Exercise 2: Localization and Control*

EENG350: Systems Exploration, Engineering, and Design Laboratory

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1 Introduction

Mobile robots both need a way to move around, and a way to keep track of where they are in the world. For your mobile robot, you will use DC motors to drive two wheels, and read the motor encoders to monitor wheel rotation. You will be exploring this process in both simulation and hardware.

Exercise Objectives:

- Use Simulink to model a DC motor and design a proportional controller to regulate velocity
- Use the Matlab interface to run a simulation and display plots or animations of the results
- Determine the relative location of a two-wheeled mobile robot from wheel encoder measurements
- Use the publish function of Matlab to produce a report

Read the accompanying tutorial handout on Canvas and go through the exercises. In the next section, there are four demonstration exercises. You should arrange with your Localization and Control partner to divide them between you. Each of you should choose one that starts with 1 and one that starts with 2. The demonstration exercises are checked off by a TA or instructor in pairs: Each of you will set up an exercise of the same number (e.g. 1a and 1b) and will get checked off at the same time.

Each of you will submit the documentation related to the demonstration exercises that you chose. For documentation involving Matlab or Simulnk results, one easy way to create these documents is to have well documented code, and to use the publish function of the editor. You can watch a video demonstration of this. The publisher can create a variety of document formats, for submissions select a .pdf format. These documents should include the Simulink block digram, system and simulation parameters, plots of the results, and an interpretation of the results (for example, using comments).

2 Demonstration Exercises

1a The Fading example demonstrates the use of analog output (PWM) to fade an LED. It is available in the File->Sketchbook->Examples->Analog menu of the Arduino software. Implement this example, and use an oscilloscope to measure the voltage at the analog output pin and explain to the TA/Instructor what is happening.

- Documentation: None

1b Spin a DC motor using the Arduino and motor driver board. Using an oscilloscope, show the voltage applied to the motor. Demonstrate how to change the voltage sign, and the pulse width.

- Documentation: None

2a Demonstrate motor velocity control by setting a desired speed in radians per second given to you by the TA/instructor, running the controller (starting with the wheel at rest) displaying the time, voltage, and velocity at regular intervals, running again with the results sent via serial to Matlab, and finally plotting the experimental results (voltage vs time and velocity vs time) along with your simulated design results on the same plots.

- Documentation: Your well documented Arduino code in one file, and the experimental results processed by Matlab, **with comments and interpretation**, in another file. (As discussed above, we suggest using the publish function of Matlab to create the file, where you add appropriate comments for interpretation of the results). The documentation is sufficient if someone else would be able to re-create your results.

2b Demonstrate the ability of the Arduino to keep track of its position and orientation with respect to rotations of its wheels, and to animate the results in Matlab. You will spin the wheels by hand, rather than using the motors.

- Documentation: Your well documented Arduino code in one file, and the experimental results processed by Matlab, **with comments and interpretation**, in another file. (As discussed above, we suggest using the publish function of Matlab to create the file, where you add appropriate comments for interpretation of the results). The documentation is sufficient if someone else would be able to re-create your results.