Master 2 Systèmes Dynamiques et Signaux

Supervisors	Rémy GUYONNEAU – remy.guyonneau@univ-angers.fr Franck MERCIER – franck.mercier@univ-angers.fr
Title	**SLAM evaluation using Interval Analysis**
Keywords	Mobile Robotics, Interval Analysis, SLAM, ROS2
Laboratory	LARIS, University of Angers
Team	Systèmes Dynamiques et Optimisation (SDO)

Context

In Mobile robotics, localization and mapping are fundamentals: to be able to move from a point A to a point B, a robot needs to know where it is, thus, its localization. To be able to localize itself, the robot usually needs a map. When the map in unknown, the robot has to build it while localizing itself: this is the Simultaneous Localization and Mapping (SLAM) problem. It exists a wide number of SLAM algorithms [1].

At the LARIS, we are developing a robot that aims to provide illuminance maps of indoor environments (the RoMuLuX robot [2] depicted on the figure).
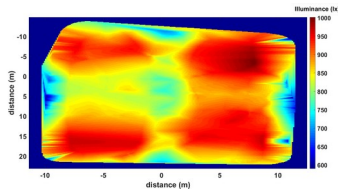
Objectives

We would like to be able to evaluate the localization precision of the RoMuLuX robot (the illuminance measurements). The issue is that to be able to test a SLAM algorithm, it is usually needed to have a *ground truth* to compare the SLAM results with. Most of the time, this ground truth is not available or really hard to obtain. The idea in this project is to use landmarks to locate the robot, assuming that the distances between the landmarks are known. Then, using Interval Analysis it should be possible to generate a ground truth (and then to evaluate a SLAM). The localization algorithm based on landmarks with known distances, will have to be based on the *triangle contractor algorithm* that is currently being developed by one of our PhD student [no ref available so far].

Some steps of the work

- Developing a localization algorithm based on the triangle contractor (simulation, then robot);
  - Creating a filter to be able to detect the landmarks in the LiDAR data set.
- Using RTK GPS (in outdoor environment) to create a landmark map and validate that the localization algorithm is OK;
- Designing an experimentation to test the landmark localization indoor;
- Testing SLAM precision in several contexts.

Note that all the implementation will have to be done with the ROS2 middle-ware.

Bibliography

[1] Khan, Misha Urooj, et al. "A comparative survey of lidar-slam and lidar based sensor technologies." 2021 Mohammad Ali Jinnah University International Conference on Computing (MAJICC). IEEE, 2021.

[2] Guyonneau, Rémy, Franck Mercier, and Vincent Boucher. "Robotic system for indoor illuminance map generation." Journal of Building Engineering 86 (2024): 108800.

[3] Jaulin, Luc, et al. *Interval analysis*. Springer London, 2001.