EPIC Meeting on Photonics at the Final Frontier at European Space Agency (ESA)

Development of a Massively Parallel 3D Metrology Instrument for In-Orbit Operation

Ommatidia LiDAR

Grégory Pandraud – Co-founder/VP research

13th of September 2022

Ommatidia LiDAR

- Founded in 2020
- ESABIC member for the first two years
- Located in Spain and in the Netherlands
- We are now 7 and growing
- EIC Seal of Excellence 2021


SEAL OF EXCELLENCE

European Commission

European Commission

Horizon Europe

The project proposal

190186630 (190139634) — 3DAD

"3D light field sensor for Autonomous Driving"

submitted under the Horizon Europe EIC call

HORIZON-EIC-2021-ACCELERATOROPEN-01 — EIC Accelerator Open 2021

by

Ommatidia LIDAR S.L.

following evaluation by an international panel of independent experts

was recognised as a high-quality project proposal in a highly competitive evaluation process

but could not receive funding due to budgetary constraints and is therefore recommended by the European Commission for funding by other sources.

Mariya Gabriel, Commissioner for Innovation, Research, Culture, Education and Youth

Elisa Ferreira, Commissioner for Cohesion and Reforms

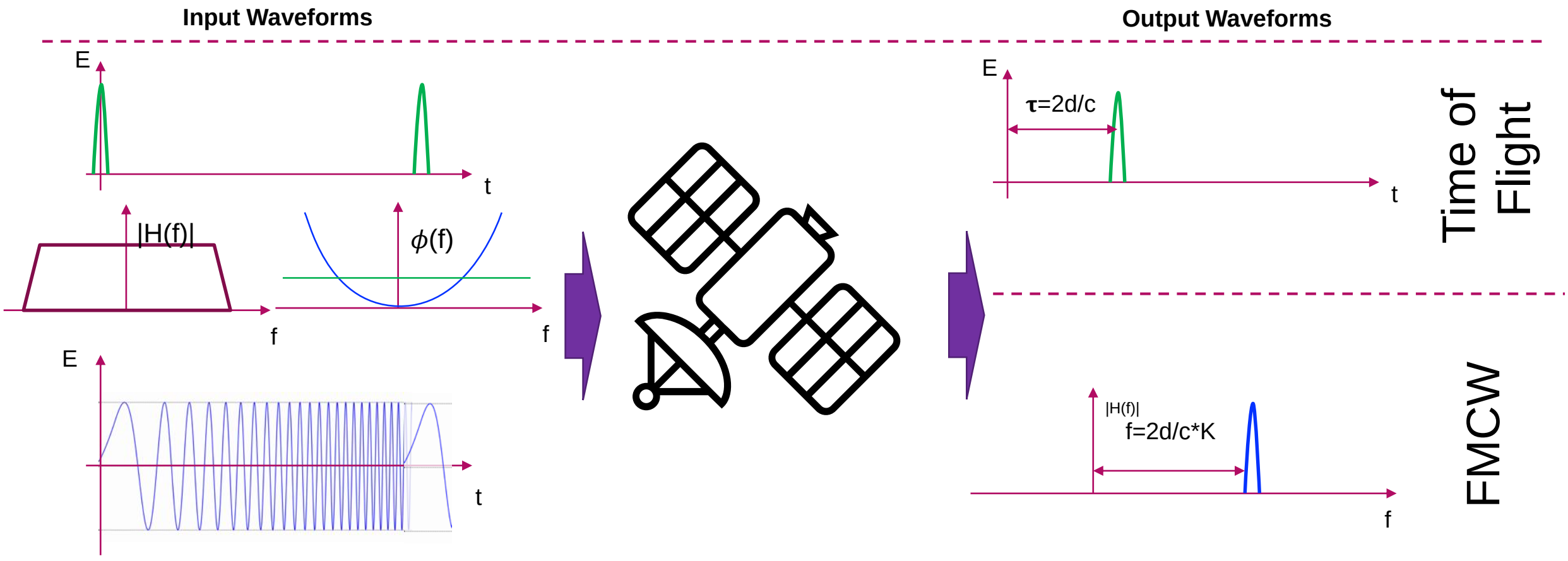
HORIZON EUROPE

Brussels, 04/2022

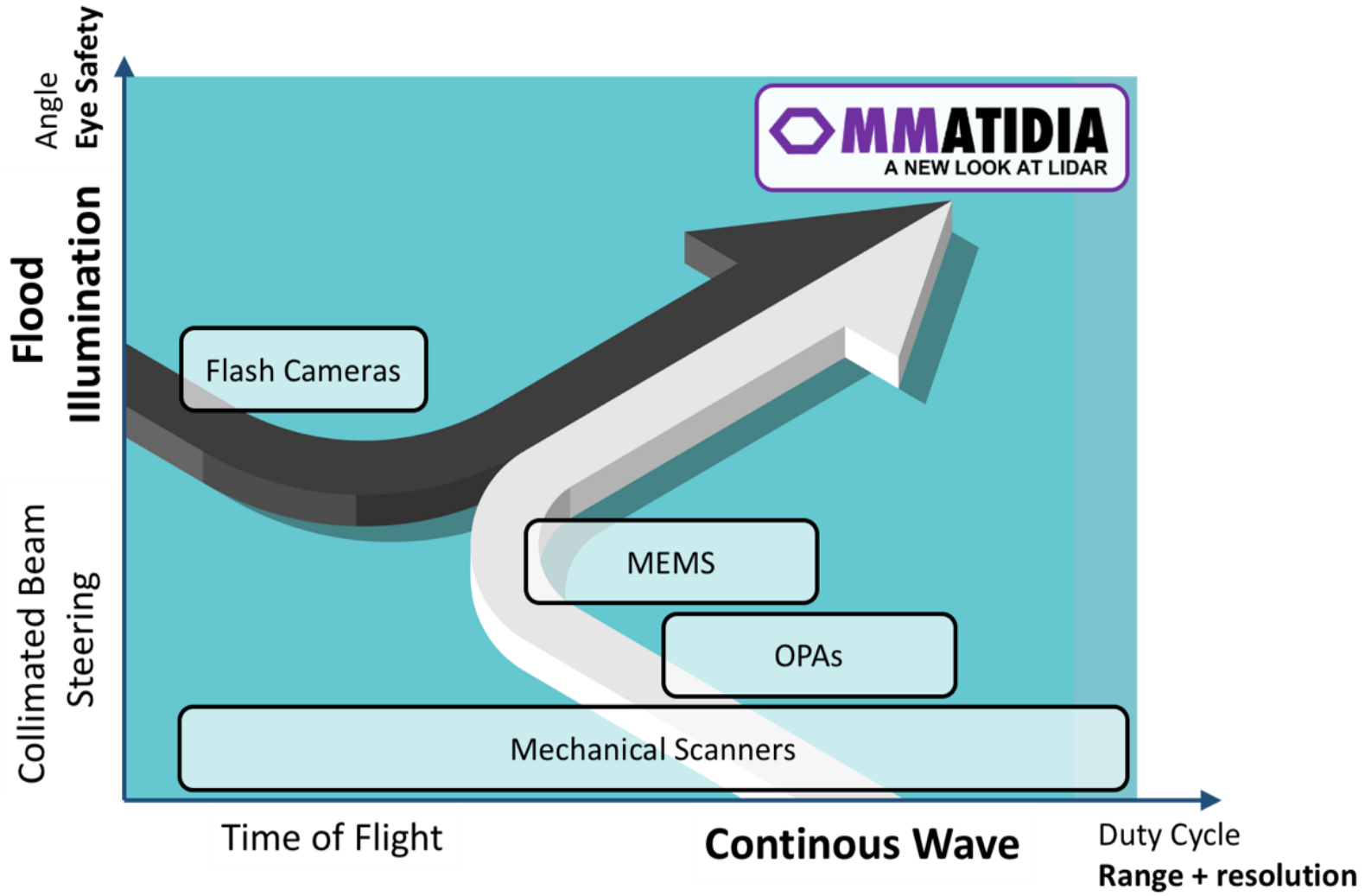
Madrid

Rijswijk

ToF vs. FMCW


Input Waveforms
Output Waveforms
E
t
|H(f)|
ϕ(f)
f
f
E
t
E
τ=2d/c
t
Time of Flight
|H(f)|
f=2d/c*K
f
FMCW

