Question 7

Bounded Acceleration Trajectory Generation [10]: Develop a straight line time-parameterized polynomial trajectory with initial and final endpoint constraints ([0, 0, 1] and [0, 0, 10], respectively; higher-order terms zero). Choose a time-scaling that ensures a bounded (maximum/minimum) acceleration less than 3 m/s^2. Generate a set of error plots that depict the performance of the platform when tracking the trajectory (using PD control) including the error in the pose and linear/angular velocities. Does the robot track the trajectory as expected? Is there any substantial error arising while tracking the trajectory? If so, what is the source? Continue to increase the desired acceleration bound. At what value does the system begin to exhibit degraded tracking accuracy? How does this empirical observation relate to the motor response? How does the performance improve if you artificially increase the motor gain configuration parameter thereby effectively upgrading the robot motors?

Remark: Ensure that throughout these trials the maximum thrust stays within a reasonable level appropriate for the real-robot system. Remember to restore the motor model configuration value to the original value upon completion of this exercise.

Q7 Performance within acceleration constraint

7.1 Below are the figures showing the actual/desired position, as well as the errors in pose and velocities.

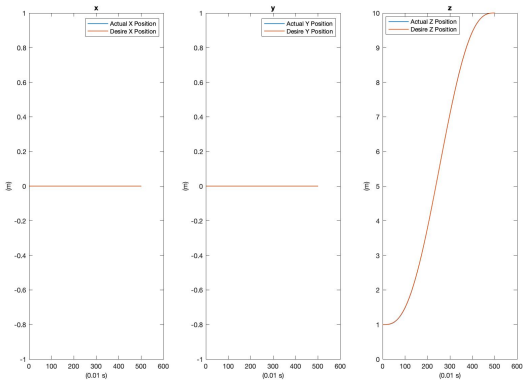

Figure 1. actual position vs desired position

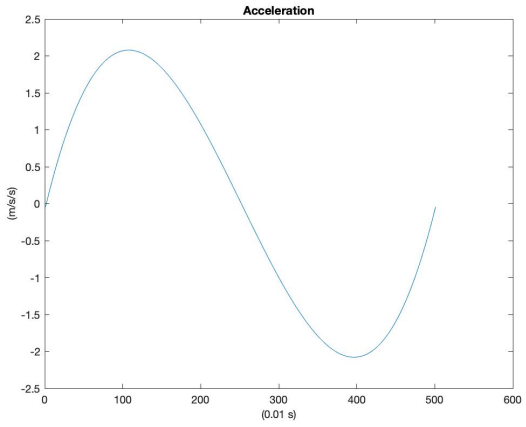

Figure 2. Acceleration

(We notice that acceleration is within the constraint)

