NOVEL INSPECTION SYSTEM, BACKPACK-BASED, FOR 3D MODELLING OF INDOOR SCENES

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Abstract

Novel system for **indoor positioning** and data acquisition based on **LiDAR sensors and Inertial Units**.
Data processed with **SLAM** techniques, obtaining an accurate computation of the **trajectory** followed by the system, in any working environment.
Evaluation of **accuracy** from two case studies

Introduction

Generation of **digital 3D models** of existing buildings: interest in **indoor scenes** for refurbishment and design tasks.

Existing Indoor Mobile Mapping Systems: cart, backpack, manual platforms.

Backpack-based systems, fixed to the back of the human operator, allows the inclusion of more weight than the manual system (sensors, autonomy).

SLAM algorithms for **hybrid 2D-3D systems**: detection of 3D characteristics in the point cloud at high-speed, operation online

Líneas del proyecto

I. Indoor Inspection System

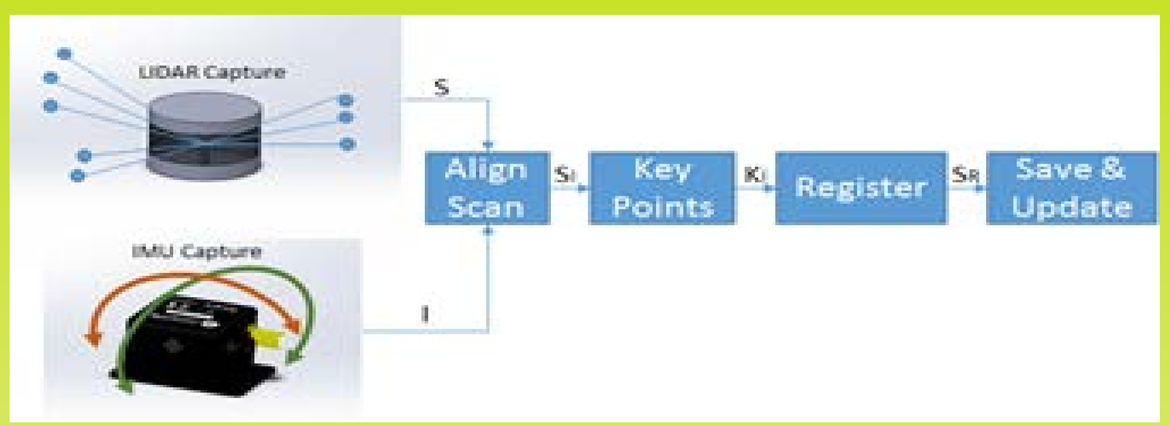
Backpack system with **internal structure** for rigidity (3D printed)

Inside: electronics, batteries, cable

Outside: sensors:
- Velodyne VLP-16
- IMU Advanced Spatial Navigation
- Hokuyo UTM 30EW

System control:
- BQ Edison tablet (communicated with PC through WiFi connection)

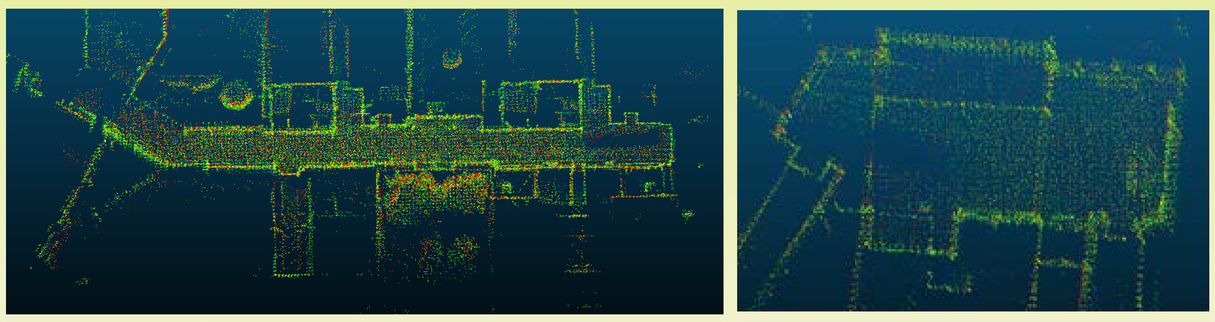
II. SLAM Algorithm



Steps:
1. Acquisition of a **scan, S**: one revolution of the laser, angular resolution 0.1º with 16 rays.
2. Simultaneous data acquisition with the **IMU, I**.
3. **Roll and Pitch** values from the IMU are used to correct the position of the system.
4. Search of **characteristic points** (planes, corners) within the point cloud.
5. **ICP** for registration of consecutive scans based on characteristici points.
6. Storage of **transformation** matrix between scans + transformed **points**.

III. System Analysis

Map from **Indoor Inspection System**



Map from **FARO Focus (ground truth)**

Two case studies, indoor scenes:

Left – Corridor, 55m lenght, side windows and doors
Acquisition time: 55s

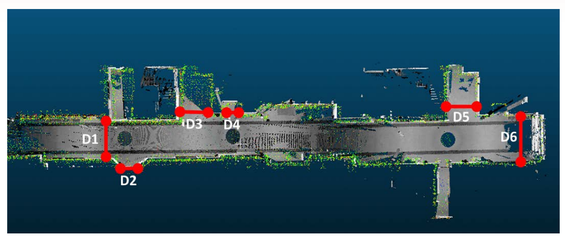
Right – Hall, big windows with different orientations.
Acquisition time: 16s

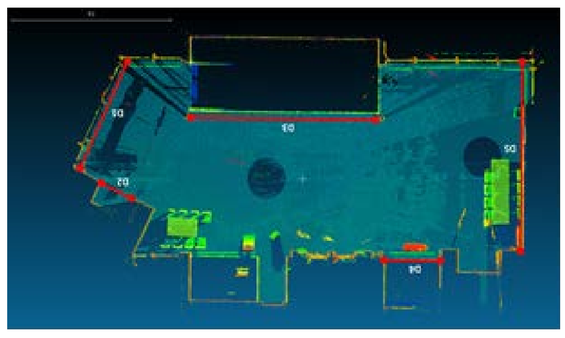
Acquisition with FARO Focus terrestrial laser scanner for reference

IV. Results

Comparison of **geometric measurements** performed in the map from the **Indoor System** and the **ground truth** (measured with FARO Focus)
Number of measurements per case study: 5

CASE STUDY	MEAN ABSOLUTE DIF (m)	MEAN RELATIVE DIF (%)
A	0,058	1,698
B	0,018	0,257





V. Conclusions

Indoor Inspection System:

- Homogeneous **point density**
- Acquisition of **points from outdoors** through the Windows

Future work:

- Incorporation of **RGB sensor** to perform **close loop detection** in images:
  IMPROVEMENT OF THE TRAJECTORY

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