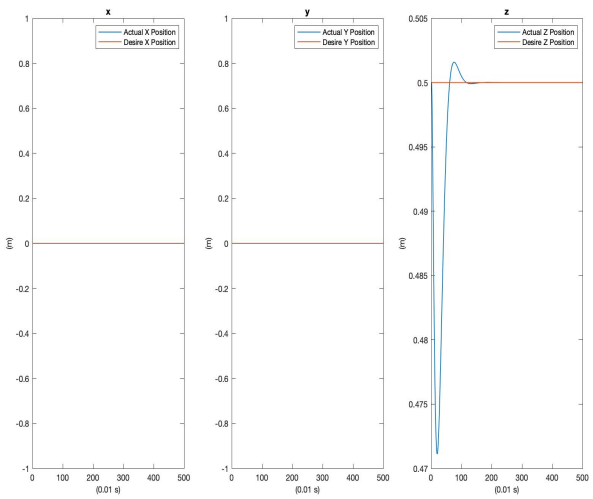

Figure 3. actual position vs desired position

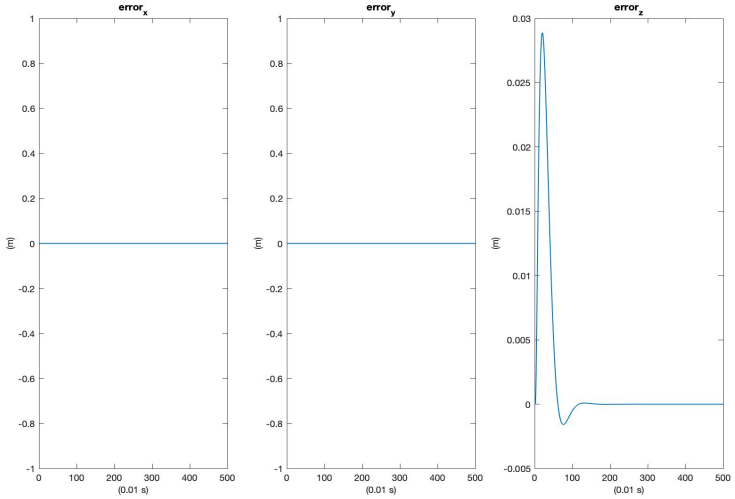

Figure 4. Position Errors

1.3 Below are the figures showing the actual/desired position, as well as the position error (**using bigger Kv**):

Kp	17	17	20
Kv	6.6	6.6	**18**
Kr	190	198	80
Kw	30	30	17.88

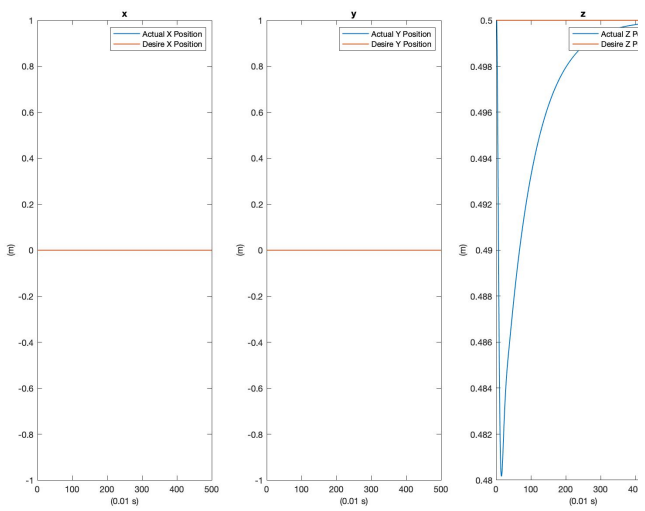

Figure 5. actual position vs desired position

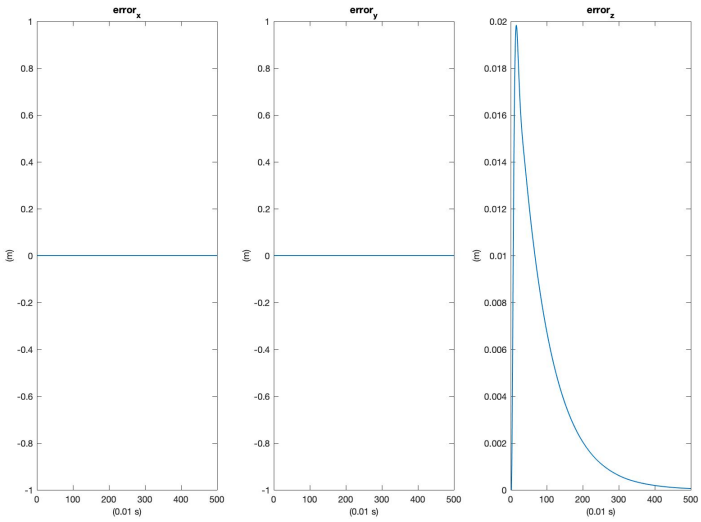