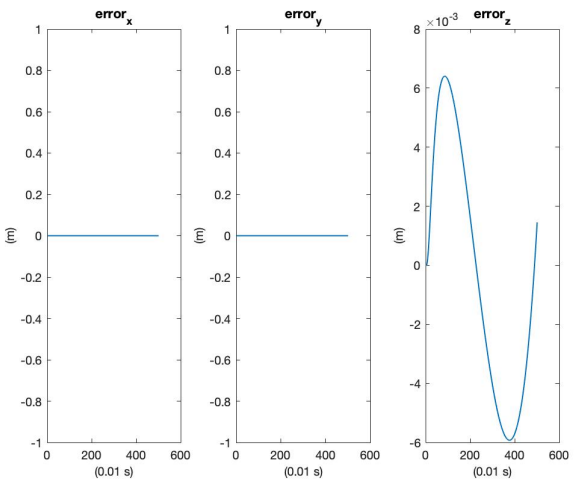

Figure 3. Position Error

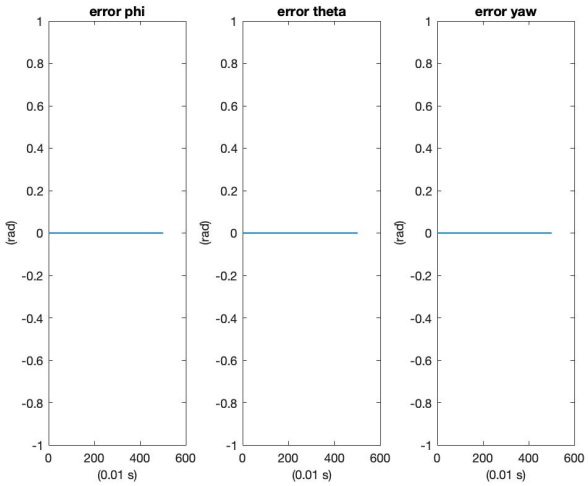

Figure 4. Rotation Error

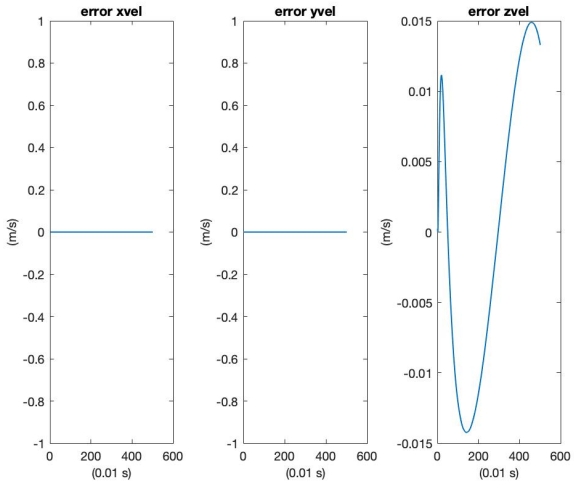

Figure 5. Linear Velocity Error

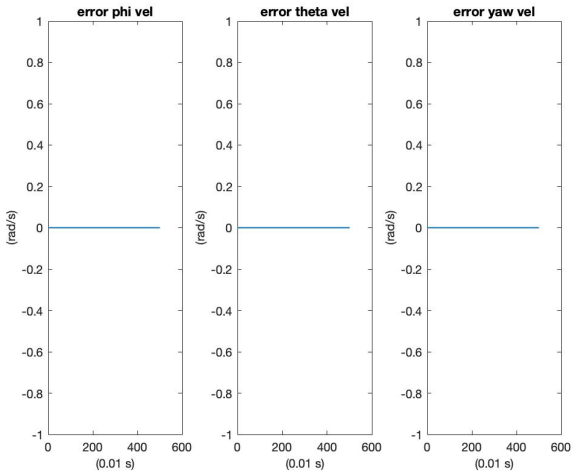

Figure 6. Angular Velocity Error

Q7 Performance violating acceleration constraint

7.2 Below are the figures showing the actual/desired position, as well as the errors in pose and velocities.(The max acceleration is 10m/s/s, greater than the 3m/s/s constraint)

