FIG WORKING WEEK 2019

22–26 April, Hanoi, Vietnam

"Geospatial Information for a Smarter Life and Environmental Resilience"

ORGANISED BY FIG

PLATINUM SPONSORS esri THE SCIENCE OF WHERE Trimble

We are living in a smart world

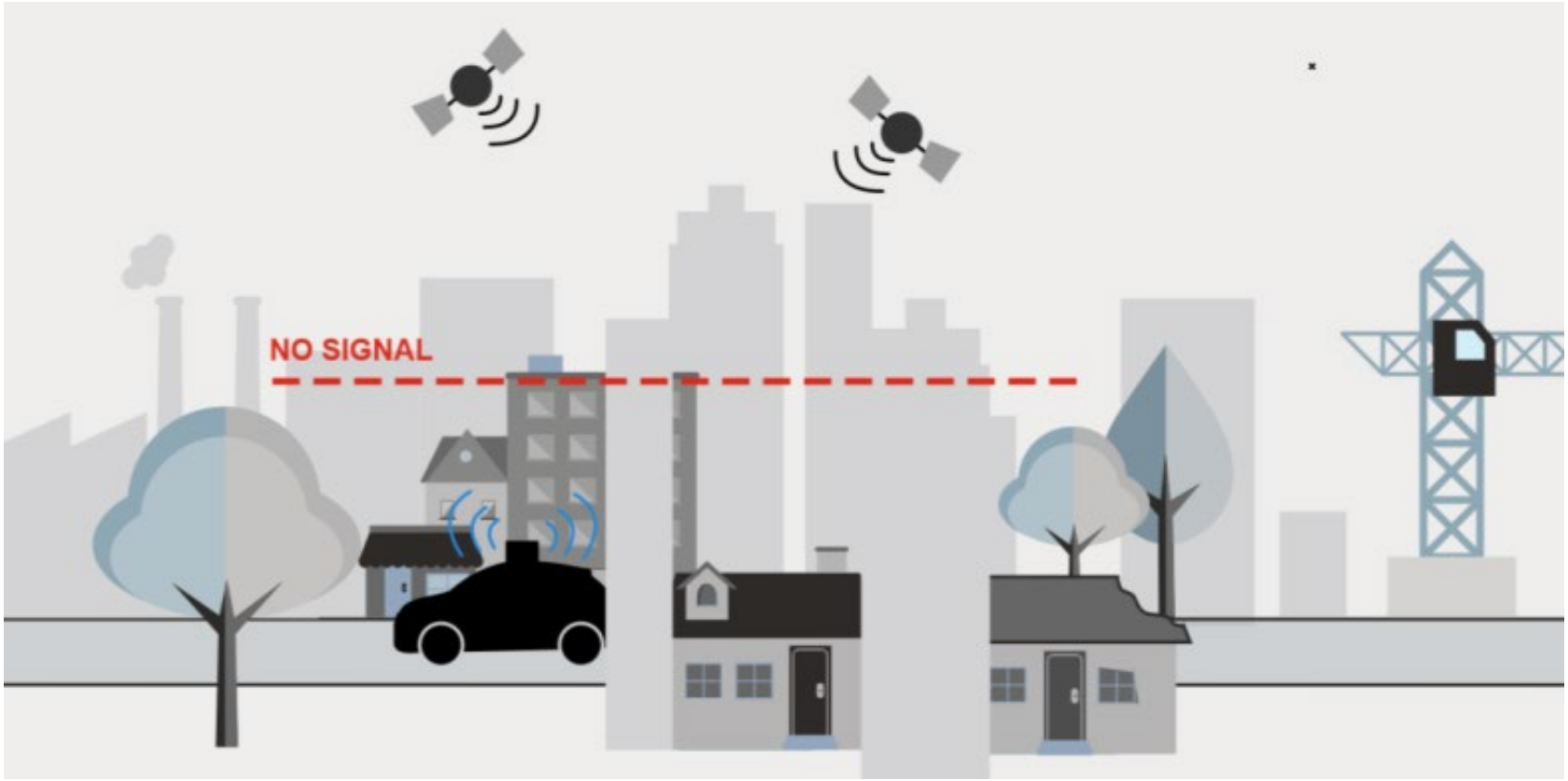
a) The experience we present wants to introduce an innovative procedure to align 3D point clouds from different sources in the same 3D data set, in a smart, fast and easy way.

B) And to show how to use a software platform to organize and manage all indoor/outdoor 3D geospatial DBs

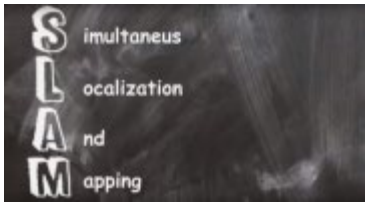
Mobile Mapping System and UAV based surveying systems have speed up the 3D mapping of reality

- To map and document in 3D the reality has never been son fast and affordable

- Problems are present for indoor mapping


NO SIGNAL

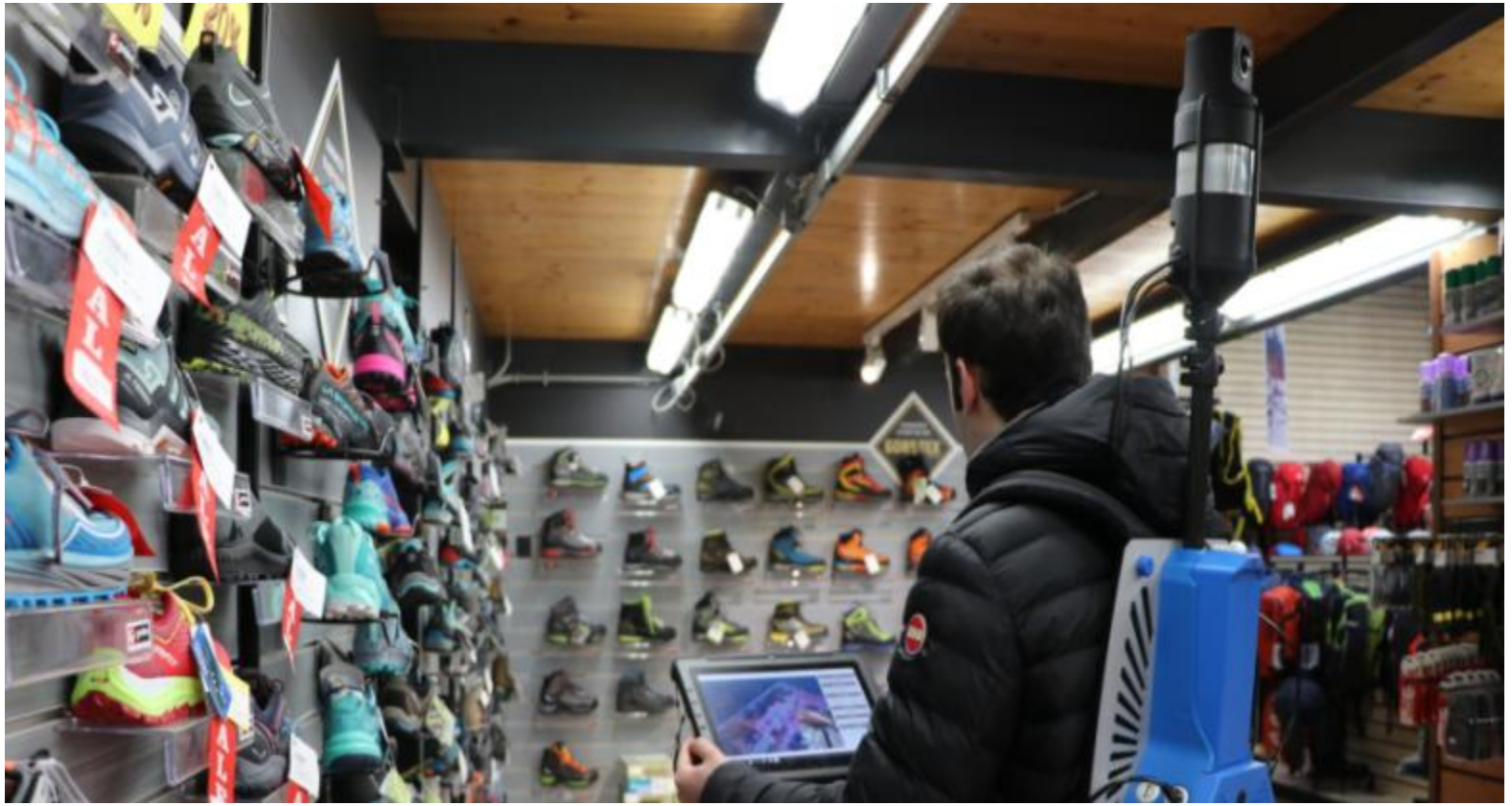
Innovative MMS based on SLAM have been introduced



- "SLAM addresses the problem of a robot navigating an unknown environment. While navigating the environment, the robot seeks to acquire a map thereof, and at the same time it wishes to **localize** itself using its map. The use of SLAM problems can be motivated in two different ways: one might be interested in **detailed environment models**, or one might seek to maintain an accurate sense of a **mobile robot's location**. SLAM serves both of these purposes."

