Broad beam FMCW LiDAR on chip

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Ommatidia LiDAR

EPIC
EUROPEAN PHOTONICS INDUSTRY CONSORTIUM

Ommatidia LiDAR

Company

- Founded in 2020
- Spain and Netherlands headquarters (<20 employees)
- Multichannel coherent LiDAR
  - Based on photonic integrated circuits (PICs)
- First available product
  - Industrial Metrology
  - Aerospace
  - Civil Engineering

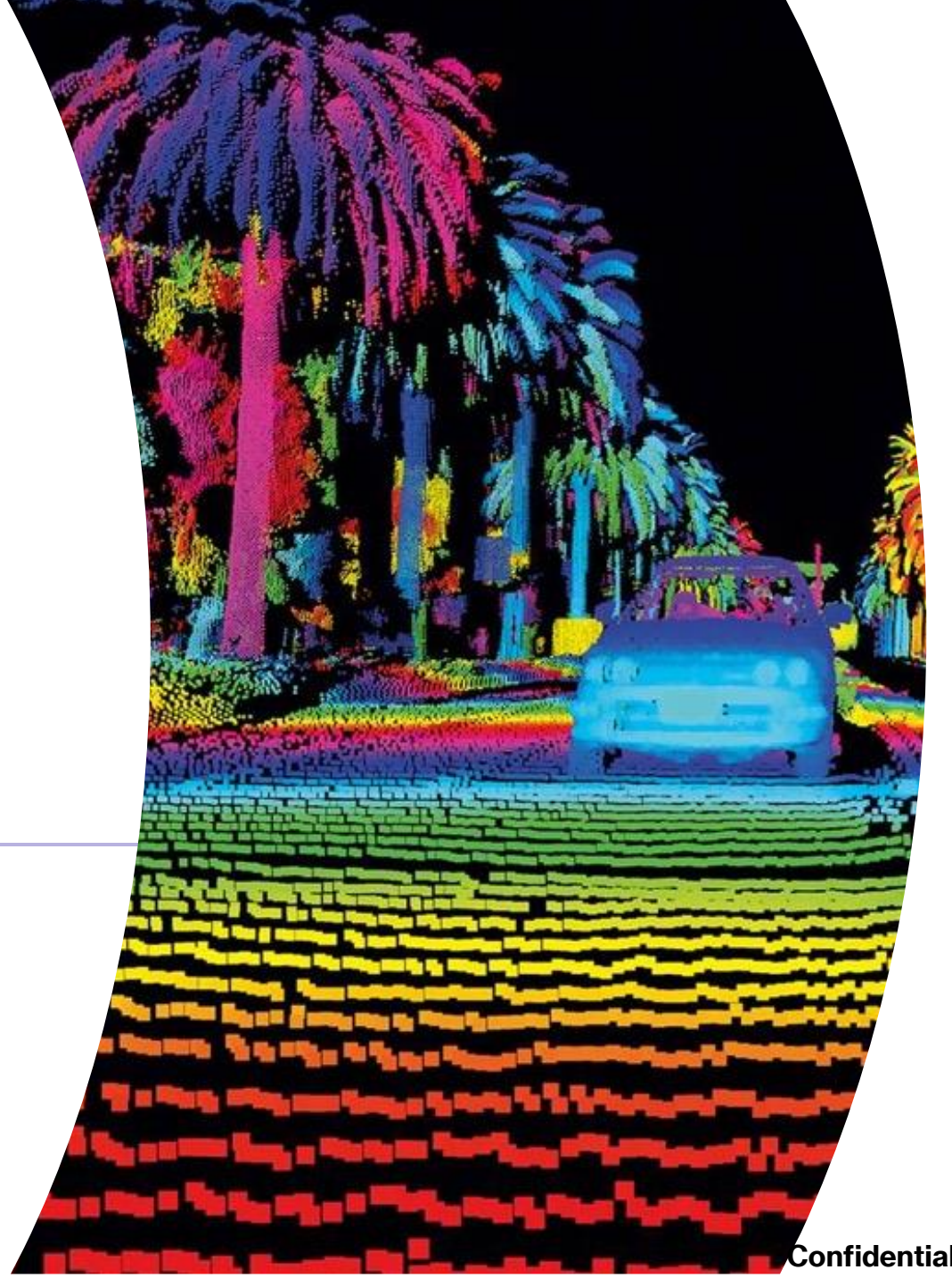
Scientific Park- Madrid

Rijswijk

https://ommatidia-lidar.com/q-series/

Broad beamed FMCW LiDAR on chip

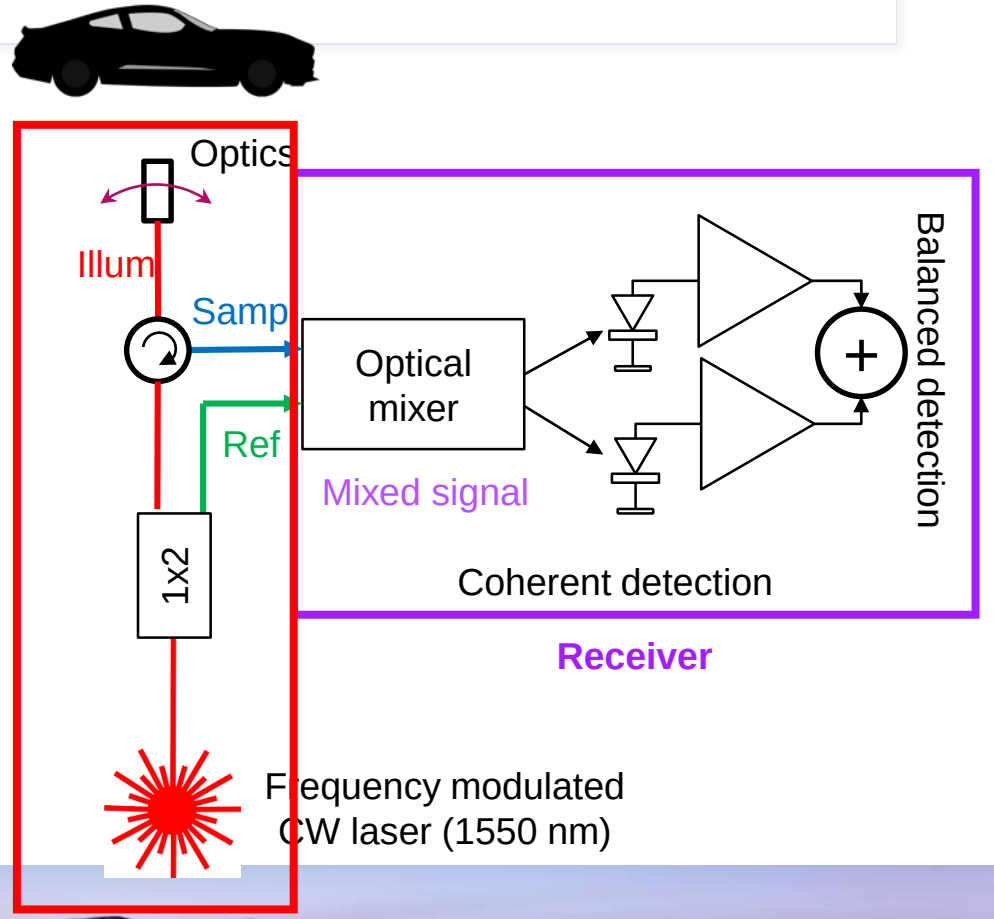
- FMCW
- Architecture
- Practical implementations
- Scale up
- Conclusions



