

Assignment 1

Due: Monday, 1/14/2012, 5:00pm EST (Written) and 11:59pm EST (Electronic)

Objective: The objective of this assignment is to give you an opportunity to learn more about robotics technology, practice different coordinate transformations, and get started with MATLAB.

1 Handwritten Portion (Due 5pm EST)

1. Coordinate transformation (25 points) Referring to the hand-out on coordinate transformations downloadable via BBVista, please complete the following problems: 2.2, 2.4, 2.11, 2.13, 2.29. Students registered in MEM 800 must complete these additional problems: 2.34, 2.35, 2.38. (15 additional points)

Note: You may do these problems by hand and submit this portion of the homework by placing your papers in Prof. Hsieh's mailbox in the MEM Department Office before 5pm EST on Mon 1/14/2013. Make sure you show your work.

2 Electronic Submission Portion (Due 11:59pm EST)

You must type the following portion up and generate a single PDF file and email the file to MEM380.grader@gmail.com before 5pm EST on Tues 1/24/2012.

2. Internet Research (10 points) There are many resources on the internet on robotics and robotics-related technology. Using the power of internet search, please write a brief paragraph (< 500 words) describing how a stepper motor works. Make sure you cite the resource you used to come up with your description.

3. Internet Research (10 points) Again, using the power of internet search, please write a brief paragraph (< 500 words) describing how wheel encoders work. Similarly, make sure you cite the resources used.

4. MATLAB Intro Exercises: DO NOT submit your Matlab m-files. Instead, submit in **PDF** format, your *commented* Matlab code (where applicable), the output of the code (where applicable), and/or the answer to the exercises. You will be graded on how understandable your code is as well as whether it generates the correct answer.

4a. (5 points) We can generate a set of data with a random error about some mean value with the commands

```
>> num=100;  
>> spr=0.1;  
>> data=5.0+spr*sign(1.0-2.0*rand(1,num)).*rand(1,num)
```

(i) What is the last line doing?

- (ii) Write a program which computes the mean and standard deviation of the data. Use FOR LOOPS.
- (iii) Eliminate the FOR LOOPS using the sum function or the mean function and the std function.

4b. (10 points) Use the rectangular approximation method, numerically integrate the following integrals in MATLAB:

(i) $I = \int_0^2 \sqrt{1 + e^x} dx$

(ii) $I = \frac{1}{\sqrt{\pi}} \int_{-4}^4 e^{-x^2} dx$

(iii) $I = \int_0^{10} e^{-x/10} \sin x dx$

Recall the rectangular approximation method is given by:

$$\int_a^b f(x) dx \approx \sum_{i=0}^{n-1} f(x_i) \delta x.$$

5. (10 pts) Part 0: For this last problem you will code up the software for a vending machine in MATLAB. Assume the vending machine sells 10 different items all for the same price. The vending machine can be in any of four states: x_1 - waiting for money, x_2 - waiting for user to select item, x_3 - vending item, and x_4 - returning change. In each of these states, the machine has a set of actions that it needs to execute. For example, if the machine is in the x_1 state, it needs to prompt the user for money. Once the user has put in enough money, the machine should ask the user to choose on of the available items. Once the user has selected the desired item, the machine should vend the item or let the user know that the selected item has run out. At this point, the machine can either return the money to the user or prompt the user to select a different item. Using what you have learned in lecture, select 10 different items for a vending machine. Now design the software that would run on the vending machine. Your main program should be named `vendingMachineP0_user.m` such that `user` is replaced with your Drexel e-mail username. You are highly encouraged to write separate functions so as to enable the vending machine to execute the various commands. The functions `input` and `disp` will be helpful here.

(5 pts) Part 1: Assume you have 10 different items such that some of are priced different from the others. Change your code to accomodate the different prices. You should name your main program `vendingMachineP1_user.m` where `user` is replaced with your Drexel e-mail username.