

# Map My World

## Abstract

SLAM is computational problem of constructing or updating a map of an unknown environment. SLAM algorithms need to be tailored to specified environment. We will discuss such engineering consideration in following work. This project complete the mapping task with provided environment and customized world, work including: setup the world, equip the robot, and debugging with ros tool. Utilizing with rtab-slam toolchain, environment's 2d occupancy grid map and 3D point cloud are generated

## Introduction

To fullfill various task, the robot need a map of the unknown environment while simultaneously localizing itself in this map. Learning maps under pose uncertainty is often referred to as the simultaneous localization and mapping (SLAM) problem. Such SLAM process is only based on robot on-board sensors and without relying on external GPS

## Background

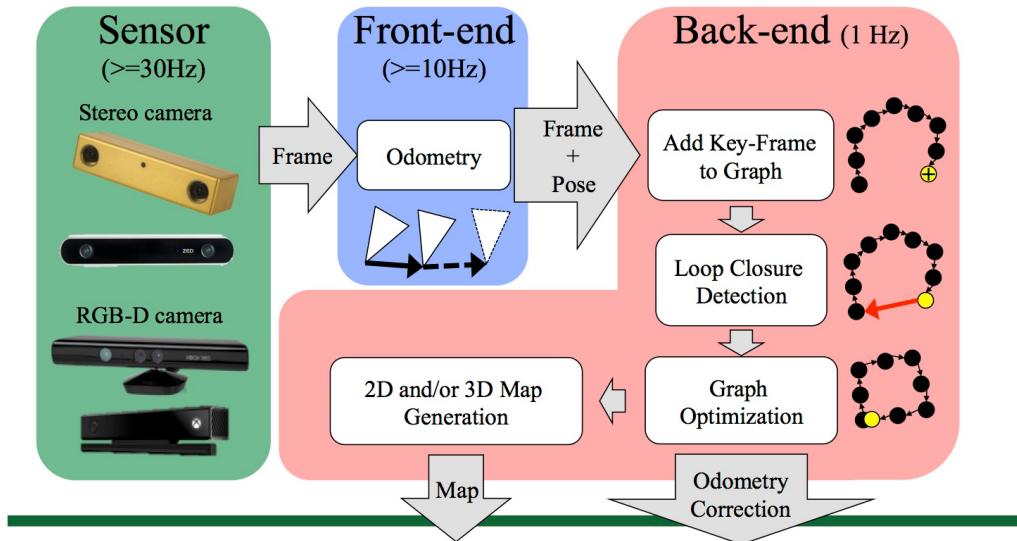
There are mainly two approach to SLAM,

- Particle Filter Approach ; FASTSLAM need predefined landmark positions, gmapping adapts FastSLAM into grid map without landmark. Filtering approaches model the problem as an on-line state estimation which is augmented and refined by incorporating the new measurements as they become available.
- Graph optimization Approach ; Solving a graph-based SLAM problem involves to construct a graph whose nodes represent robot poses or landmarks and in which an edge between two nodes encodes a sensor measurement that constrains the connected poses. Such optimization of constraints is done in the backend (in rtab it's left to vertigo/g2o), and the frontend will deal with input from sensor, one of step in frontend is loop detection where rtab is good at.