Proposed solution: coherent LiDAR

Working principle – single channel concept

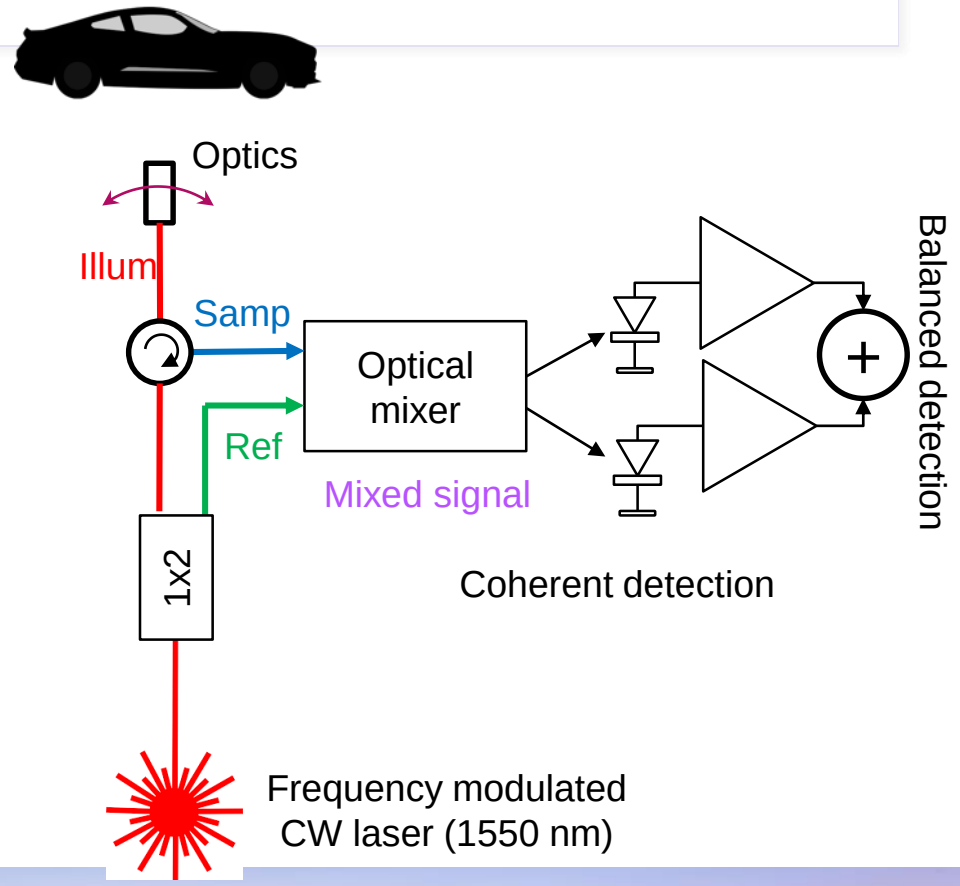
- **LiDAR: LIght Detection And Ranging**
  - Non-contact distance measurement of a point in space using light (optical wavelengths)
- **Coherent LiDAR with the method of Frequency Modulated Continuous Wave (FMCW)**
  - **Transmitter:** Reference (local oscillator) + Illumination signal: Single-frequency laser (CW) modulated in frequency
  - **Receiver:** Receives sample signal from the scene: delayed signal but same freq. modulation
  - Both signals are coherently mixed in the 3D receiver sensor resulting in a beat frequency: distance information



Proposed solution: coherent LiDAR

Working principle – single channel concept

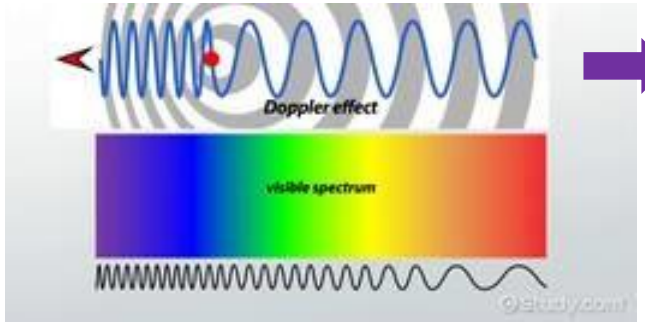
- **Ommatidia LiDAR scheme for FMCW:**
  - **Coherent and balanced detection** (Amplification of low-power sample signal by mixing with a high-power local oscillator signal) gives single-photon sensitivity
    - Shot noise limited: **high distance accuracy**
    - Mixing only between signals with same frequency modulation **immunity to interference with solar radiation**
  - **Amplitude and phase** detection through the optical mixer



How can we go one step ahead and measure multiple points simultaneously?

FMCW Principle

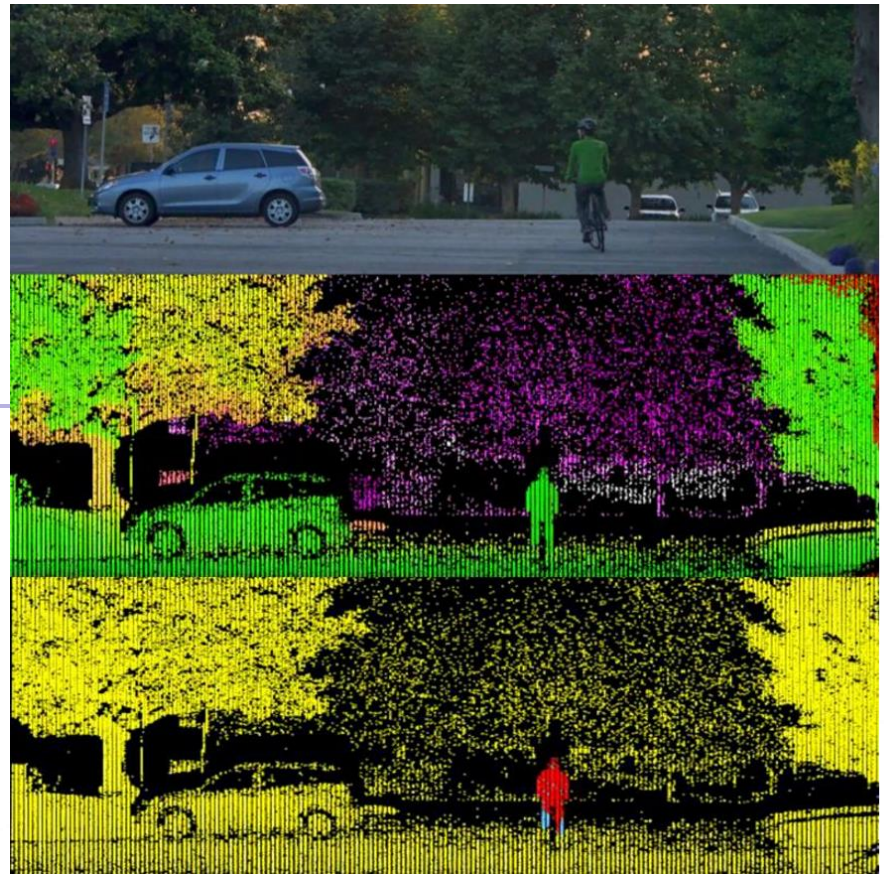
Velocity Measurement (Doppler Effect)



