Hilti Challenge

GeoSLAM Report

About GeoSLAM

GeoSLAM is a market leader and pioneer in the development of portable laser scanning hardware for the geospatial industry.

GeoSLAM first brought mobile 3D data capture to the geospatial market in 2013 in a joint venture with CSIRO (the Commonwealth Scientific and Industrial Research Organisation), with the launch of the ZEB1, the first handheld SLAM scanner to become commercially available.

The ZEB range of scanners utilize SLAM to allow an unskilled operator to rapidly and accurately map their environment in 3D. This is supported by GeoSLAM's data processing platform, GeoSLAM Connect, which, in addition to automating processing and allowing meaningful information to be derived from the pointcloud, provides the ability to export GeoSLAM data in a variety of industry standard formats for further processing in 3rd party software.

Objectives

- Assess the compatibility of GeoSLAM's SLAM algorithm with the provided sensor configuration
- Assess the robustness of the algorithm when applied to a variety of different capture environments.

Overview of Approach

The SLAM algorithm is an optimisation-based approach consisting of a causal local optimisation which utilises a sliding window, followed by a separate global optimisation step to close loops and ensure global consistency which utilises the entire dataset [1] [2]. Only two sensors were used for optimisation, an IMU and the Ouster LiDAR.

Processing Details

The details for each of the datasets processed for the Hilti SLAM challenge [3] are listed below.

Sequence	Sensors Used	Proc. Time (s)
RPG Drone Testing Area	OS-0, Alphasense IMU	561.724
IC Office	OS-0, Alphasense IMU	1541.68
Office Mitte	OS-0, Alphasense IMU	2974.68
Parking Deck	OS-0, Alphasense IMU	6247.18
Basement	OS-0, Alphasense IMU	816.148
Basement 3	OS-0, Alphasense IMU	2106.46
Basement 4	OS-0, Alphasense IMU	811.667
Lab	OS-0, Ouster Internal IMU	811.667
Construction Site Outdoor 1	OS-0, Alphasense IMU	2531.01
Construction Site Outdoor 2	OS-0, Alphasense IMU	2787.15
Campus 1	OS-0, Alphasense IMU	3367.49
Campus 2	OS-0, Alphasense IMU	2634.71

All datasets could be processed successfully using GeoSLAM's SLAM algorithm; however, under normal circumstances an initial stationary period is required for IMU bias and orientation estimation purposes. Where this was not included in the scan, a reasonable guess for the initial bias values and orientation were provided in the initialisation parameters instead; but this may result in degraded quality for the 5 scans which have no such stationary period.

In general, the parameters chosen reflect the emphasis the Hilti Challenge places on accuracy for the evaluation, while maintaining sensible processing times.

Processing Specifications

Each dataset was processed on a machine with the following specifications:

- CPU: 3.50GHZ AMD Ryzen Threadripper 2920X 12-Core Processor
- Memory: 64GB

References

[1] M. Bosse and R. Zlot. Continuous 3d scan-matching with a spinning 2d laser. *2009 IEEE International Conference on Robotics and Automation*, pages 4312–4319, 2009.

[2] Michael Bosse, Robert Zlot, and Paul Flick. Zebedee: Design of a spring-mounted 3-d range sensor with application to mobile mapping. *IEEE Transactions on Robotics*, 28:1104–1119, 10 2012.

[3] Michael Helmberger, Kristian Morin, Nitish Kumar, Danwei Wang, Yufeng Yue, Giovanni Cioffi, and Davide Scaramuzza. The hilti slam challenge dataset, 2021.