High-resolution solid-state scanning LIDAR for in orbit servicing applications

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Company profile

Beamagine (www.beamagine.com) Beamagine is a SME company based in Barcelona, devoted to designing and **manufacturing solid-state imaging LIDARs**. The lidars produced by Beamagine allows obtaining 3D images in real-time using a patented concept developed by the company which is able to generate very high-resolution 3D images at long range by using the time-of-flight technique.

For the space market, Beamagine has a partnership agreement with Lidax, a company with long track experience on optomechanics for space applications. The consortium aim to develop and commercialize a space qualified lidar based on the Beamagine ground lidar.

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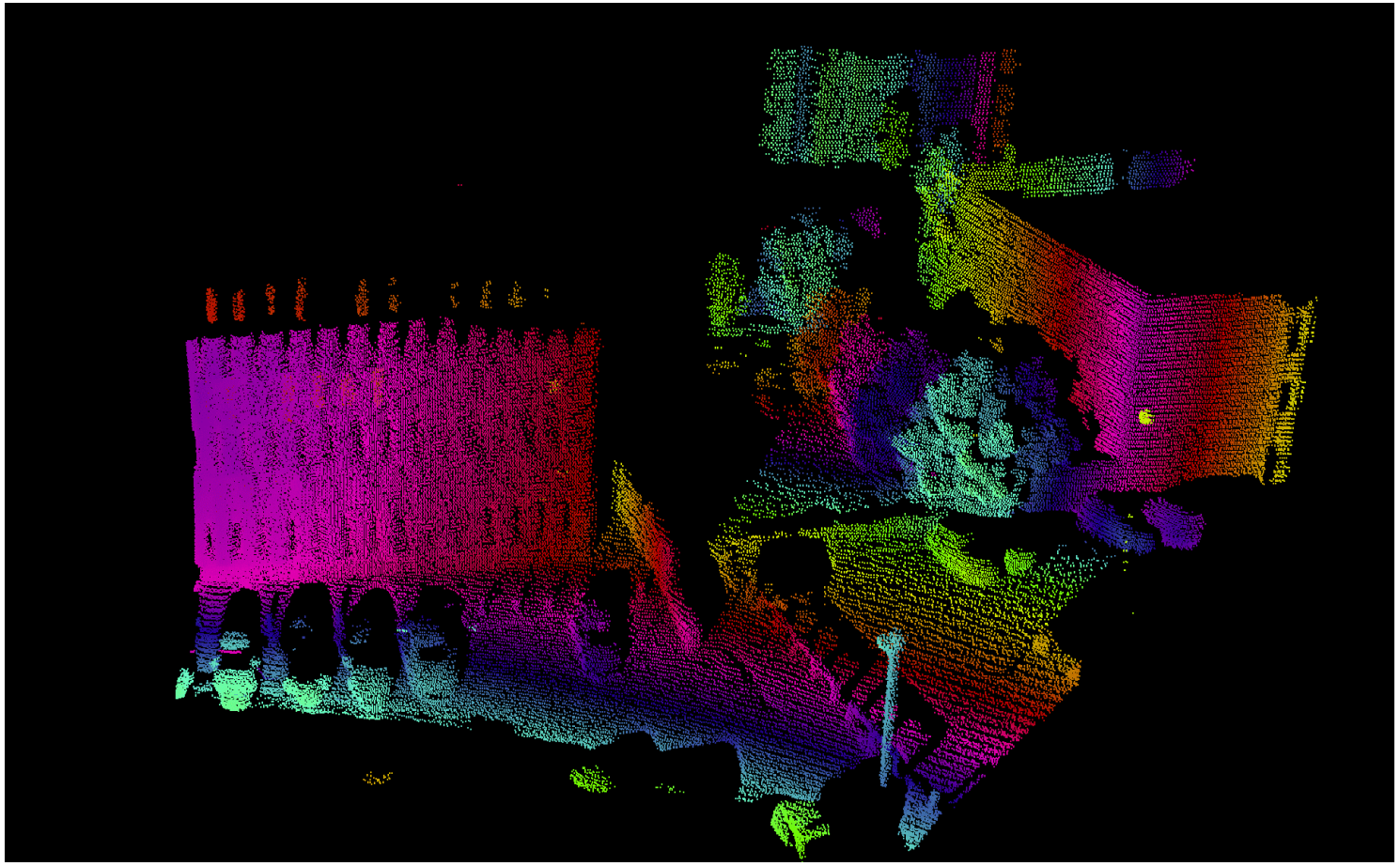
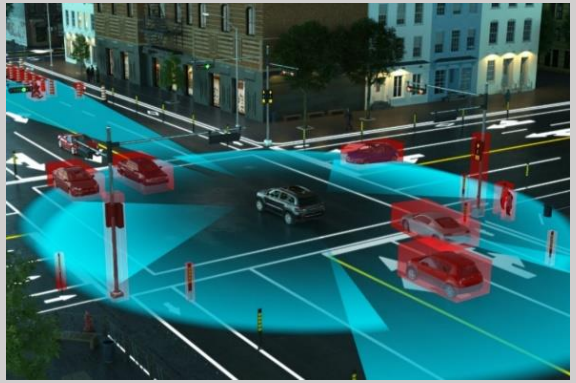
LIDAR imaging