$$\Delta f \propto \Delta v$$

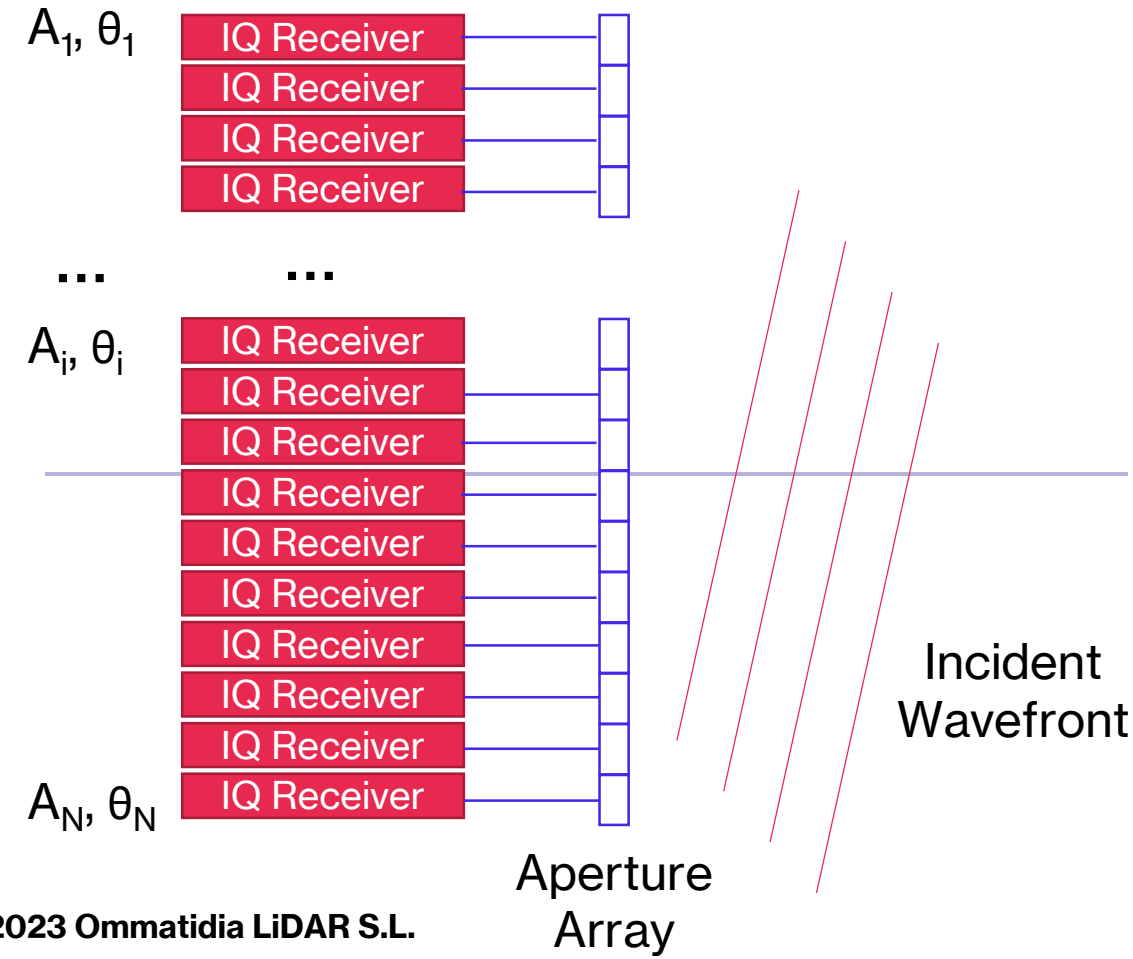
- Doppler effect also causes shift in frequency.
- Work with two slopes to separate delay and velocity.
- FMCW is standard in RADAR for velocity measurement.

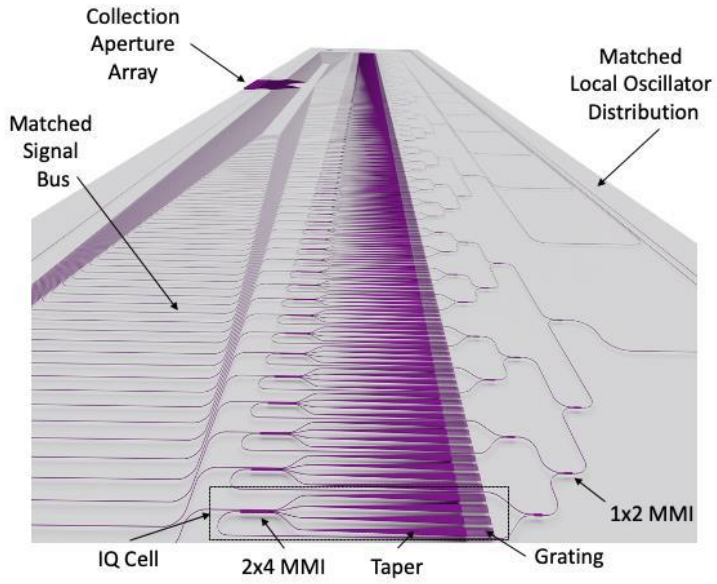
FMCW velocity information is a game changer

