A LIDAR Interactive Data Visualization for Ground Aircraft Detection at Small Airports

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María-Jesús Lobo, Christophe Hurter,
Mathieu Cousy

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ENVISION project

Low cost surveillance system using low cost sensors and the advances in image detection algorithms

SESAR H2020 ER3 funding

: Project leader, ADS-B receiver, datafusion

: Video and Lidar processing, A-SMGCS HMI, field test

: Operational requirements

: A-CDM interface

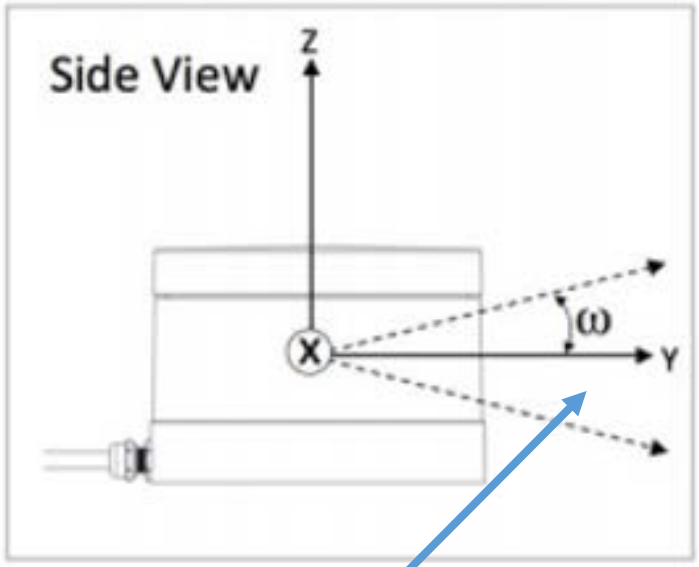

ASTRA ADS-B Receiver
Camera
LIDAR
ASTERIX

LIDAR sensor

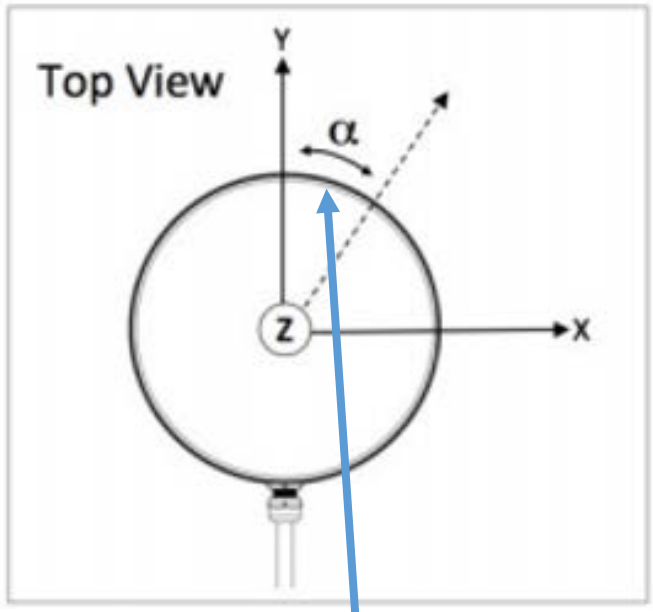
Model and characteristics, output sample

- ~300 000 points/second
- 30° vertical field of view
- 100 m range
- 5000€ in 2017