Application domains

AUTONOMOUS VEHICLES AND NAVIGATION

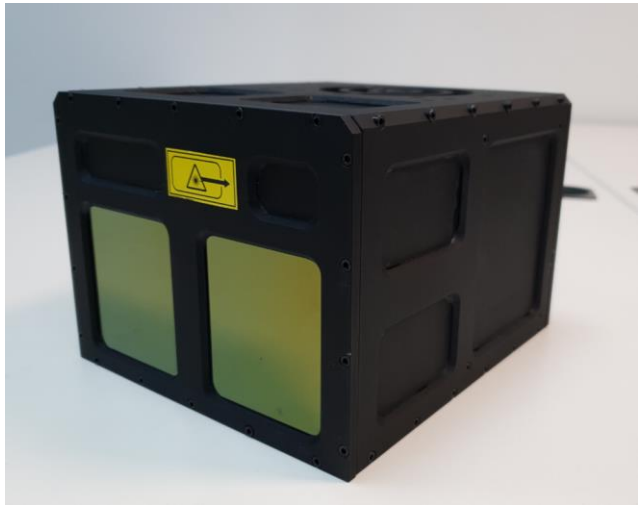
SMART CITIES, SECURITY AND SURVEILLANCE

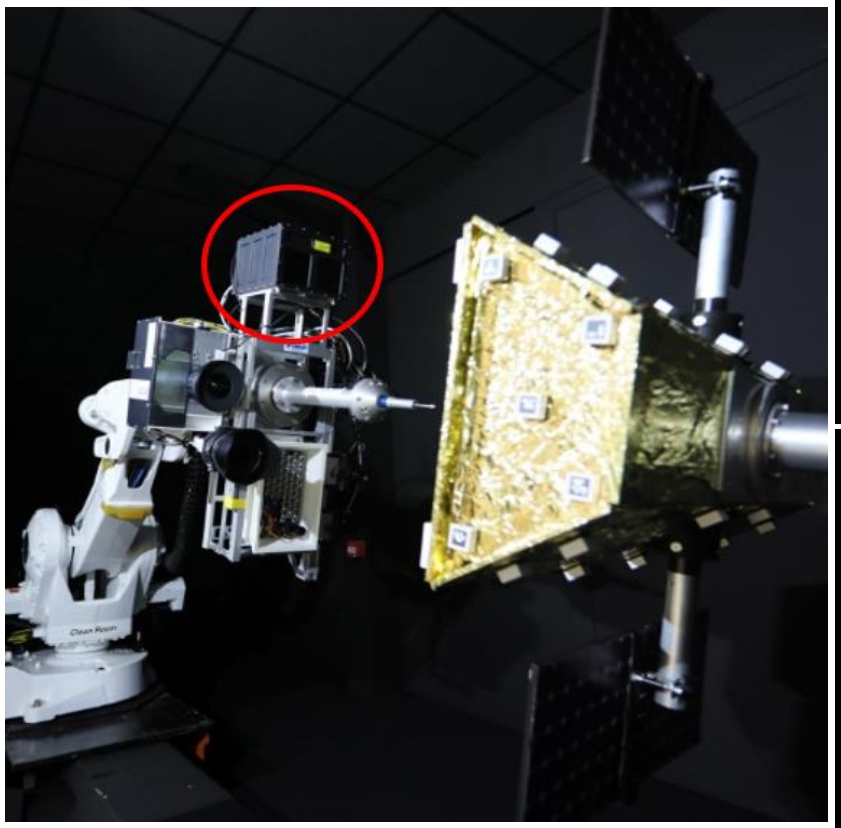


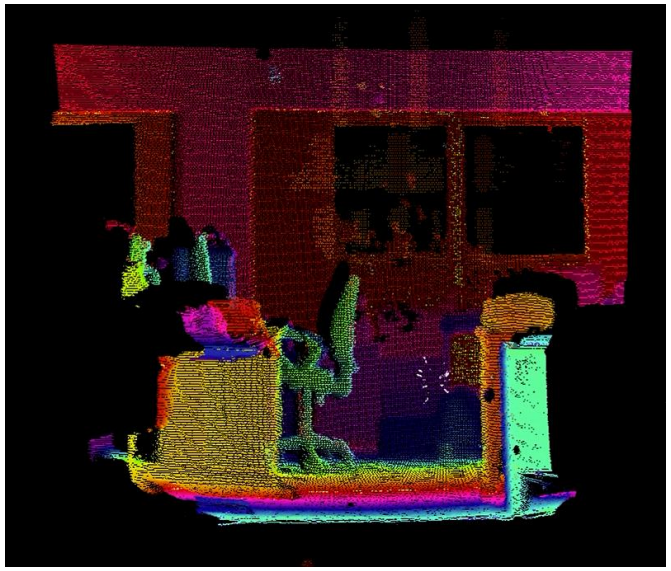