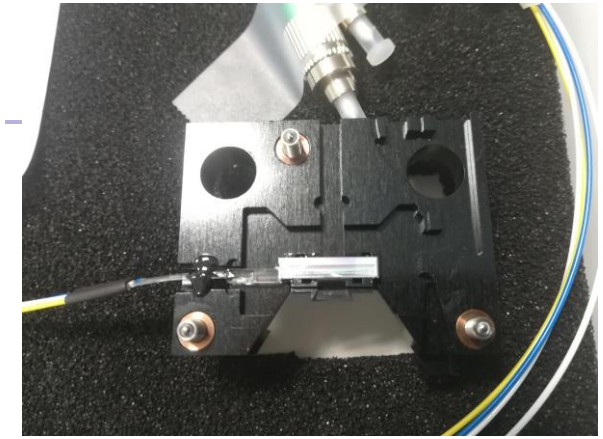


Architecture

Receiver working principle



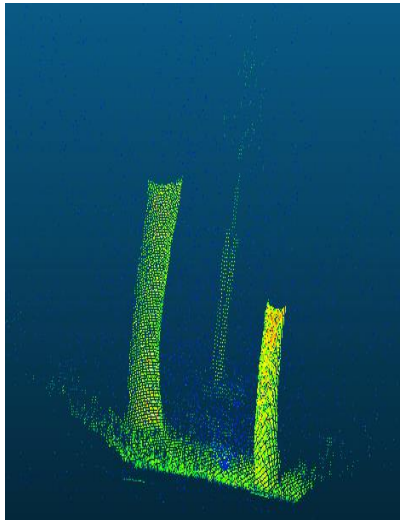


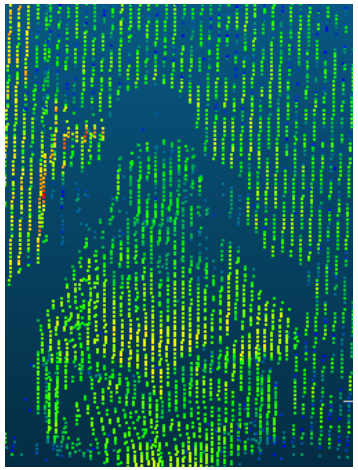


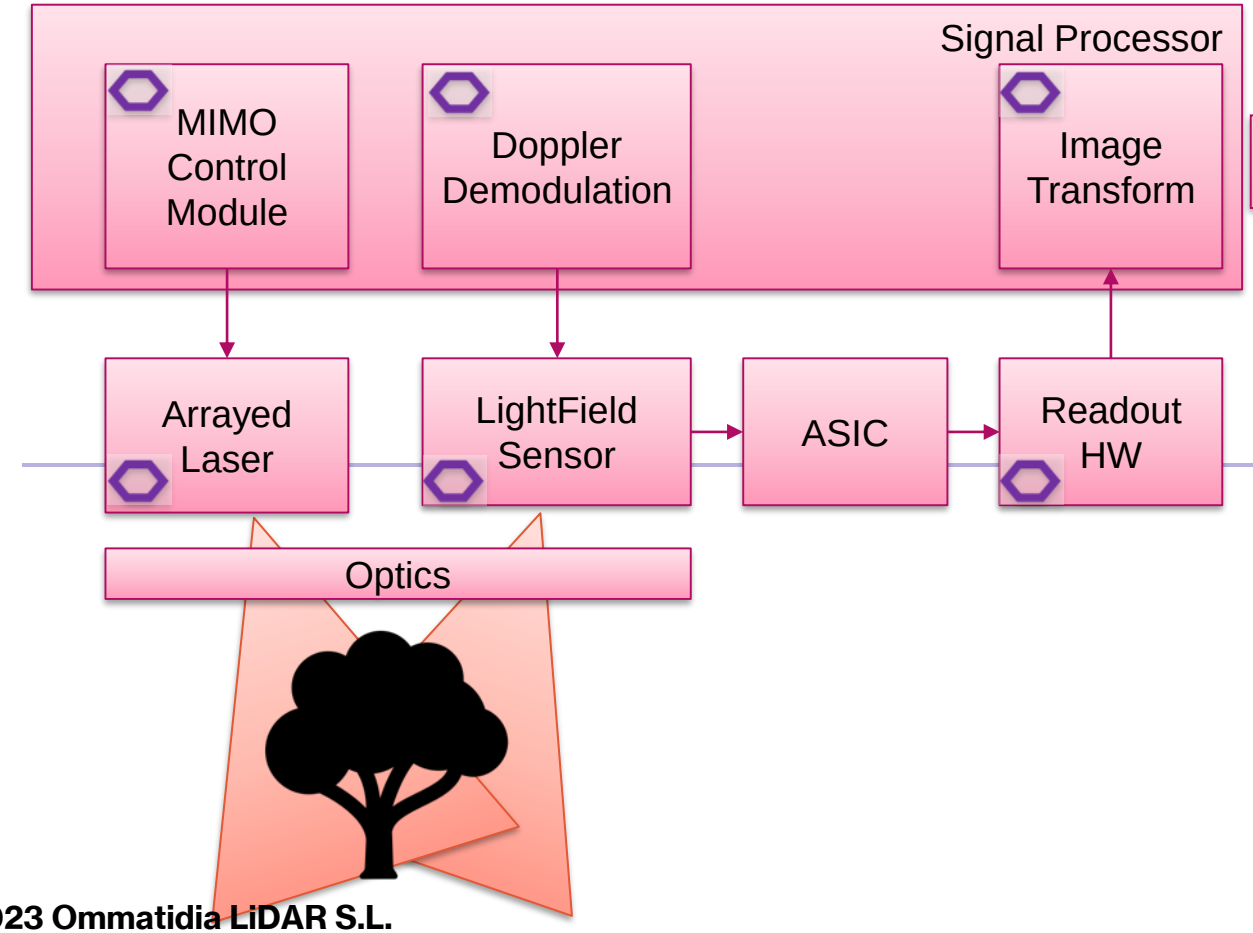
