Mestrado em
Engenharia Informática e de Computadores
MSc in
Information and Computer Engineering

INTRODUÇÃO À ROBÓTICA / INTRODUCTION TO ROBOTICS

2019/2020

Mini-Project 2

Hand-out: 23 September 2019 **Due:** 29 November 2019

Objective

The objective of this homework is to provide the course students with the opportunity to get familiarized with the practical aspects of mobile robot path planning and path following, using guidance algorithms. For this purpose, students must get acquainted with some of the available ROS packages for navigation (particularly the navigation stack), learning how to use them, and being able to explain formally their operation principle. Students must also get used to saving all the relevant data to be reported using `rosbags`.

Procedure

The work will be implemented in a TurtleBot3 Waffle Pi[1] mobile robot. The robot has an onboard laser scanner, used to acquire the environment map and to self-localize (done in Mini-Project 1), as well as to detect unexpected obstacles, and a Raspberry Pi processor where all ROS drivers are running. The algorithms implemented in the mini-project will run on an external computer that communicates with the onboard ROS master using WiFi.

The main steps to be followed to achieve the objectives of the project are (using the real robot):

1. Use the map obtained in Mini-Project 1. to plan a path that visits a set of four waypoints within the map, located so as to avoid known obstacles/objects in the map. Use one of the path planning methods taught in class for this purpose.
2. Use `move_base` (from ROS navigation stack) to follow the planned path through the four waypoints. While following the path, the robot will have to self-localize – use one of the algorithms from mini-project 1 for this purpose and integrate it with `move_base`.

1 http://www.robotis.us/turtlebot-3-waffle-pi/

3. Repeat 2. but add unexpected (unmapped) obstacles to the path to be traversed by the robot. Modify/configure `move_base` to adequately avoid those obstacles, using the laser scanner to detect them.

Expected results

The following list represents the minimal set of results to be reported:

- planned path – in RVIZ;
- actual robot path (estimated by the robot) – in RVIZ;

The groups are strongly encouraged to explore and modify relevant parameters of the methods used, so as to be able to present a diverse set of results and justify the differences among them as a function of the parameters used.

The waypoints should be such that the path to be followed is not trivial. This choice will be subject to evaluation.

Reporting

The mini-project will be evaluated taking into account the quality of reporting on the work done, the results presented in class and in the written report, and the ability to explain them formally. The written report should be no longer than 10 pages A4, one column, 12pt, 1.5pt spacing. All reports shall be structured in Sections as follows:

1. Introduction – *summarizing the work done*
2. Background – *brief introduction of main equations and algorithms involved in the used methods, to establish notation, citing references used*
3. Implementation – *core section, where the implementation of the applied methods is described with some detail*
4. Results – *addressing mainly the questions raised in the homework text*
5. Conclusions – *what went well; what went less well, explaining why*
6. References