## RTAB



## RTAB-Map: Real-Time Appearance-Based Mapping

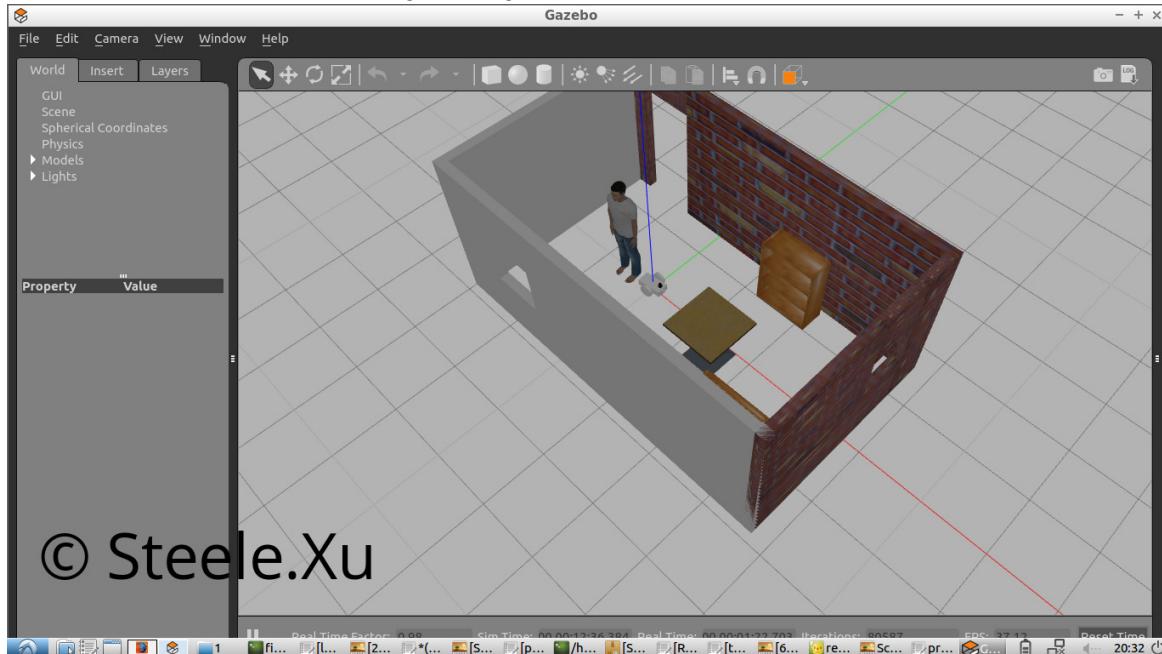


RTAB-Map (Real-Time Appearance-Based Mapping) is a RGB-D, Stereo and Lidar Graph-Based SLAM approach based on an incremental appearance-based loop closure detector. The loop closure detector uses a bag-of-words approach to determinate how likely a new image comes from a previous location or a new location. When a loop closure hypothesis is accepted, a new constraint is added to the map's graph, then a graph optimizer minimizes the errors in the map. A memory management approach is used to limit the number of locations used for loop closure detection and graph optimization, so that real-time constraints on large-scale environments are always respected.

### Model Configuration & World Creation

#### World

Aside from the provided world, my personal world consist of stairs and table and standing person. surrounding with wall and window. This world is created in the building editor of gazebo, save as world/house1.world



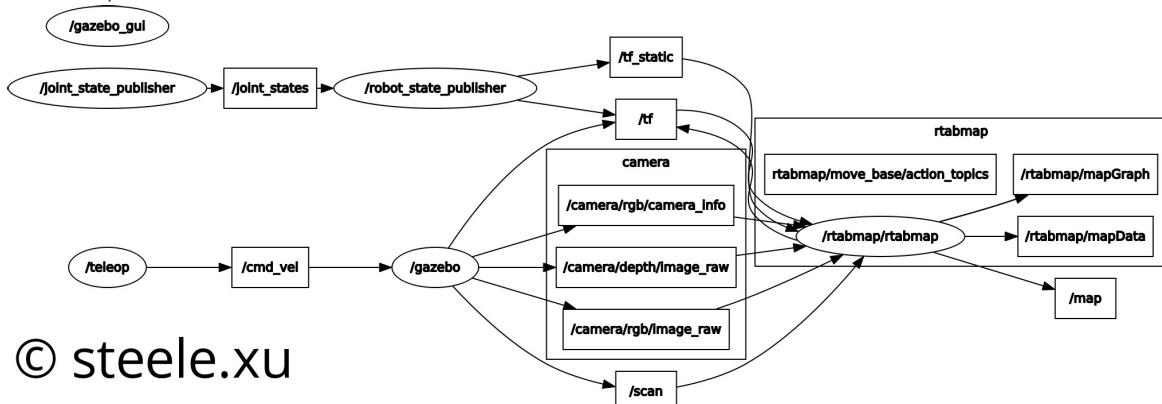
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## Robot