Ommatidia's LightField Sensor



Ground Metrology

Ommatidia Q1

- 128 Channels
- Interferometric absolute measurement
- 20.000 points/s
- 6µm/m

Aerospace

- Antenna measurements
- Composite structures

Production

- Automotive manufacturing
- Naval engineering

Civil Engineering

- Imaging vibrometry for structural analysis

Solution

Contactless

No markers
Any surface
No preparation

Accurate

Absolute Distance
1µm/m
1 µrad

Fast & Effective

Simple Setup
>20,000 pts/sec
>50m range

Insightful

Vibrometry for
structural analysis

Application to In-Orbit Metrology

ESA project – In-orbit surface metrology for large deployable reflectors

European Space Agency

MMATIDIA A NEW LOOK AT LIDAR

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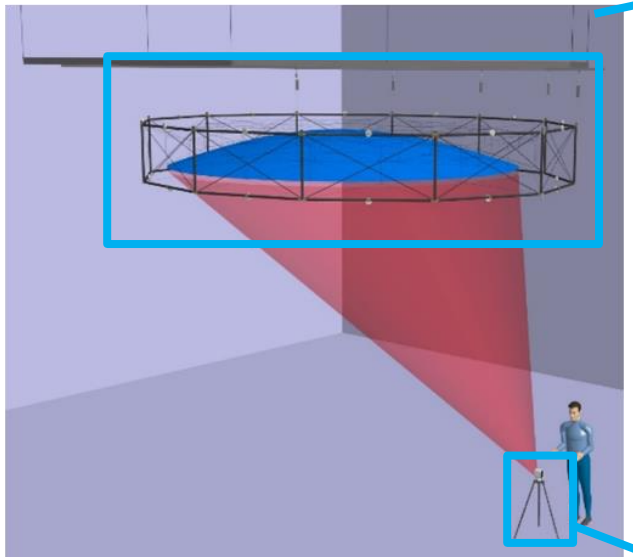
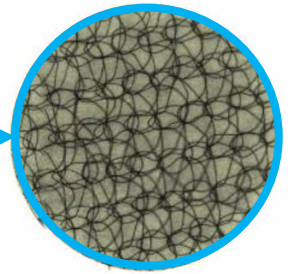
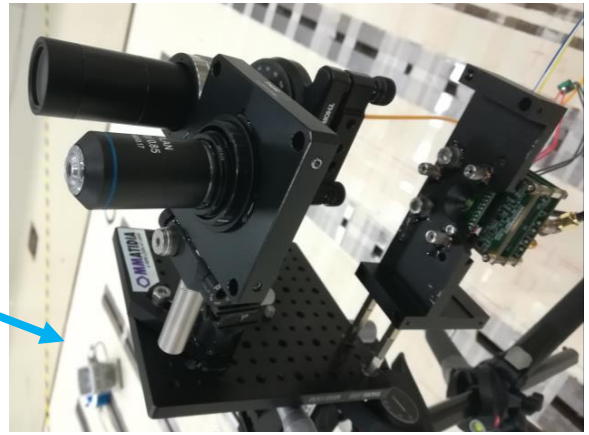
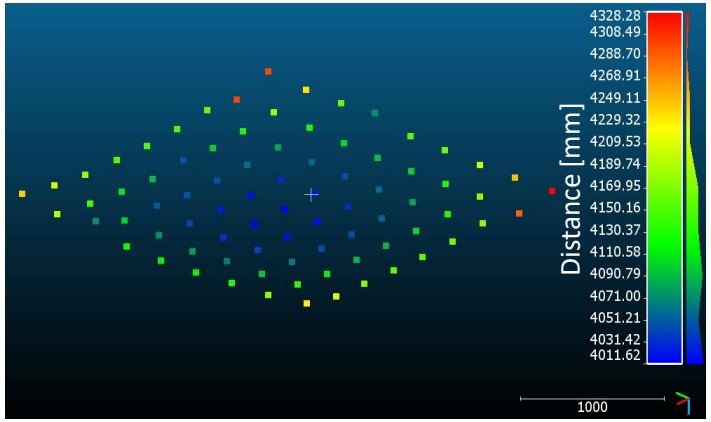