Figure 6. Position Errors

1.4 Below are the figures showing the actual/desired position, as well as the position error (**using bigger Kr and Kw - multiply the value by 2**):

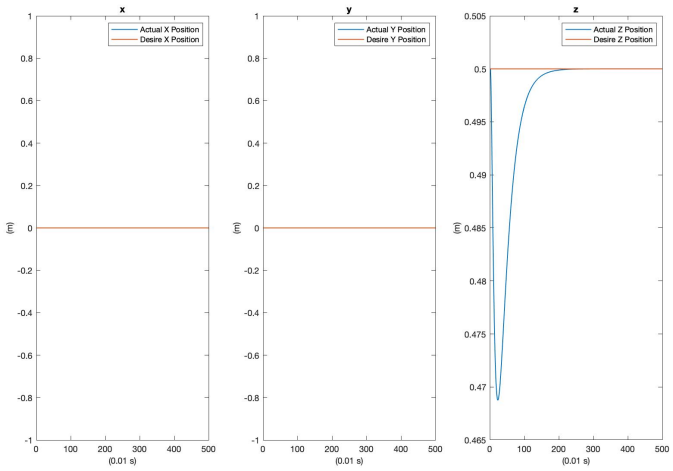

Figure 7. actual position vs desired position

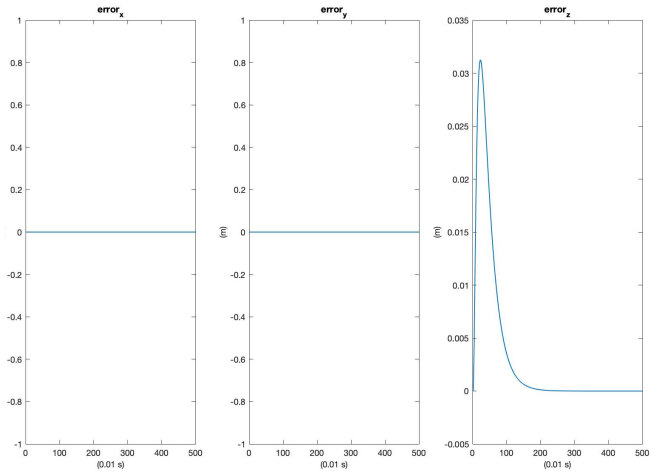

Figure 8. Position Errors

X-Tracking Performance

2.1 Below are the figures showing the actual/desired position, as well as the position error (**using the normal gains**):