2-wheel robot is from previous lesson(udacity\_bot) , with a hokuyo scan and replace camera with kinect(RGBD camera),package inherit a lot from udacity\_bot, adopting scripts from Student+Project+Materials.zip, adding some new launch file

slam\_rtab.sh integrating all these launch file, afford to start the mapping environment

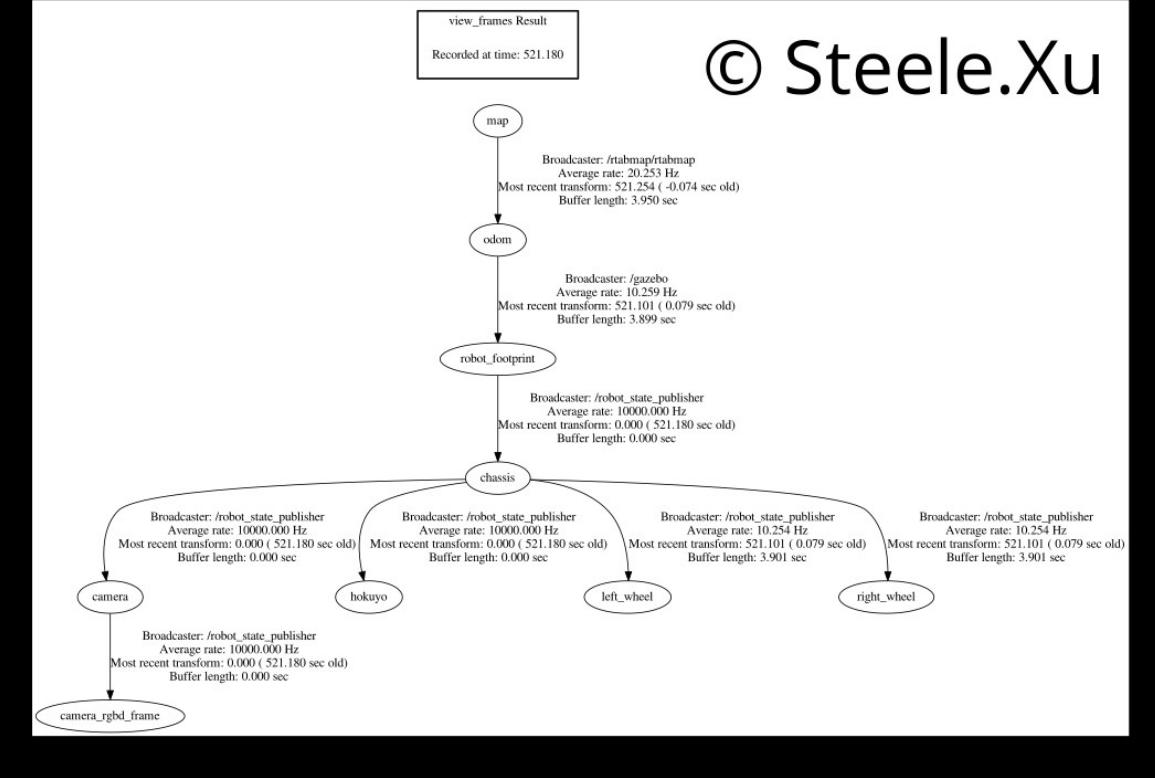
whole setup tf tree is here,



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also see the docs/frames.pdf, by "rosrun tf view\_frames"

