

SLAM & Autonomous Exploration

Alexander Dodge, Matthew Stanley, Tyler Thune, Mitch Waibel
Human-Centered Robotics CSCI573



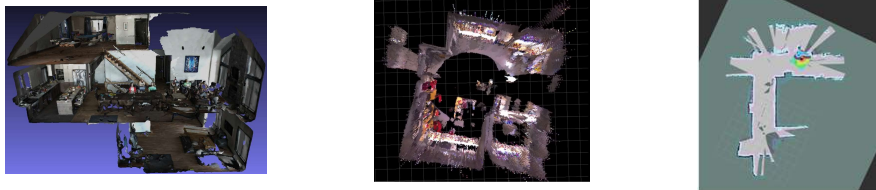
Introduction

SLAM

- Simultaneous Localization and Mapping (SLAM) is process of updating a local map of an unknown environment
- Robot is tasked determining location from familiar features while updating the map with new features from its surrounding

Autonomous Exploration

- Determine exploration path that maximizes new information while simultaneously avoiding obstacles and mapping



Examples of SLAM mapping with different software and environments

Implementation

Robot Operating System

- Open-source meta-operating system for a wide variety of robot platforms
- Applications are comprised of different packages, which have nodes that can each publish and subscribe to topics
- ROS Version Kinetic on Ubuntu 16.04 Laptop



TurtleBot 2

- Low cost, personal robot kit that supports a wide range of open-source software
- Flexible, mobile platform that supports a variety of hardware and is designed for ROS



Modular TurtleBot 2 Platform

Orbbec Astra

- RGB-D camera used to provide 3D vision for the TurtleBot and to create 3D maps

Approach

Mapping

- Real-Time Appearance Based Mapping (RTAB) used to visualize the environment in 3 dimensions
- GMapping's 2D map creates the framework of the RTAB map
- Using depth and RGB information from the Astra camera, create a 3D point cloud to visualize objects and surroundings more accurately

Exploration

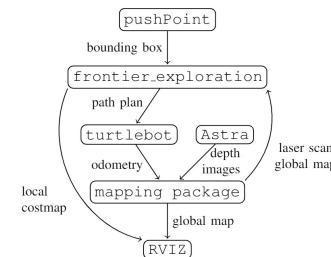
- Autonomous exploration achieved via the Frontier Exploration package
- Create a bounding box with RViz markers to define an area to explore
- Explore the area until everything is mapped or when the robot cannot proceed further
- Based on the robot's surroundings, a 2D cost map is generated and sends movement goals to the Turtlebot navigation stack

Push Point

- Simple Python script publishes the markers to frontier exploration package

Visualization

- Maps can be generated and visualized in real-time using RViz



Interactions between nodes in the created Autonomous SLAM package



RTAB Map of Alderson 130

References

1. "ROS", <http://ros.org>, accessed on 5/5/19.
2. "TurtleBot 2", <https://www.turtlebot.com/turtlebot2/> accessed on 5/5/19
3. "RTAB-Map" <http://introlab.github.io/rtabmap/> accessed on 5/7/19

Packages Used

- [1] M. Labbe, "Rtab-map: Real-time appearance-based mapping." <http://introlab.github.io/rtabmap/>, Sept 2017.
- [2] P.Bovbel, "frontier exploration." https://github.com/paulbovbel/frontier_exploration/, Oct 2016.