Map My World Robot

Hsin-Wen Chang

Abstract—This project leverage Real time Appearance Based mapping or RTAB-Map for Simultaneous localization and mapping which is the best solution to develop robots that can map environments in 3D. From RTAB-Map's speed and memory management, its custom developed tools for information analysis and, most importantly, the quality of the documentation. Being able to leverage RTAB-Map with our own robots will lead to a solid foundation for mapping and localization well. For this project we will be using the rtabmap ros package, which is a ROS wrapper (API) for interacting with rtabmap. Loop closure is detected using a bag of worlds approach which is commonly used in vision based mapping.

Index Terms—Robot, IEEEtran, Udacity, LaTeX, SLAM.

✦

1 INTRODUCTION

SIMultaneous localization and mapping (SLAM) is used for constructing and updating a map from unknown environment while keep tracking agent's location. In this project, SLAM was perform on two simulate 3D world where robot can mapping and localize them self by interface the robot with RTAB-Map addition of an RGB-D camera which allows robot estimate their trajectory and map feature pose through explore its environment and create high accuracy map of it's surround environment. The two environment should be mapped in 2D and 3D by using Gazebo and RViz.

2 BACKGROUND

When a mobile robot is mapping a large environment while traveling in cycles and correlating between different objects will face challenges and difficulties such as Unknown map, huge hypothesis space, size, noise, cycles and perceptual ambiguity. Mapping with know pose. The technologies combine localization and mapping process called Simultaneous localization and mapping (SLAM) [1]

2.1 Occupancy Grid Mapping

While listing the different challenges and difficulties in mapping, The words discrete and continuous:

Discrete Data: You obtain this data by counting it. This data has finite values. Example: Number of robots in a room.

Continuous Data: You obtain this data by measuring it. This data has an infinite number of steps, which form a continuum. Occupancy Grid Mapping applied Posterior Probability implement a mapping algorithm and estimate the map given noisy measurements and assuming known poses.

2.2 Grid-based FastSLAM

The FastSLAM algorithm solves the Full SLAM problem by following:

- Estimating the Trajectory: FastSLAM estimates a posterior over the trajectory by applying particle filter

approach which is an advantage to SLAM to solve the problem of mapping with known poses.
- Estimating the Map: FastSLAM uses a low dimensional Extended Kalman Filter to solve independent features of the map which are modeled with local Gaussian.

The custom approach of representing the posterior with particle filter and Gaussian is known by the Rao-Blackwellized particle filter approach.
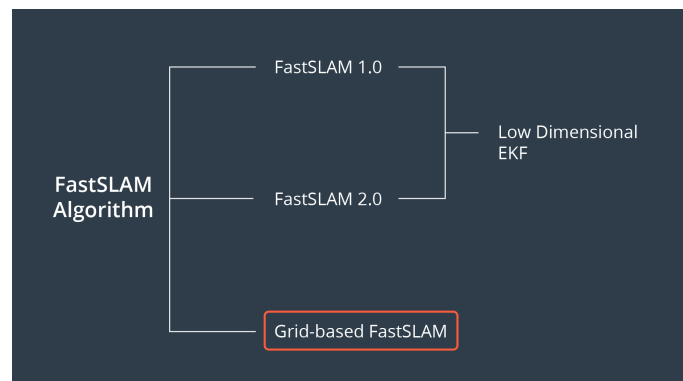

Fig. 1. FastSLAM.

2.3 GraphSLAM

GraphSLAM is a SLAM algorithm which solve the full SLAM problem and recovers the entire path and map instead of just recent pose and map.At the core of GraphSLAM is graph optimization - the process of minimizing the error present in all of the constraints in the graph by applying maximum likelihood estimation (MLE) to structure and solve the optimization problem for the graph. In RTAB-Map, loop closure is detected using a bag of worlds approach which is commonly used in vision based mapping.