Sebastian Thrun, John J. Leonard

We have been tested the Heron AC-2




CAMERA
IMU
Velodyne
HDL-32E
Battery pack
Internal
Control Unit
External
Control Unit

HERON AC-2 Color tech details

Time of initialization	~ 30 sec
Working time (1 battery in continuous use)	~ 3 h with MS-2 ~ 2 h with MS-2 Color
Indoors/Outdoors	YES
Real time visualization	YES
Operating temperature	-10° ; + 40°
Storage temperature	-40° ; + 60°
Scanning rate	700.000 points per second
Local accuracy	~ 2 cm
Final global accuracy	~ 5 cm* in short close rings
Final survey resolution	~ 2 cm
Output data	e57, las, ply
LiDAR Sensor	Velodyne HDL-32E
Wavelength	903 nm
Max range	80-100 m

Min range:	1 m
Angular FOV (horizontal)	360°
Angular FOV (vertical)	+ 10.67° ; - 30.67°
Laser safety class	1
Battery:	NiMH 12V 9Ah

PANORAMIC CAMERA

Resolution:	FULL HD
Max frame rate:	60 FPS
Horizontal – Vertical FOV	360°
Interface	USB 3.0
35mm equivalent focal length	1.036 mm
Depth of focus	40 cm to ∞
Automatic color and light balance	YES
Automatic exposure control	YES

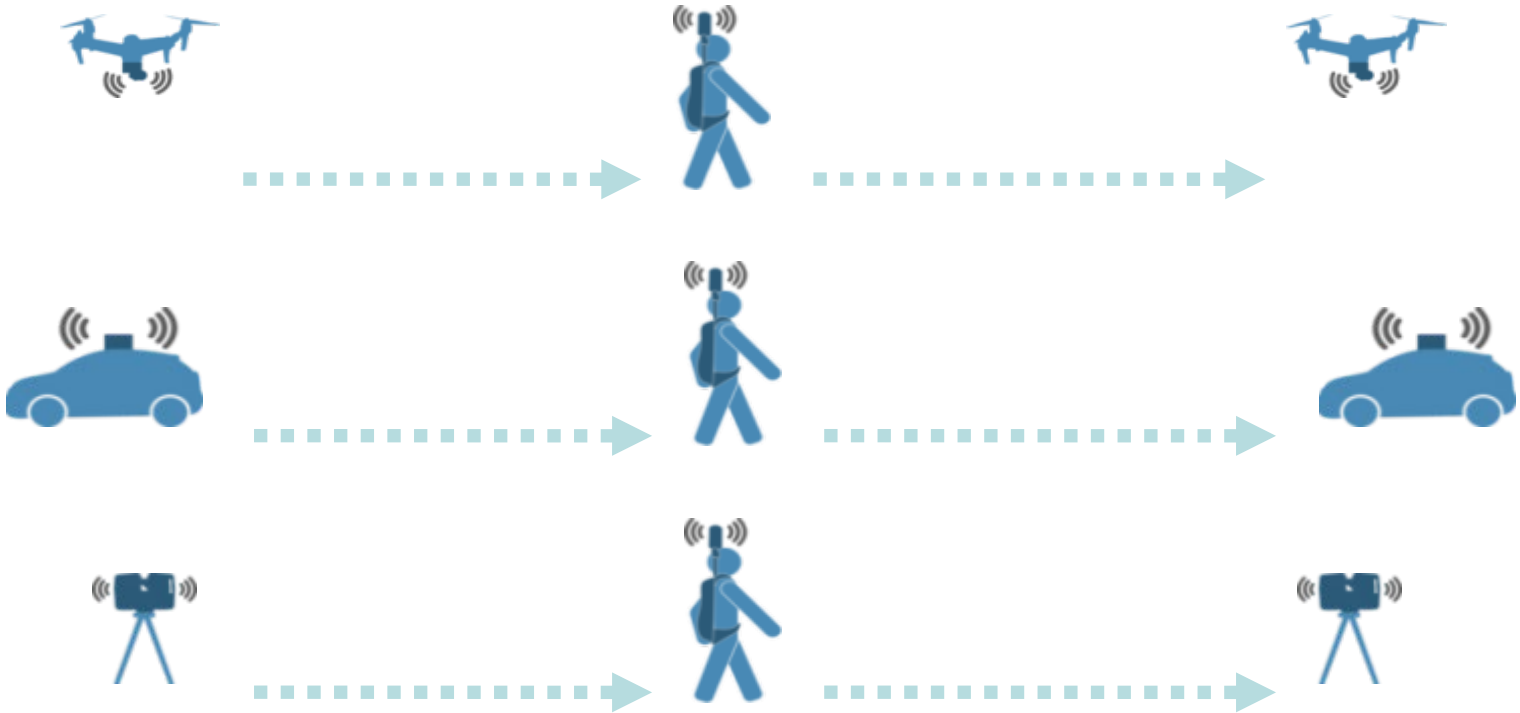
PANORAMIC CAMERA

Resolution: Full HD and 5K
Max frame rate: 60 FPS
Horizontal-Vertical FOV: 360°
Interface: USB 3.0
35mm equivalent focal length: 1.036 mm
Depth of focus: 40 cm to ∞
Automatic color and light balance: Yes
Automatic exposure control: Yes

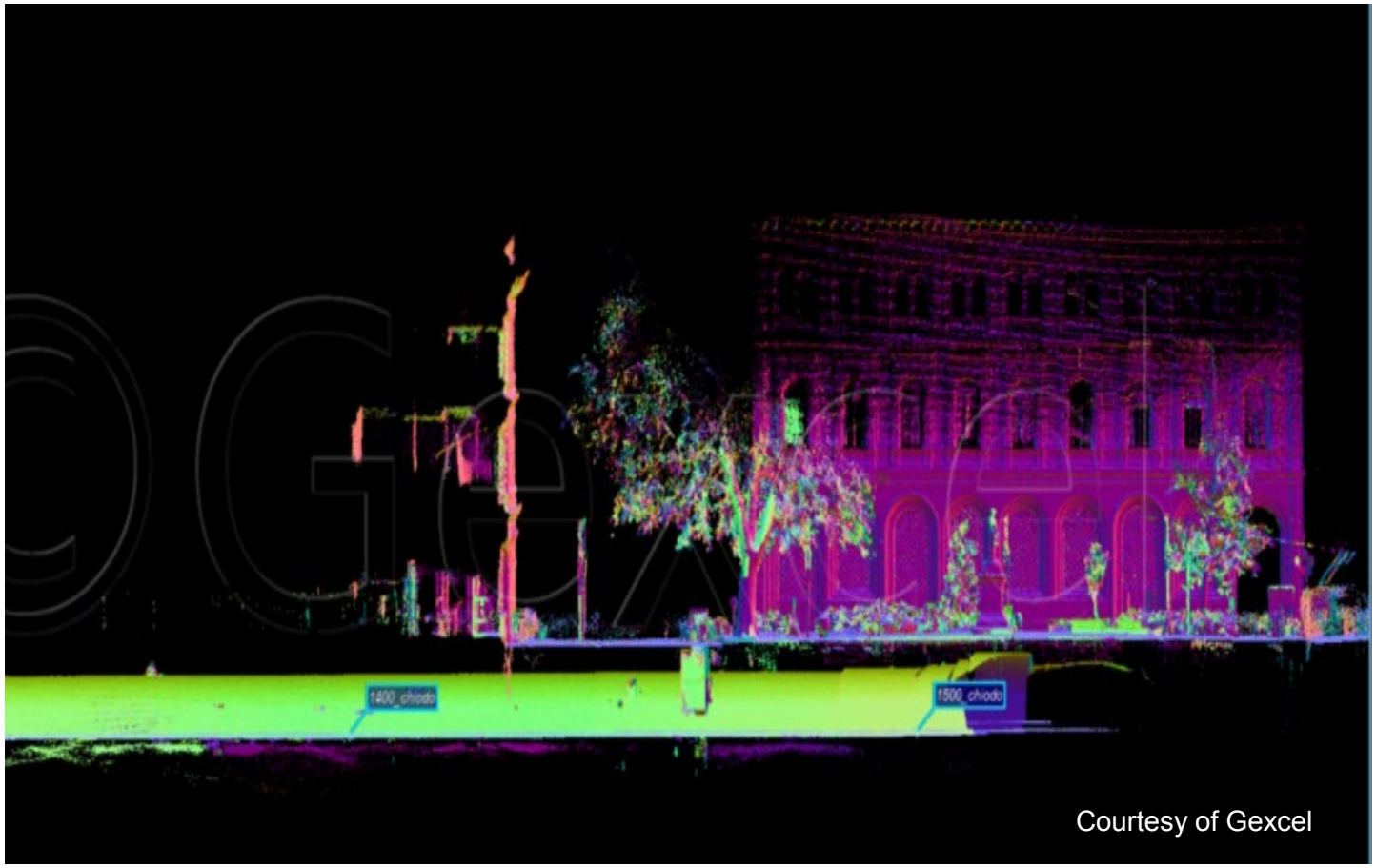
The iMMS HERON has no GNSS. How to georeference the point cloud model ?

- Point cloud data can be used as constrain in the SLAM process
- Cloud to Cloud automatic alignement can be used. Georeferenced point cloud models can be used not only for georeferecing but for SLAM drift correction too.
- Selection of point cloud from UAVs and MMSs can be used