Previous developments: I3DS project

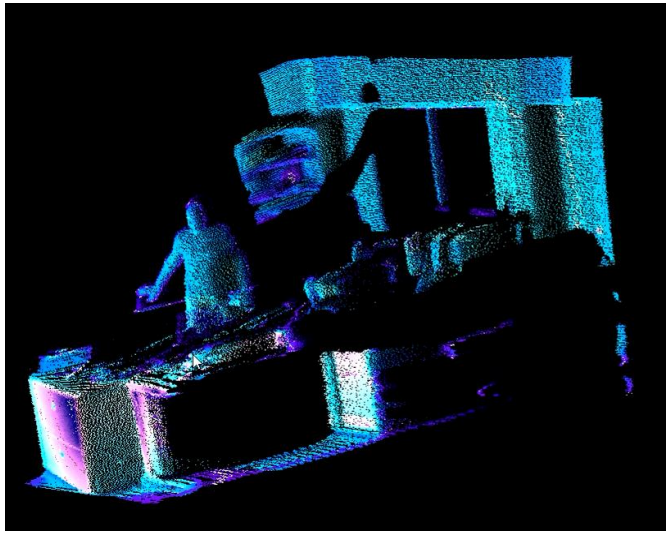
Development of custom LIDAR unit for ground testing

The units where provided under the framework of the I3DS project lead by Thales Alenia Space in Cannes.









