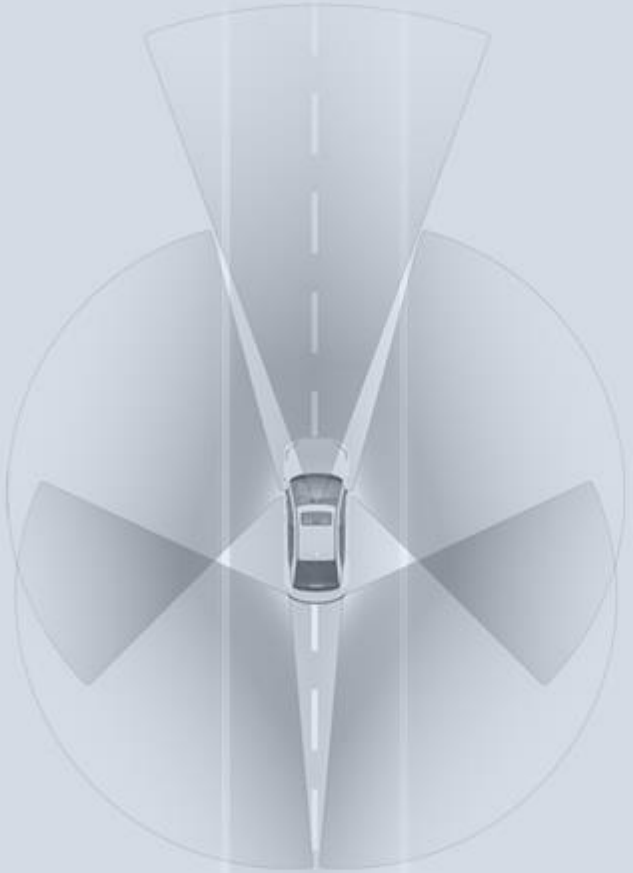
HYBRID LIDAR SYSTEMS AG



Breakthrough for Autonomous Driving

# Next Generation LiDAR for Industrial and Automotive Use Cases

AZO Space of Innovation

1/40 BEST HIGHTECH VENTURE DAYS 2019

PLUGANDPLAY

European Commission
Horizon 2020
European Union funding for Research & Innovation
SEAL OF EXCELLENCE

ZIM Zentrales Innovationsprogramm Mittelstand

Supported by:
Federal Ministry for Economic Affairs and Energy
on the basis of a decision by the German Bundestag

pwc

DEKRA AWARD

## What We Do

Selling precise, flexible and affordable LiDAR* systems to automotive and industrial high tech OEMs.

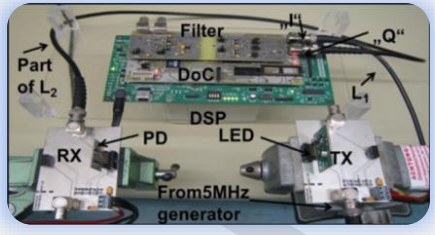
*LiDAR systems are the eyes of autonomous cars and next generation automation systems; they are indispensable for autonomous driving and real-time situational awareness.

We are the only LiDAR company that has invented a new method to measure distance with light.

This hybrid method is always up to 50% cheaper and allows a 10 times higher resolution than the standard measuring methods.

# Initial Research and Development Phase - Completed

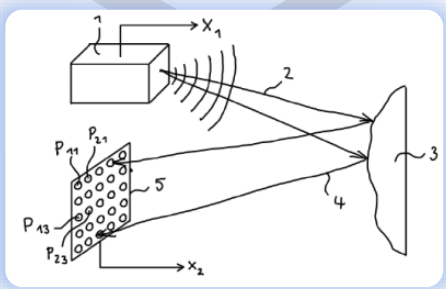
2017




## Demonstrator

Hybrid Method verification

2018




## Patent

Hybrid Method patent application

2019



## 1D Prototype

Practical proof

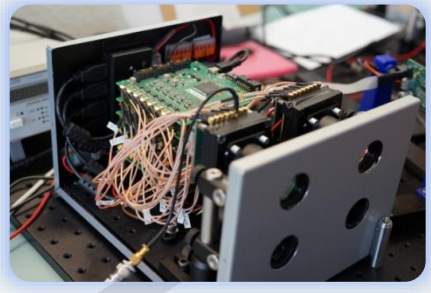
2020



## 16 Pixel

3D Prototype

2021



## Microprocessor

3D Prototype

# Future Milestones

2022



Function samples

2022



Sample

For first customers

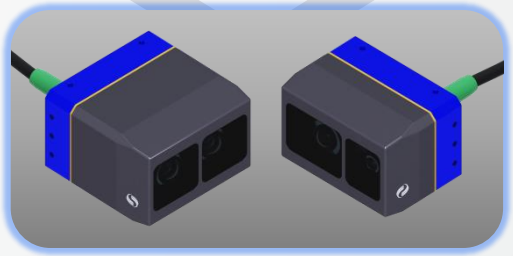
2023



SA-LiDAR

Acc. Customers requirements

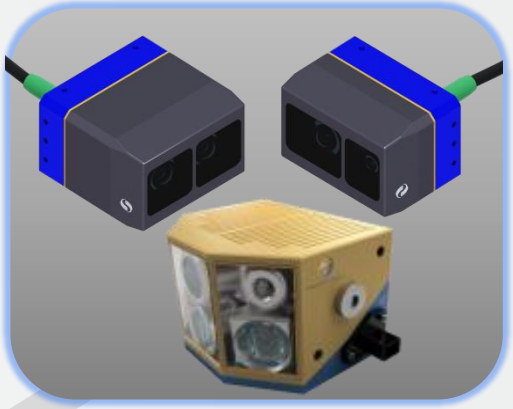
2026



LiSSA Automotive

240k Pixel, samples

2027



LiSSA Automotive

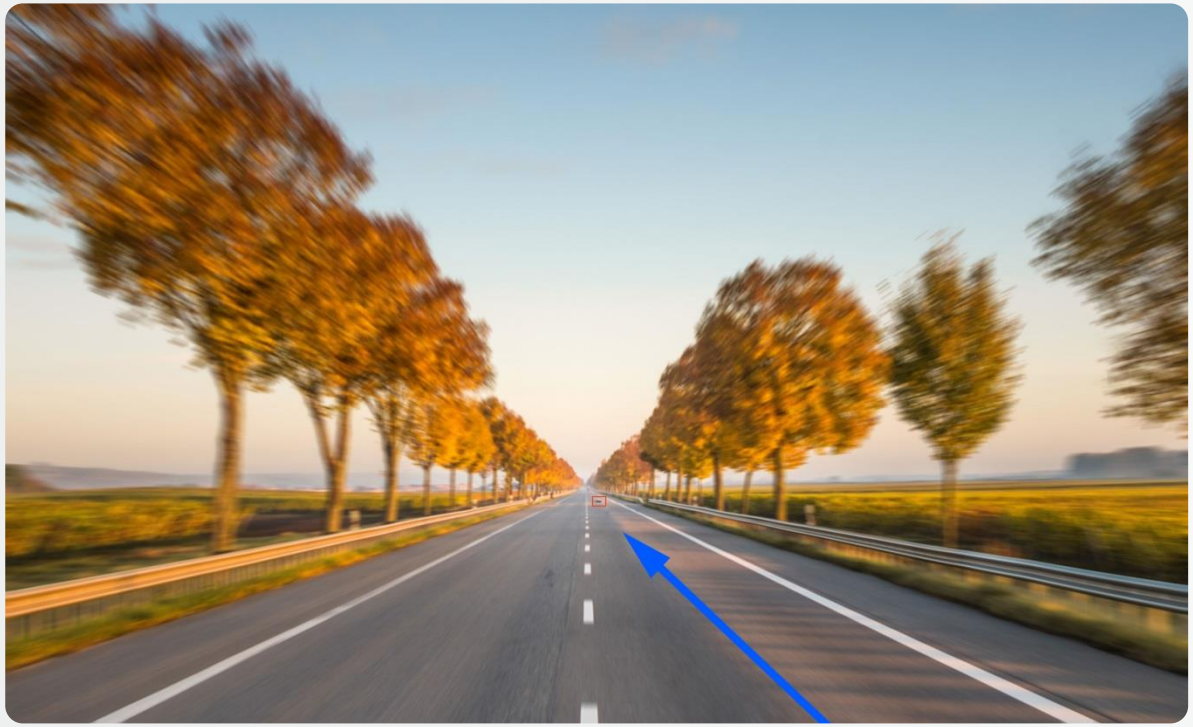
Series production Long Range, Corner (Mid-Range) LiDAR and Tripple LiDAR, samples

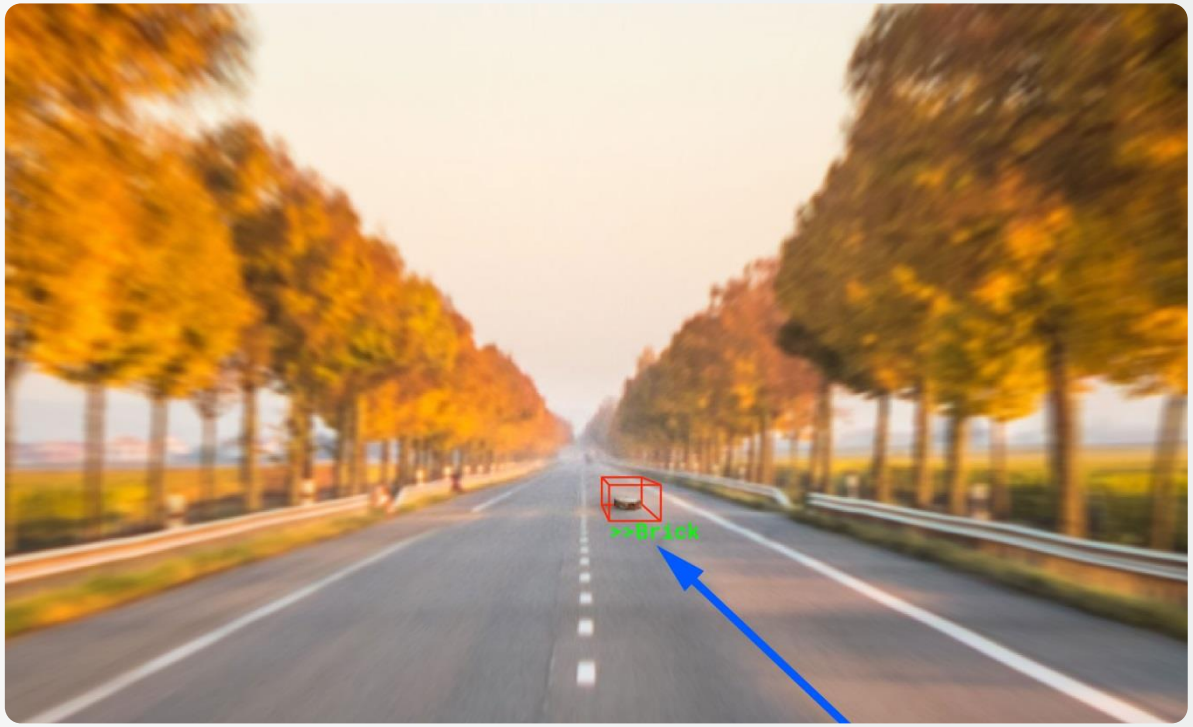
BMW VW GAC GROUP 广汽集团

LEAPMOTOR

## Why – Challenges LiDAR systems are facing: Resolution

LiDAR should not only detect objects, but also classify them.
Objects of 10cm height should be detected by 200m range.





