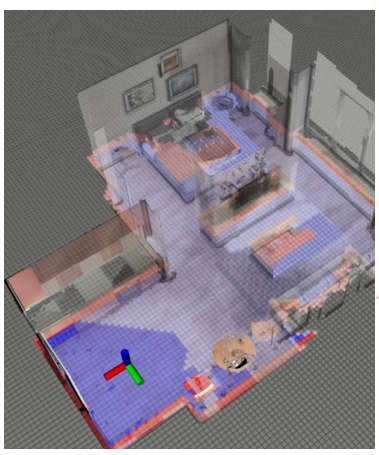
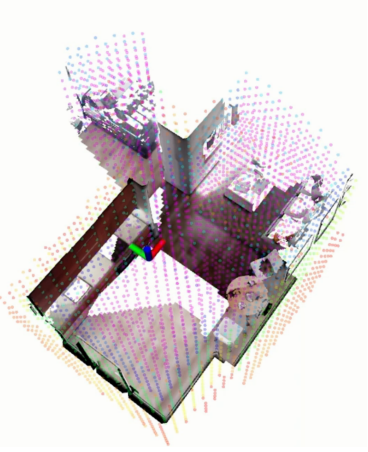
ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Spatio-temporally consistent Volumetric Mapping using panoptic submaps

Semester Project / Master Thesis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Description

A central capability of autonomous robots is to model their surroundings in a map that can be used for navigation and interaction. This requires the modelling of surfaces and free space for collision avoidance as well as a semantic understanding of a scene.

Traditional approaches typically build a dense map by integrating sensor data into a grid, accumulating geometric and semantic information over time. To address the problem of spatial consistency, for example when the state estimate of the robot is drifting, splitting the environment into submaps and aligning these through pose graph optimization has proven to be effective. However, these methods still struggle in changing environments, such as during long-term operation.

In this project, the goal is to leverage semantic understanding and submaps on a per-object level to account for changes in the state estimate of the robot as well as in the long-term scene dynamics. This includes primarily the development and integration of a pose or scene graph to relate objects and observations, as well as a method to associate and merge submaps to enable long-term operation. An infrastructure for photo-realistic simulation and dense per-object submapping is provided. In case of project success, the student is invited to contribute towards a publication of the work.

Work packages

- Literature Review.
- Development and integration of a pose or scene graph for a per-object sub-mapping framework.
- Development of a method to associate and merge consistent data.
- Evaluation of the proposed system.

Requirements

- Highly motivated and independent student.
- Strong interest in Robotics and Computer Vision.
- Programming skills in C++ are mandatory.
- Experience with ROS, Unreal Engine 4, and other frameworks are a plus.