The concept

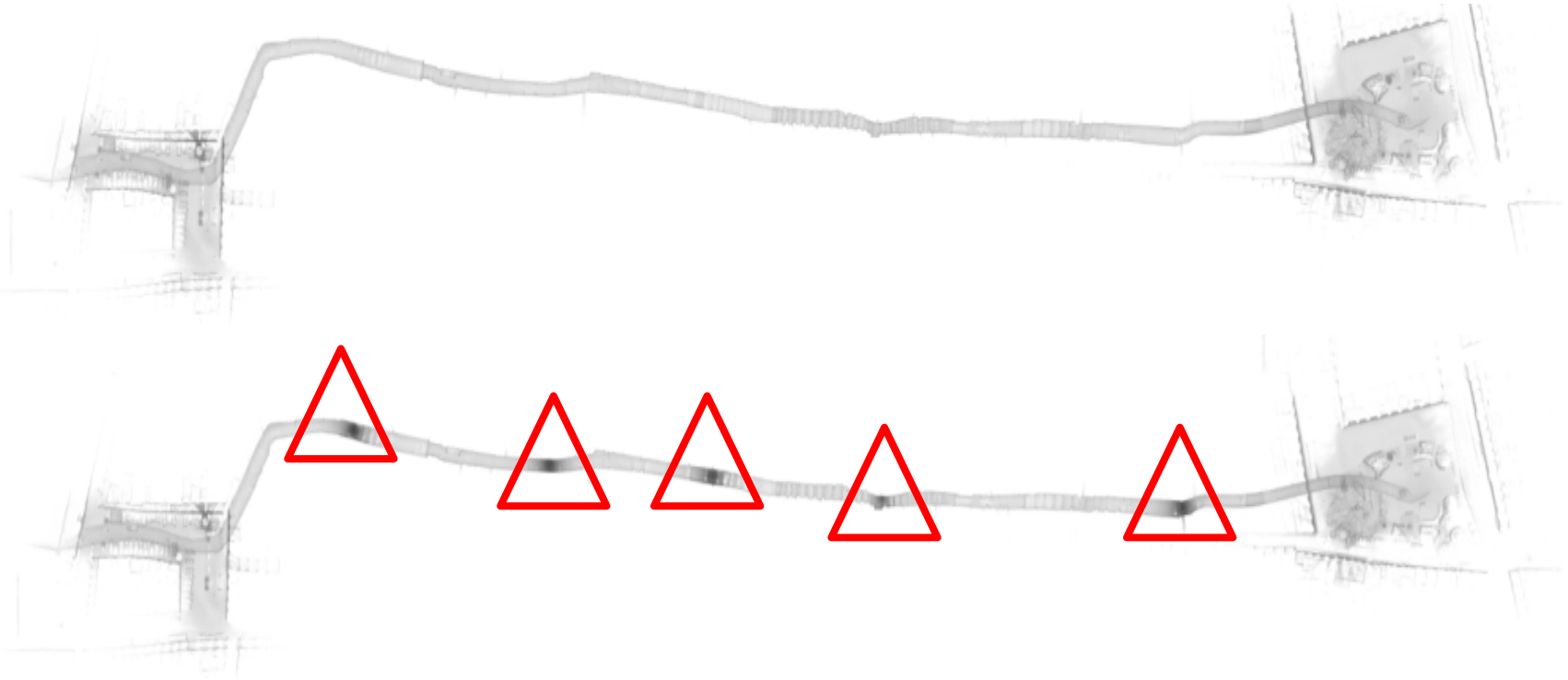


8th International Workshop 3D-ARCH
Bergamo – 6-8 February 2019



Courtesy of Gexcel

Static scans as constraints



TEST SITE – MOBILE MAPPING as system to access to global reference frame

SITE – UNIVERSITY OF BRESCIA - ITALY

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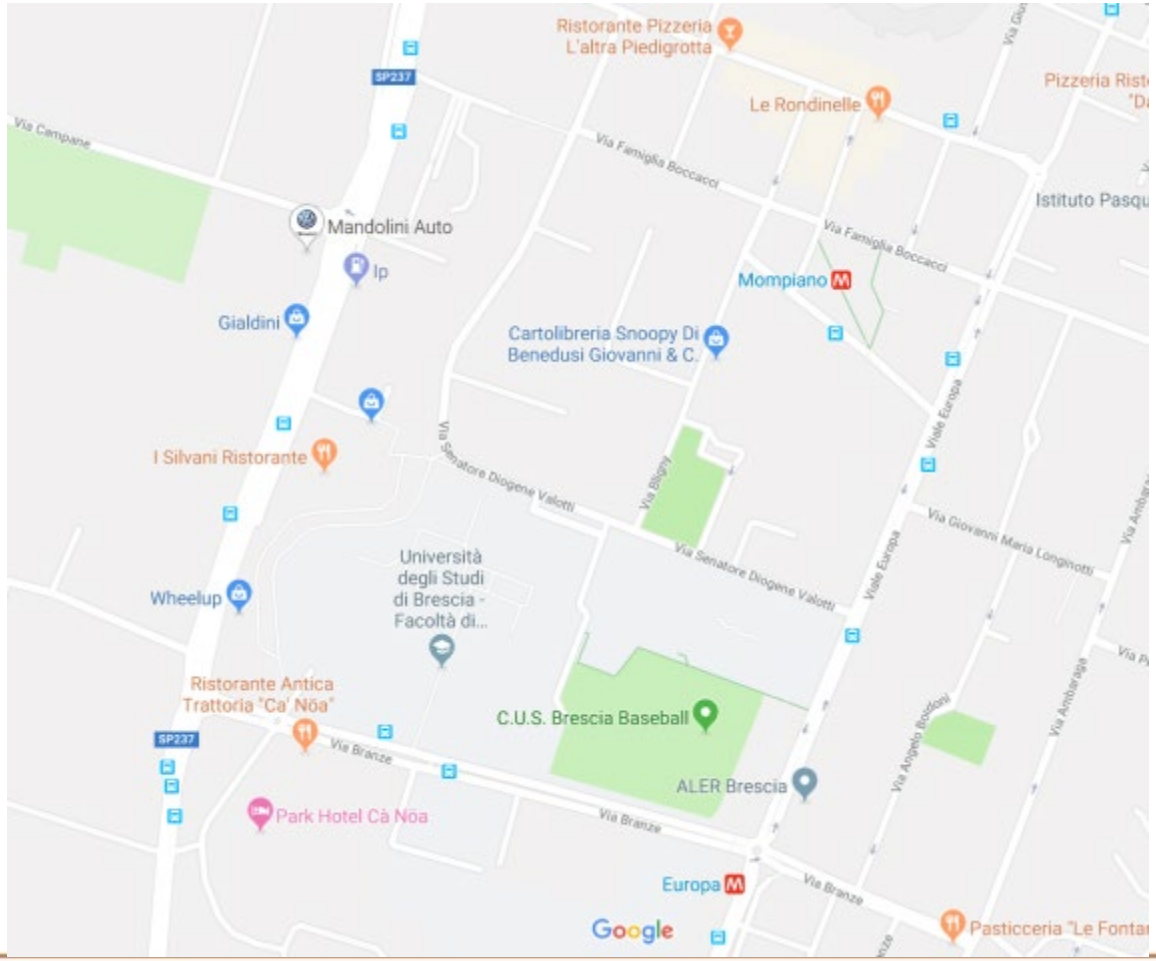
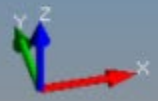

Ristorante Pizzeria L'altra Piedigrotta
Le Rondinelle
Pizzeria Rist
SP237
Via Campane
Via Famiglia Boccacci
Istituto Pasqu
Mandolini Auto
Ip
Mompiano
Gialdini
Cartolibreria Snoopy Di Benedusi Giovanni & C.
I Silvani Ristorante
Via Senatore Diogene Valotti
Via Bligny
Viale Europa
Via Giovanni Maria Longinotti
Università degli Studi di Brescia - Facoltà di...
Wheelup
Ristorante Antica Trattoria "Ca' Nöa"
C.U.S. Brescia Baseball
SP237
Via Branze
ALER Brescia
Park Hotel Cà Nöa
Via Angelo Bolloni
Via Ambaraga
Europa
Pasticceria "Le Fonta
Google

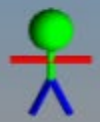
Forensic field work by students of the University of Brescia

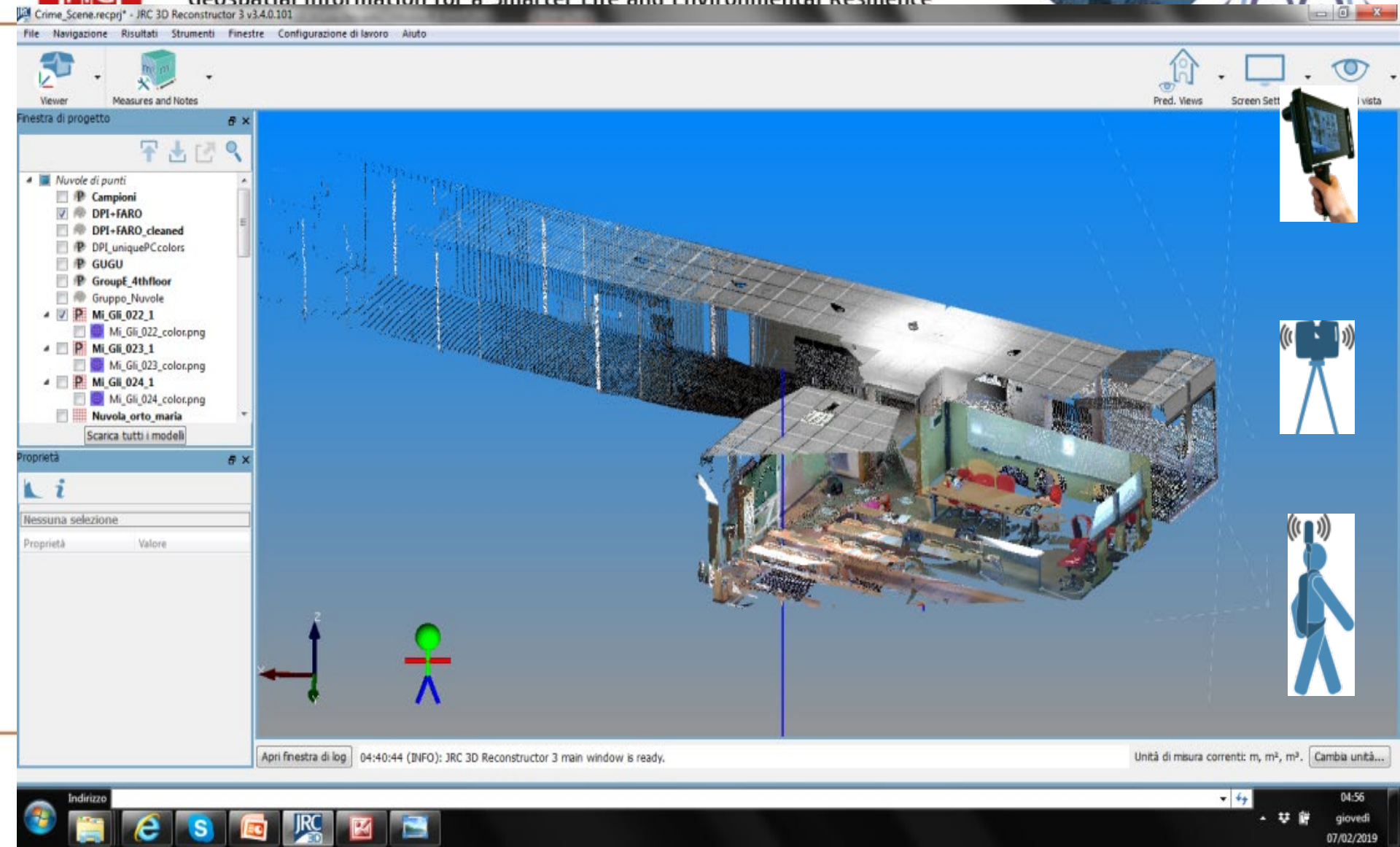
2017 - 2018

Forensic field work by students of the University of Brescia

2017 - 2018







Maverick mobile mapping system have been used


Via delle Stadio
Via delle Sad
Via Giuseppe Verginella
Via Bligny
Mompiano
Via Gaetano Salvemini
Università degli Studi di Brescia - Facoltà di Ingegneria
Via Piero Calamai
Via Ambaraga
Via Arnaldo Borzoni
Via Trumpel