Previous developments: I3DS project

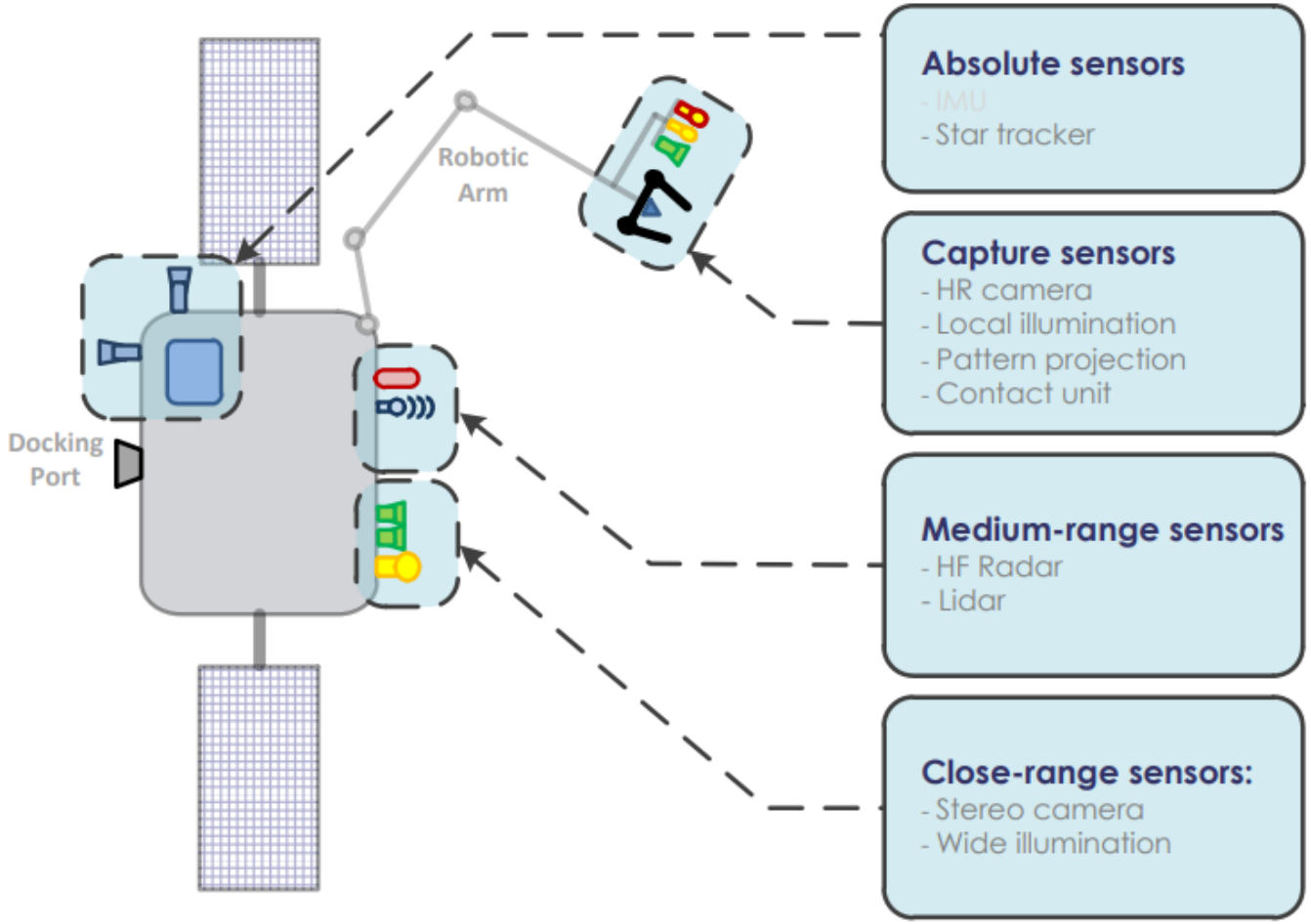


Figure 33 – Sensor configuration of the servicer for the cooperative capture

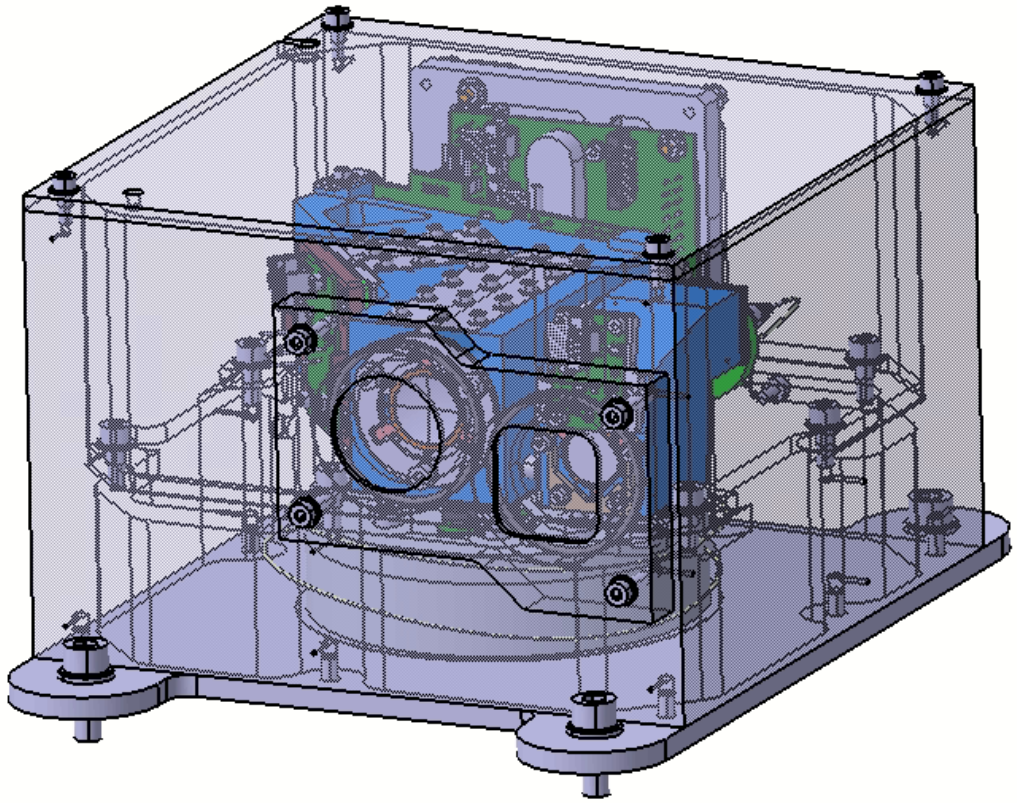
SOURCE: http://i3ds-h2020.eu/publications/deliverables File: OG4_I3DS_D1.2-Use_case_Identification_PublicRelease.pdf

L3CAM: Multimodal perception system

AT A GLANCE:

- System composed by three complementary imaging modes:
  - High resolution solid-state 3D LIDAR (12 patents)
  - RGB camera
  - Optional: Polarimetric and/or Thermal camera
- Embedded data fusion in-house calibrated
- Embedded AI perception software for automatic object detection
- Perception SW can be trained on demand for any kind of object
- Minimum false alarms due to the triple imaging analysis approach
- Performance guaranteed in all environmental conditions: day/night or bad weather (rain, snow, dust or wind)
- Small size: 10x18x20 cm

