Lab 4. Omnibot introduction and data collection.

Deliverables: **Each group must submit a *short* (~3-page) Postlab Assignment, processing data collected during Lab 4. Be sure to MEASURE the position and angle (using measuring tape) where your omnibot ends up after a trial, in addition to logging and saving data for a run. We suggest video documentation may be helpful, to examine the transient behavior and trajectory of the robot (and not just the end state).** Post-processing data will allow you to determine what the expected (ideal) motion of the omnibot would be for actual motor angles that were recorded over time.

Overview

The goal of this lab is to control the omnibot to accurately follow each of two desired paths:

1. A square (approximately 1 meter on a side)
2. A circle (approximately 1 meter in diameter)

As always, you are encouraged to explore various solutions, depending on your personal knowledge, interests, curiosity, and persistence.

The assignment requires that you have completed the tasks listed below. **We are creative/flexible about how you approach particular problems.** Include relevant presentations of data, such as plots of data (e.g., desired vs actual motor position over time), and a summary of the methodology and calculations required.). *Please be concise and efficient in your presentation; well-labeled plots are always appreciated – and often can be much more effective in communicating details than excessive text.*

Your tasks in this lab include:

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1. Design a trajectory for both the square and circle paths. You should have done most if not all of the required work for the square in Prelab 4. The robot should not rotate during each path; keep φ_b constant. Ensure the paths are "smooth" functions of time. Also determine how quickly the path should be execute, and modify your simulink model to play back trajectories at the desired speed.

2. Implement a proportional controller to follow each path. You must (1) log and save data for each run and (2) record the final position of the robot. Your data will be used in the post-lab assignment, in which you will predict the motion of the robot, based on the recorded actual motor position over time.

3. Repeat part 2, but follow only half the path, so you can accurately record the robot position midway in the trajectory. This data will allow you to estimate how close the size of your shape is to what was planned.

4. Modify your simulink model to improve performance. Suggestions include the following: (a) including feedforward control, (b) modifying trajectories (adjusting maximum speeds, correcting or improving kinematic models, etc.), (c) including integral control (PID), (d) using better velocity estimation/filtering. Good luck.

EXTRA CREDIT 5. Now, plan a more interesting trajectory, in which the vehicle turns as it is moving. For example, turn while tracing the square, or draw a circle with the same wheel always pointing inward.

Postlab Assignment:

Use your saved data to determine the expected motion of the robot for each recorded trial. Compare the expected end point (based on data), the planned end point (i.e., since it is a closed path, the planned end point was your start position and orientation), and the measured end point.

Comment on accuracy, sources of error, and on the success of your attempts to improve accuracy.

Note that Homework 2 will require you to develop code to facilitate the analysis above. Namely, it will require you to calculate a trajectory of the robot over time, given a set of motor angles over time.