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### trouble shooting

but I got error initialy

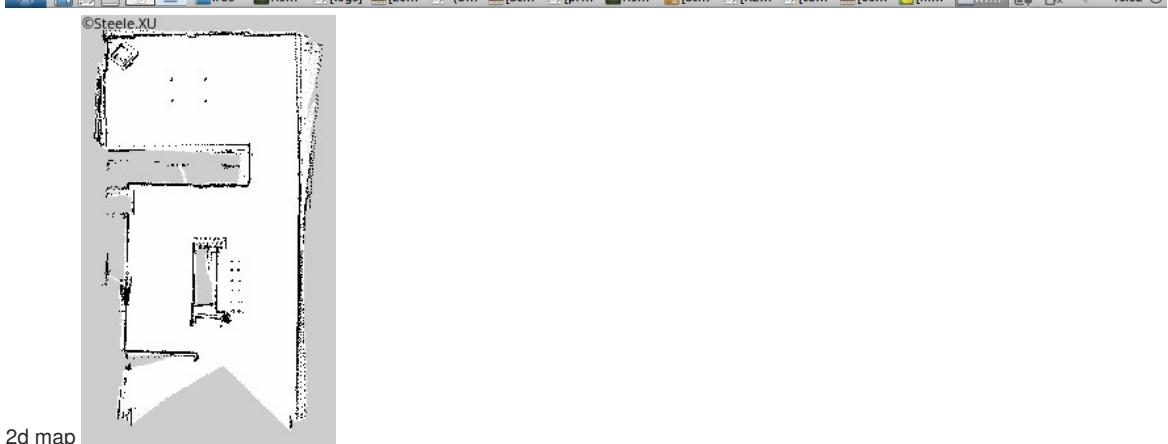
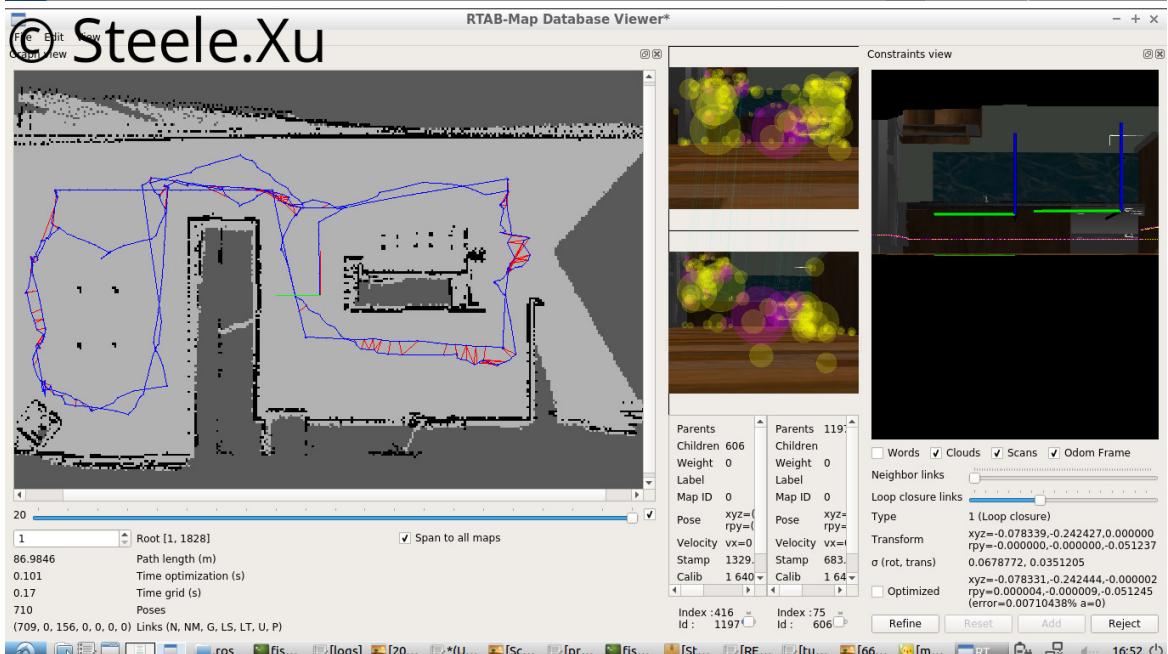
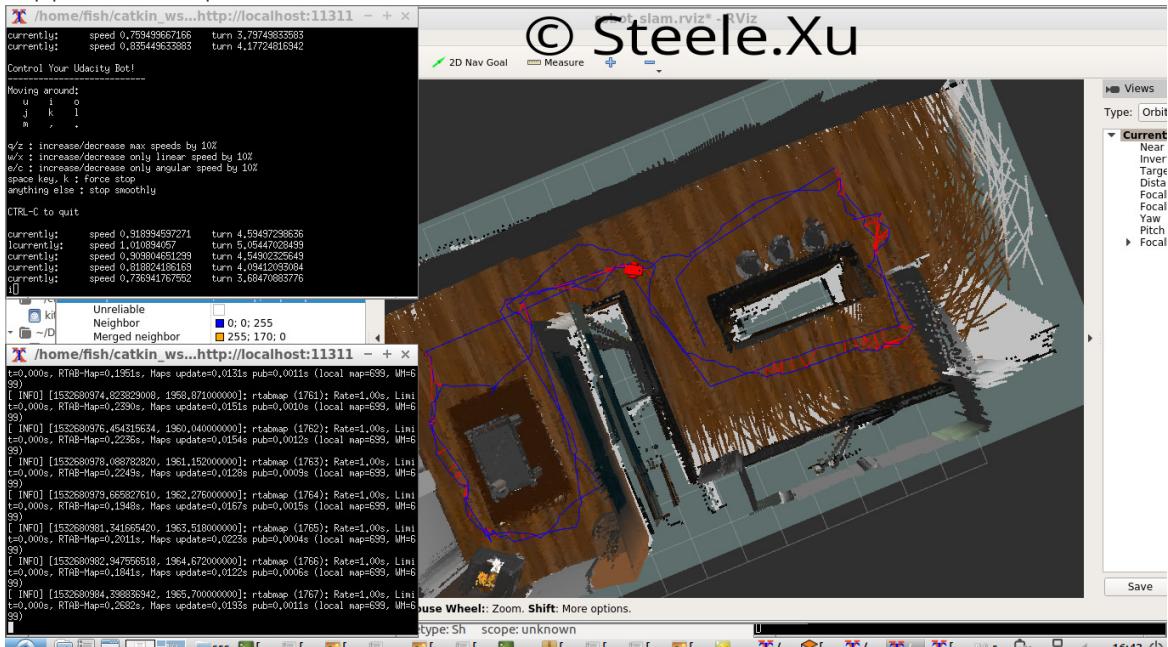
```
[ WARN] Could not get transform from robot_footprint to camera_rgbd_frame after 0.200000 seconds (for stamp=20.723000)
Error="canTransform: source_frame camera_rgbd_frame does not exist"
```