MAVERICK

IMAGES

Laser Components

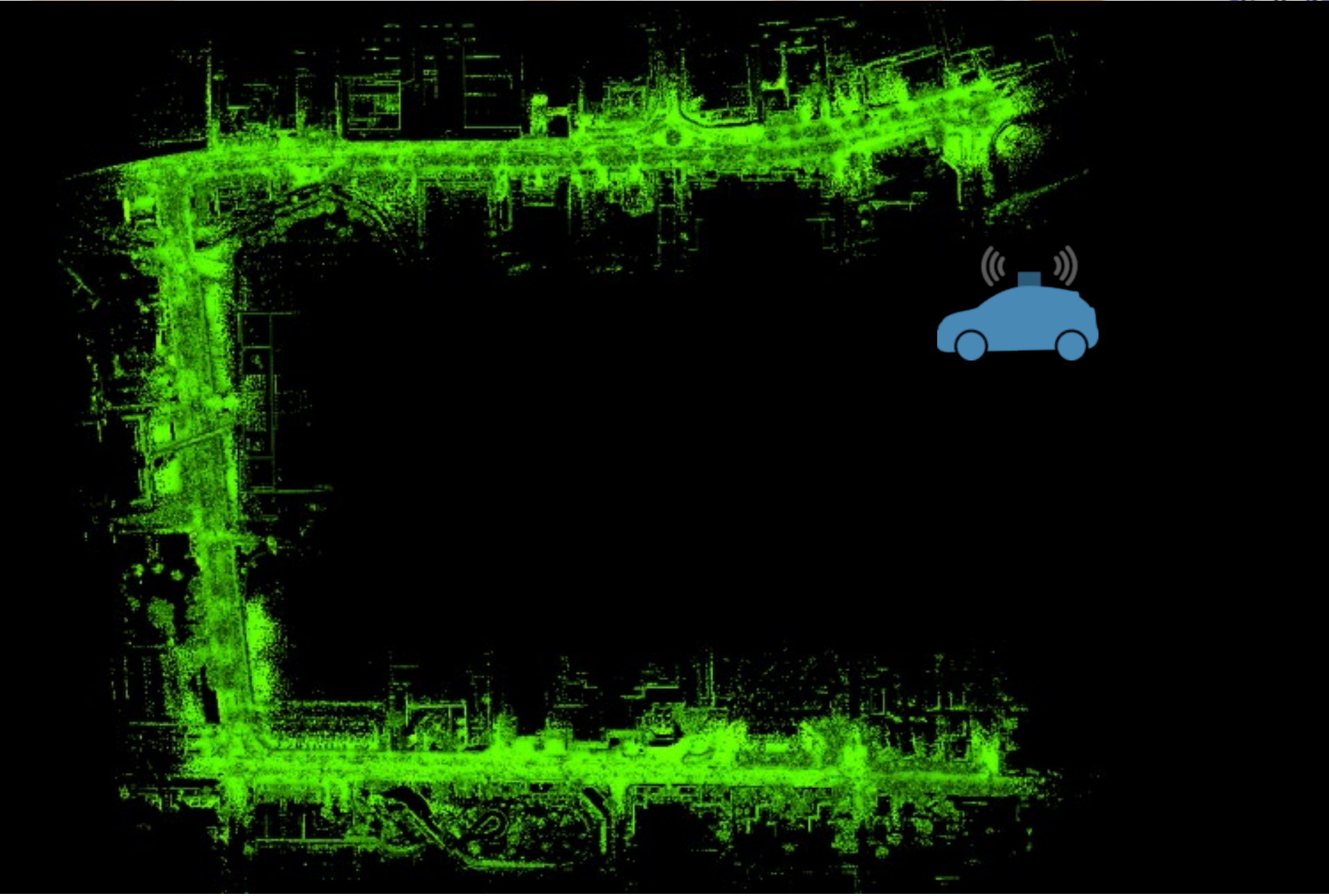
Laser/Detector Pairs	32	Horizontal Field-of-View	360°
Vertical Field-of-View	+10° to -30°	Output	Up to 700,000 points/second
Maximum Range	Up to 100 m	Safety	Class 1, eye-safe
Absolute Accuracy	Better than ± 3cm*	Relative Accuracy	± 1cm (1 sigma)**

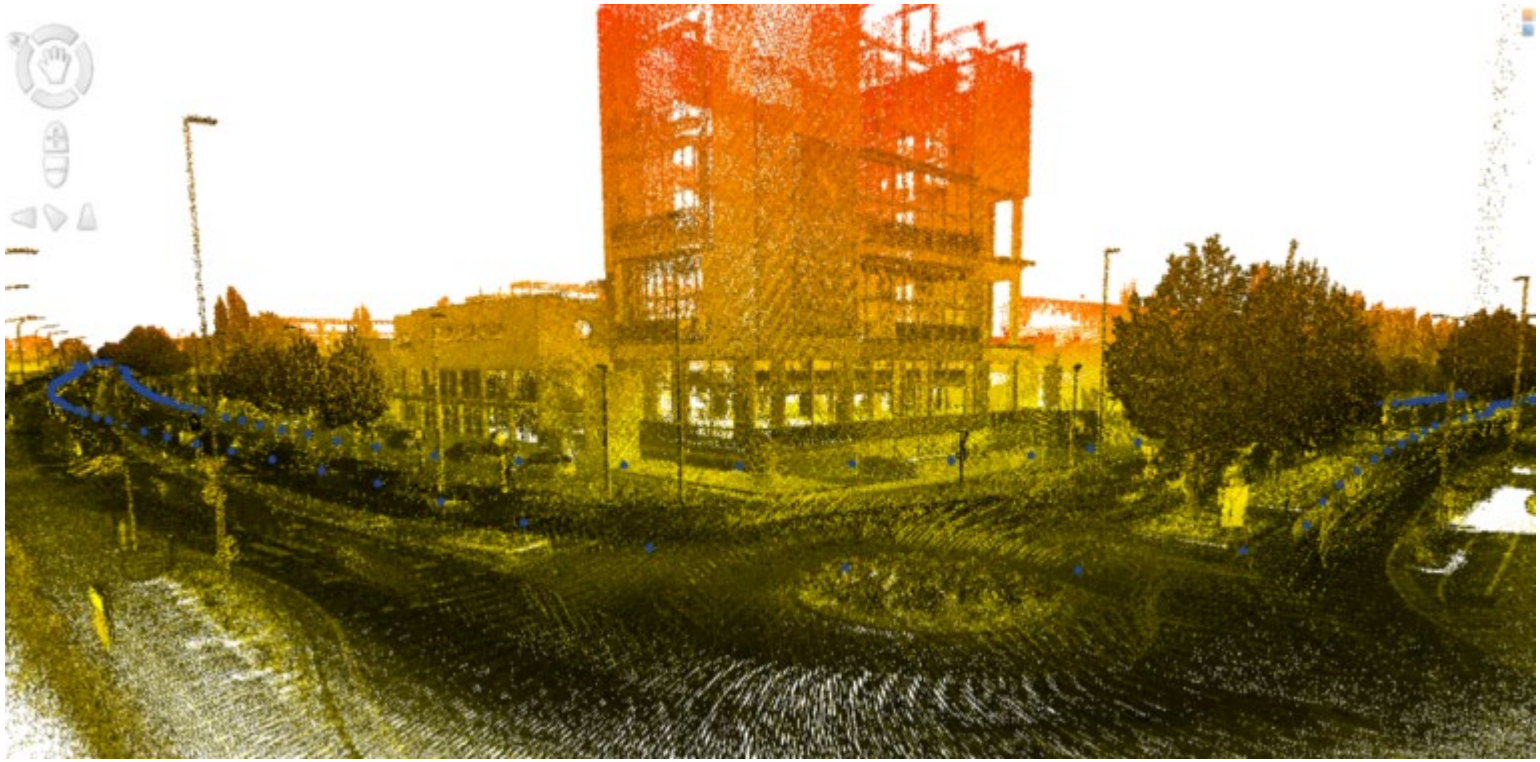
* Root Mean Square Error (RMS). Assumes good GNSS data (PDOP <3), data collected following best practices, and a 10-m range using a post-processed trajectory. Also assumes use of the LMS Pro software solution to adjust data with control points. Contact Teledyne Optech for more details.

**Plane fitting results on flat wall at approximately 10 m from the sensor. Average from assessment performed on 10 different Maverick units from 20 collection drives. Assumes the use of LMS Pro sensor calibration and good-quality post-processed trajectory data. Contact Teledyne Optech for more details.