Reflector knitted mesh (L-Band)





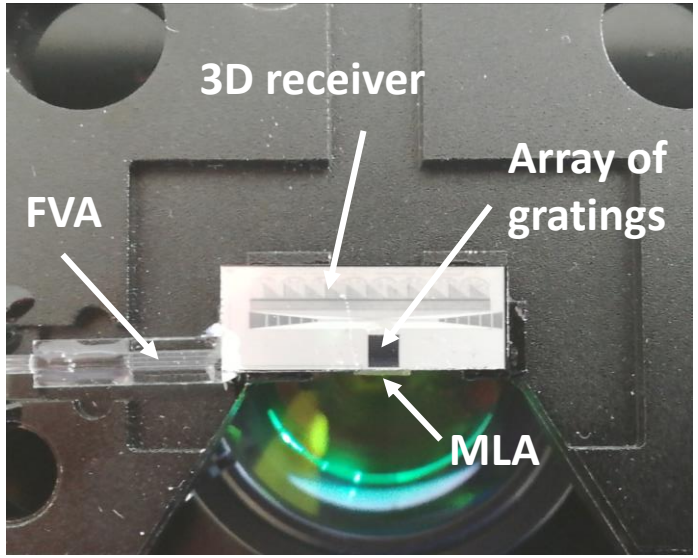
Goal: Develop a metrology instrument at TRL 4 for in-orbit surface characterization of LDRs with high accuracy