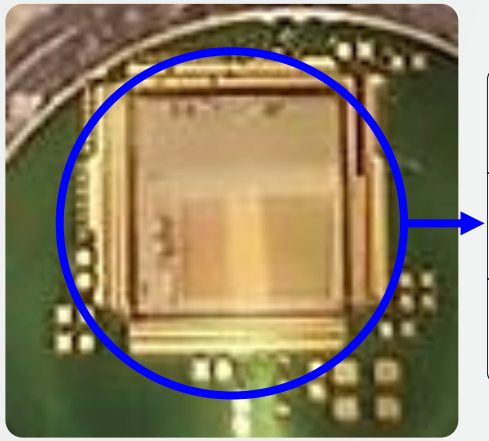

**Current LiDAR solutions have the problem of resolution!**

The greater the distance at which small objects are detected, the faster and safer can be driven.

## State of the art

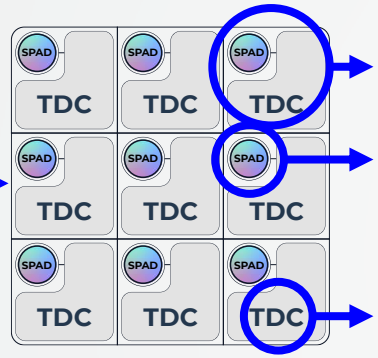
### Competitors

Imager Chip of Time of Flight Solid State LiDAR



Reference: ibeo

12.800 pixel




One pixel

Light receptor

Counter (processor for each light receptor)

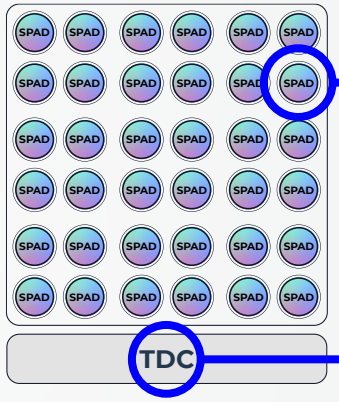
### Problem:

In total, the counters take 60-95% of the imager area, hence reducing the number of possible pixels and resolution. This technology is almost at its limit.

HYBRID LIDAR SYSTEMS

Imager Chip of Hybrid Method Solid State LiDAR

120.000 (far field) or 240.000 pixel (near field)




Light receptor (no separate counters required)

One global counter




### Benefit:

- **Highest resolution in class**
- **No moving parts**
- **Low Costs**

## Product – Pure Solid State Flash LiDAR Sensors

# The proprietary distance measurement method is our core technology.

## Our Product

Our know-how is the proprietary distance measurement method. This is a unique measurement approach that allows for high resolution.

This method allows us to use market – available parts, which make our product inexpensive.

Competition has to develop own hardware,
thus increasing cost.

Market Ready

Version 1: Industry grade

### LiSSA Industrial

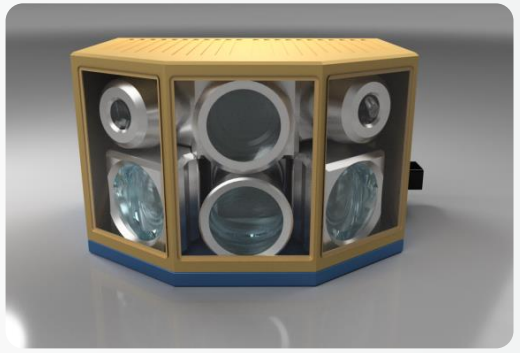


- Industry grade system with 20.800 pixels (this is more than currently available systems)
- Small series production
- Series production > 10.000 pcs. from March 2027

In Development

Version 2: Automotive grade

### LiSSA Automotive



- Automotive grade system with 600.000 pixels (2x 240.000 and 1x 120.000 sensors)
- Series production for automotive SOPs in 2027
- Meets all automotive specifications

Concept Phase

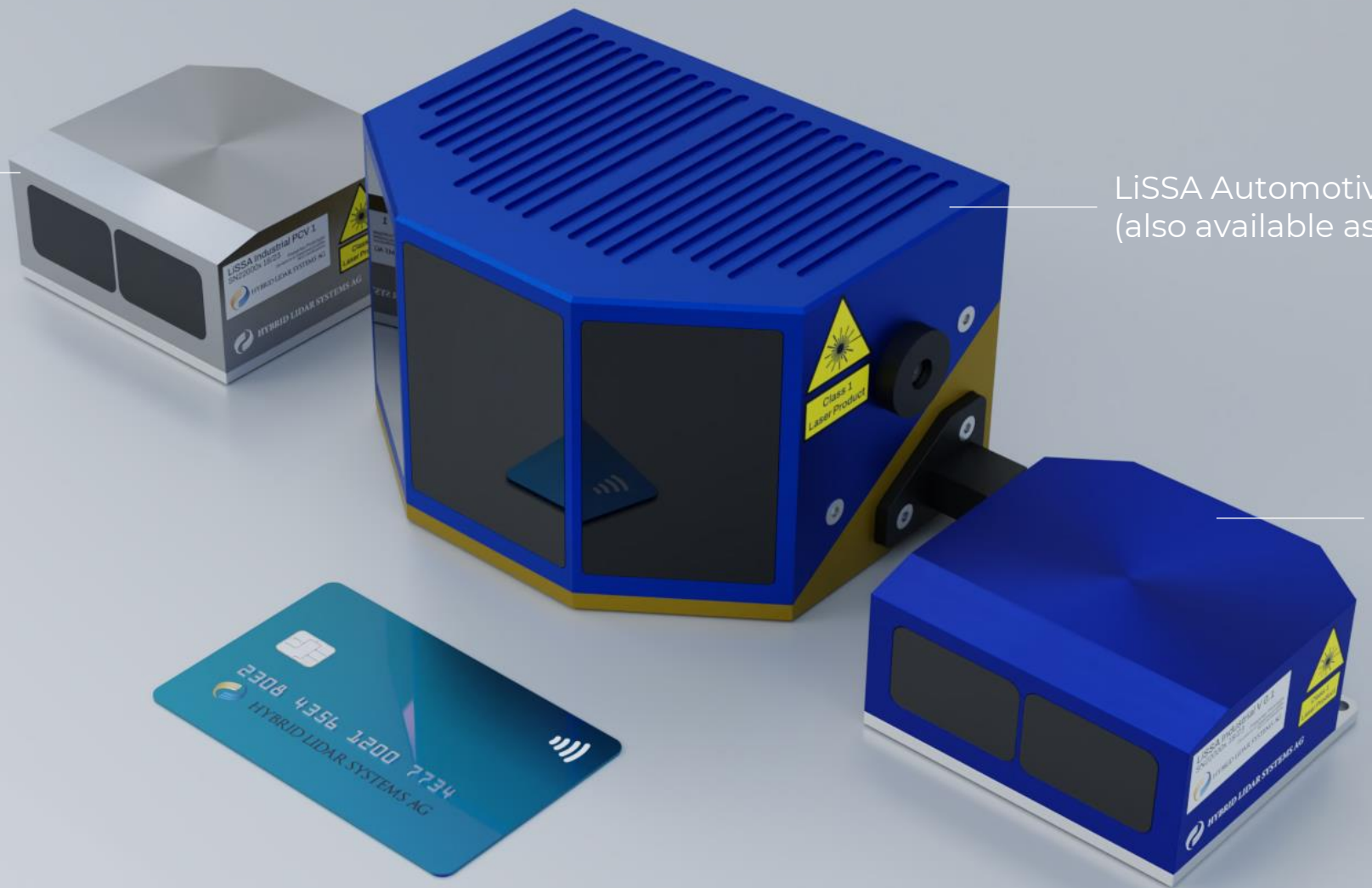
Version 3: Consumer grade

### LiSSA Consumer



- Concept phase with AR glasses manufacturer for industrial use
- Combination of camera and Lidar to detect gestures.
- Further applications smartphones, tablets, cameras