Imaging Components

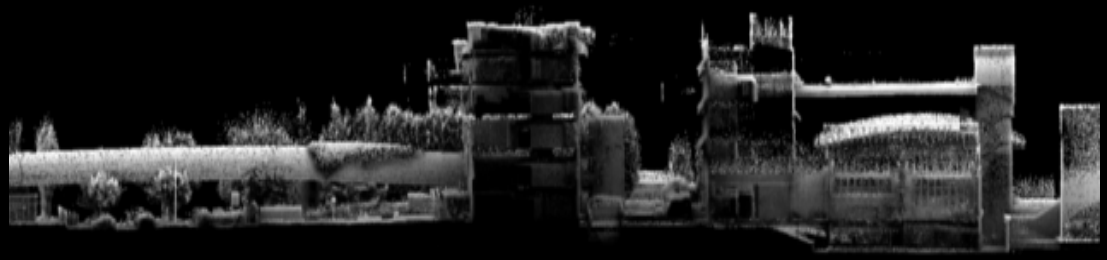
Type	Ladybug 5	Megapixels	30 MP (5 MP x 6 sensors)
Imaging Sensor	Sony ICX655 CCD x 6, 2/3"	Optics	6 high-quality 4.4-mm focal length lenses
Field-of-View	90% of full sphere	Spherical Distance	Calibrated from 2 m to infinity
Focal Distance	≈200 cm. Objects have an acceptable sharpness from ≈60 cm to infinity		

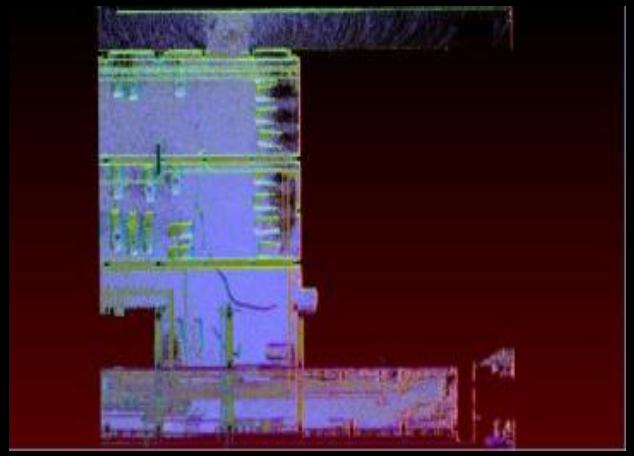


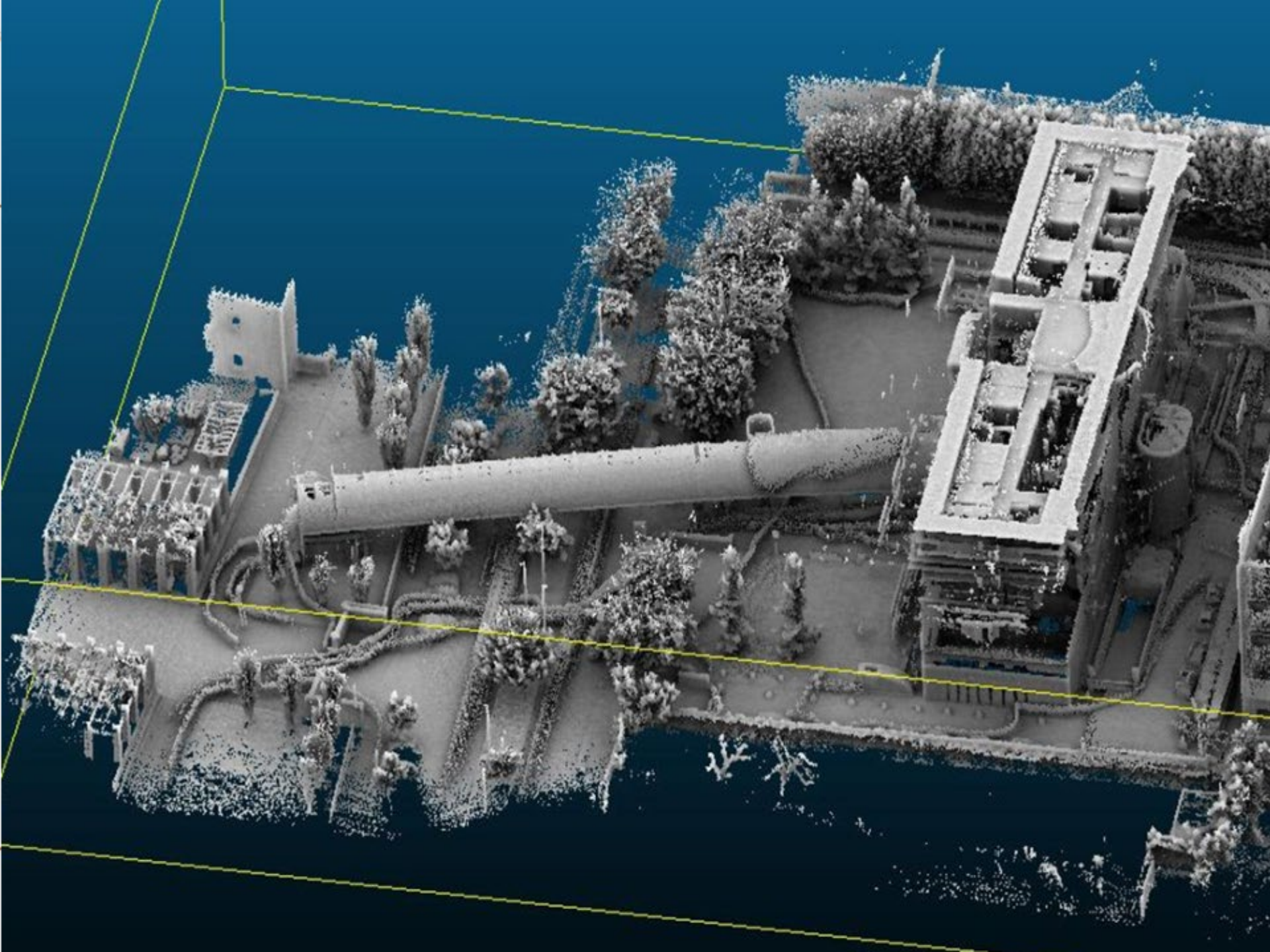


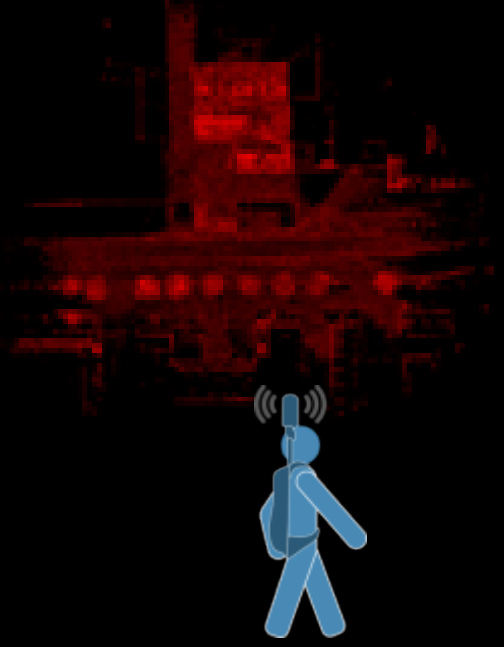
2/3 cm accuracy 3D model has been obatined