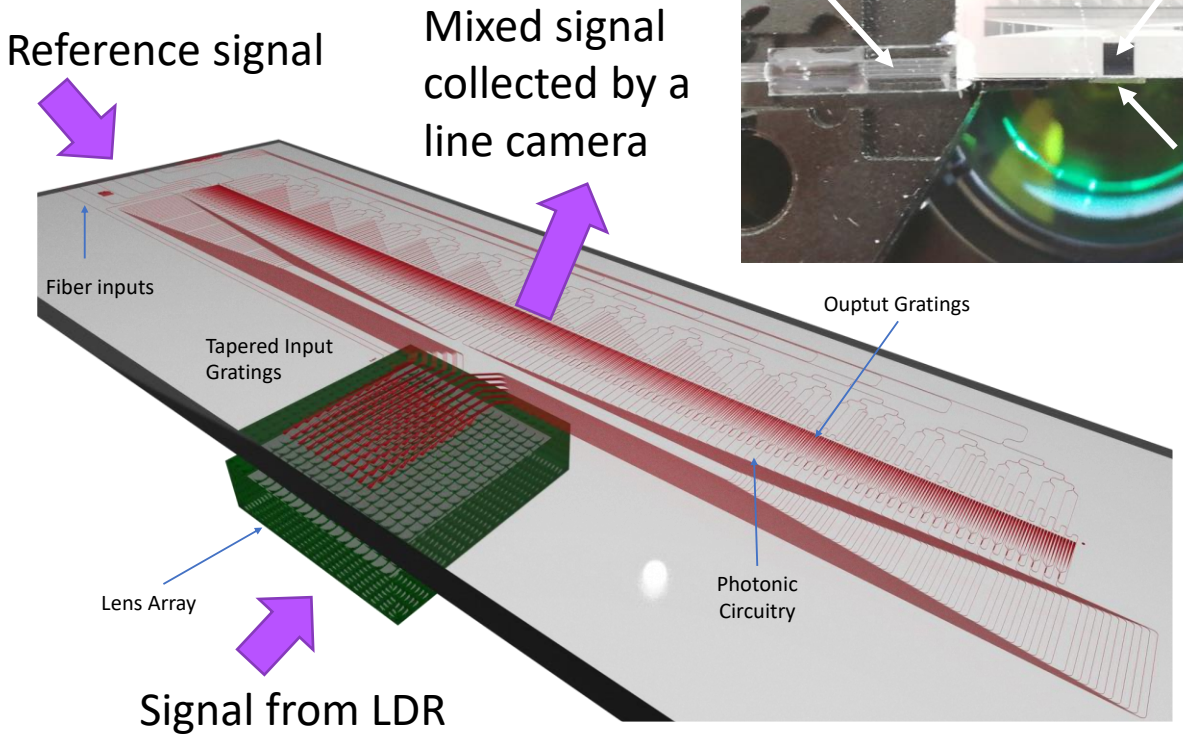
Application to in-orbit metrology

Our approach in the project - 3D photonics receiver sensor

3D receiver sensor (Ommatidia's patented technology):

- **121-channel parallel sensing on a photonic integrated circuit chip:**
  - 121 interferometers in a chip of 5mm x 12 mm that gives **121 simultaneous measurements**
  - Array of grating couplers + microlens array (MLA) to collect light from the scene
  - FoV is increased to 45 degrees with a standard objective