CLEO 2021

Architecture

From Photons to 3D point cloud



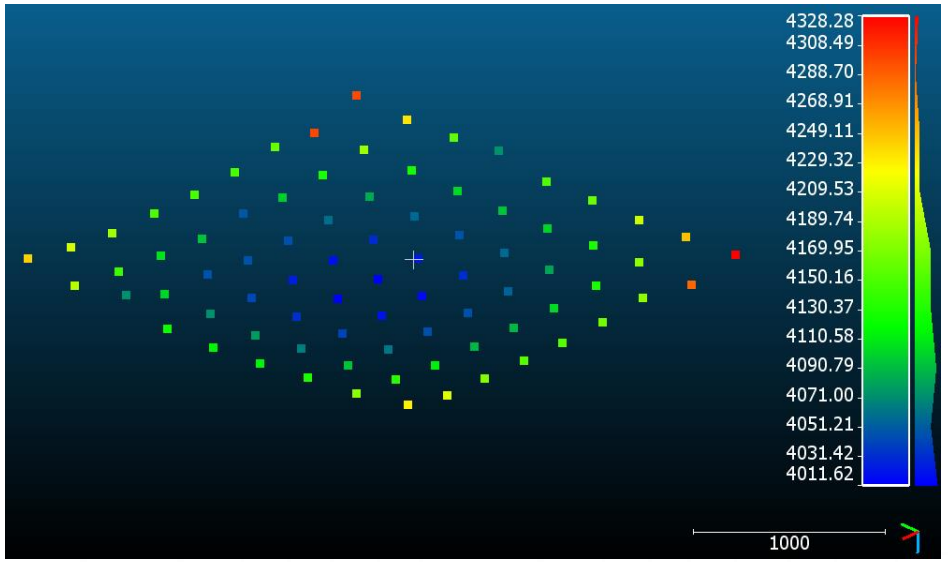


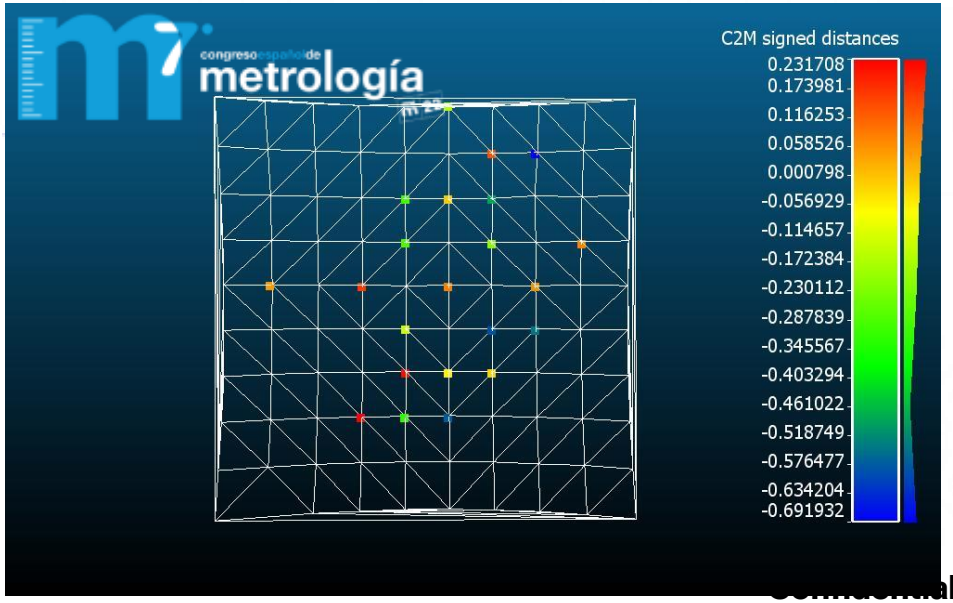


Practical implementations

Metrology

Distance accuracy better than 100 µm





