Lab 4
SLAM with the Turtlebot3

March 3, 2022

Learning Objectives

1. Utilize the Turtlebot3.
2. Utilize the RViz visualization environment.
3. Learn the principles of SLAM (Simultaneous Localization and Mapping).
4. Research and compare/contrast at least 3 SLAM techniques.
5. Program a single-board Linux computer for an embedded application.
6. Utilize the Linux operating system, including its command line interface (CLI).
7. Leverage the usability of Python and its libraries for the rapid development and prototyping of embedded systems.

Overview

For this lab, you will implement Simultaneous Localization and Mapping (SLAM) on the Turtlebot3. SLAM is a core-function in any robot - the ability to determine its position and orientation in a given space by using a known map or generating a map.

Much of the background for SLAM on the Turtlebot3 can be found in this TB3 tutorial. The first requirement will be to download the appropriate packages for the Turtlebot3.

```
$ cd ~/catkin_ws/src/
$ git clone https://github.com/ROBOTIS-GIT/turtlebot3_simulations.git
$ cd ~/catkin_ws && catkin_make
```

The configure your .bashrc to export the correct Turtlebot3 model.

```
$ export TURTLEBOT3_MODEL=waffle_pi
```

Now execute SLAM. You will need to open multiple terminal windows. The following commands are examples of using the TurtleBot3 Waffle Pi model.

```
$ roscore (Remote PC)
$ roslaunch turtlebot3_bringup turtlebot3_robot.launch (on RPI)
$ roslaunch turtlebot3_slam turtlebot3_slam.launch slam_methods:=gmapping
```

```
$ roslaunch turtlebot3_teleop turtlebot3_teleop_key.launch or teleop_twist_keyboard
```

Drive the robot in your environment. Build the map as shown in Rviz and then save the map.

```
$ rosrun map_server map_saver -f ~/map
```

Lab Requirements

Perform two types of SLAM on the Turtlebot and save the generated map. Create a custom script that allows the robot to explore the environment without using teleoperation. Compare/contrast the two SLAM techniques. Write a lab report with your results.

Deliverables

- Demonstrate the robot successfully performed two types of SLAM by including the generated map.pgm in your write-up.
- Do research on SLAM and compare and contrast three SLAM algorithms.
- Build a custom script to perform SLAM in 'explorer' mode to build a map (either of the two SLAM algorithms).
- Upload a video with voice descriptions to Canvas that demonstrate your SLAM algorithm.
- Write a lab report IAW lab write-up procedures.
- In accordance with DAW, include any applicable documentation with your lab report.