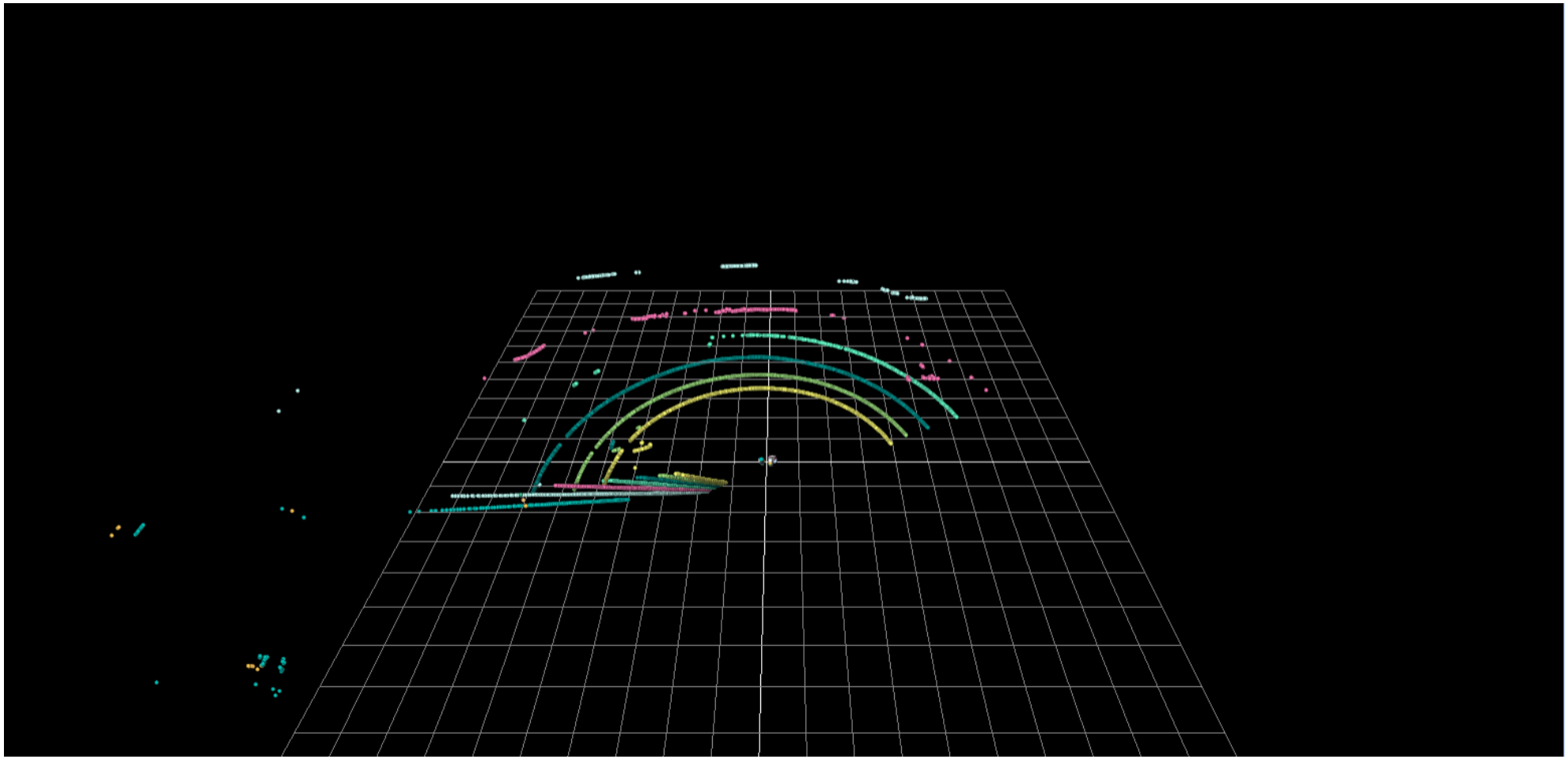
VLP 16: 16 Vertical lasers



Vertical angle: 16 lasers



Horizontal angle, at intervals of 0.2 degrees



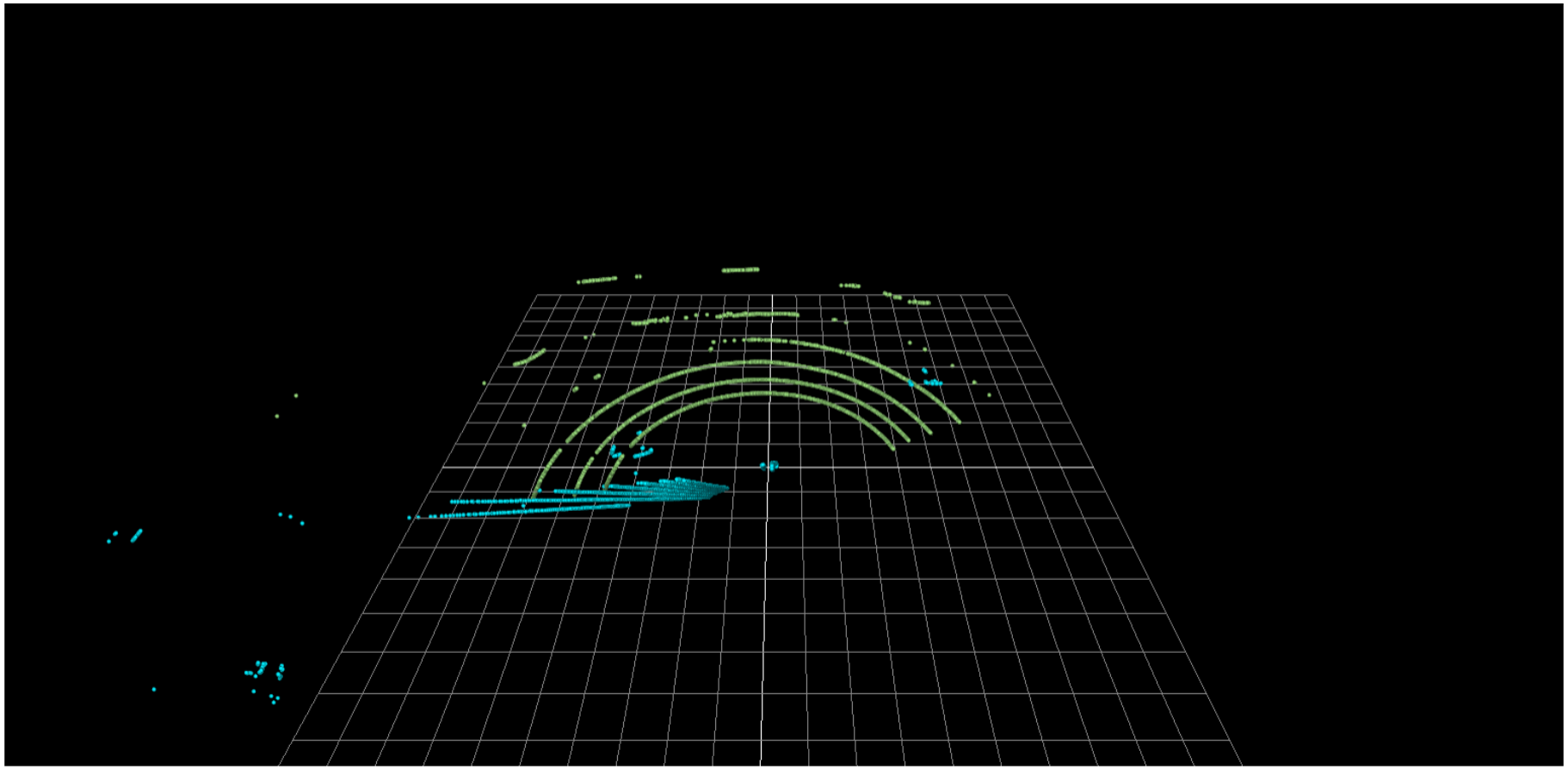
Objects detection algorithm

Algorithm introduced by **Bogoslavsky and Stachniss (2016),** targeted at low resolution LIDAR point clouds. Two main steps:

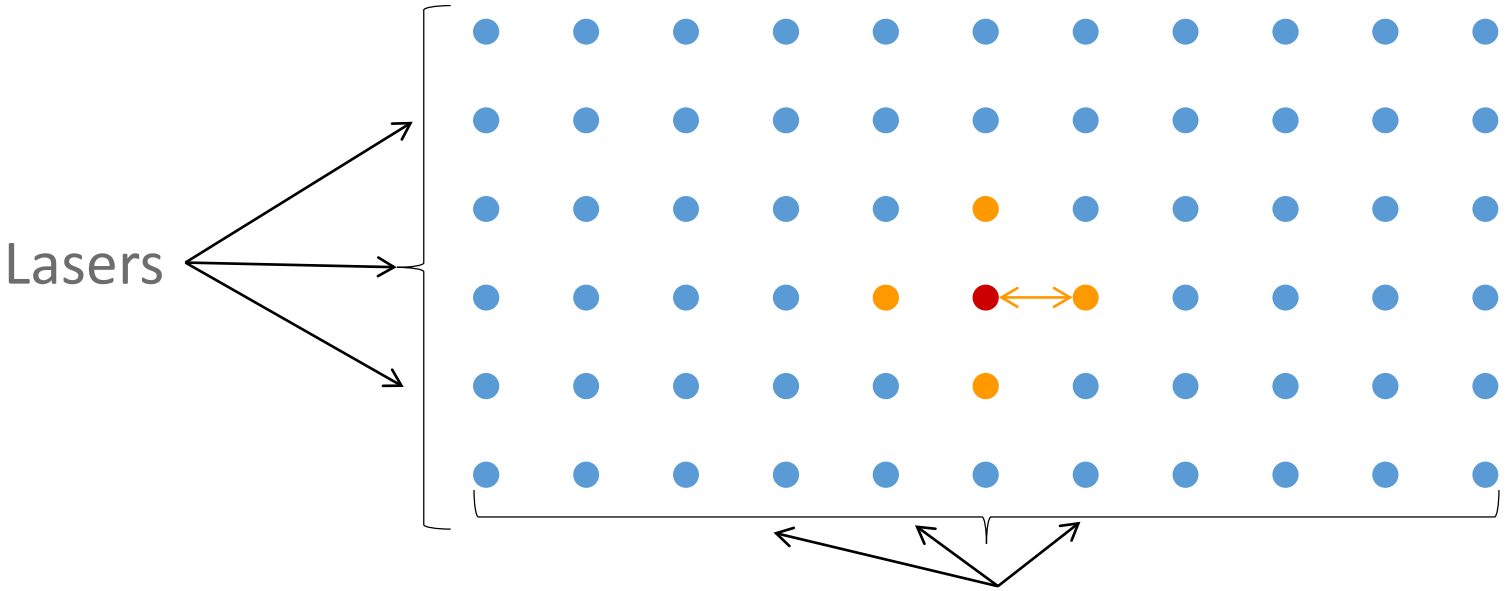
1. Classification of points by ground and non-ground
2. Object segmentation according to the beta angle