# Our Products



# Our Products



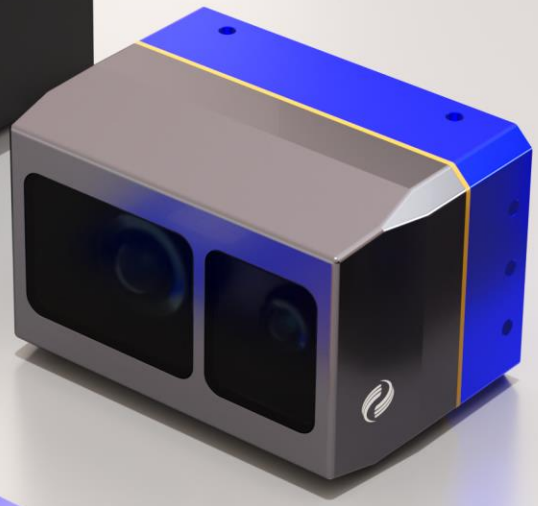
## Competitor Hesai



HESAI

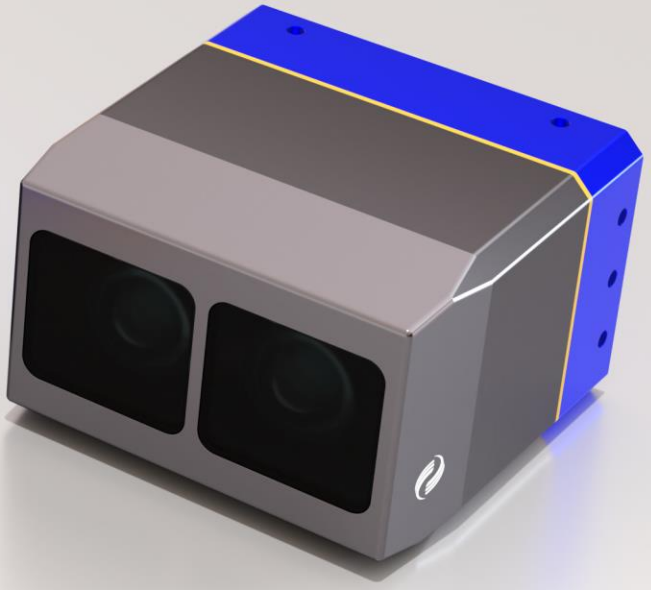
Top Product in China

LiSSA Automotive
corner Lidar






LiSSA Automotive
long range Lidar



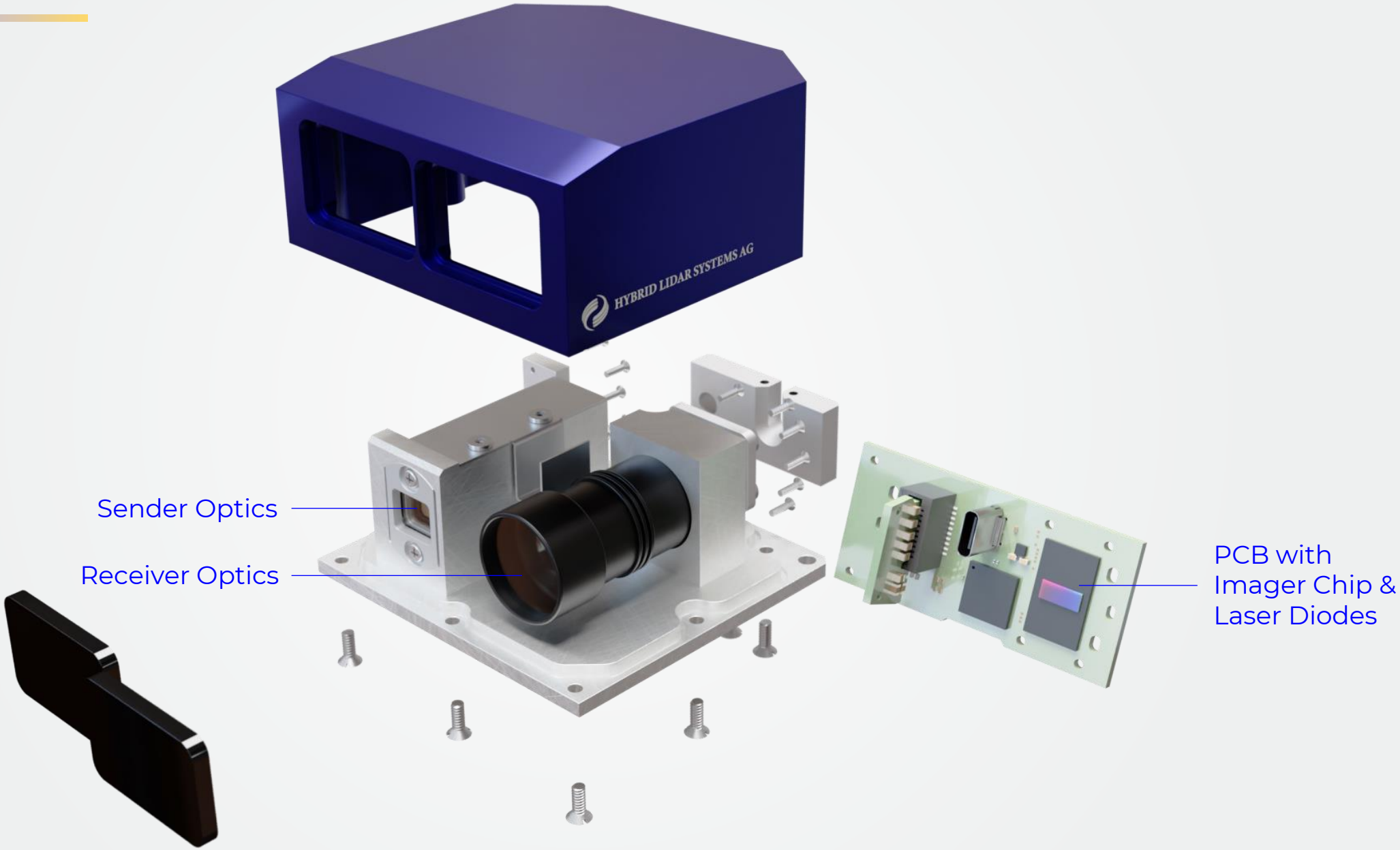
# Competitor Hesai

| | HESAI | LiSSA Automotive long range Lidar | LiSSA Automotive corner Lidar |
|---|---|---|---|
| Operational Tech. | Mechanical | Pure Solid State | Pure Solid State |
| Measurement Method | ToF | Hybrid Method | Hybrid Method |
| FoV (Field of View) | AT128: 120° x 25.4° | 40°x 10° | 120°x 45° |
| Angle Resolution (H x V) | 0.1°x0.2° (@10 Hz) | 0.1° x 0.05° (@25Hz) | 0.15° x 0.15° (@25Hz) |
| **Pixel Resolution @ 25 Hz** | **25 Hz not possible** | **120,000 Px** | **240,000 Px** |
| Data points per second | 1,536,000 | 4,800,000,000 | 9,600,000,000 |
| Frame Rate | 10-20Hz<br>Res. Dependent!! | 25Hz @ high Resolution | 25Hz @ high Resolution |
| 100% Automotive certified components used | No | Yes | Yes |
| Complexity > Scrap rate in production | High | Low | Low |
| Cost | Medium | Low | Low |
| Reliabaility/Scale up | Low/Medium | HIGH | HIGH |
| autonomous driving L4, L5 | not possible | **possible** | **possible** |

# Industry use cases

# LiSSA Industrial

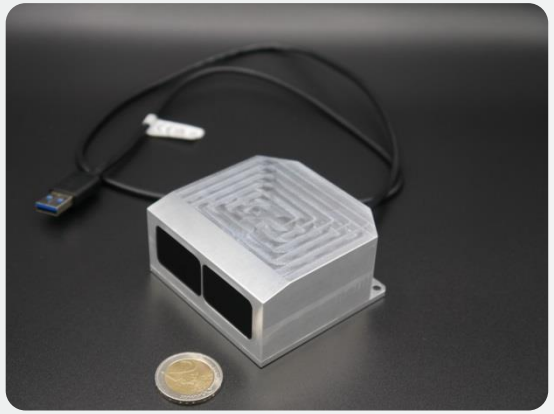
# LiSSA Industrial



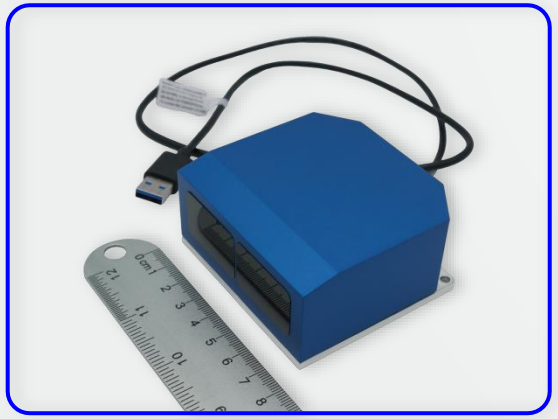
# LiSSA Industrial

**Ready for order now.**

## LiSSA Industrial Plug and Play



## LiSSA Industrial Standalone



| Optical Performance | |
|---|---|
| Technology | Sequential Solid State LiDAR (no moving parts), 3D data output via USB 3.0 or Ethernet |
| Wave length | 905 nm |
| Laser class | Class 1, eye - safety |
| Range (10% object reflectivity) | 20 m (50 m long range version) |
| Resolution (H x V) | 256 x 80 px (20,480 px) |
| Resolution angular | 0,33° x 0,42° (customizable) |
| Field of view (H x V, customizable) | 80° x 33° (customizable) |
| Number of echos | 1 (up to 32 possible)** |
| Frame rate | 10 – 30 fps (customizable)* |
| **Mechanics \| Environment \| Consumption** | |
| Dimensions (W x H xD, customizable) | 70 x 35 x 70 mm |
| Weight | 350 g |
| Operating temperature range | -20° to +55°C |
| Protection class (dust, water) | IP44 (customizable) |
| Supply voltage (customizable) | USB 3.0 (customizable) |
| Power consumption | <15 W |
| **Interface** | |
| Power supply | USB 3.0 (acc. customer) |
| Data | USB 3.0 (acc. customer) |

Up to 2.662.400.000 Measured points per second (10fps)

* Can be changed via software on the device. ** Via software upgrade.
The field of view can be adjusted via different optics. Subject to change without notice.

## LiSSA Industrial – LOI from Sensor Makers

# We Supply Our already Developed LiSSA Industry to a Major European Sensor Manufacturer Deal volume: 270 M€ in 10 yr.



PEPPERL+FUCHS Your automation, our passion.

Pepperl+Fuchs SE • Postfach 480280 • 12252 Berlin • Germany

Fa
Hybrid Lidar Systems AG
Herrn Ingo Dieterle
Tec Center 1
31162 Bad Salzdetfurth

Name: Hinrik Weber
Tel.: +49 30 616 72-239
E-Mail: hweber@de.pepperl-fuchs.com

Datum: 15.04.2025

**Lidar Technologie Kooperation**

Guten Tag, Herr Dieterle,

vielen Dank für die angenehmen Gespräche auf der Hannover Messe 2025. Ich fasse nachfolgend die Ergebnisse für uns zusammen:

Die Pepperl+Fuchs SE entwickelt, produziert und vertreibt PRT Lidar Sensoren für industrielle Anwendungen insbesondere für den Markt der autonomen Fahrzeuge in der Intralogistik.
Wir verfügen in diesem Bereich über ein breites Anwendungs-Know-How.