3 SCENE AND ROBOT CONFIGURATION

3.1 Kitchen and dining scene

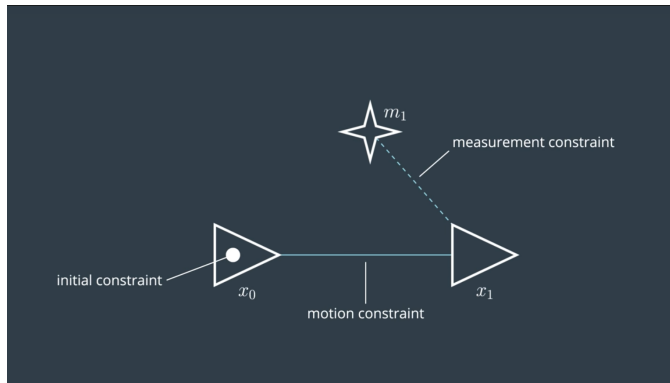The Kitchen and dining scene was provided by Udacity as benchmark scene.
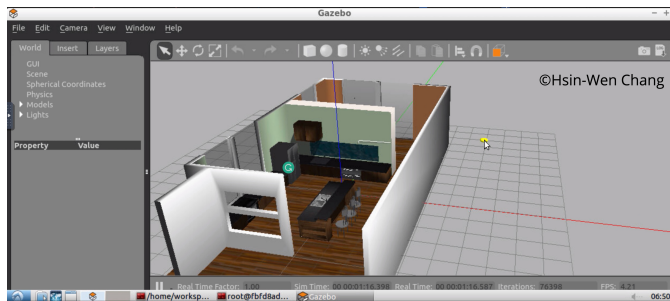
Fig. 2. GraphSLAM.

Fig. 3. Kitchen and dining scene.

3.2 My World scene

You should describe what you achieved for localization in the project with the benchmark model and your own model. Includes charts and graphs show how parameters affect your performance.

3.3 Robot configuration: Transformation frame

Both of scenes are mapped by the designed robot which based on Udacity bot configuration equipped with RGB-D camera and laser scanner. RTAB-MAP algorithm will augment the depth measurements of the RGB-D camera with the measurements from the hokuyo laser scanner.
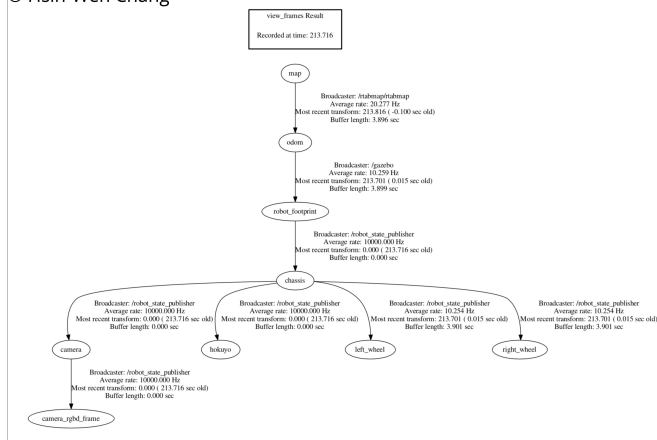

Fig. 4. Robot transformation frame.

4 RESULTS

4.1 SLAM Results

4.1.1 Kitchen and dining scene

4.1.2 My World scene

5 DISCUSSION

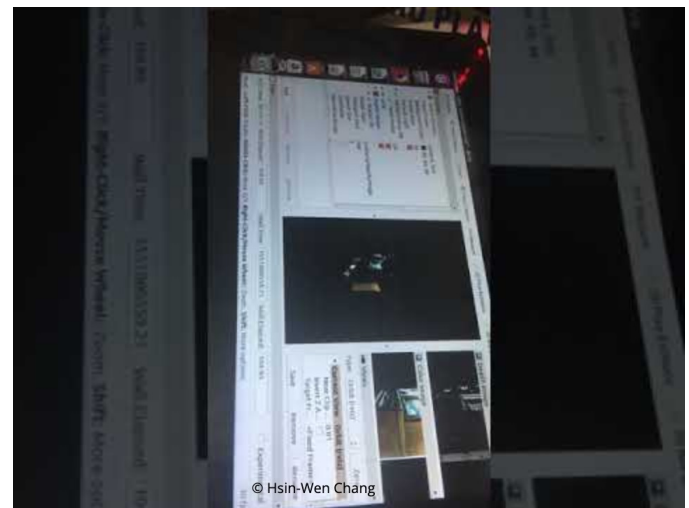# 6 CONCLUSION / FUTURE WORK

Fig. 5. Intel aero Flying Car.

Fig. 6. Deploys RTAB-Map on the Intel aero Flying Car.

REFERENCES

[1] L. Lamport, *LATEX: a document preparation system: user's guide and reference manual.* Addison-wesley, 1994.

[2] The GraphSLAM Algorithm with Applications to Large-Scale Mapping of Urban Structures, Sebastian Thrun, Michael Montemerlo , Stanford AI Lab,Stanford University thrun,mmde@stanford.edu. THE INTERNATIONAL JOURNAL OF ROBOTICS RESEARCH / MayJune 2006