Practical implementations

Vibrometry

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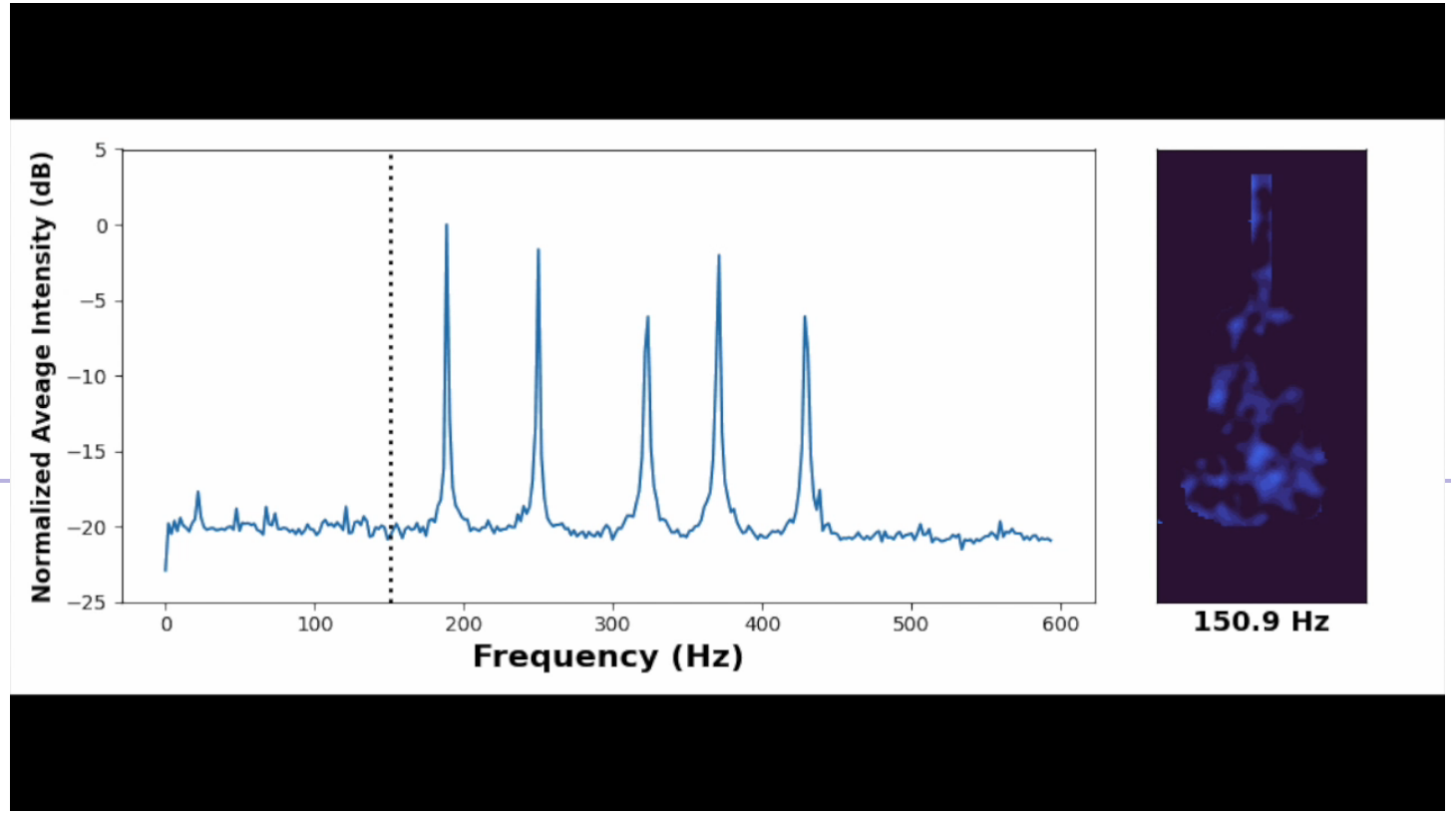
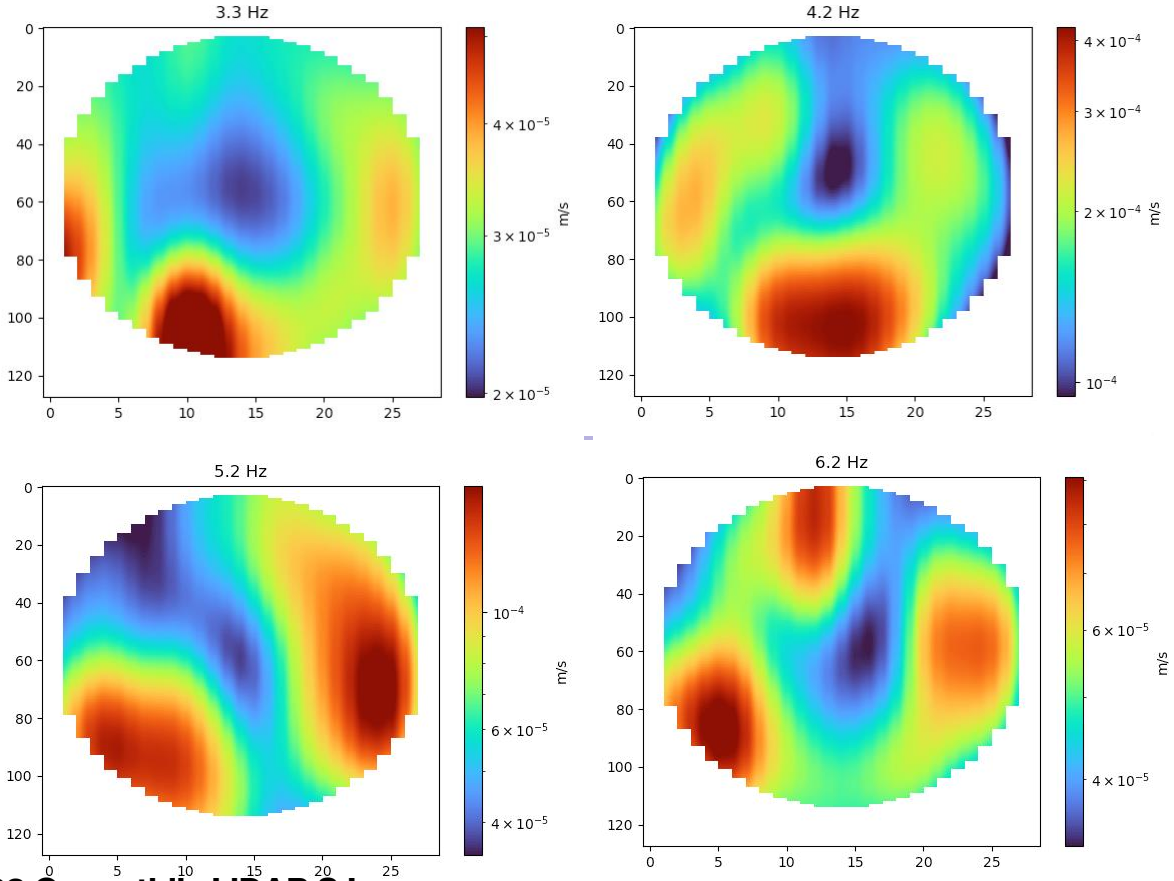
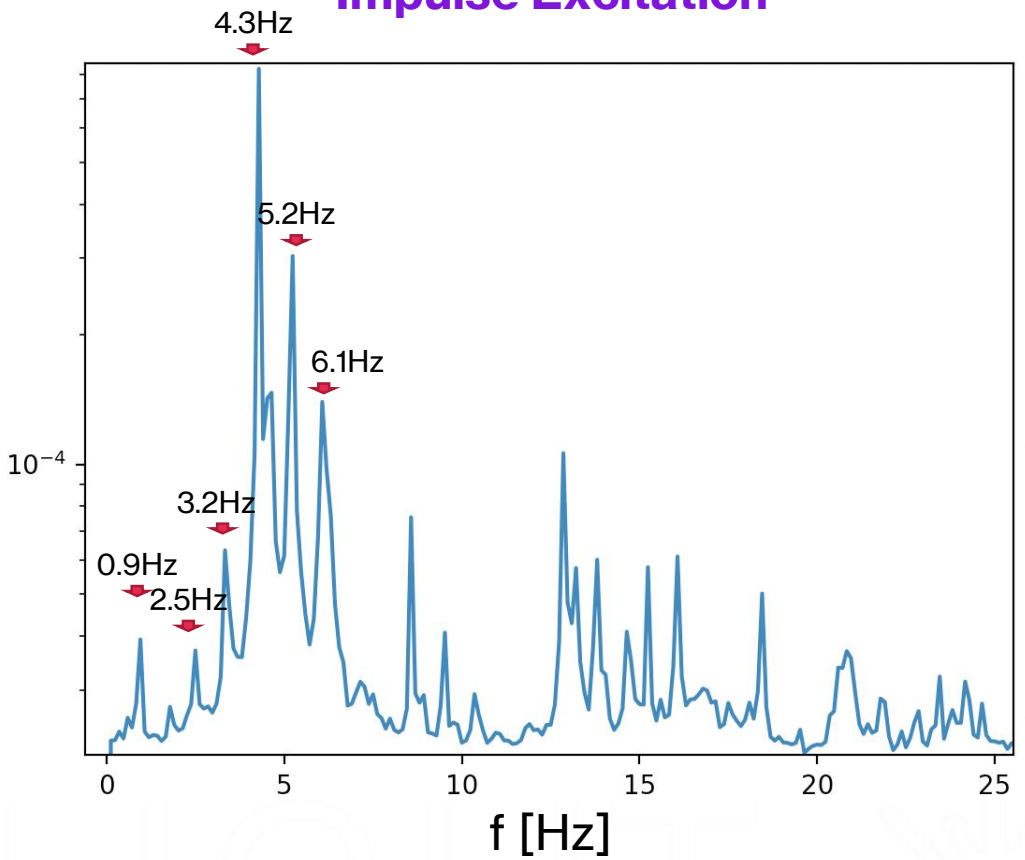