Kp	17	17	20
Kv	6.6	6.6	9
Kr	190	198	80
Kw	30	30	17.88

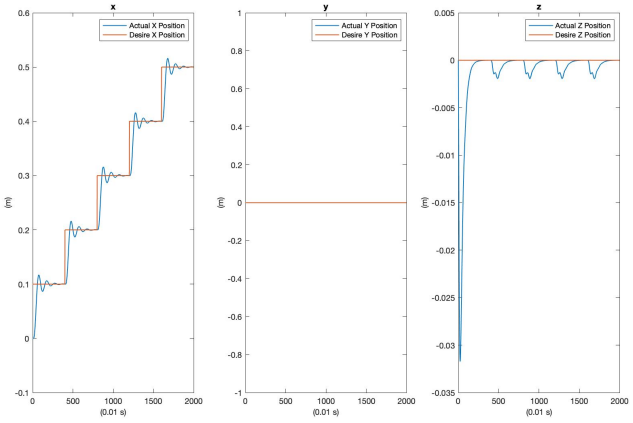

Figure 9. actual position vs desired position

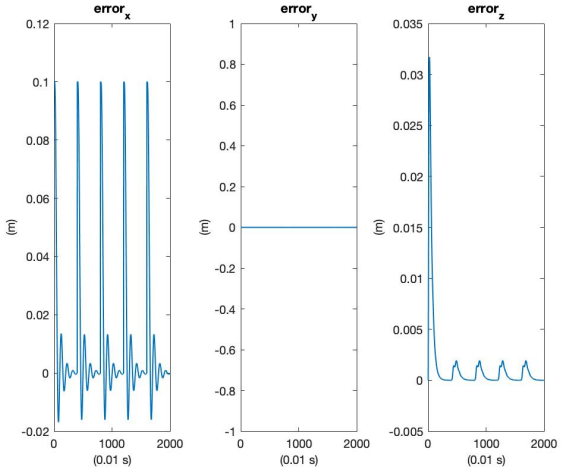

Figure 10. Position Errors

2.2 Below are the figures showing the actual/desired position, as well as the position error (**using bigger Kp**):

Kp	17	17	**40**
Kv	6.6	6.6	9
Kr	190	198	80
Kw	30	30	17.88

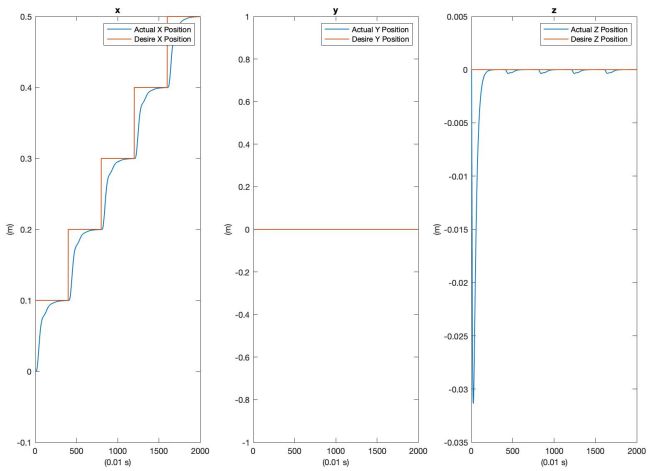

Figure 11. actual position vs desired position

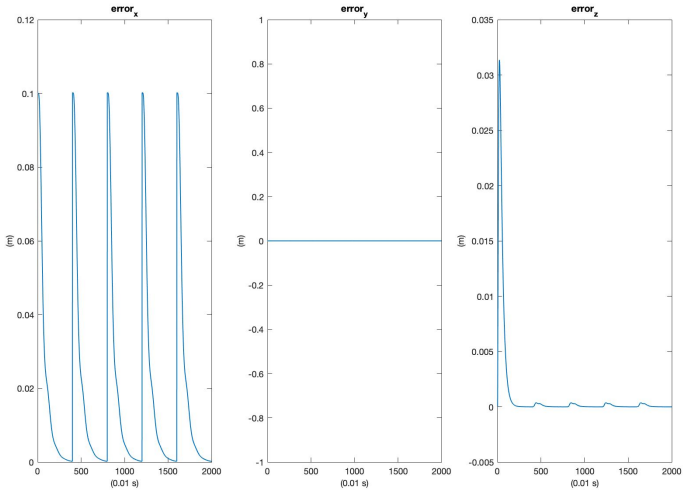

Figure 12. Position Errors

2.3 Below are the figures showing the actual/desired position, as well as the position error (**using bigger Kv**):

Kp	17	17	20
Kv	6.6	6.6	**18**
Kr	190	198	80
Kw	30	30	17.88