Die Hybrid Lidar System AG hat eine neue hochmoderne Solid State Flash Lidar Technologie entwickelt. Diese Technologie birgt hohes Potential innovative Sensorlösungen für die Automatisierungstechnik in der Intralogistik zu realisieren.

Pepperl+Fuchs SE hat vor neue Lidar Sensoren zu entwickeln und großes Interesse an einer technologischen Zusammenarbeit mit Hybrid Lidar Systems mit dem Ziel, die Tauglichkeit und Skalierung der Hybrid Laser Technologie für einen neuen P+F Lidar Sensor zu untersuchen und anschließend in eine Produktentwicklung einzusteigen.

Wir schätzen die aktuellen Stückzahlen der Fahrzeuge mit Lidar Sensorbedarf auf >250 TStk. per anno. Diese Fahrzeuge benötigen einen oder mehrere Sensoren vornehmlich zur Navigation und Antikollision.

PEPPERL+FUCHS Your automation, our passion.

In Abhängigkeit der technischen Skalierung sehen wir 2 realistische Stückzahlszenarien für die Zukunft:

Szenario 1: 10.000 Einheiten pro Jahr
Szenario 2: 100.000 Einheiten pro Jahr.

Als nächsten Schritt schlagen wir vor, zügig unsere Zusammenarbeit mit der Erarbeitung der spezifischen Anforderungen an den neuen Lidar Sensor zu starten.

Wir sind überzeugt, dass eine enge Zusammenarbeit unserer beiden Häuser zu erfolgreichen neuen Produkten führen kann.

Wir freuen uns auf das gemeinsame Projekt.

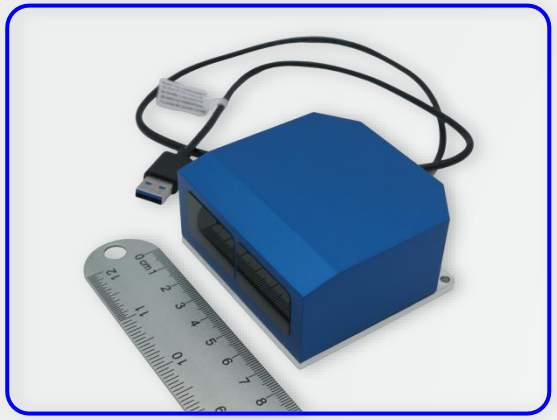
Mit freundlichen Grüßen

ppa. Hinrik Weber
Leiter IU OMS

i. A. Thorsten Schroeder
IU OMS Global Product Manager

# Use cases

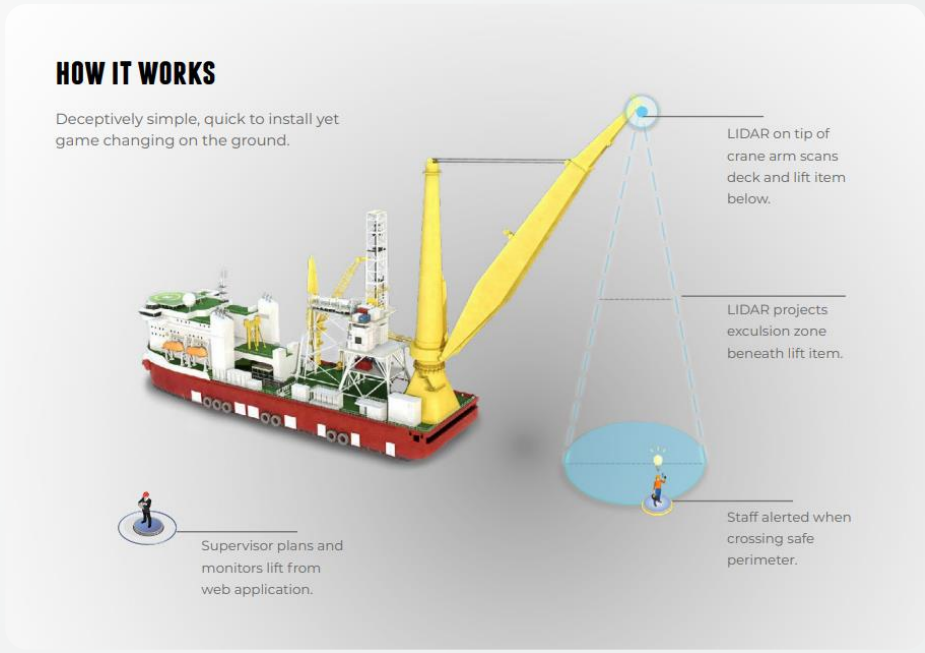
## LiSSA Industrial Standalone



- Current applications in logistics:

  Safety solution for the crane on the Subsea7 fleet.
  Safety solution for portal crane application.



Use cases

## Safety solution for the crane area

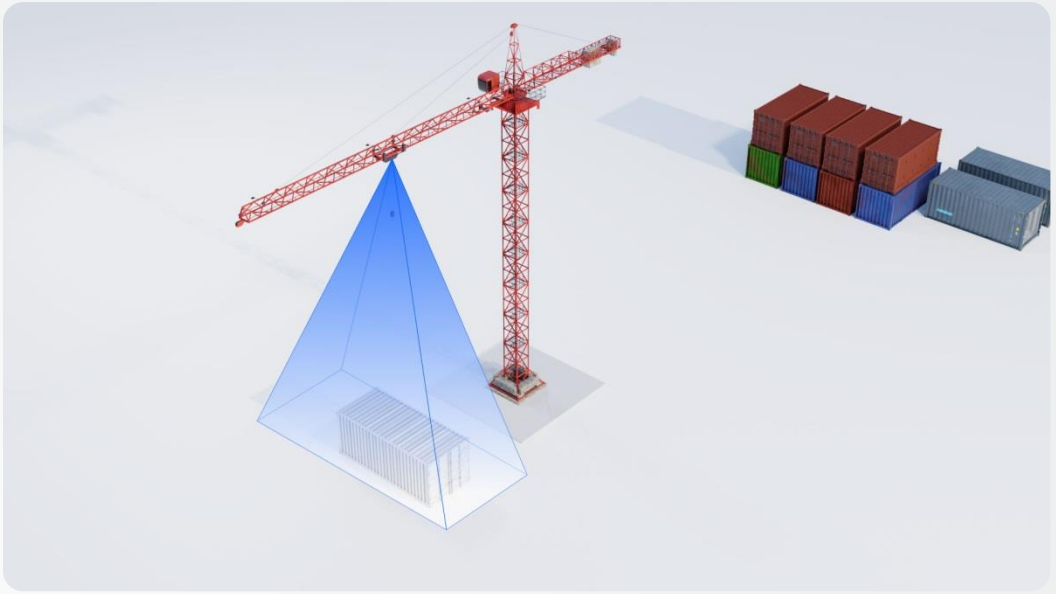
How it works:

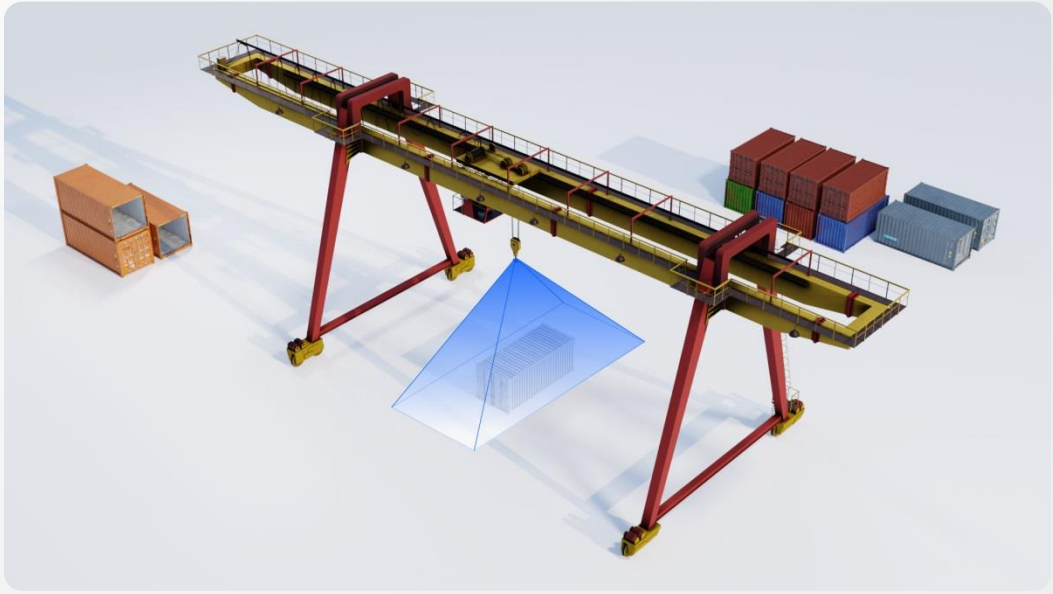
Deceptively simple, quick to install
yet game changing on the ground.

LiDAR on tip of crane arm scans deck
and lift them below.

LiDAR projects exclusion zone
beneath lift item.
Staff alerted when crossing safe
perimeter.

Supervisor plans and monitors lift
from web
application.