Practical implementations

Vibrometry



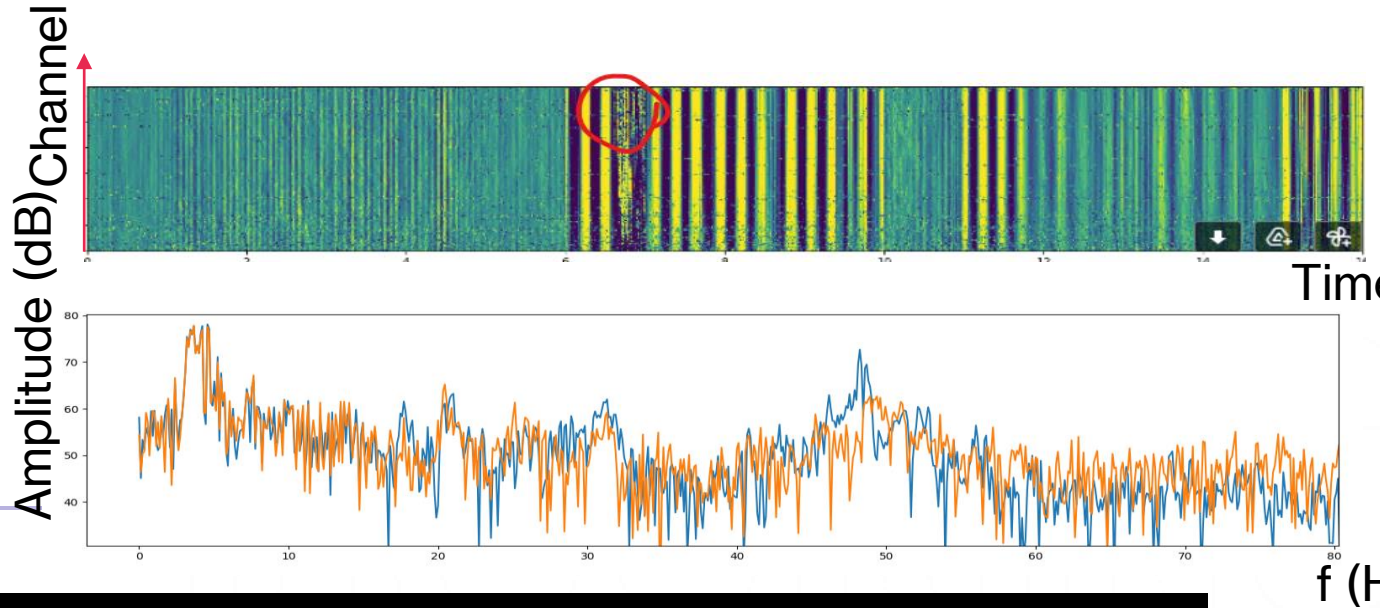
Impulse Excitation

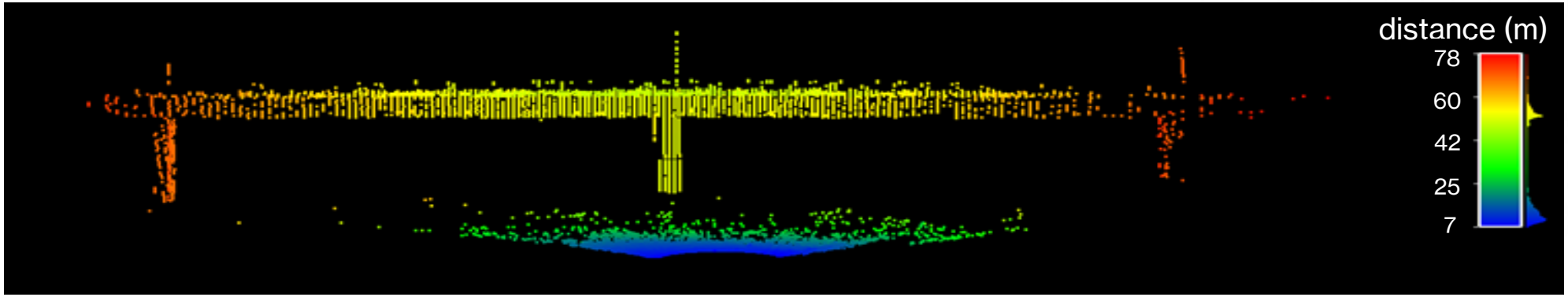


AIRBUS

Practical implementations

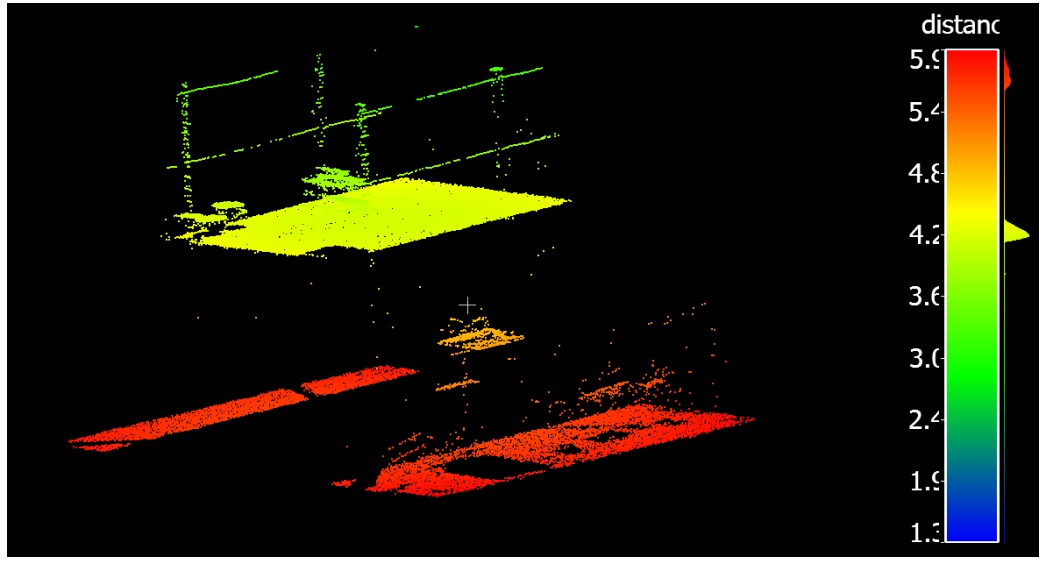
Vibrometry

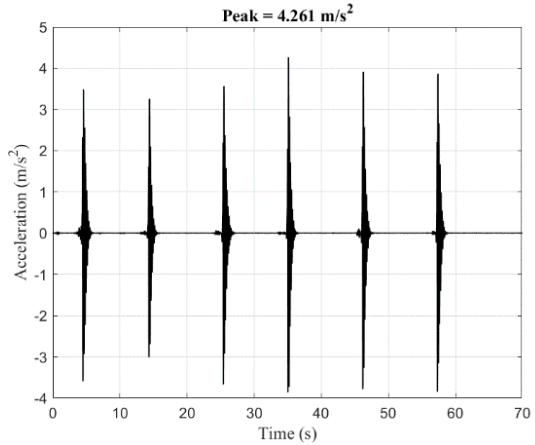


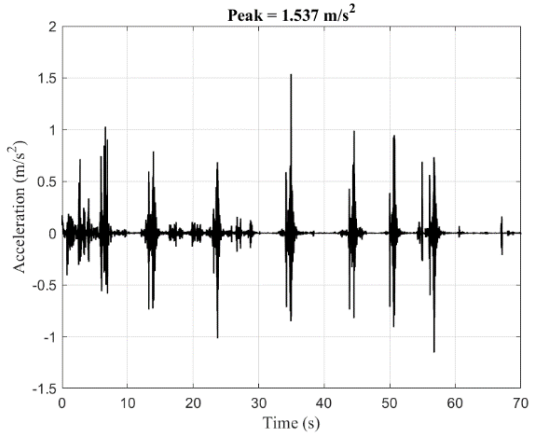


Practical implementations

Vibrometry







Peak Response (m/s2)	
Accelerometer	Laser RADAR
4.261	1.537

MPSVA 2022

Scale up

To address larger markets efforts

On size

And prize (at identical performances) are required

EU support our efforts and granted us with a Seal of Excellence

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

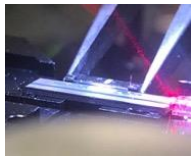
AGRARSENSE (KDT JU)