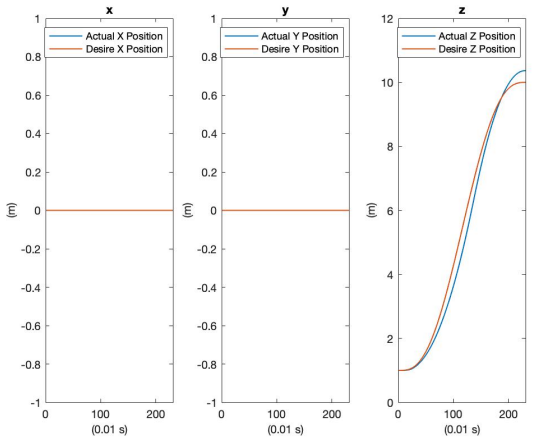

Figure 1. actual position vs desired position

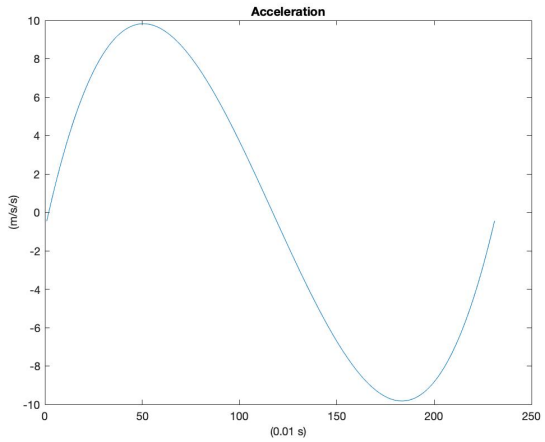

Figure 2. Acceleration

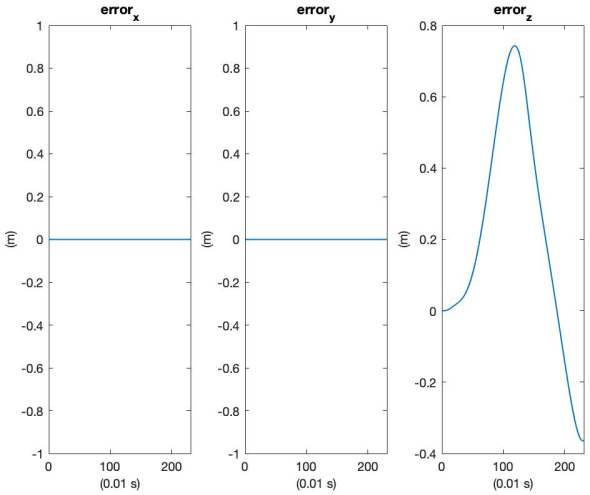

Figure 3. Position Error

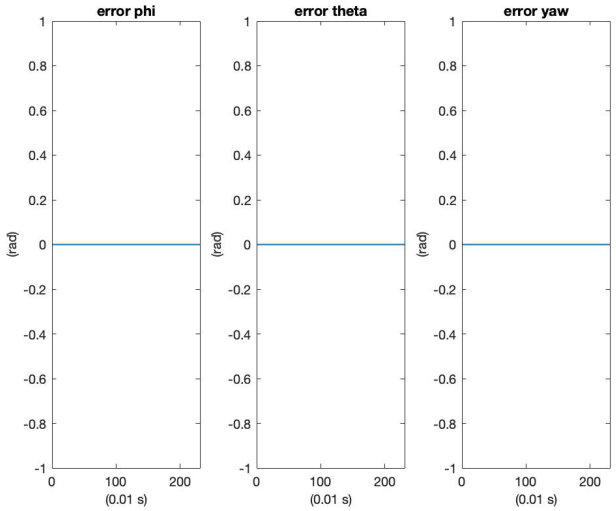

Figure 4. Rotation Error

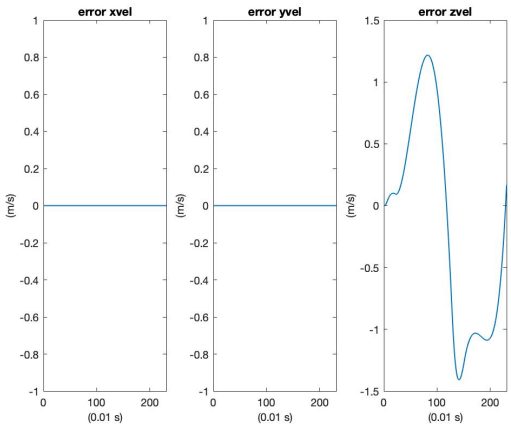

Figure 5. Linear Velocity Error

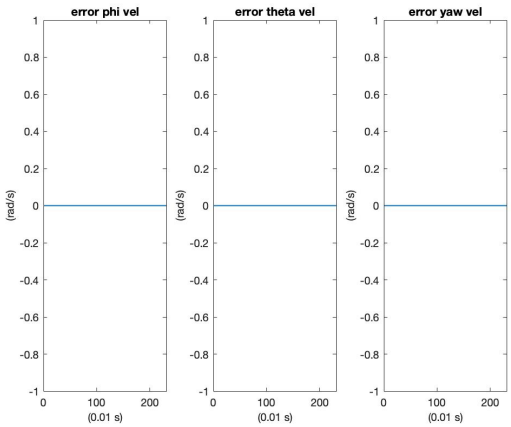

Figure 6. Angular Velocity Error

Q7 Performance by modifying motor gain parameters

7.3 Below are the figures showing the actual/desired position, as well as the errors in pose and velocities. (We make the CT lager by multiply a factor of 2)