Use cases

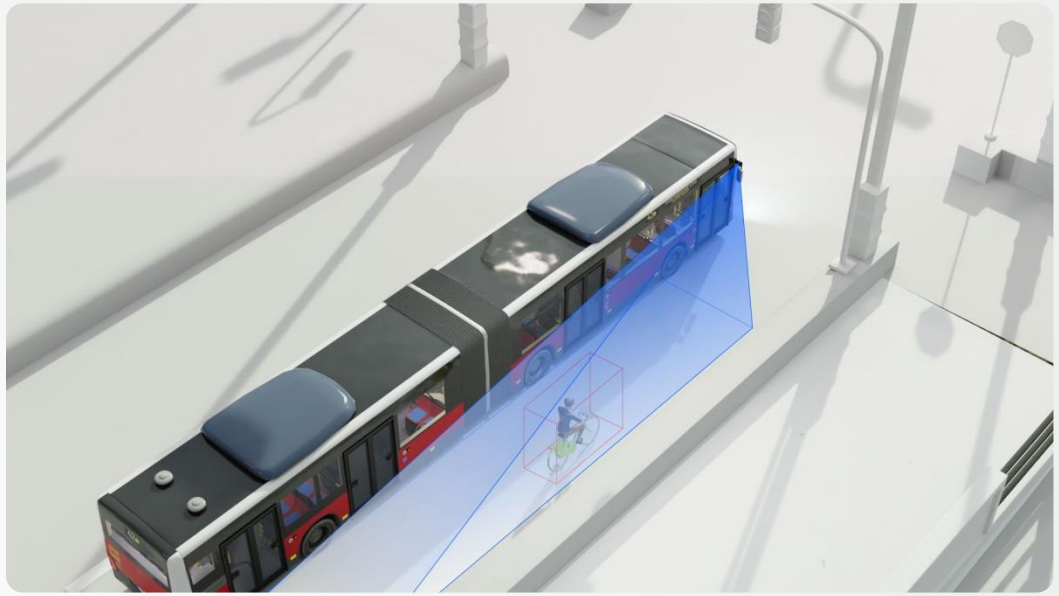
## Blind spot detection

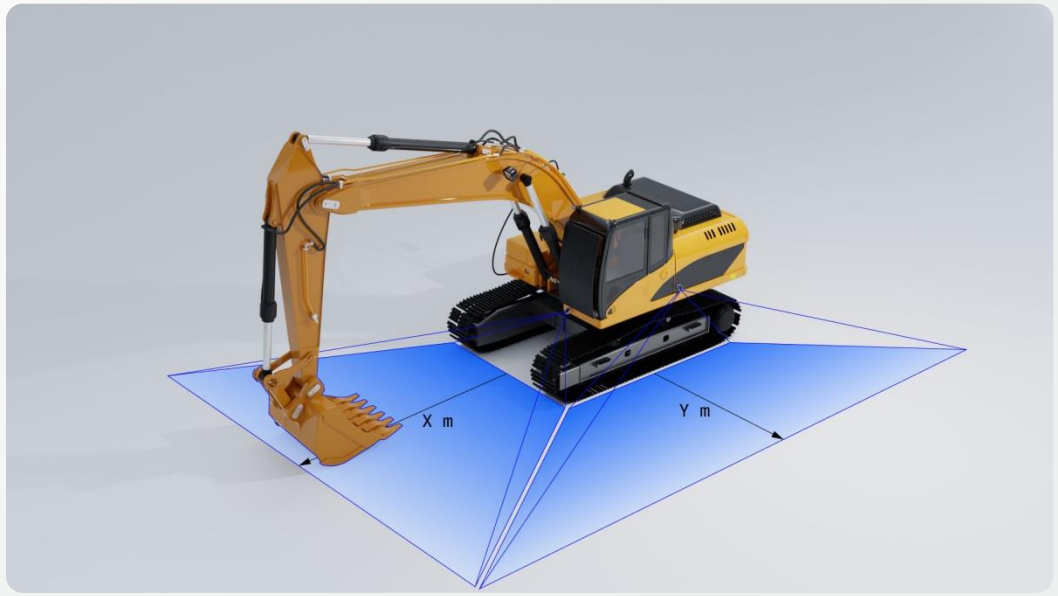
-Real 360° 3D monitoring

-No blind spot

-Independent of daylight

-Classification of:
- -Vehicles
- -Pedestrian
- -Cyclist

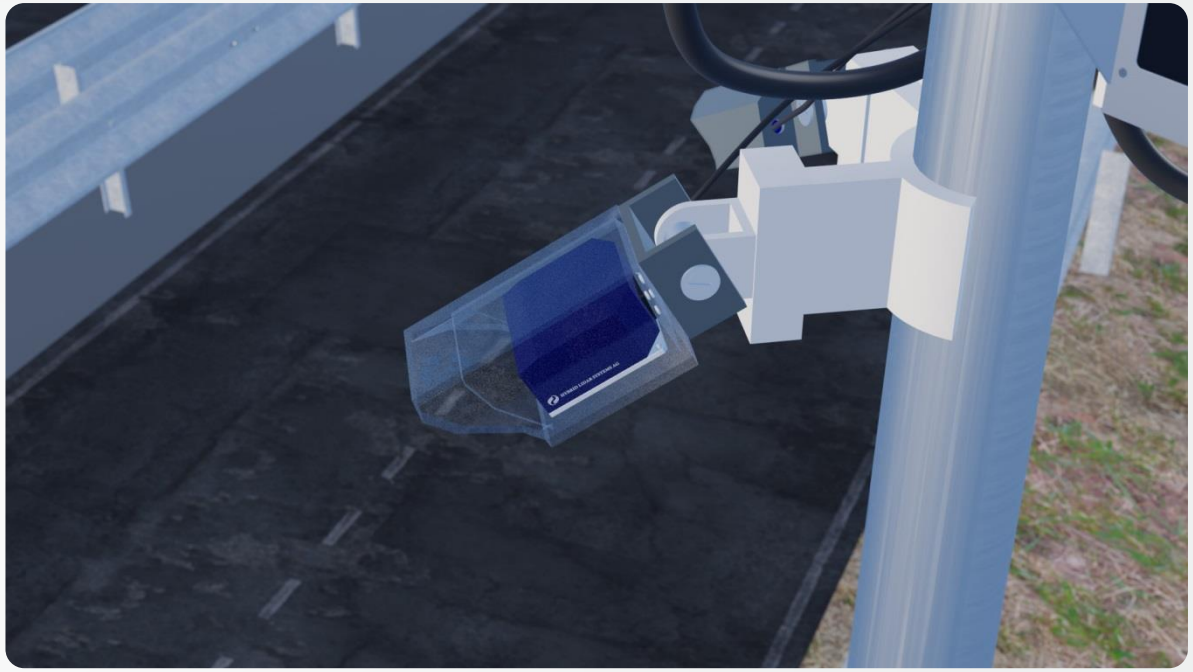




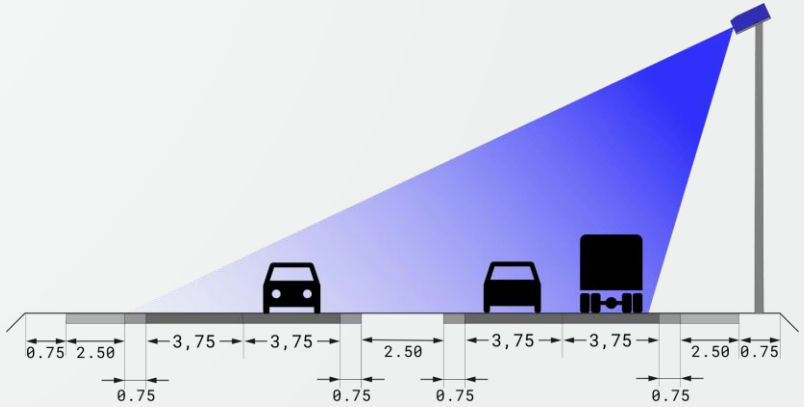
## Use cases

# DLR GmbH* - Smart City Solution





Autonomous driving testfield
Lower Saxony Autobahn A39.




*german aerospace center

Use cases

## Humanoid robotics

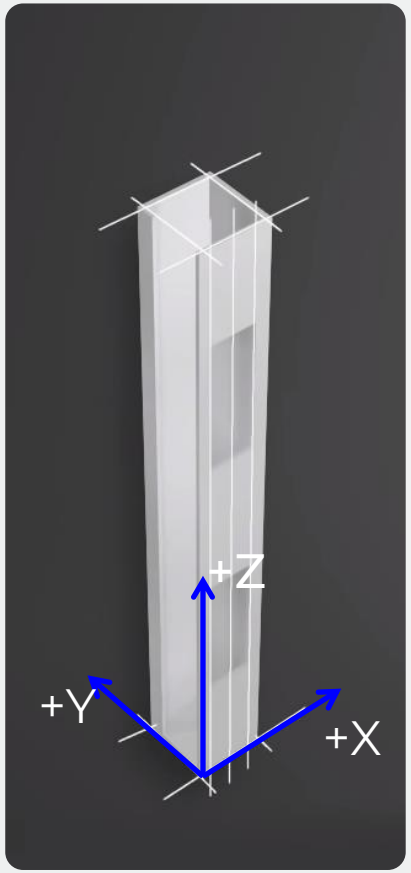
Humanoid robots see with the help of cameras and Lidar.
The camera recognises colours and the Lidar recognises depth and distances.
This enables maximum precision.

This market is still completely new. Morgan Stanley forecasts an increase in annual sales to 2.6 million units by 2035.
By 2050, there could be a billion humanoid robots in use worldwide.