1. Classification of points by ground and non-ground:

using a plane fitting approach

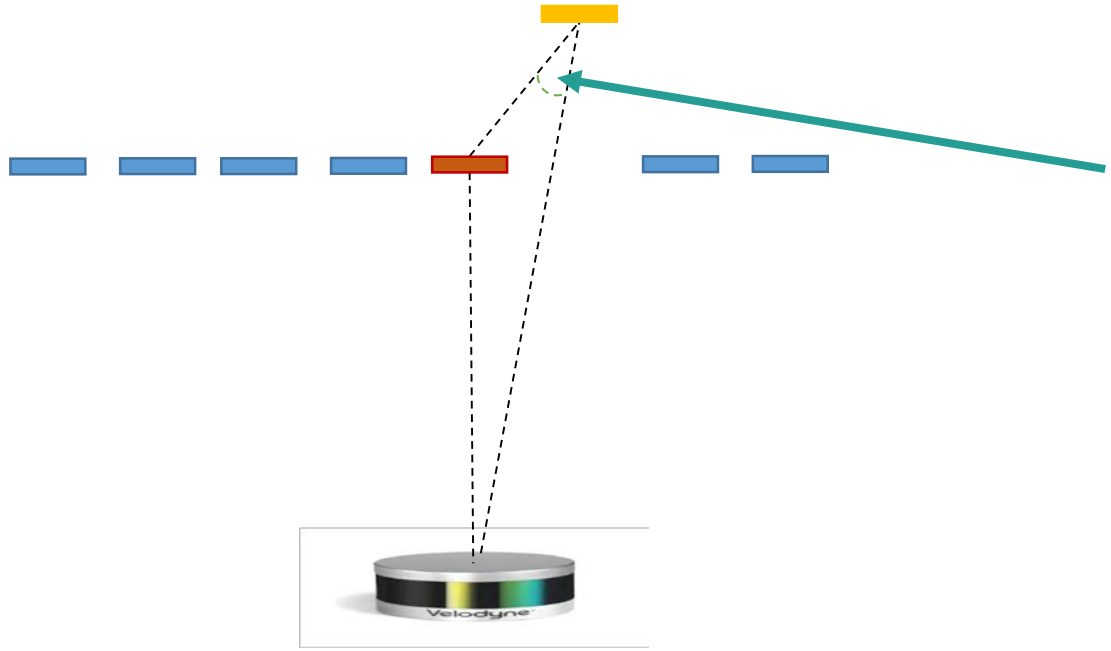


2. Object segmentation according to the beta angle



For each points we consider their 4 neighbors (if their distance is smaller than the *distance threshold*) Then the beta angle test is applied

2. Object segmentation according to the beta angle



Beta angle. If it is small, the objects are probably at different depths

- Two parameters to set: *Beta angle* and *distance threshold.*
- Other parameters can be useful to filter out noise such as minimum and maximum size.
- It can be hard to understand the effects of the changes of these parameters in the detection results

Interactive visualisation

Design requirements

R1: Support navigation in the point cloud

R2: Support manipulation of the algorithm parameters and present the detection results in the visualization

