B39VT Integrated Group Project

Spring Semester 2018

Assignment 1

BASIC REACTIVE MOTION PLANNING

Background: Your robot is now equipped with a basic obstacle avoidance algorithm. However, it is currently not able to decide where to go and will only react to obstacles and avoid them without a end position in mind.

Objectives: The objectives of this assignment is to equip the robot with a reactive motion planning algorithm that you will design. The algorithm should take a goal position in 2D space as argument and derive velocity and/or position commands to drive the vehicle towards the goal whilst avoiding obstacles. We will assume that we have no-prior map of the environment and that the algorithm is only reacting to live measurements of the laser scanner. You can however envisage to store the environment in a grid cased system to record obstacles (and memorize them) when you find them. If you decide to use a third party algorithm, which is not recommended, you will need to acknowledge your source and be able to explain the theory behind it in details and understand the code implementation in full.

Evaluation & Reporting: Your algorithm will be evaluated in simulation (gazebo) on a number of unknown environments that we will provide. It will also be tested on the real robot in a simple environment. The assignment will be evaluated by a combination of live demonstration and code scrutiny as well as a short report detailing the theory behind the algorithm implementation, an evaluation of the algorithm on a few scenarios (provided by us in gazebo) and a copy of the code you have produced. Beside well performing programs and correctly implemented algorithms, we want to see well designed (modular, re-usable) and readable/well commented code showing appropriate use of relevant libraries. The report should be no longer than 6 pages, excluding the code. It should provide evidence of background reading, and offer a concise description of the design/implementation approach together with an analysis of the results of the tests performed.

References: You can find below an extensive presentation of motion planning algorithms and some references to seminal works in reactive motion planning and obstacle avoidance for mobile robots. Whilst not all of them are relevant, they present important notions in robotics and we would strongly encourage you to read it in full. We will be available to answer any questions you will have on the topic

[1] http://ais.informatik.uni-freiburg.de/teaching/ss11/robotics/slides/18-robot-motion-planning.pdf (also in Learning Material\Motion Planning)

[2] M. Khatib and R. Chatila, “An extended potential field approach for mobile robot sensor-based motions,” in Proc. of the Intelligent Autonomous Systems, IAS-4, IOS Press, pp. 490–496, 1995.

[3] J. Borenstein and Y. Koren, “The vector field histogram - fast obstacle avoidance for mobile robots,” IEEE Transaction on Robotics and Automation, vol. 7, no. 3, pp. 278 – 288, 1991

[4] I. Ulrich and J. Borenstein, “Vhf+: Reliable obstacle avoidance for fast mobile robots,” Proc. of the IEEE Int. Conf. on Robotics and Automation, pp. 1572 – 1577, 1998

[5] D. Fox, W. Burgard and S. Thrun, "The dynamic window approach to collision avoidance," in IEEE Robotics & Automation Magazine, vol. 4, no. 1, pp. 23-33, Mar 1997. doi: 10.1109/100.580977