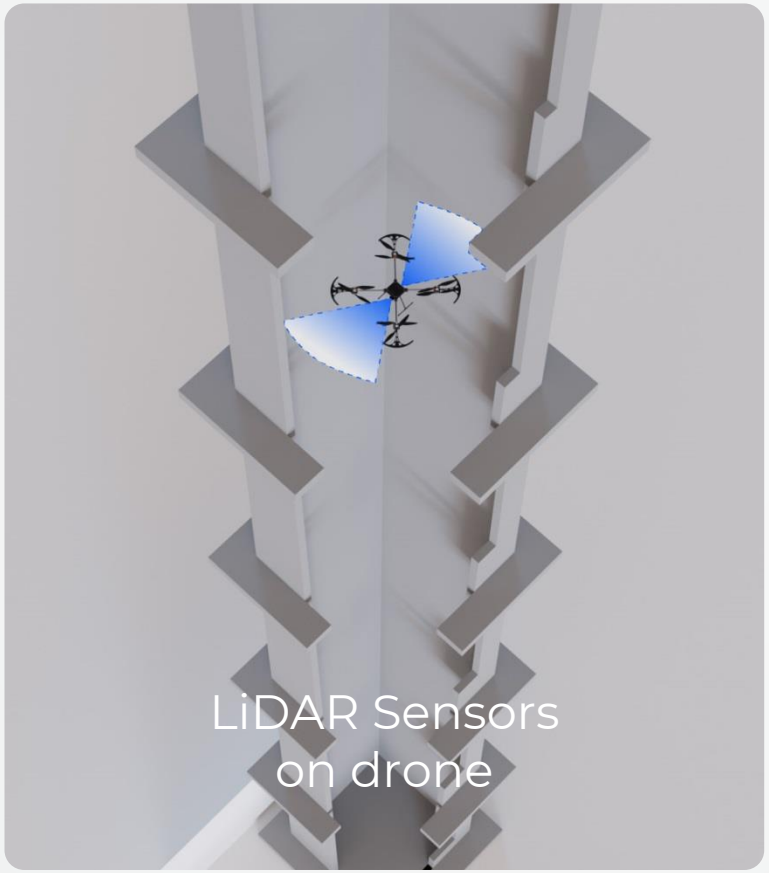


Use cases

## Elevator measurement and digital twin

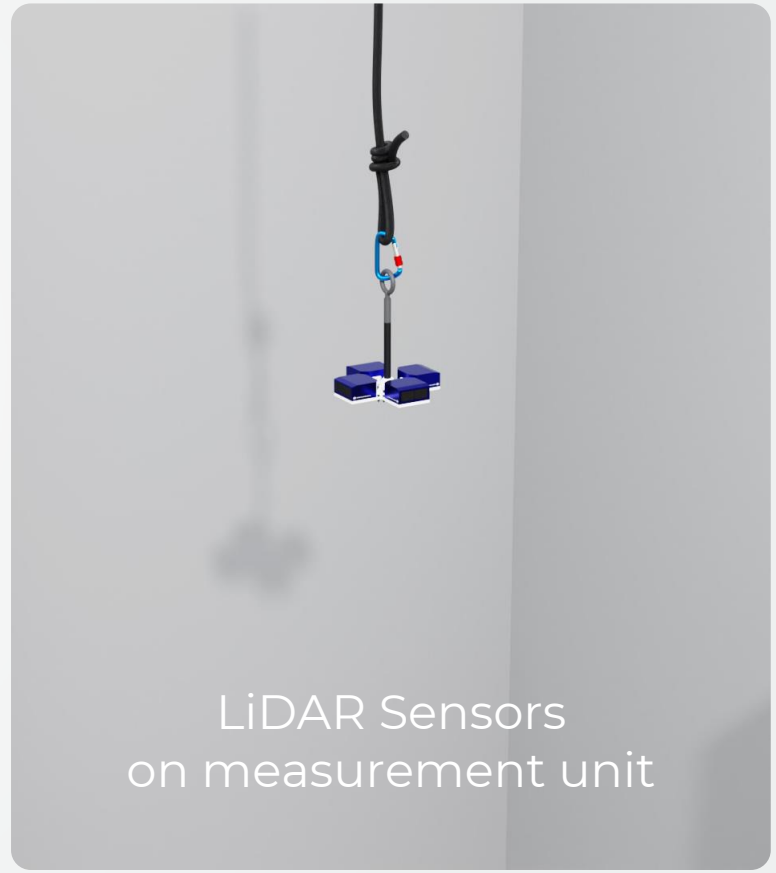



### Automatic solution




→ Result is a digital twin of the shaft

### Low cost manual solution

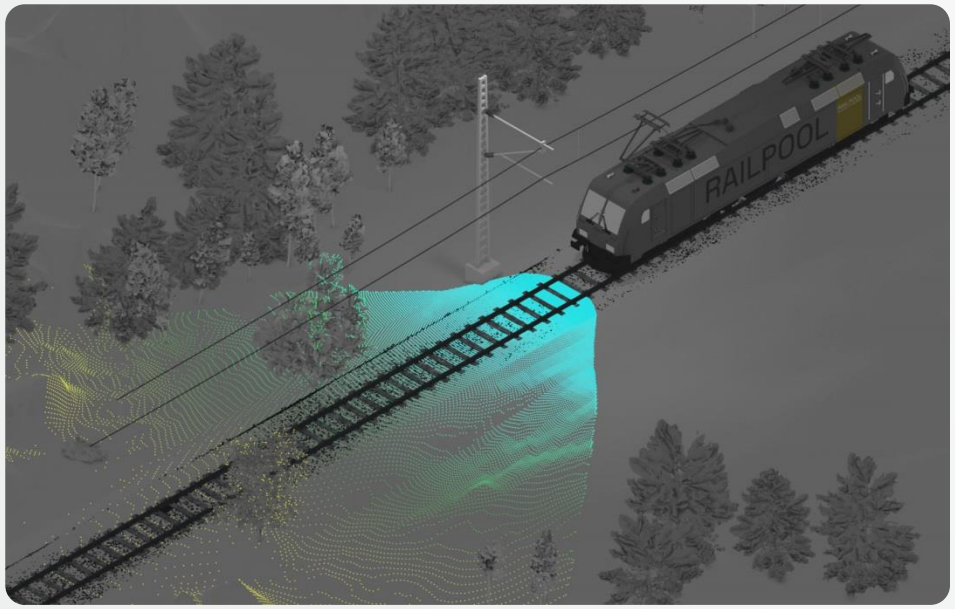


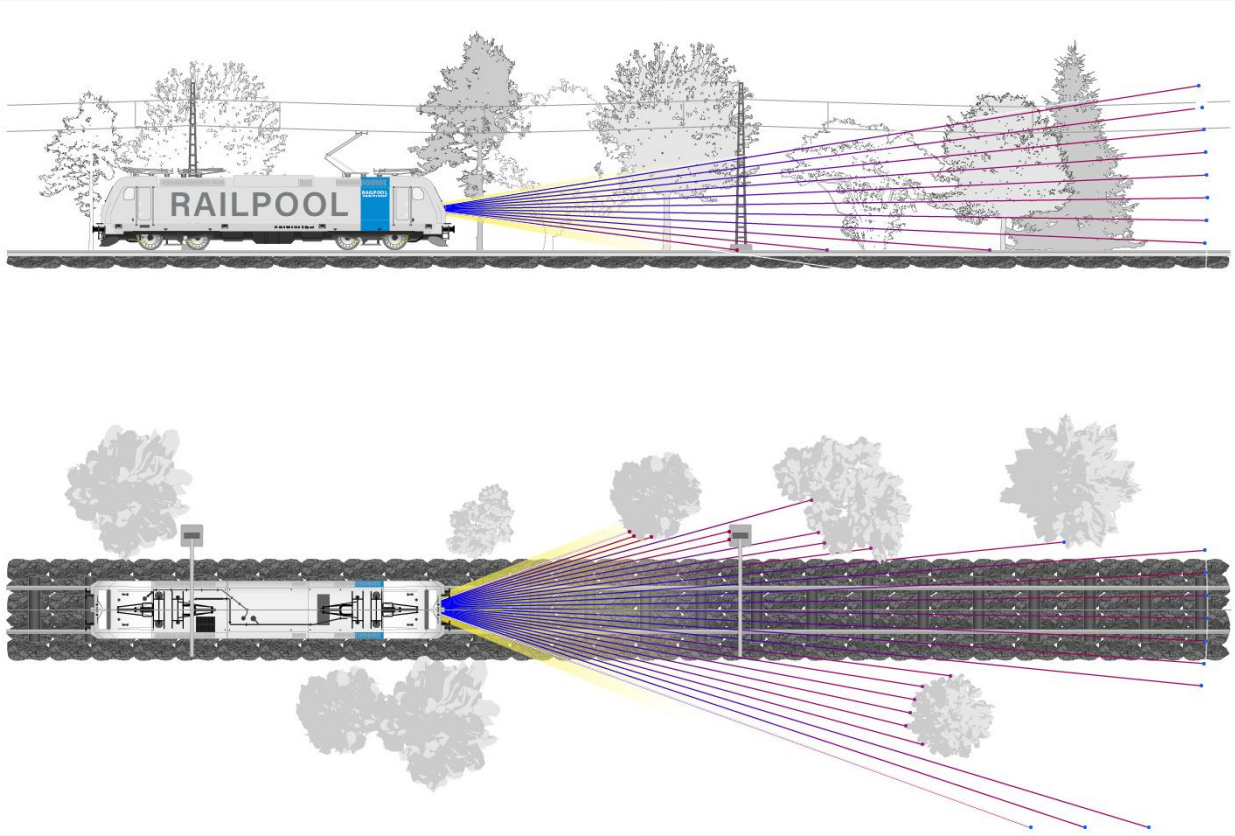

→ Result is a digital twin of the shaft

Use cases

## Railroad Solution 1 – 3D map of railroad and stations

- Scanning the environment and creating high resolution 3D map of railroad network across Germany and Europe.