SMARTLID3



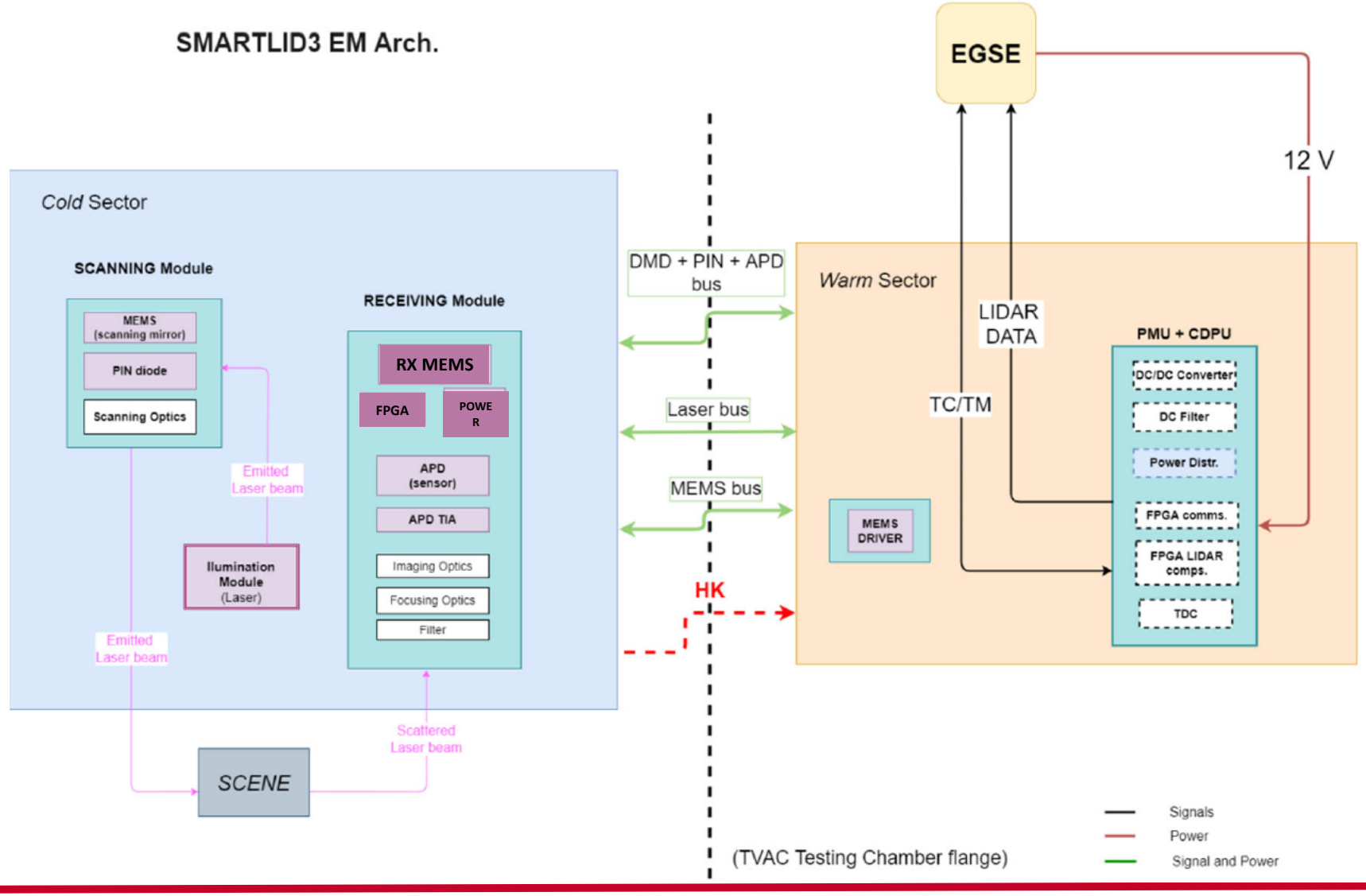
Project Goals

- Development of an Elegant Breadboard model of a space LIDAR based on the L3CAM design
- Target: TRL5
- Qualification of the critical optomechanical components like:
  - Optomechanics
  - MEMS
  - Laser
  - Detectors

Current status of the project

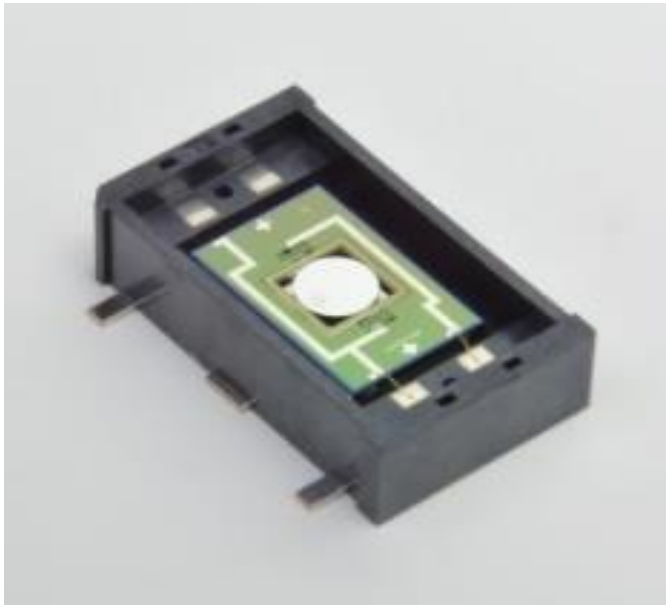
- CDR (Critical Design Review) Passed in July ’22
- EBB (Elegant Breadboard) built in November ’22
- Environmental test campaigns: Vibration, shock and TVAC.
- End of the project T1 2023