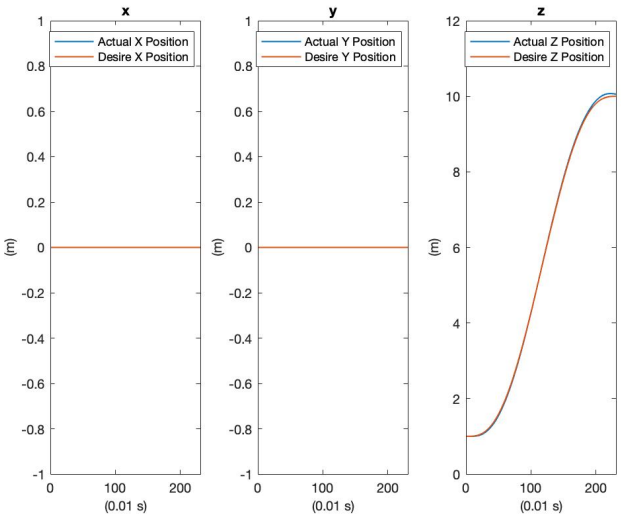

Figure 1. actual position vs desired position

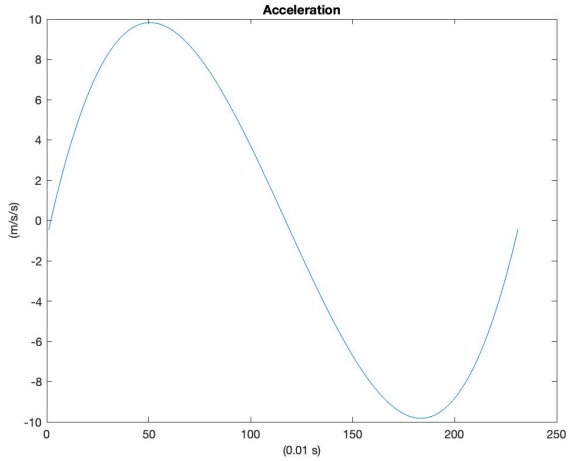

Figure 2. Acceleration

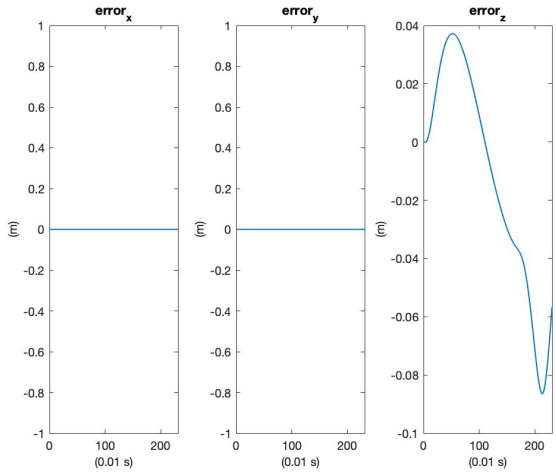

Figure 3. Position Error

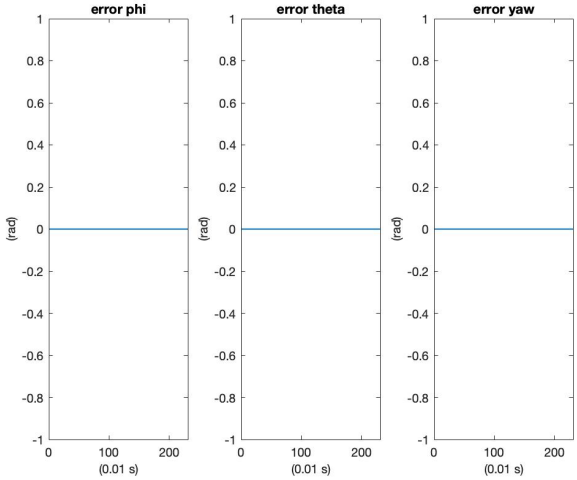

Figure 4. Rotation Error

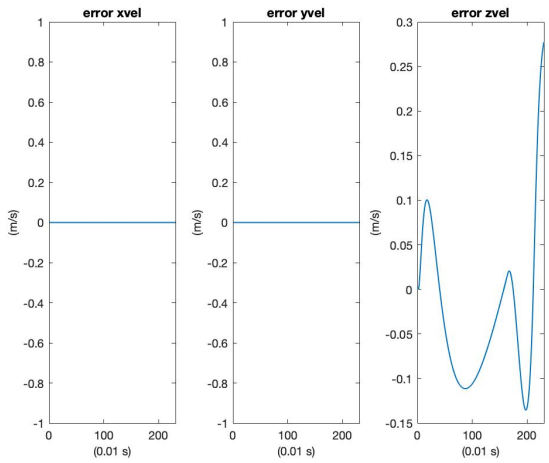

Figure 5. Linear Velocity Error

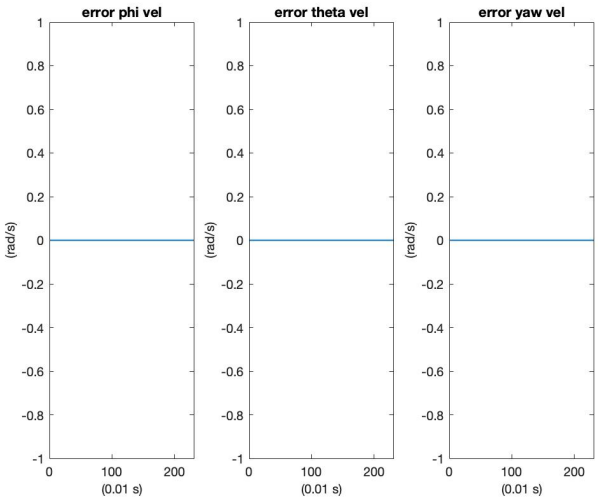

Figure 6. Angular Velocity Error