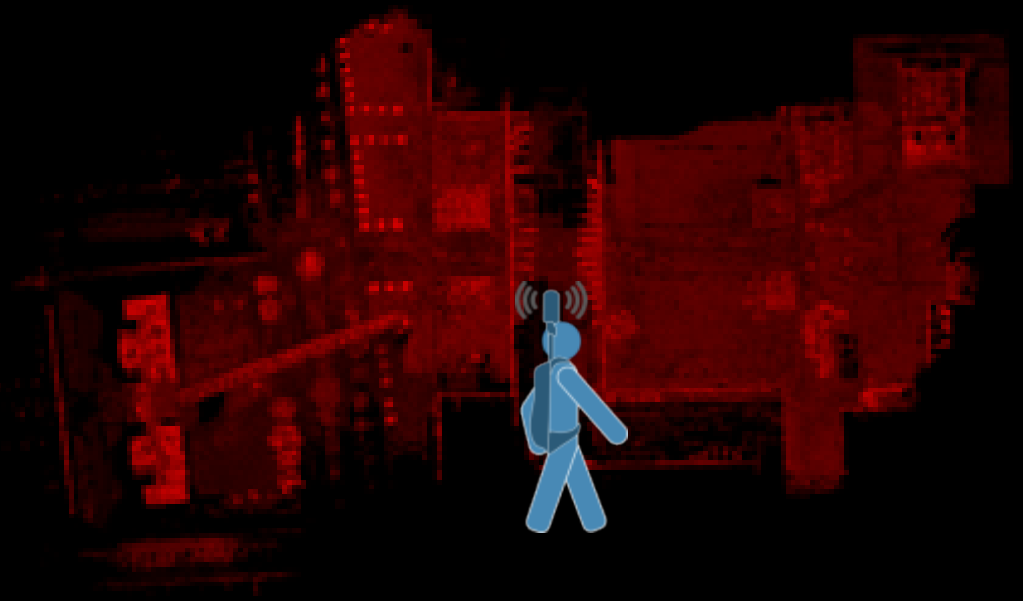

MLSP

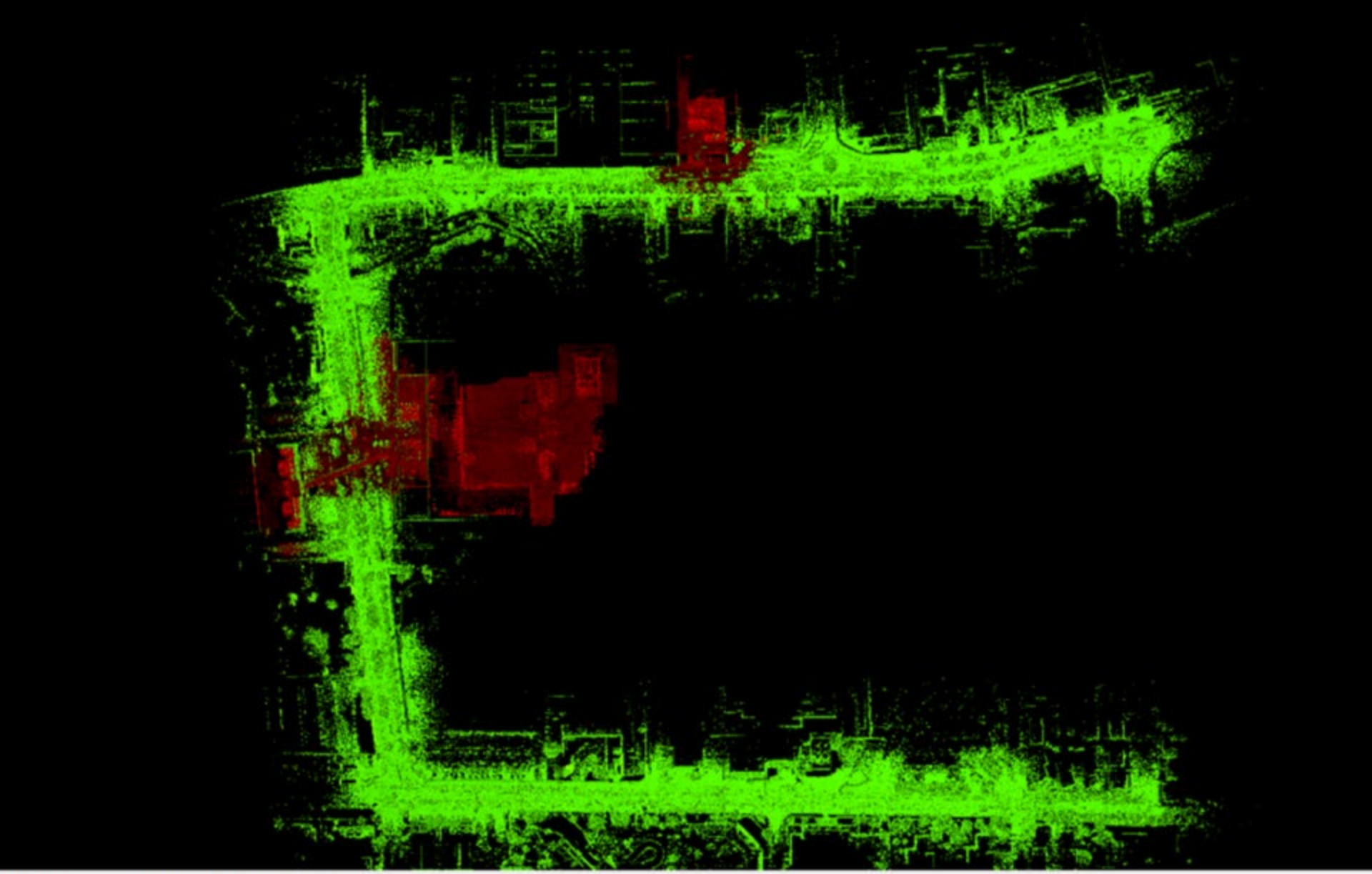




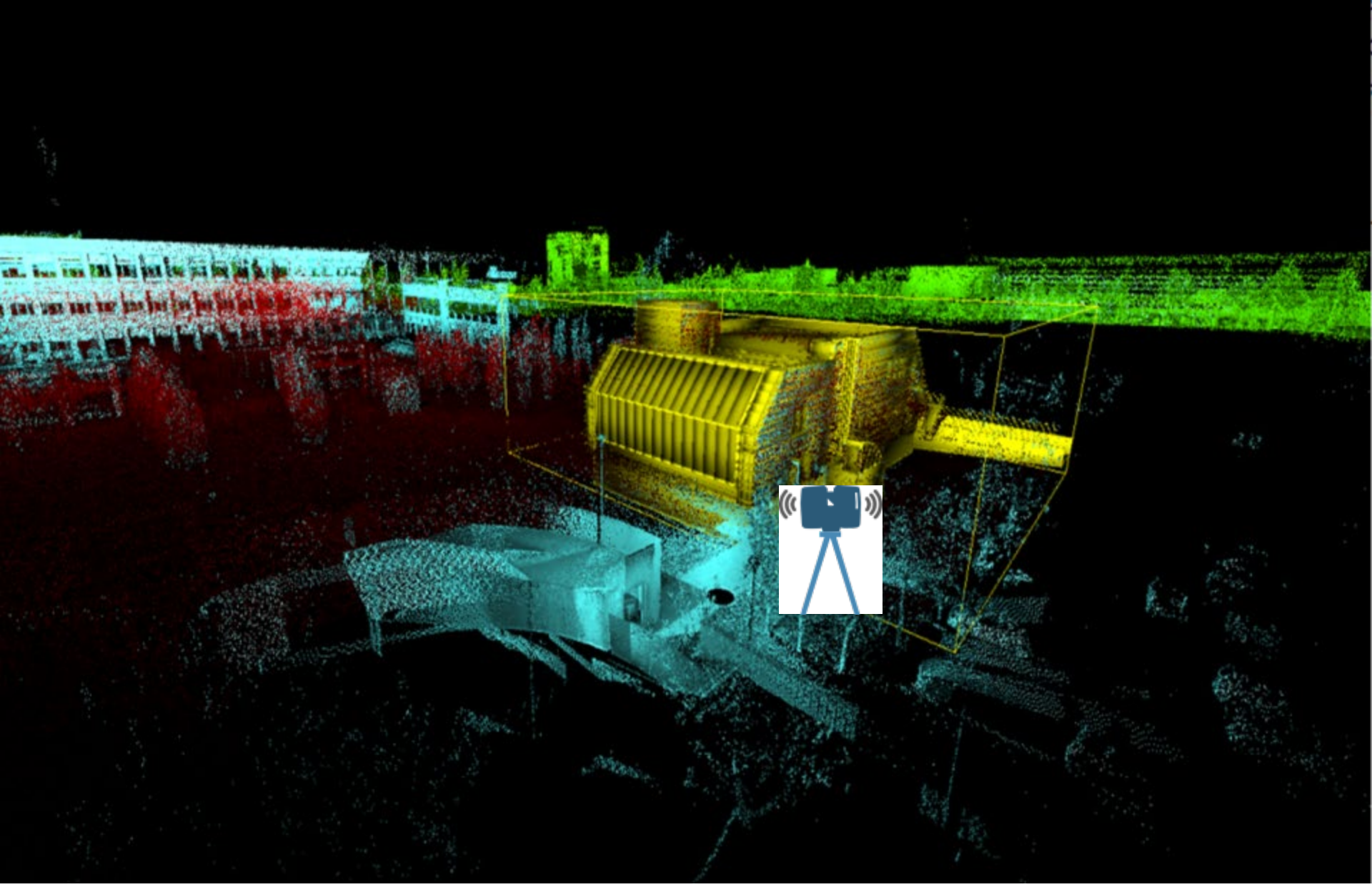








B of RAM memory are currently allocated for the models.