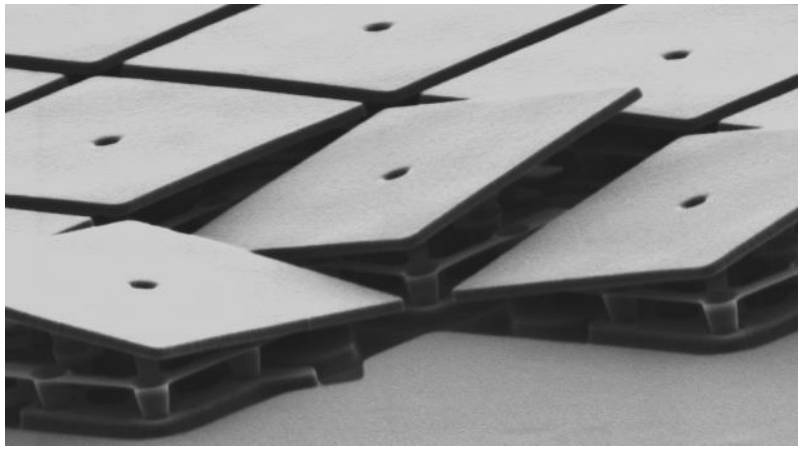
SMARTLID3

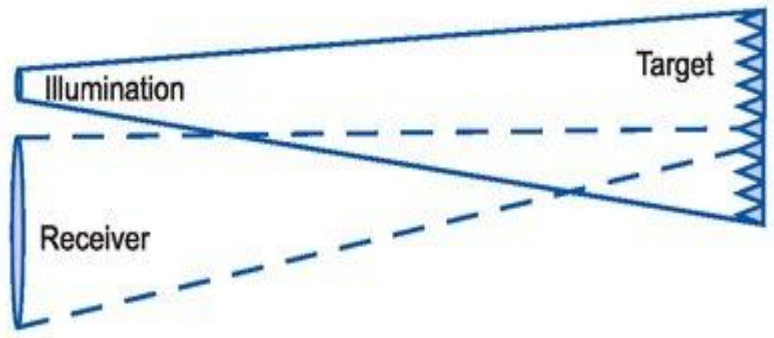


MEMS scanning: Technology highlights (1)

- Solid-state design (no “moving” elements)
- MEMS devices are used for scanning and receiving the laser beam
- Patented approach with 12 active patents
- Bistatic design
- Energy efficiency: single collimated beam for the measure.
- Active solar background suppression. The system is compatible with strong background scenarios:
  - Earth within the FOV
  - Specular reflections
  - Direct sunlight