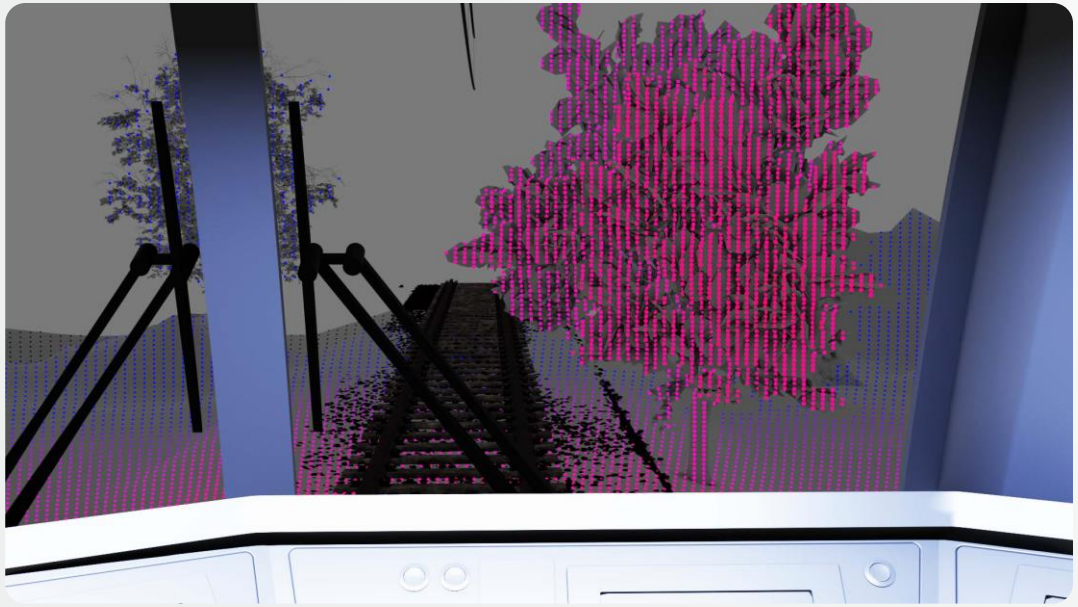



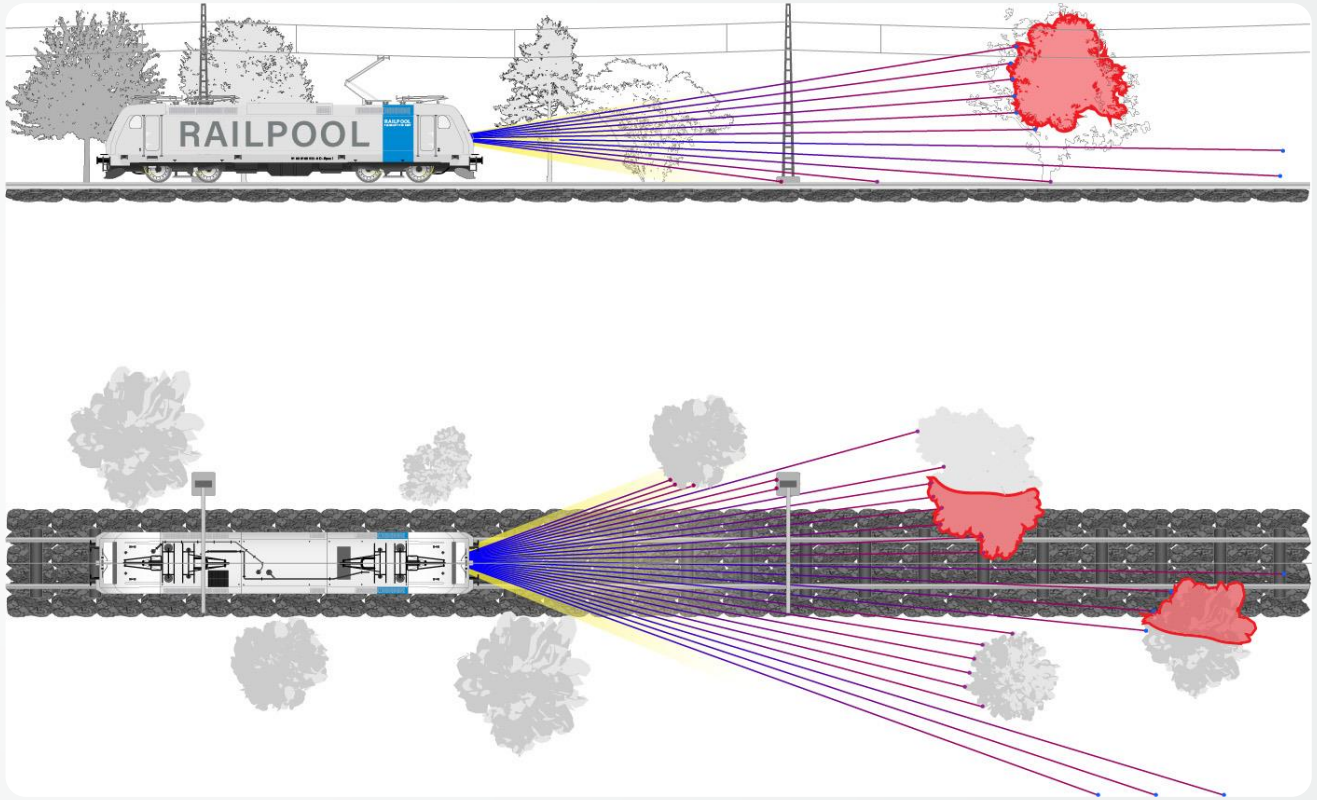
Use cases

## Railroad Solution 2 – Scanning the environment

- Detection of the tree branches that are blocking the railway.

- Sending direct data of exact position, as the point cloud and the GPS data for railway service.



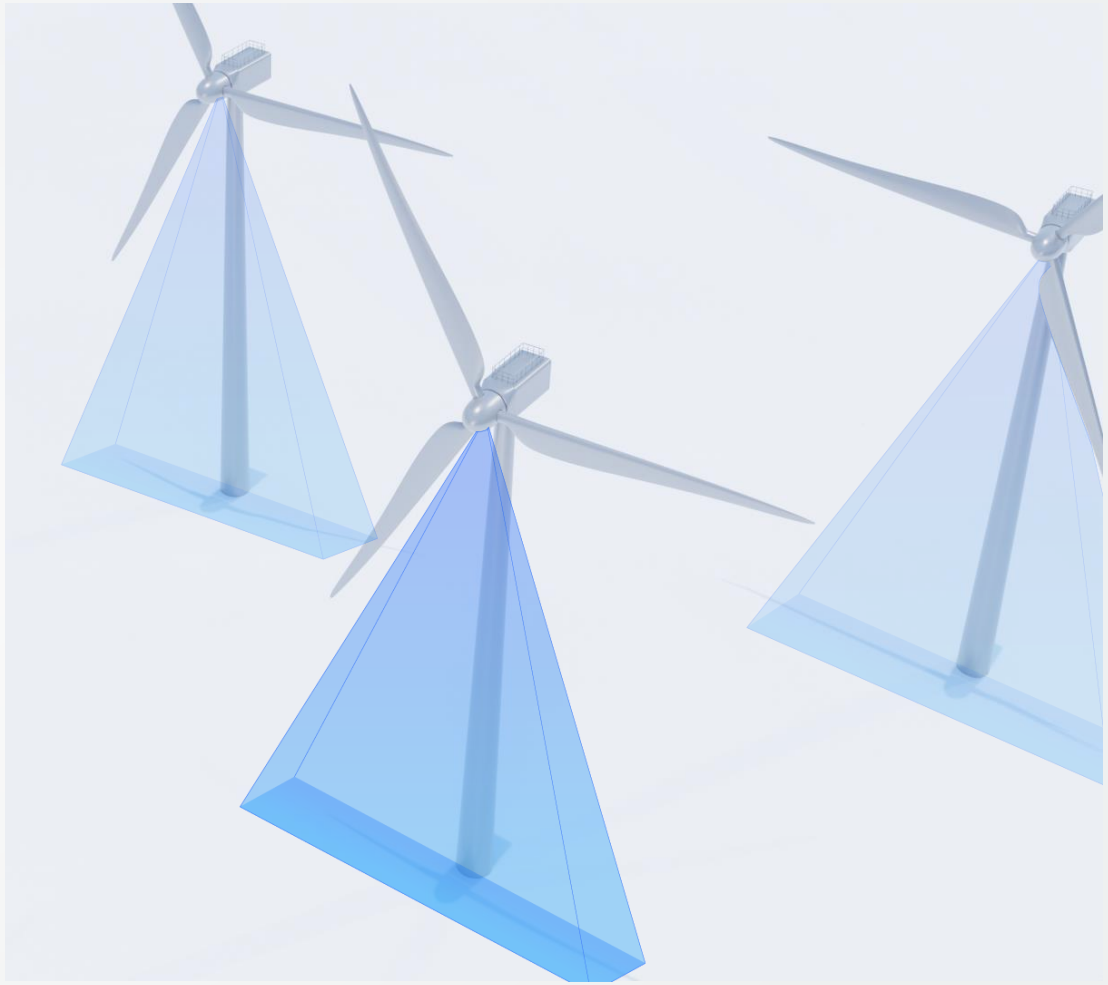


Use cases

## Blade tip protection for wind turbines

In strong wind, the blade tip is deformed so much that it can hit the pole.

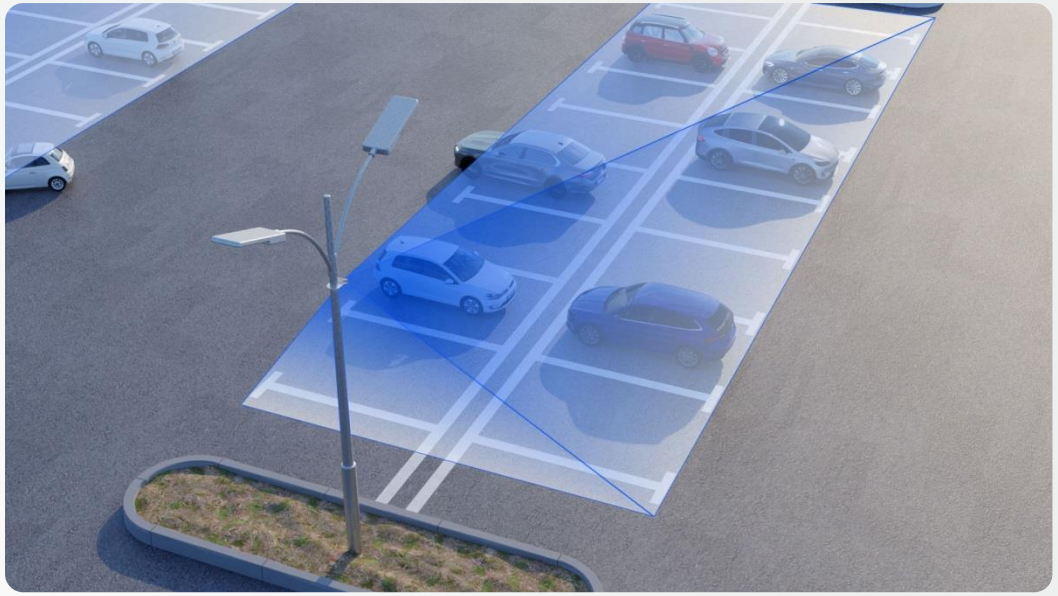
We measure the distance between the blade tip and the mast. The challenge is that the blade tip is 400 km/h fast.