First classic approach

CLOUD to CLOUD automatic aligment

Innovative approach

Point clouds as constrain in the SLAM process

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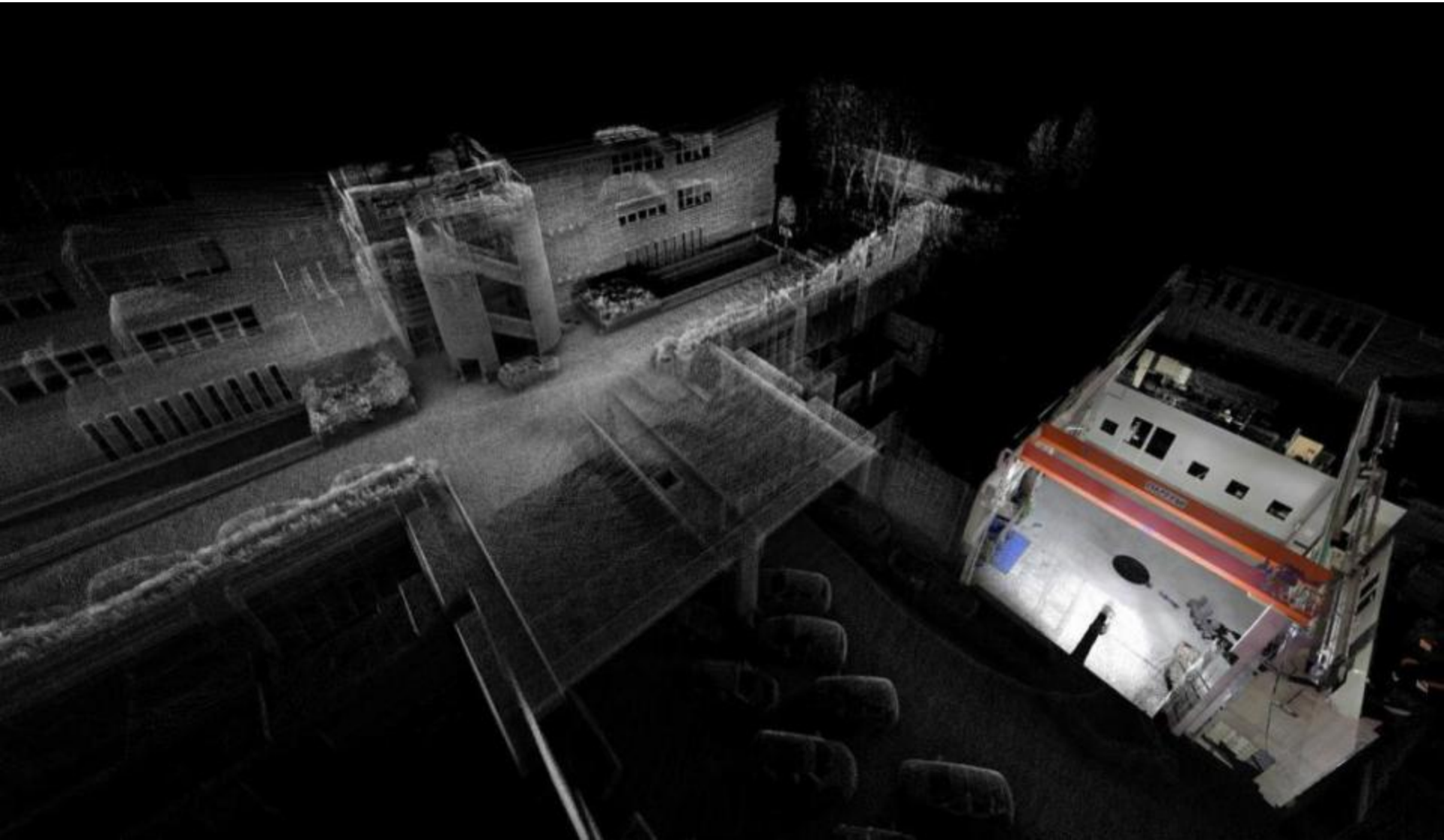
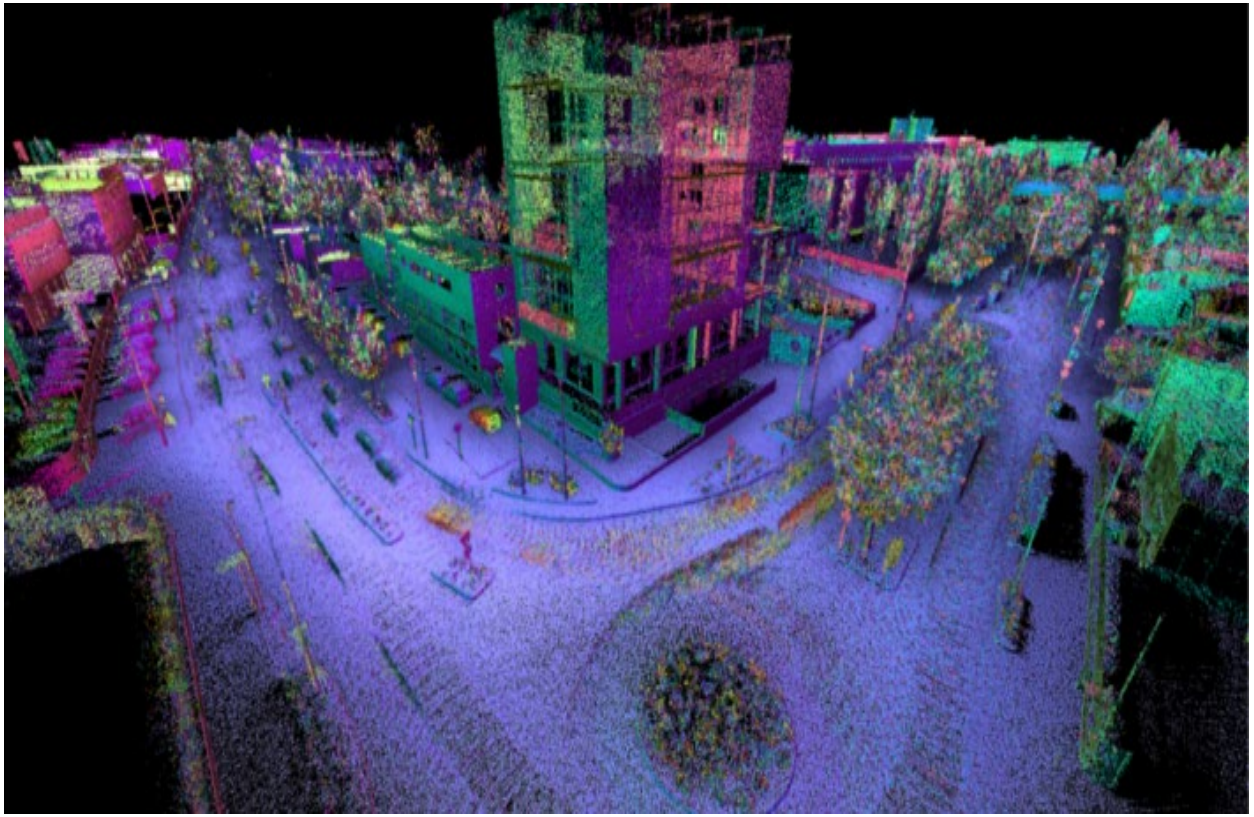


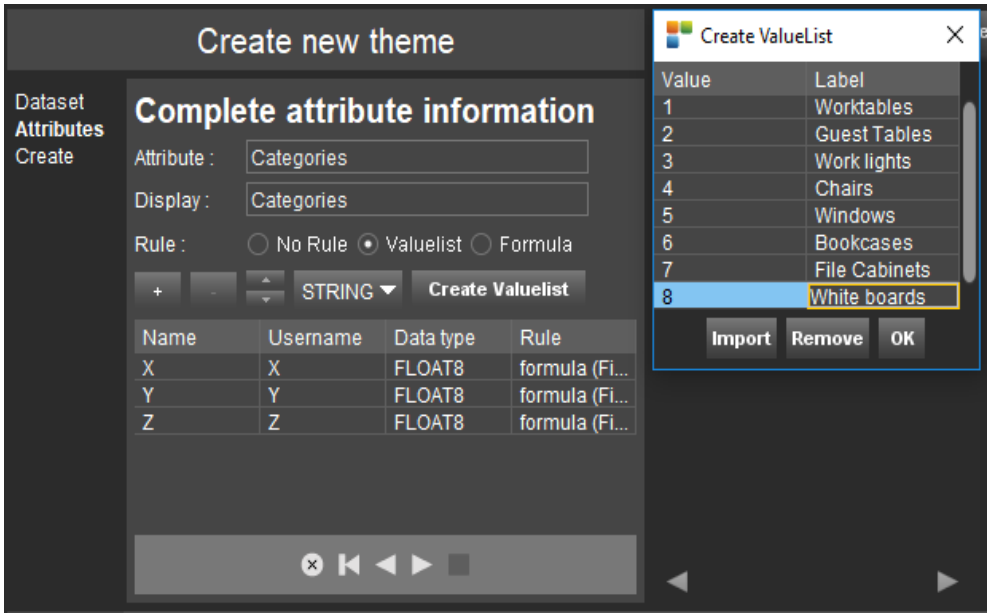
FIRST RESULT

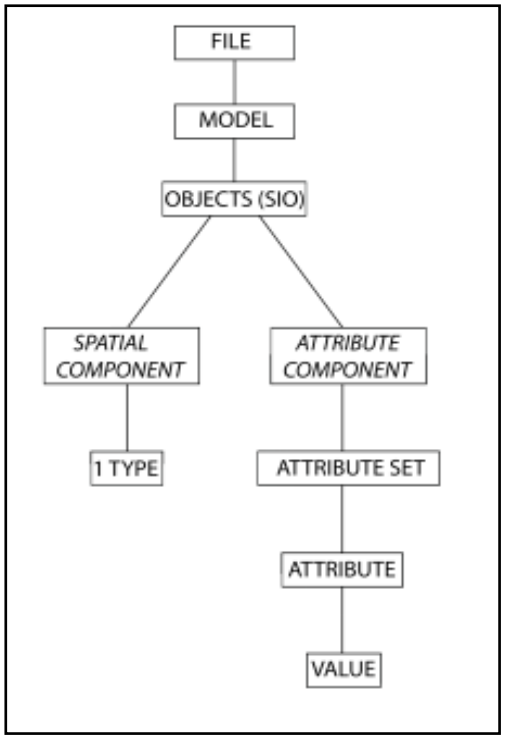
It is possible to manage in a single platform the data acquired on the field based on a multiresolution and multisources point cloud data.

