Christopher Tsai

ME 449 Capstone Project README

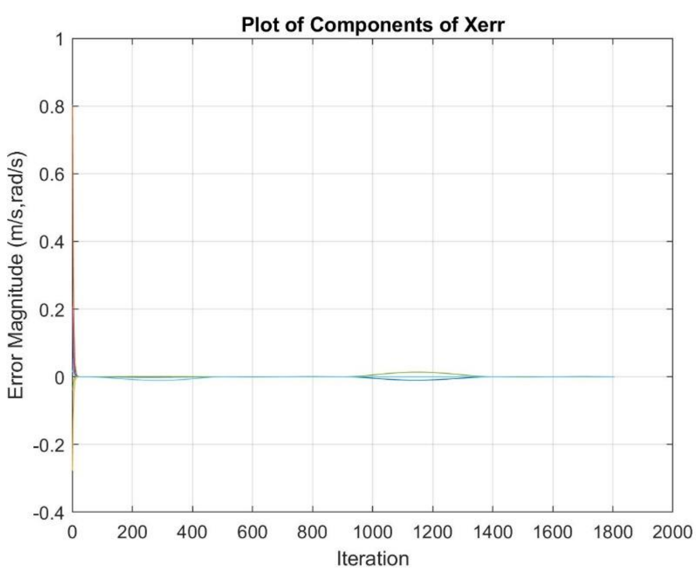
This hands-on project was a great way to integrate all of the material that was taught in ME 449. In summary, the software creates a reference trajectory that a mobile manipulator follows to pick-and-place a cube of known parameters and performs odometry as well as feedback control to actually move the robot through the trajectory. The code can be separated into steps:

1. Creating a desired trajectory.
2. Initializing values and parameters that are used by functions, such as dimensions, max speed, and timesteps.
3. Iterating through each step of the desired trajectory and:
    a. Calculating control law to generate wheel and joint controls that move current configuration to desired configurations.
    b. Feeding these controls to a function that creates and builds the actual trajectory.
    c. Storing errors for later data visualization and analysis.
4. Plotting and exporting error data.
5. Exporting .csv file of actual trajectory.

After integrating the functions from the different milestones of the project, I found success by:

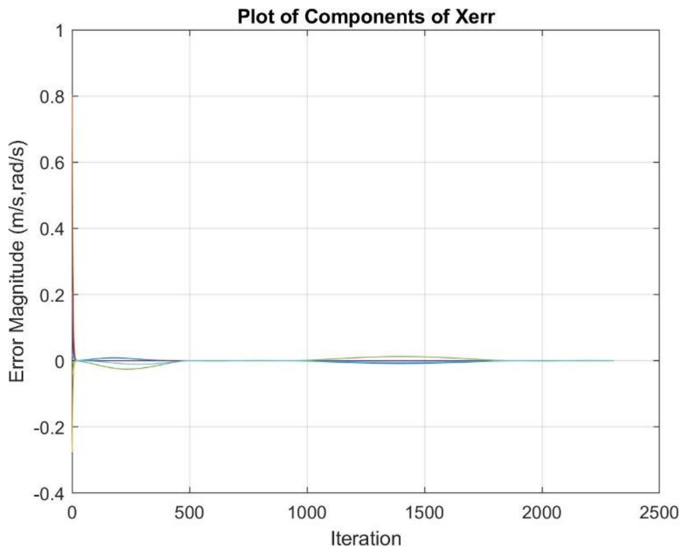
1. Tuning the gain parameters Kp and Ki.
2. Changing the length and speed of the reference trajectory segments so that the robot wouldn't drop a cube once it grabbed it or take too long grabbing it.
3. Increasing the parameter k, the number of trajectory reference configurations per 0.01 seconds.

Results:



My best run exhibited very little error between the reference trajectory to the actual trajectory. The mobile manipulator was able to pick up, transport, and place down the cube very effectively.

This was further supported by the low errors in the New Task graph, which involved a longer trajectory:



As mentioned in the Overshoot README, increasing Kp too much (>2) led to unstable behavior when keeping Ki at 0.8. This was an interesting way to observe how control gains can also negatively affect the performance of a system.