Advanced Robotics

ROS Project

Pôle

Numérique

Author	: Guillaume GIBERT
Version	: 1 R 0
Promotion	: 2026
Program	: EENG4
Date	: July 23th 2024

1. Lab description

The aim of this lab session is to apply the ROS knowledge introduced during last weeks' lectures, tutorials and labs. Each pair of students will experiment using a mobile robot Turtlebot that is fully ROS-compatible. This lab session is project-oriented. Its aim is to create a ROS package composed of one or several nodes that drive(s) the robot in autonomous exploration. Launching this/these node(s) will ease building the map of the environment.

2. Setup

One Turtlebot and one laptop are available for each pair of students. They are all connected to a local network whose SSID is **RoboticLab**. Each laptop will run a ROS Master and each Turtlebot will connect to its dedicated ROS Master as represented in Figure 1.

Before starting the ROS package development, you should check the setup i.e. determine network settings, check network connectivity, and check ROS settings...

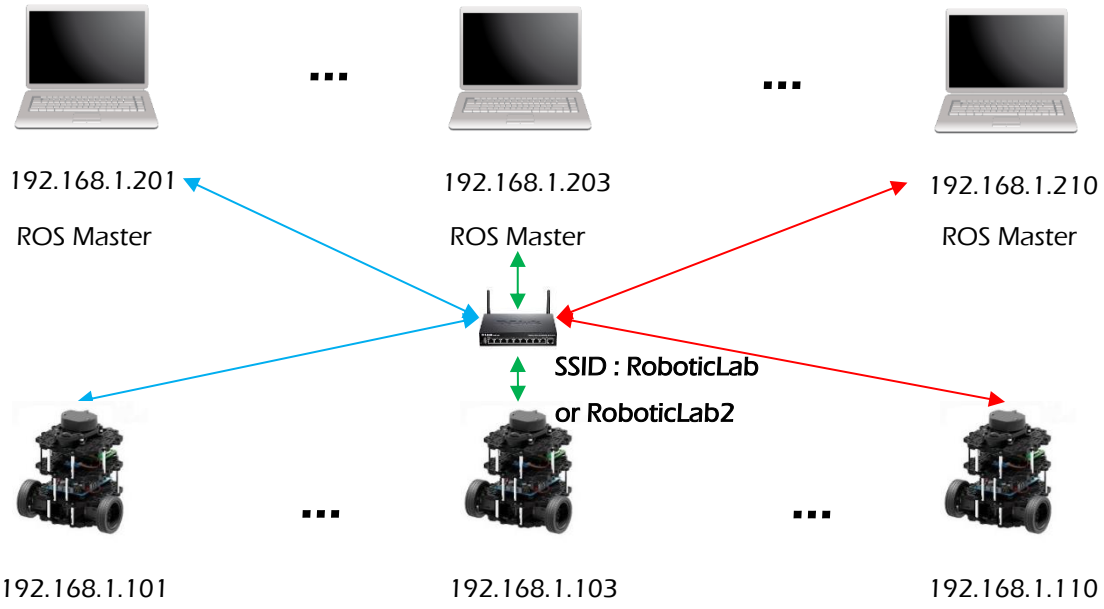

Figure 1 : Architecture of the connections of the laptops and robots in the local network

3. ROS Package

As you have experimented during the previous lab, building a detailed map requests a long exploration of the environment. Performing exploration using the teleoperation node (on the PC or the Smartphone) is a tedious task.

Your mission is to build a node (or several nodes) that drive(s) the robot automatically in every corner of the area avoiding all the obstacles. This node should stop once the covered area is higher than a predefined threshold **for example** (or you may imagine other stopping criteria).

3.1. Instructions

- To achieve this goal, you must use as many tools as possible to ease your development (git, documentation, unit tests...).
- You must write a report describing the project, the methods you used and the results you obtained (do not forget to write an introduction and a conclusion!). While writing you report, keep in mind that it should contain enough information for a new student to rebuild the same experiment later on.

- You will be assessed on the behaviour during the lab session, the final report and the corresponding source code.
- You should use the provided Word template to write your report.
- You must submit the report written in **English** as a **pdf** file through Moodle before Sunday November 10th 11.59pm.
- The title of the report should be **AdvancedRobotics_ROS_Lab2_Student1*Name_Student2Name*.pdf** (please change *Student1Name* and Student2*Name* accordingly).
- A penalty of 1 point will be applied for late submission every 5 min i.e. -1point if submitted between 12am and 12.05am, -2 points if submitted between 12.06am and 12.10am...
- A penalty of 0.5 point will be applied if a figure does not have a cross-reference in the text, if the axis labels are missing, or if the legend/title are absent. These penalties can be accumulated i.e. up to -1.5 point / figure.

3.2. Hints

When dealing with an unknown environment, random exploration is **one of** the most efficient solution.

To perform random exploration, the robot should

- move in random directions;
- use its sensors to detect potential obstacles to avoid collisions.

For example, the first generation of Roomba robot had a very basic behaviour: moving forward until they hit an obstacle then rotating of a random angle and moving forward again, repeating this pattern indefinitely.

Therefore, you could implement (at least):

- a function that detects obstacles based on the Turtlebot's sensors;
- a function that drives the Turtlebot forward;
- a function that spins the Turtlebot of a random angle.

Then, you may combine these functions to achieve the desired robot's behaviour.

Do not forget to choose one (or several) criterion/criteria to stop the random exploration.

4. Useful links

http://wiki.ros.org/

http://wiki.ros.org/turtlebot3_bringup