Few examples are at the moment available

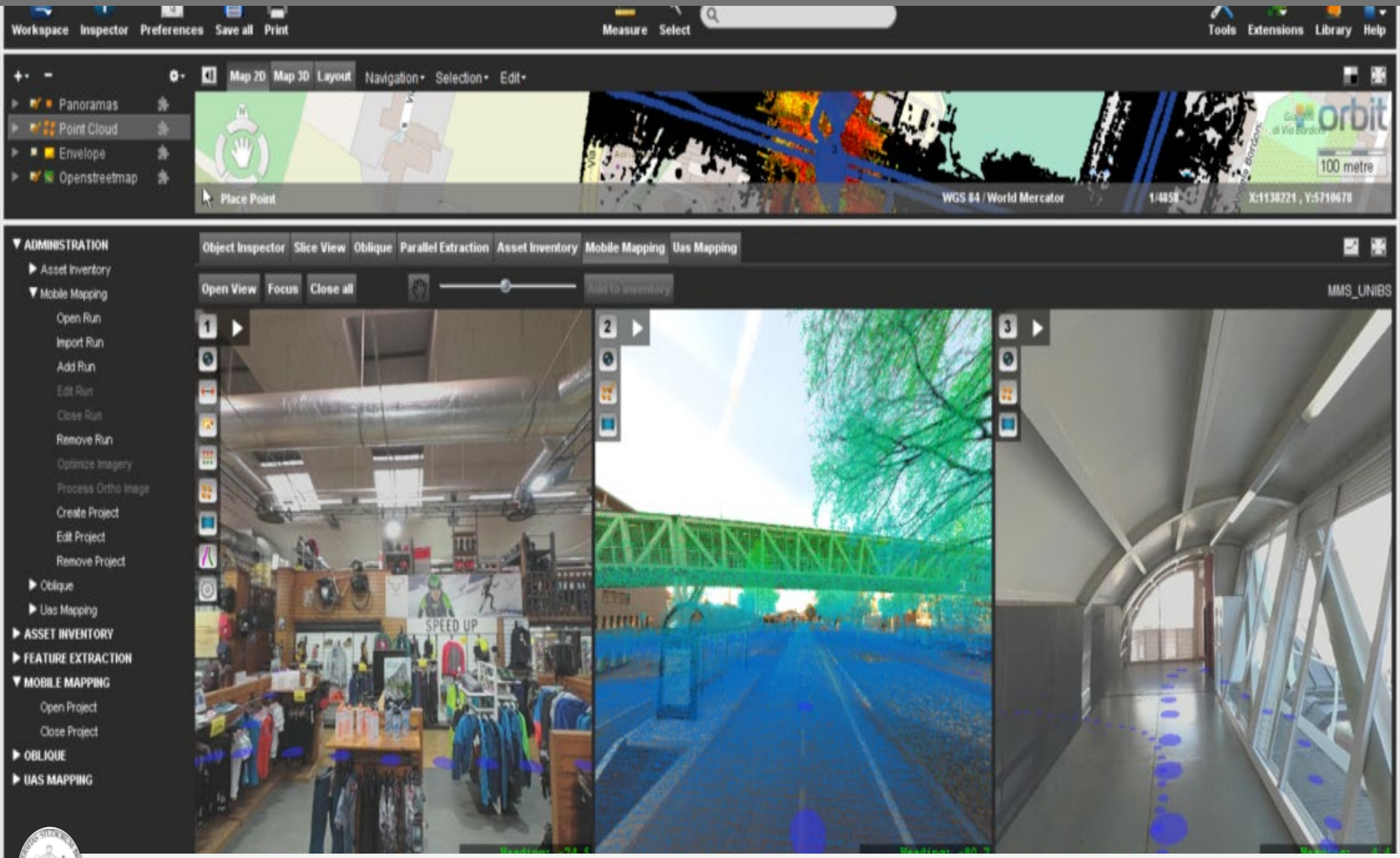


Dataset in Orbit Feature Extractions

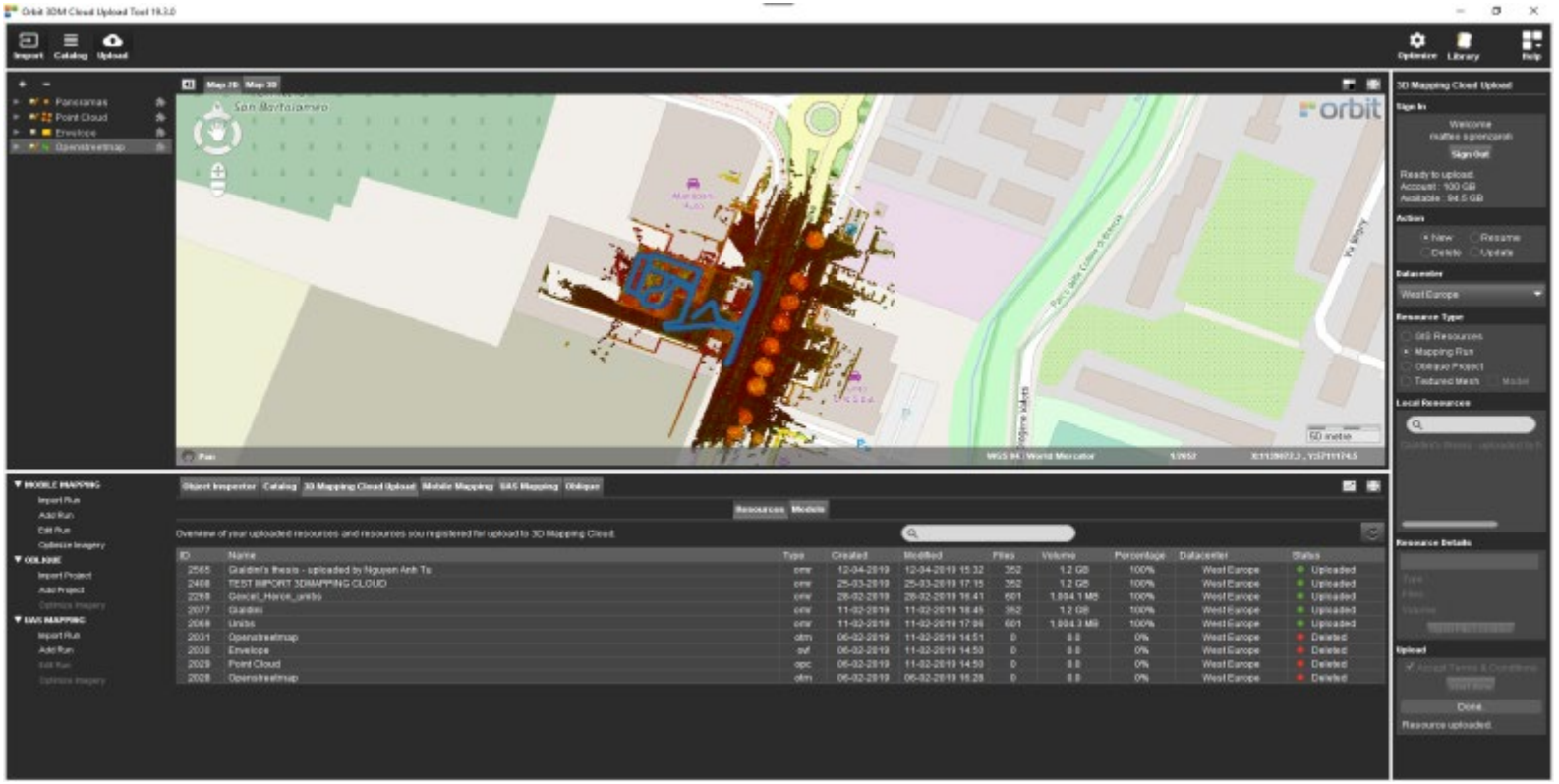




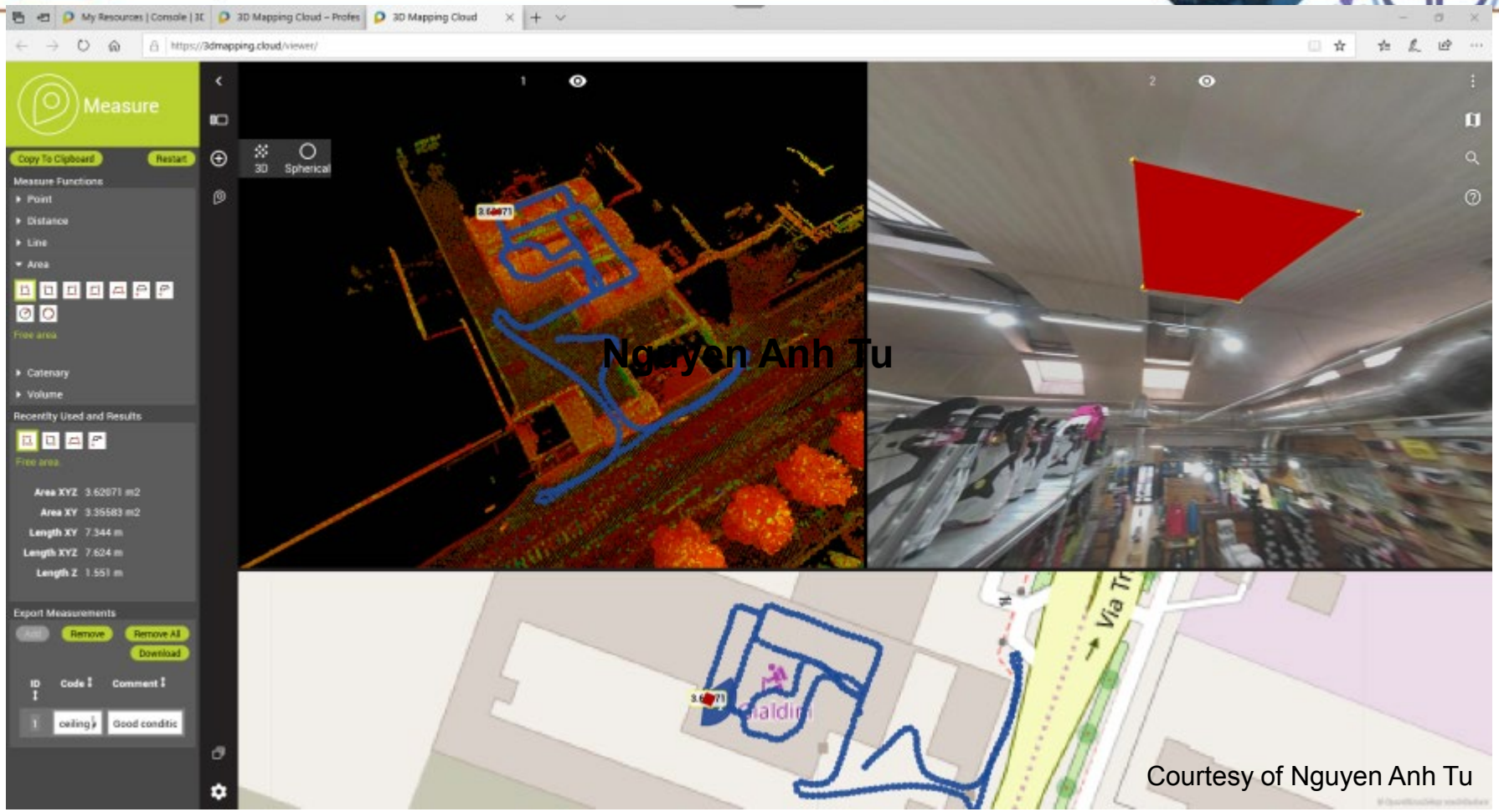
Courtesy of Nguyen Anh Tu



SHARING DATA IN WEB-BASED PLATFORM 3DMAPPING.CLOUD



Courtesy of Nguyen Anh Tu


Measure
Copy To Clipboard
Restart
Measure Functions
Point
Distance
Line
Area
Catenary
Volume
Recently Used and Results
Area XYZ 3.62871 m2
Area XY 3.35583 m2
Length XY 7.344 m
Length XYZ 7.624 m
Length Z 1.551 m
Export Measurements
Remove
Remove All
Download
3D
Spherical
Nguyen Anh Tu
Courtesy of Nguyen Anh Tu

Conclusions

- It is possible to run indoor-outdoor 3D mapping using also 3D iMMS without GNSS
- An outdoor scheleton can be used as reference frame, thanks to the new tools allowing to manage point clouds as constrain in the SLAM process
- All the model can be managed in a single platform
- A single platform can be applied to manage various DATASET
- Platform are easily available to share point clouds data

Thank You

giorgio.vassena@unibs.it