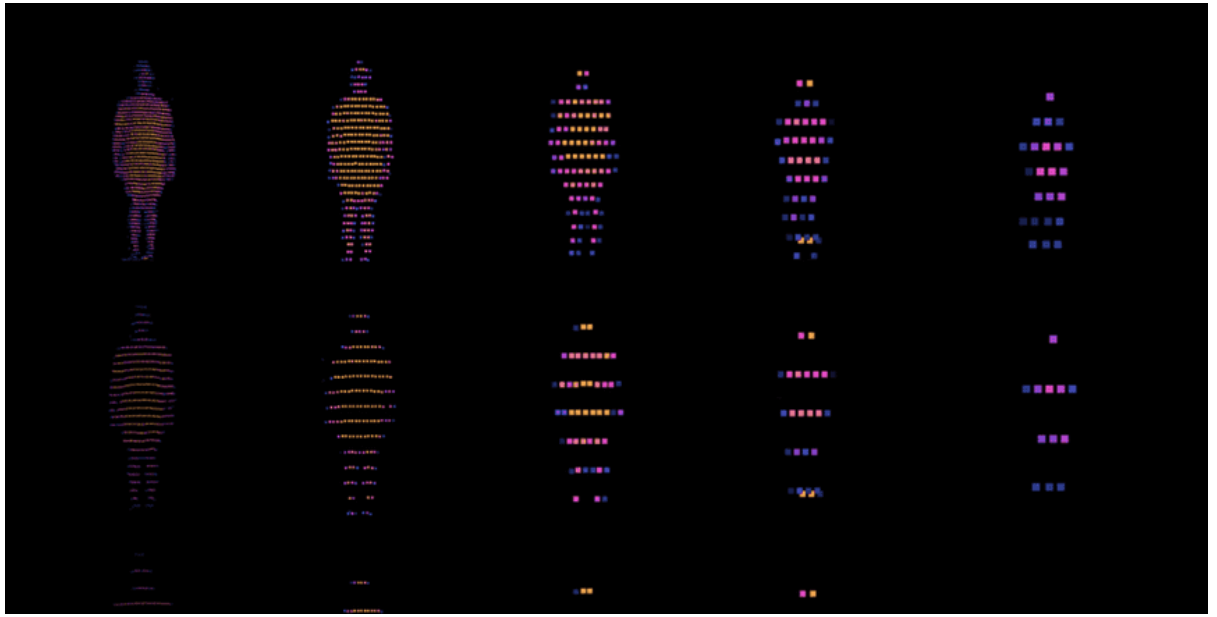






MEMS scanning: Technology highlights (2)

- Adjustable image spatial resolution vs frame-rate
- Mid-range applications with wide FOV
  - Short range <50m
  - Mid range <1km
  - Long range > 1km
- Sequential image acquisition: image distortion depending on the relative speed between the platform and the target
- MEMS are still not fully qualified for space
- Complex calibration process is needed to compensate the MEMS moving inertias

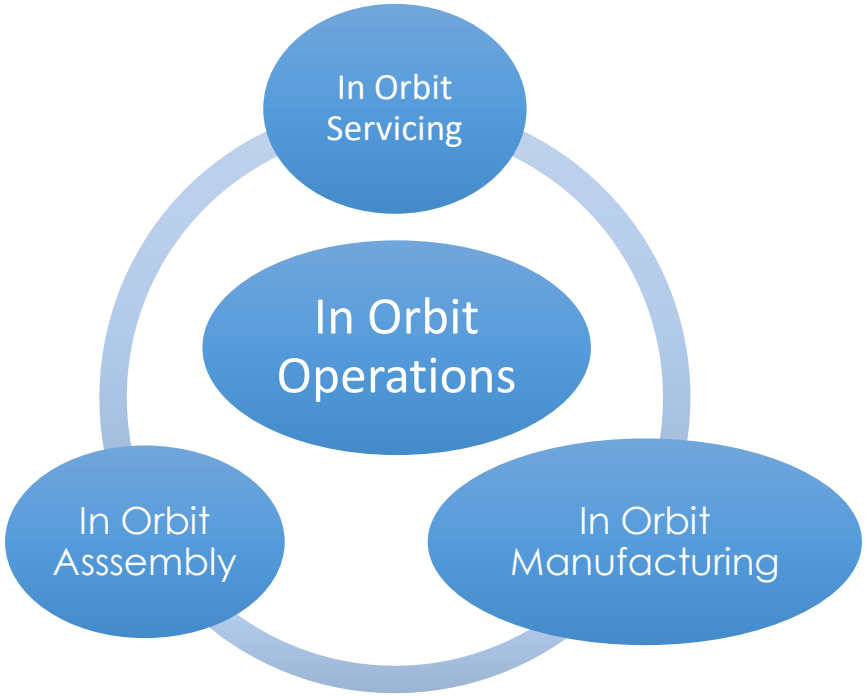


LIDAR specifications

Parameter	Value	Comments
FOV (max.)	20x20 degrees	
Angular sampling	0.1 degrees	
3σ angular uncertainty	<0.01 deg	
3σ range uncertainty	5 cm	
Max. range	~300 m	Depends on the target reflectivity and solar background
Image refresh rate	8 Hz	
Max. Power drawn	25 W	In data acquisition mode
Input Voltage	28 V DC	
Mass	< 3.8 kg	
Size	160 x 140 x 210 mm	W x H x D
Operation Temp. Range	-10 to +40 deg C	
Non-Ops. Temp. Range	-40 to +60 deg C	

In orbit servicing applications

- In the next decade, there will be emerging needs that will require technologies for:
  - Extend the life-time of the institutional and private satellites: Refueling
  - Sustainability: Reduce the orbital debris
  - Scalability in orbit assembly: New capabilities, service stations, in orbit construction



- In orbit servicing scenarios:
  - Maintenance: Repairing, reconfiguration, updating payloads, refueling, electrical recharge
  - Towing: Repositioning, deorbiting, recycling
  - Inspection: in orbit inspection of the satellite state

THANKS FOR YOUR ATTENTION!

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