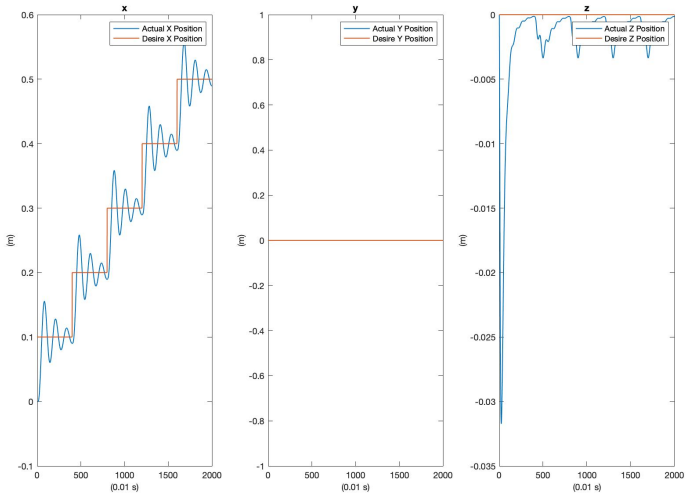

Figure 13. actual position vs desired position

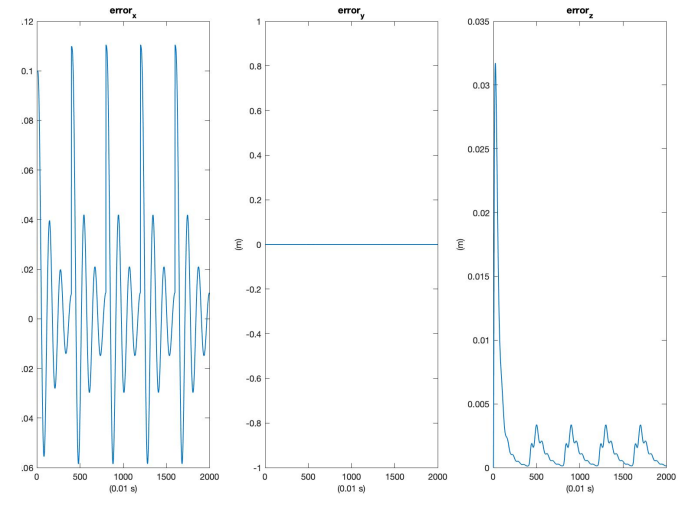

Figure 14. Position Errors

2.4 Below are the figures showing the actual/desired position, as well as the position error (**using bigger Kr and Kw - multiply the value by 2**):

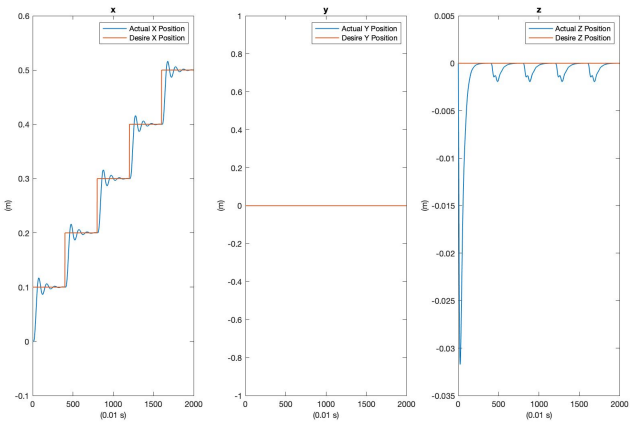

Figure 15. actual position vs desired position

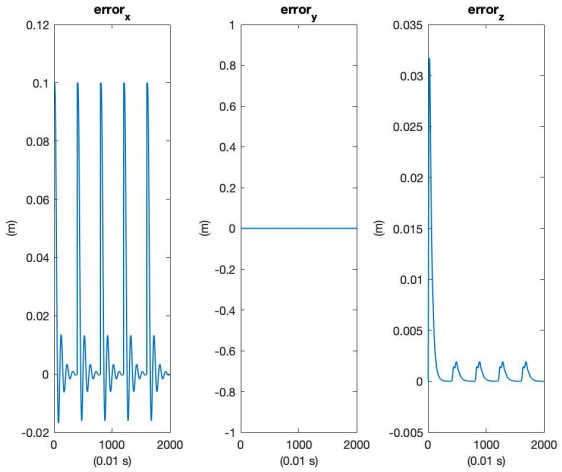

Figure 16. Position Errors

Comment

Indicate when new waypoints are sent to the system.

The waypoint is sent to the system at t=0.

Examine the convergence of the robot to each waypoint.

Robot is able to converge to the waypoint under all gain conditions.

We noticed that our system is able to converge to the waypoints