TÉCNICO LISBOA

Robotics

MEEC - MEIC-A - MEBio

Spring 2016

Departamento de Engenharia Electrotécnica e de Computadores

2nd lab assignment

Basic navigation strategies for mobile robots motion

(Due by the week of May 23-27, 2016)

1 Objectives

This lab assignment aims at (i) developing students creativity related to the use of mobile robots, and (ii) having students familiarized with the problems related to sensing, actuating, and controlling the robot to execute a mission in an a priori known environment.

2 Syllabus

Consider a mobile robot, with unicycle kinematics, as the Pioneer DT robots in the lab.

Figure 1: fig:The Pioneer DT robot

The specific objectives for this lab assignment are

1. Control the robot to navigate around the North tower 5th floor, starting from inside the lab and returning to the starting point,
2. Avoid obstacles in the way; consider only static obstacles, i.e., there will be no dynamics obstacles.

The robot can use navigation aids, namely

- QR codes to help localization (suggest public domain software such as the Zebra Crossing project, www.zxing.com, you can also check the course webpage, file QR-code.rar),
- Sound detection/recognition (suggest basic strategies such as the correlation method, available from www.mathworks.com, you can also check the course webpage, file SpeechRecognition.rar).

QR codes can be put around the floor to help the robot navigation but should not be left there permanently. Once they are not being used they must be removed.

The Pioneer XT robot is controlled through an RS232 serial communications line. Connect this line to a laptop computer running Matlab and the robot can be controlled through the functions in Table 1. These functions are available at the course webpage, file matlab_pioneer.rar.

Linear and angular velocities are in mm/s and degrees/s, respectively. As in the previous lab assignment, prior to the use of the functions to control the robot ans assess its state, the user must open the serial port for communications using the function *serial_port_start*. To disconnect the computer from the robot a *serial_port_stop* function must be called.

pioneer_set_controls("serial port object", "linear velocity", "angular velocity arg");
pioneer_read_odometry();
pioneer_read_sonars();

Table 1: Main functions to control the robot and access its state

3 Guidelines

- Calibrate the controls for the robot; in general, due to a number of factors, e.g., wheels of different size, the kinematic model of the robot is not exactly that of a unicycle and an adequate compensating strategy must be used.
- Develop an algorithm to generate paths in the free workspace that can be used by the robot to navigate between any two points.
- Develop a control strategy that generates the linear and angular velocities that will make the robot to follow the path generated in the previous item.
- Check the influence of odometry errors. Eventually, the odometry errors are too big and the execution of the mission can not rely on the odometry data exclusively. Consider using the sonars to help the navigation.

4 Expected outcomes

Students must deliver a zip/rar file containing all the software developed, tests ran, and adequate pdf documentation explaining, clearly, the project and how to use the software.