ELEE 4200/5200: Autonomous Mobility Robotics

Term I, 2018

Homework 1: MATLAB-ROS Connectivity

Note:

- The aim of this assignment is:
  - To assess whether you understand the various software components necessary for this course, as installed in the laboratory computers.
  - To demonstrate a fundamental ability to exploit the MATLAB-ROS connectivity to operate a simulated robot in Gazebo from within the MATLAB environment, as required.
- Guidelines:
  - Due date: Thursday, September 20, 2018 by 12 Noon.
  - You are permitted to work in groups of no more than two students. State the full names and T# of the students in the group on the cover page of every document that you submit.
  - Submit the report by responding to this assignment posting in Blackboard.
  - The submission should at least include the following documents, bundled together into a single zip file with the name *YourNameHW0* (use one of the group member names).
    - The main report (following the template provided).
    - The main report in 'pdf' form.
    - The MATLAB program code.
  - A hard copy (printout) of the 'pdf' report with MATLAB code; staple all pages together and follow the TA's instructions on how to submit.
  - Each group must work on its own in completing this assignment! Feel free to consult with others in developing solution ideas, but the final implementation code must be your work product alone. Refer to the Syllabus, where the policy on academic integrity is clearly outlined, our classroom discussion on this topic, and consult with me if you have any questions!

Part A

a) Construct a program in MATLAB that *continuously* drives a simulated Turtlebot (in Gazebo) at the following forward velocity and turn rate:

$$v = 0.5\frac{m}{s} \& \ \omega = 0.5\frac{rad}{s}$$

b) Obtain an estimate of the radius of curvature of the path followed by the robot.

c) Change the velocities of the robot to the new set of values below and drive the robot again:

$$v = 0.25\frac{m}{s} \& \ \omega = 0.125\frac{rad}{s}$$

d) Re-estimate the radius of the robot path.

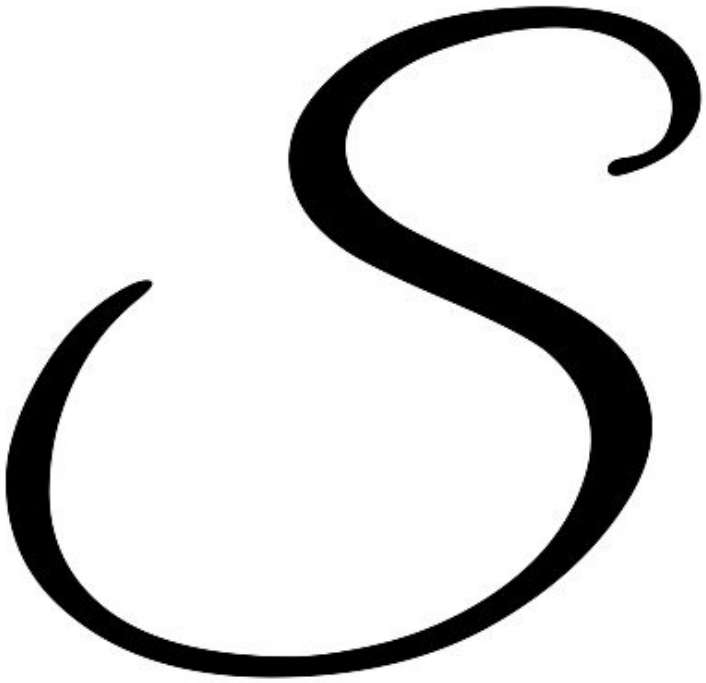
e) Change the velocities of the robot to the third set of values below and once again drive the robot:

$$v = 1.0\frac{m}{s} \& \ \omega = 1.0\frac{rad}{s}$$

f) Comment on the behavior of the simulated robot for this experiment.

Part B

g) Drive the Turtlebot in Gazebo appropriately so that the path generated produces a reasonable reproduction of the letter ‘S’ as shown below. Line thickness is not important! The robot path needs to be captured and re-produced in your report as proof of having achieved the desired result.



References:
Use the classroom discussion entitled “Introduction to ROS” and the demonstrations as a starter. Then, go to the following site which pertains to MATLAB R2018a (or the equivalent site for MATLAB R2017a):
https://www.mathworks.com/help/robotics/getting-started-with-robotics-system-toolbox.html
Then, look at the first link within this page - “Get Started with ROS”. After that, follow up with the links listed below which can be accessed at the bottom of each page.

- “Connect to a ROS Network”
- “Exchange Data with ROS Publishers and Subscribers”
- “Work with Basic ROS Messages”
- “Get Started with Gazebo and a Simulated TurtleBot”
- “Get Started with a Real Turtlebot” (for those interested in hardware implementation after the simulation phase)

The above documents contain enough information for you to finish Homework 1. While not all of the information is necessary for this homework, it is to your understanding of the MATLAB-ROS interface in general.