R3: Present visual cues to help users understand how the algorithm works

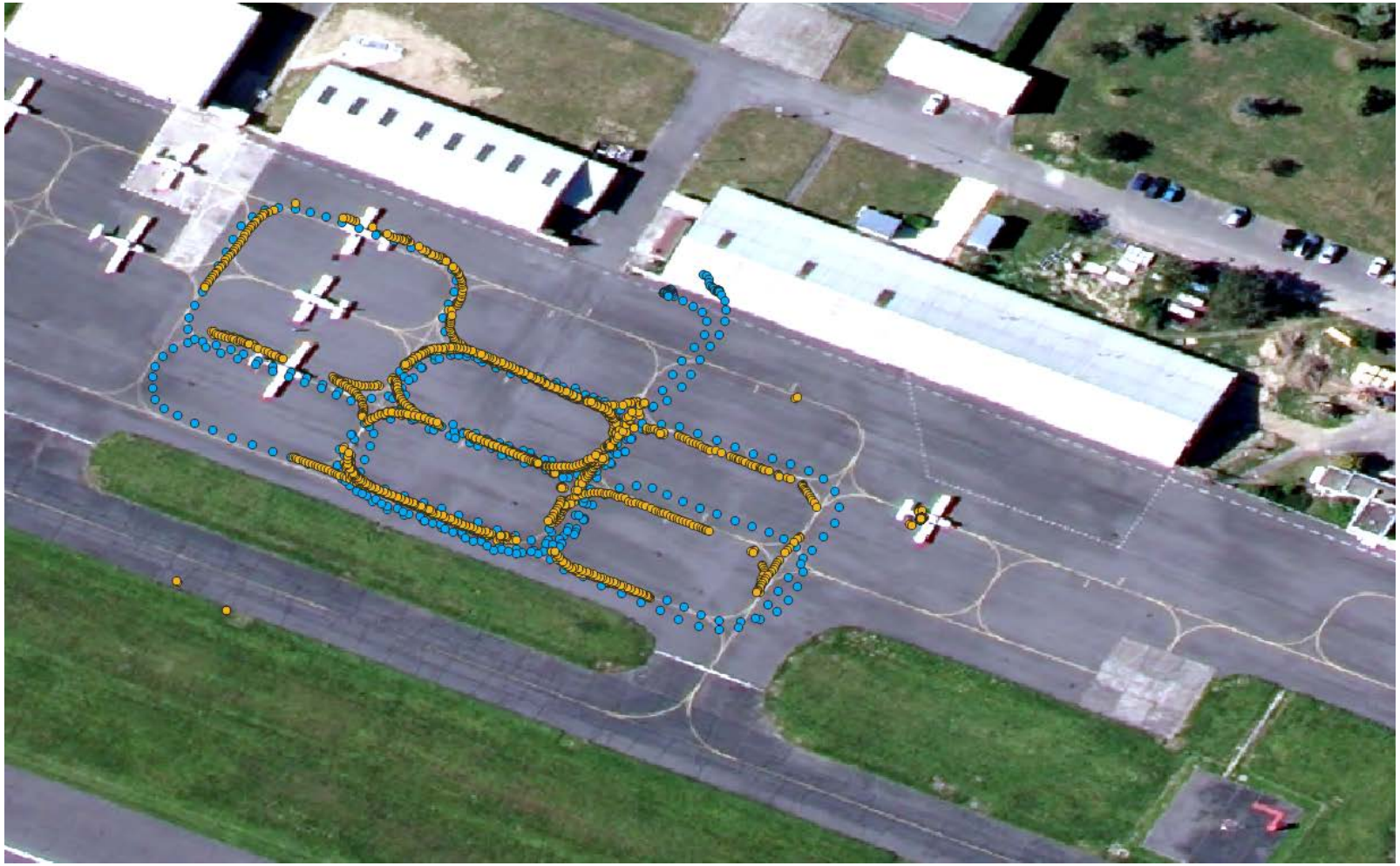
R1: Navigation

R2: Calibration

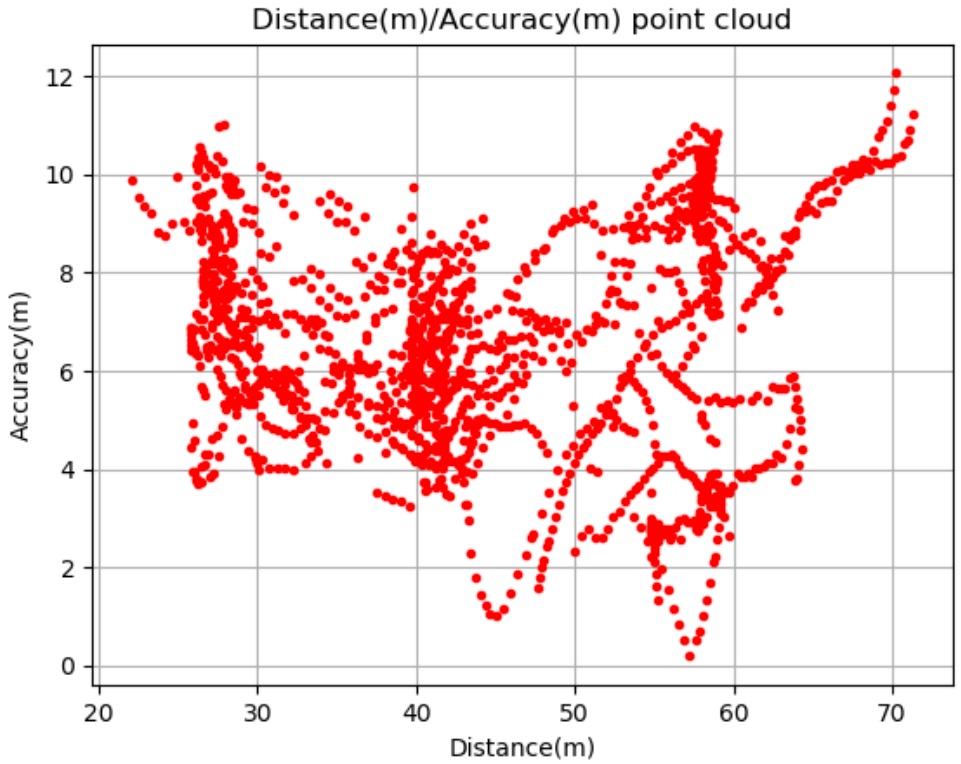
R3: Understanding results

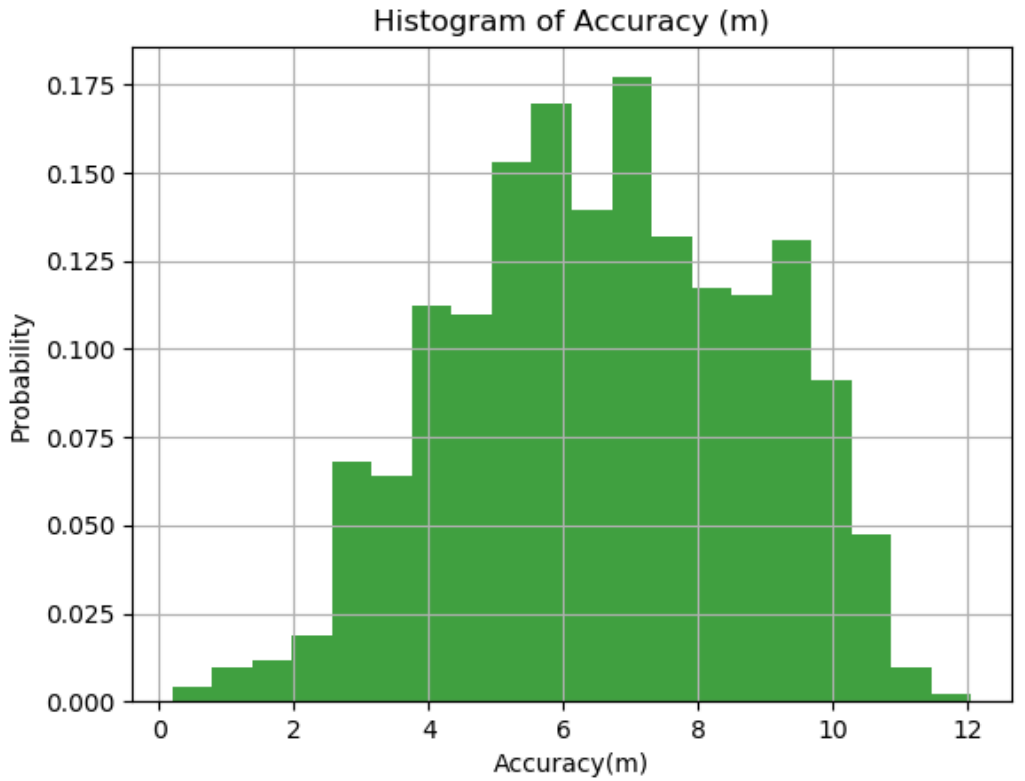
Evaluation

Muret Airfield, France



- GPS reference positions in **blue**
- LIDAR detections in **yellow**





The car was detected 85% of the time (400 seconds)

Conclusion

- We introduced a Lidar interactive visualization to facilitate the calibration phase of the detection algorithm.
- However, the algorithm presents several limitations, for example it does not do any kind of classification.
- Nevertheless, in the context of the ENVISION project, the LIDAR is complementary to the cameras, because it provides accurate depth estimations while the classification is done using the video stream.

Next Step : Understand direction of change

- Flow visualization techniques

OLIC
(Cabral and Leedom 1993)

IBFV
(Van Wijk 2002)

- Oscillating stand for the LIDAR

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- María-Jesús Lobo, Christophe Hurter, **Mathieu Cousy**
- Website : **http://www.envision-s2020.eu/**
- **mathieu.cousy@enac.fr**