from [tips](#) solution: in udacity\_bot.xacro ,add of camera\_rgbd\_joint, attach link of camera\_rgbd\_frame to it

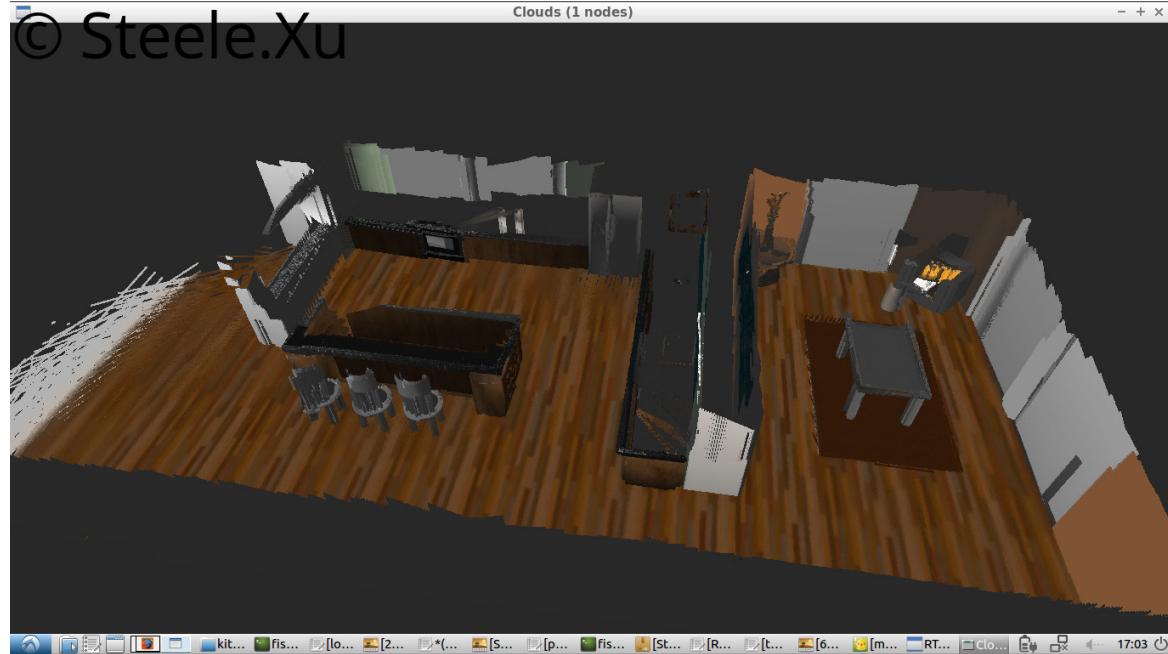
## Results

### kitchen world

map process, 156 loop closure



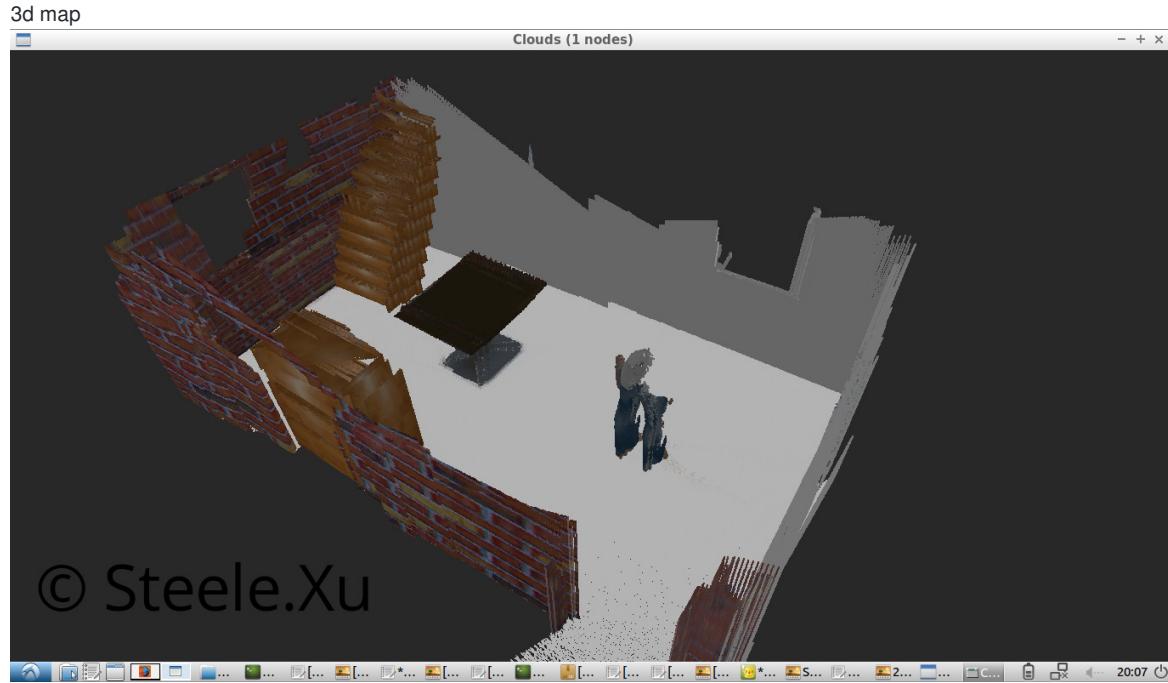
3d map



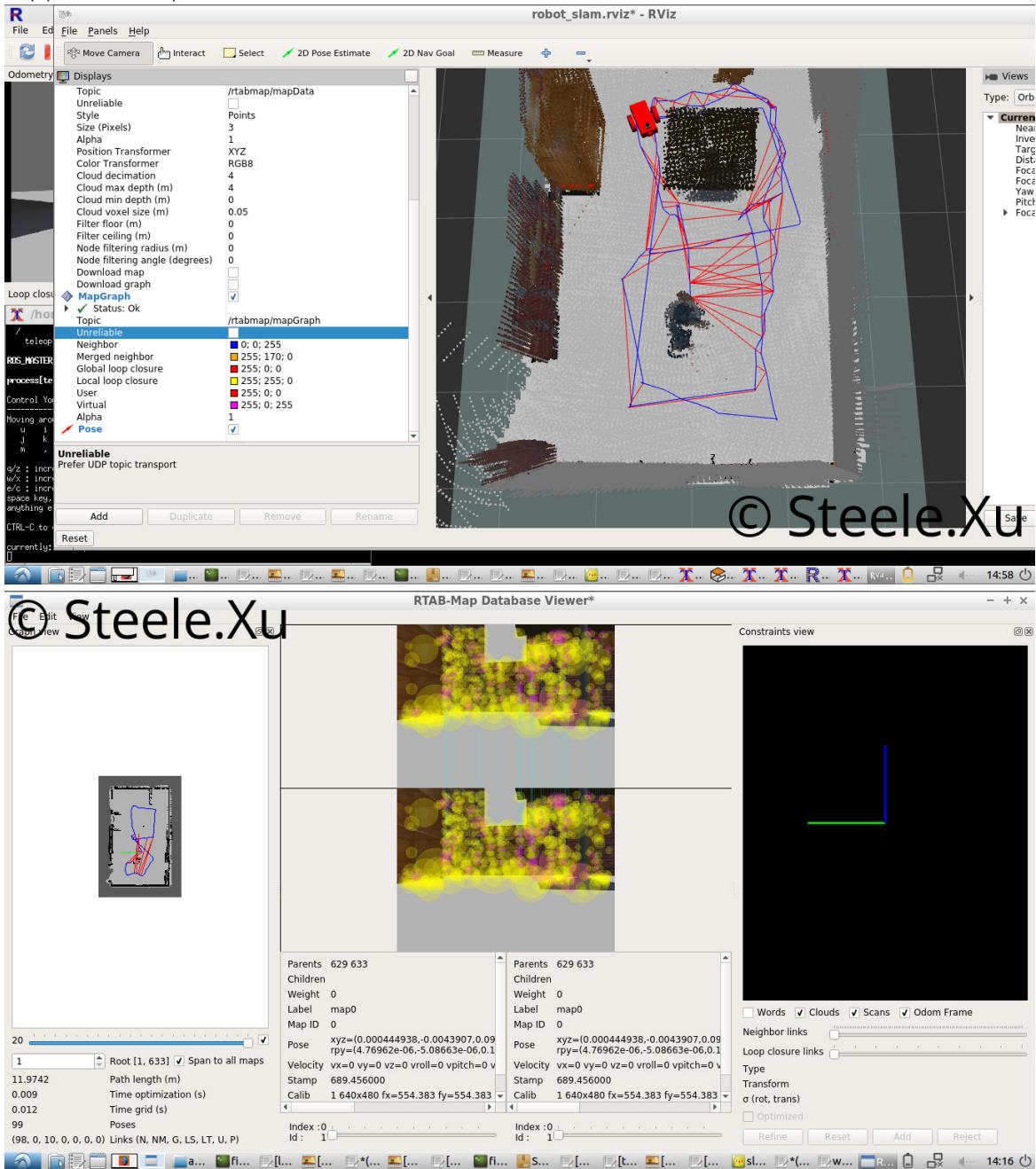
my world



2d map



map process, 10 loop closure



## Discussion

Sometime in the teleop of robot, robot resist to go, very slow, maybe the computation increase(now configuration is visual words per image (bag-of-words) 400, SURF features 100), here need to further investigate

In the mapping process try to use rtabmapviz to monitoring, and use the rtab-databaseviewer to analyze afterwards the provided world is feature-rich enough to get relative perfect result, but my customized world has less feature, so some loop closure is false(need to reject in constraint view) , and the stair is drift and distorted

## Future Work.

I would like do further mapping with a drone model by rtab-ROS, where the 3D point cloud will be more meaningful for the navigation of drone.

SLAM can be used for indoor scenario such as warehouse , also required by domestic applicaiton or business service. In driverless car, highly detailed map need to be made in advance, by help of visual slam, this will be accelerated.

