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THE HILTI SLAM-CHALLENGE

Participation report

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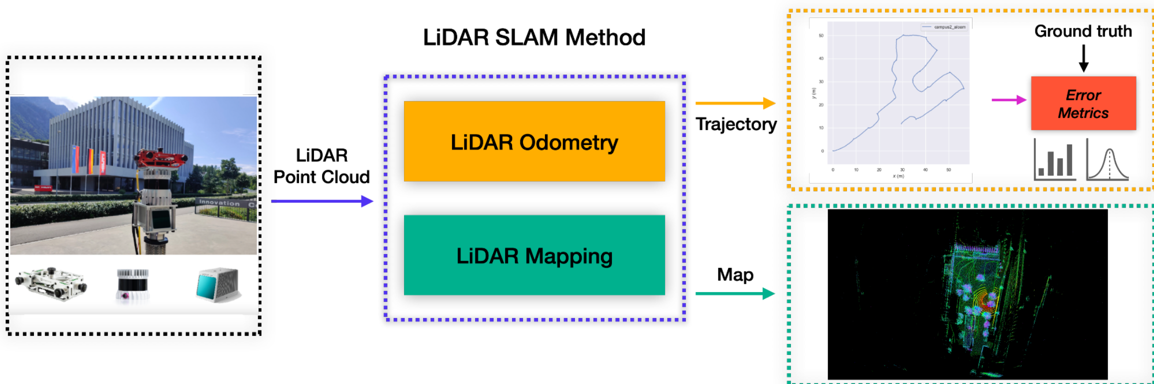
INTRODUCTION

In the framework of the International Conference on Intelligent Robots and Intelligent Systems 2021, a call for participation in the HILTI-challenge was launched by Prof. Davide Scaramuzza and Giovanni Cioffi from the University of Zürich with the collaboration of Danwei Wang, Christian Laugier, Philippe Martinet and Yufeng Yue. In response, the research group of the University of Ibagué joins this event by means of this document. In response, the research group of the University of Ibagué joins this event by means of this document.



ESTIMATED TRAJECTORIES

The 12 trajectories obtained were generated according to the requested formats. Their files can be obtained through the following link.

OVERVIEW

The challenge was addressed based on the LOAM[1] method and the A-LOAM[2] github repository [2], in which the trajectory is recovered using a batch optimisation method that processes segmented data sets with added constraints. By decomposing the original problem, a simpler problem such as online motion estimation is solved first. Then, the mapping is performed as a batch optimization (similar to iterative closest point (ICP) methods) to produce high-precision motion estimates and maps.

The method used does not report the use of future or predicted information, packet adjustment or loop closure. A-LOAM is an advanced implementation of LOAM (J. Zhang and S. Singh. LOAM: Lidar Odometry and Mapping in Real-time), which uses Eigen and Ceres Solver to simplify the code structure. The code has been modified from the original version to a cleaner and simpler version, without complicated mathematical derivations and redundant operations. Referred to by the authors as a good learning material for SLAM beginners.

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[1] Zhang, J., & Singh, S. (2014, July). LOAM: Lidar Odometry and Mapping in Real-time. In *Robotics: Science and Systems* (Vol. 2, No. 9).

[2] https://github.com/HKUST-Aerial-Robotics/A-LOAM

USED SENSORS

In this implementation only the LiDAR sensor data was used by subscribing to the topic "/os_cloud_node/points".

EXECUTION ENVIRONMENT

USED HARDWARE:

OS	Ubuntu 18.04.5 - Kernel Linux 4.15.0-137 generic
CPU	Intel(R) Xeon(R) Gold 6152 CPU @ 2.10GHz 4 Dual-core
RAM	64 GB
ROS	Robotic Operating System, Melodic distribution 1114110

SIMULATION RESULTS

Seq.	Name (trayectory)	Poses	Path_length [m]	Time [s]	ATE
RPG Drone Testing Arena	uzh_tracking_area_run2.txt	893	78.151	89.299	0.492
IC Office	IC_Office_1.txt	2004	171.163	200.301	-
Office Mitte	Office_Mitte_1.txt	2640	214.265	263.913	-
Parking Deck	Parking_1.txt	5823	556.871	582.212	-
Basement	Basement_1.txt	1129	74.981	112.803	0.297
Basement 3	Basement_3.txt	3306	118.793	330.616	-
Basement 4	Basement_4.txt	3503	113.898	350.224	0.237
Lab	LAB_Survey_2.txt	1356	48.089	135.513	0.116
Construction Site Outdoor 1	Construction_Site_1.txt	1995	106.880	199.420	
Construction Site Outdoor 2	Construction_Site_2.txt	3991	218.970	399.117	1.596
Campus 1	Campus_1.txt	4298	225.502	429.730	-
Campus 2	Campus_2.txt	3747	194.664	374.725	0.625

- The simulation was implemented in ROS with the same sequence-experiment runtimes.

USED PARAMETERS:

- **scanID** = int((angle + 45) / 1.428 + 0.2);
- **angle:** angle of vertical elevation.
- **45:** The vertical filter (lower vertical angle)
- **1.428:** the interval between each scan.
- **0.2:** for rounding, (keep the integer part).

More details on the implementation can be found in the following link