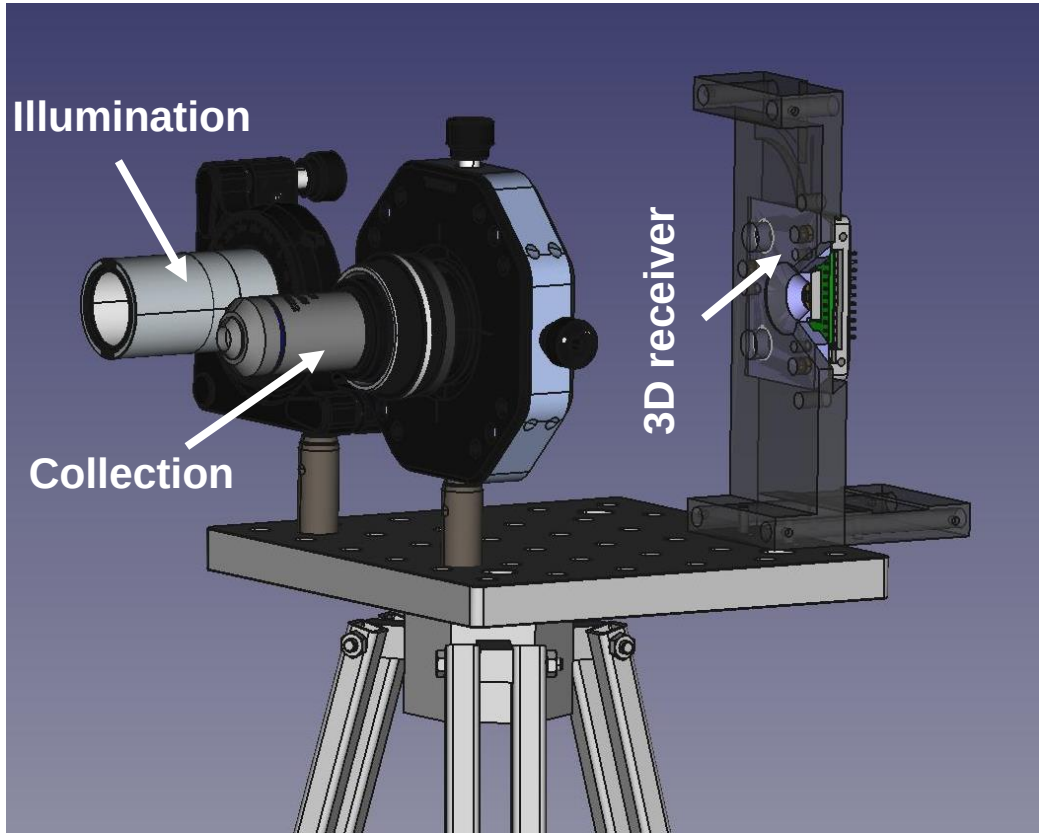




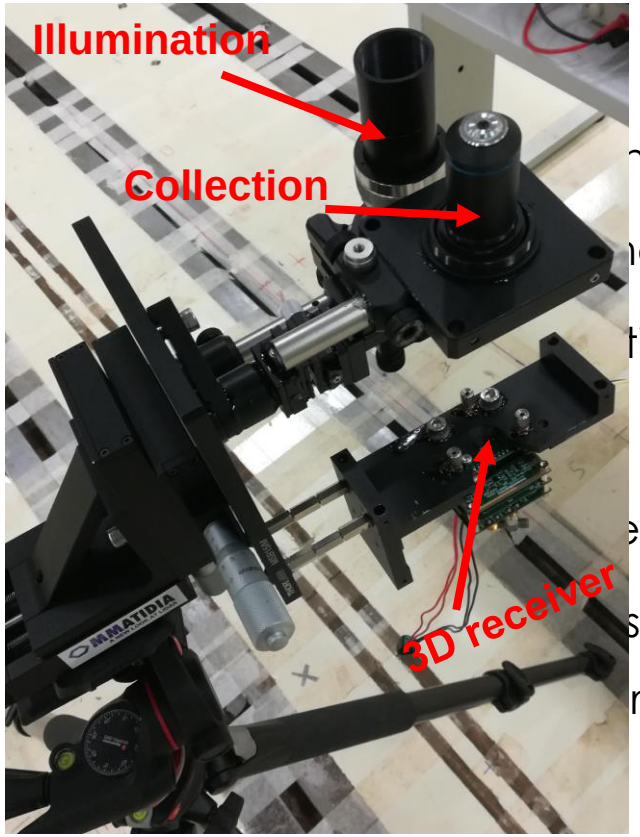
3D receiver sensor – silicon nitride platform

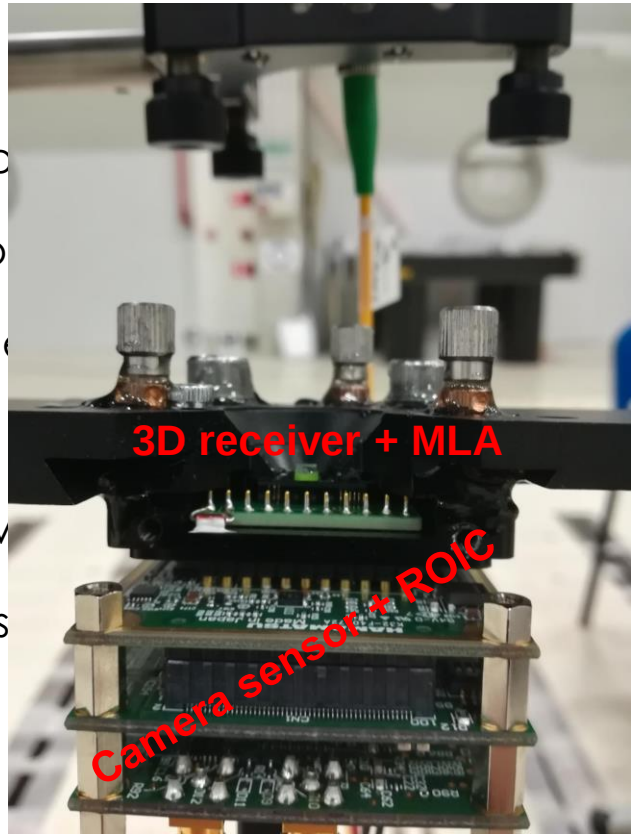
Application to in-orbit metrology

Our approach in the project – Metrology instrument



Main components:





- Embedded computer

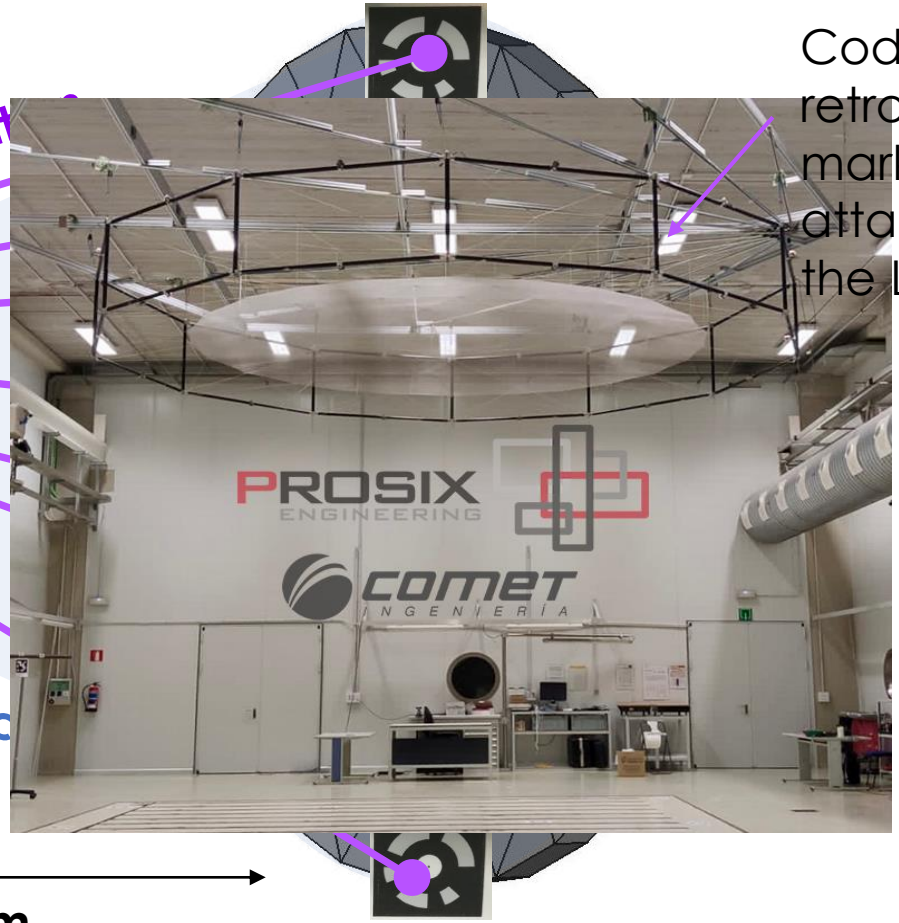
Application to In-orbit metrology

Our approach to the challenge – working principle

Metrology instrument

Discrete illuminat

45 degrees collec



Coded retroreflective markers attached to the LDR

Distance to LDR = 5m

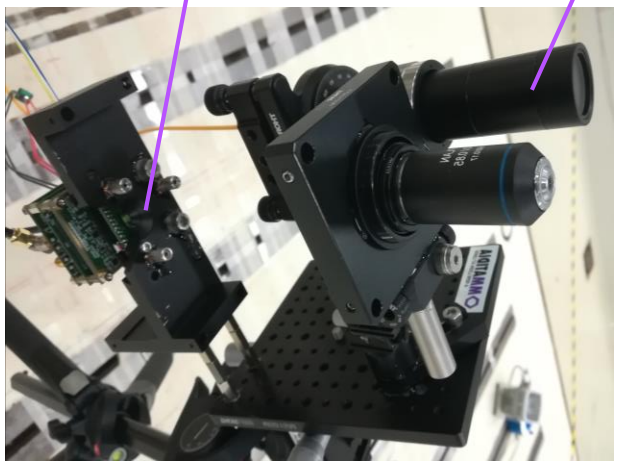
L-band LDR – 4.5m diameter

Application to in-orbit metrology

Our approach to the challenge – working principle

121 distances: 3D receiver sensor

121 directions: DOE



Metrology instrument

Simultaneous acquisition:

Distance + Directions

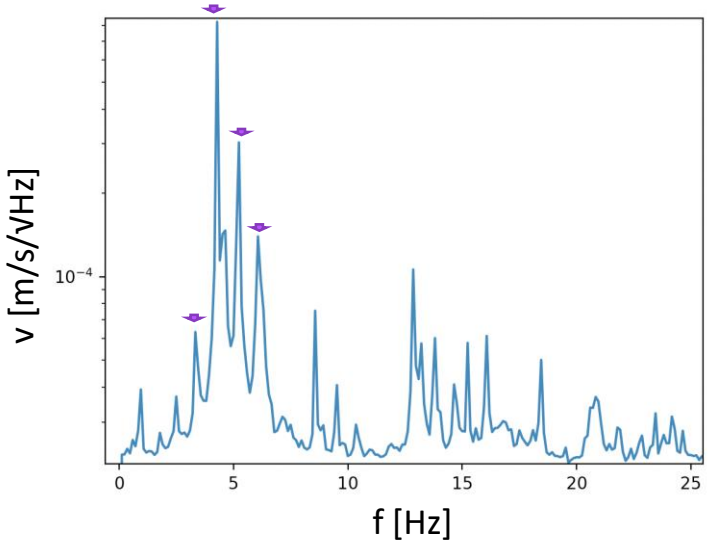
Main characteristics of the metrology instrument:

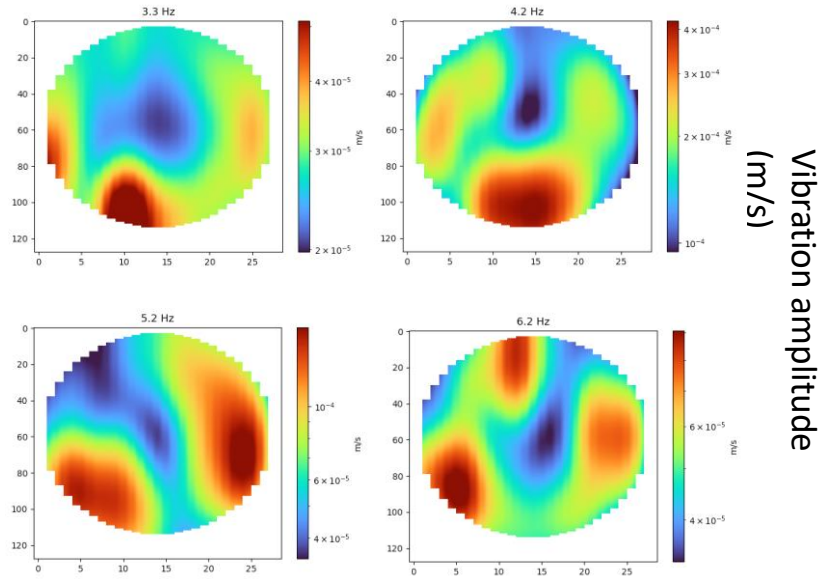
- Fully akinetic system
- Immunity to external radiation (i.e., sun radiation) due to the coherent nature of the system
- Preliminary assessed measurement accuracy of 100 µm
- Acquisition time of seconds
- Field of view adapted to the application in hand
- Compact design to accommodate to the available space resources
- Possibility to scale up the number of channels

Application to ground metrology

Our approach to imaging vibrometry of deployable reflectors for space

Hassle-free structural analysis with Ommatidia's Q1 Multi-channel Laser Radar





OMMATIDIA
A NEW LOOK AT LIDAR

AIRBUS
DEFENCE & SPACE

Future applications

Space manufacturing and assembly

Future applications

Navigation

Approaching

- For long range solutions exist
- But LiDAR could play a role at shorter ranges

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Environment awareness

Future applications

and many more….

- Need to climb the space TRL ladder
- Will require a change of technological platform (Silicon photonics)
- However we have entered such a change for the automotive
- We can definitely built on that experience too

Questions?