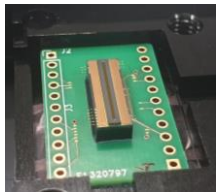
Next2Digit

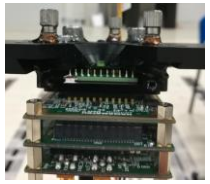
MaPalDa

Scale up

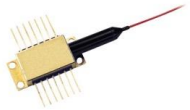
Size/Prize





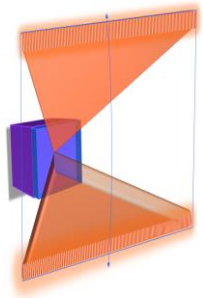


1D Sensor SiN

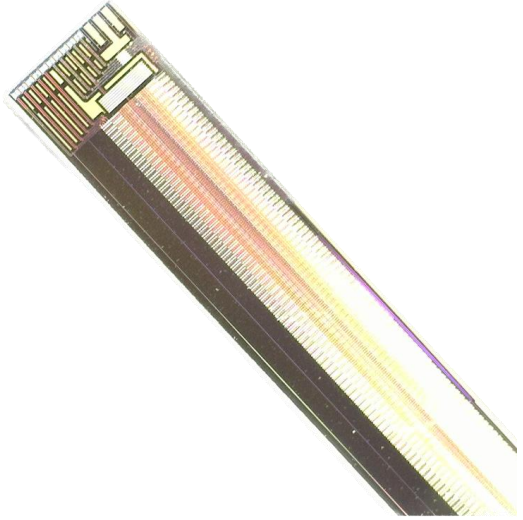


Single Laser

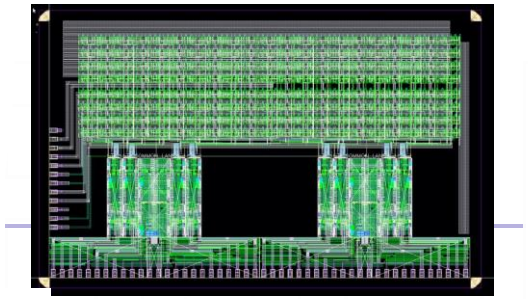
Motor



Integrated scanner

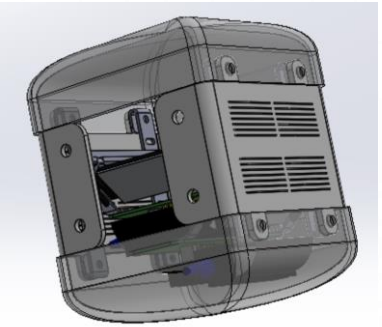


1D Sensor SiPh



Own ASIC

Industrial LiDAR

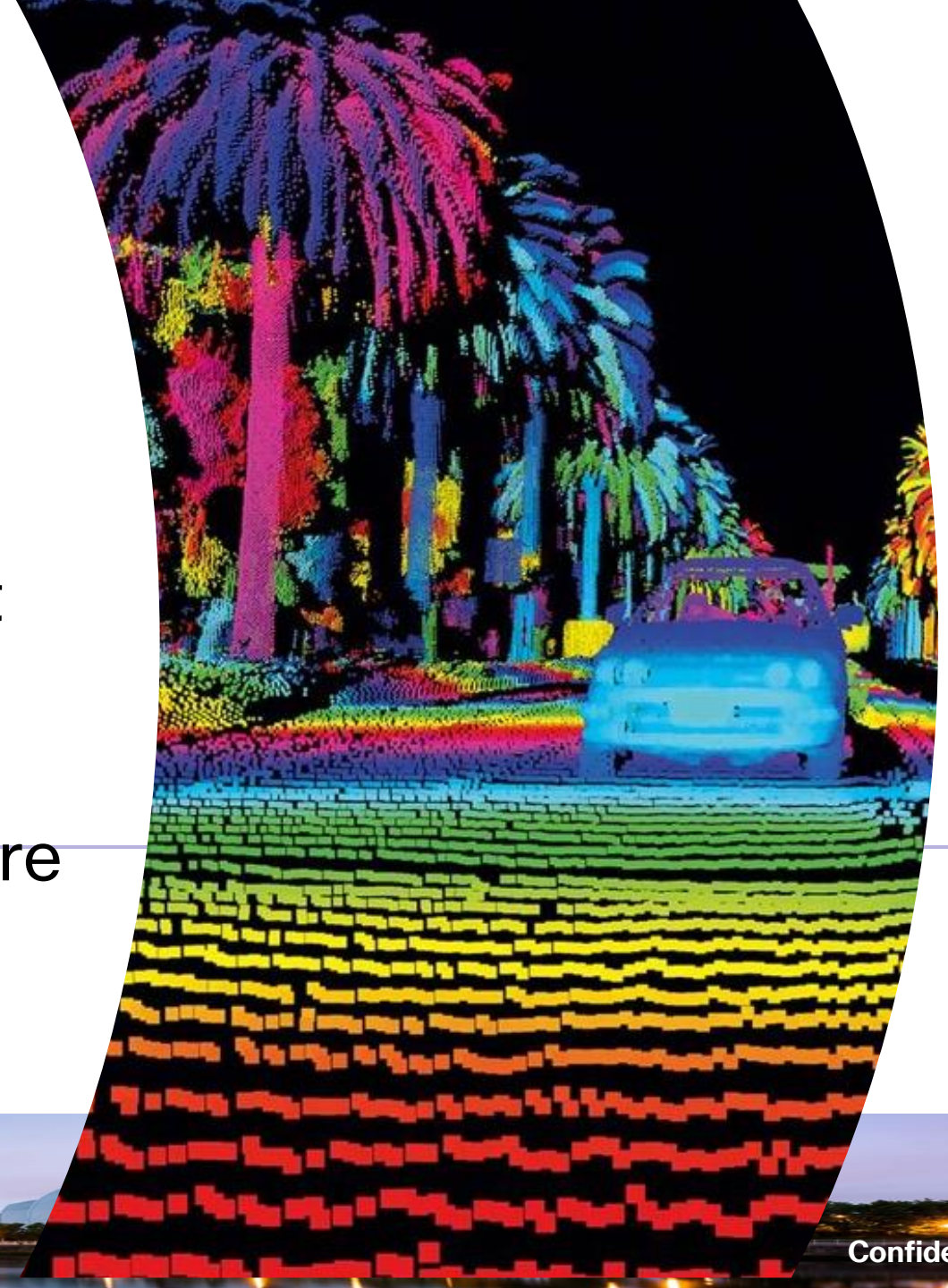


Scale up

Supply chain

Large output power optical coherent sources

Reliability (industrial LiDAR/agriculture applications/automotive)



Conclusions

We decided to address first markets to demonstrate our solution (metrology and vibrometry)

To move to large market ongoing efforts are addressing scalability