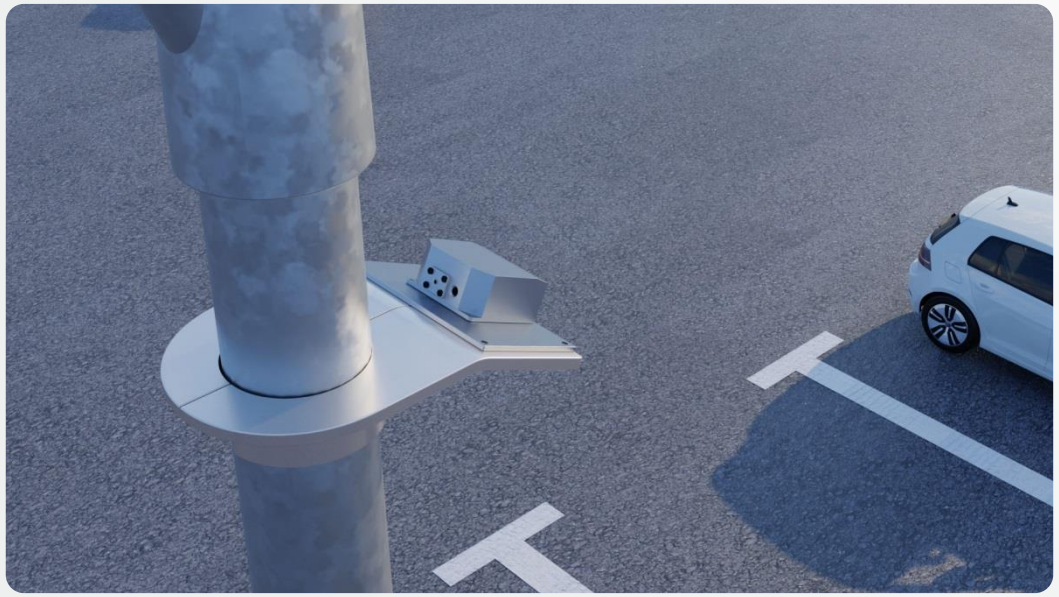


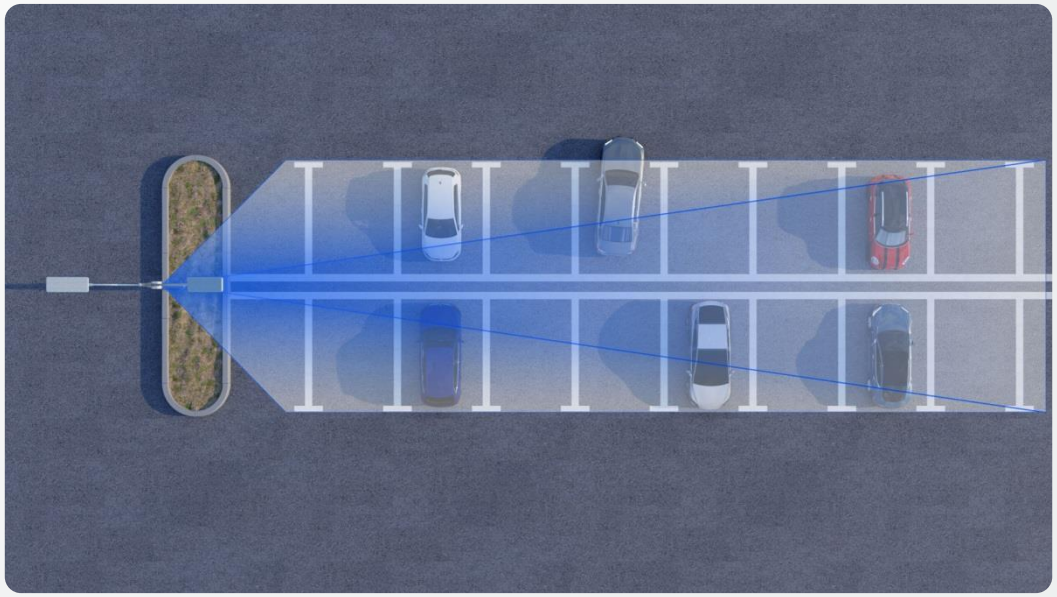
## Use cases

### Smartcity  Parking lot monitoring

- One sensor covers many parking lots.
- No additional hardware for each parking lot.
- Easy to install.
- Easy to expand monitoring area.
- Low wear due to the position.
- Classification of vehicle.
- Car mapping in sensor possible.



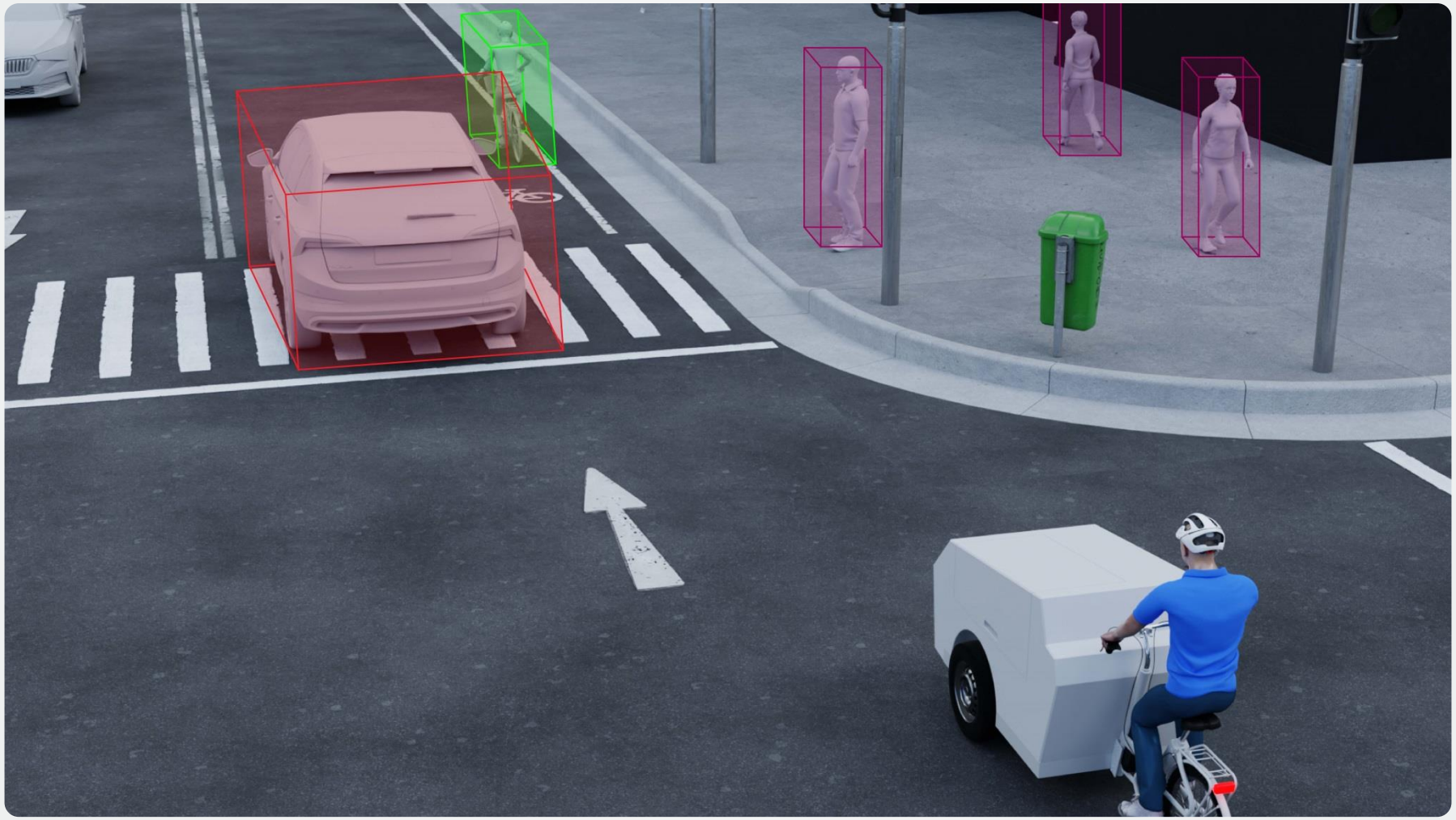




Use cases

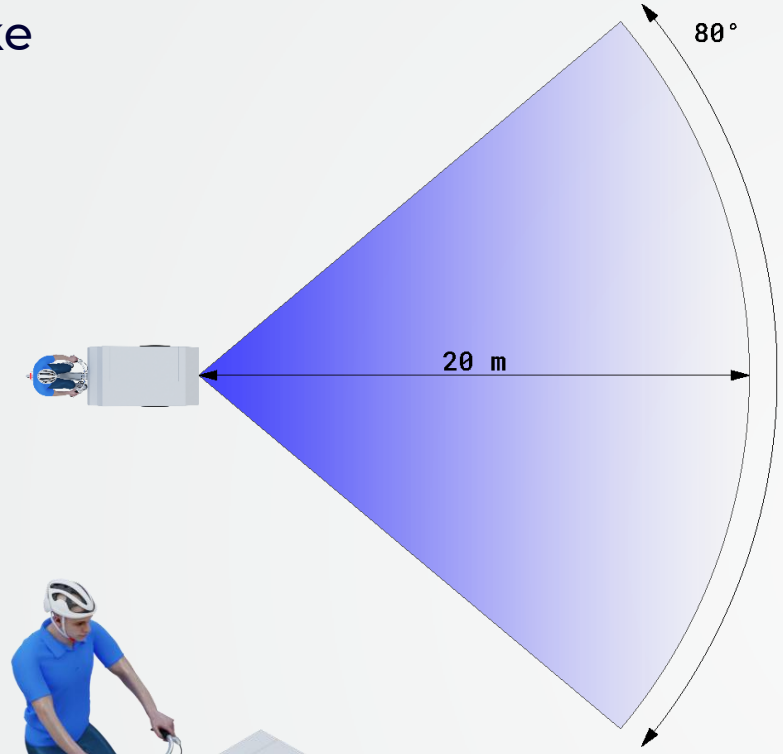
## Cargo bike

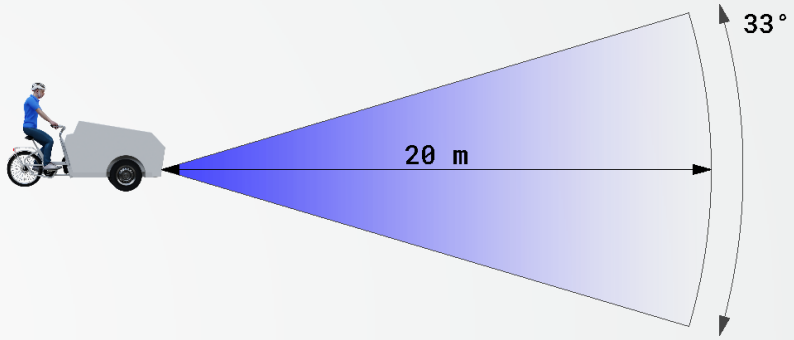
- Digital map based on LiDAR data



## Use cases

# Cargo bike








Use cases

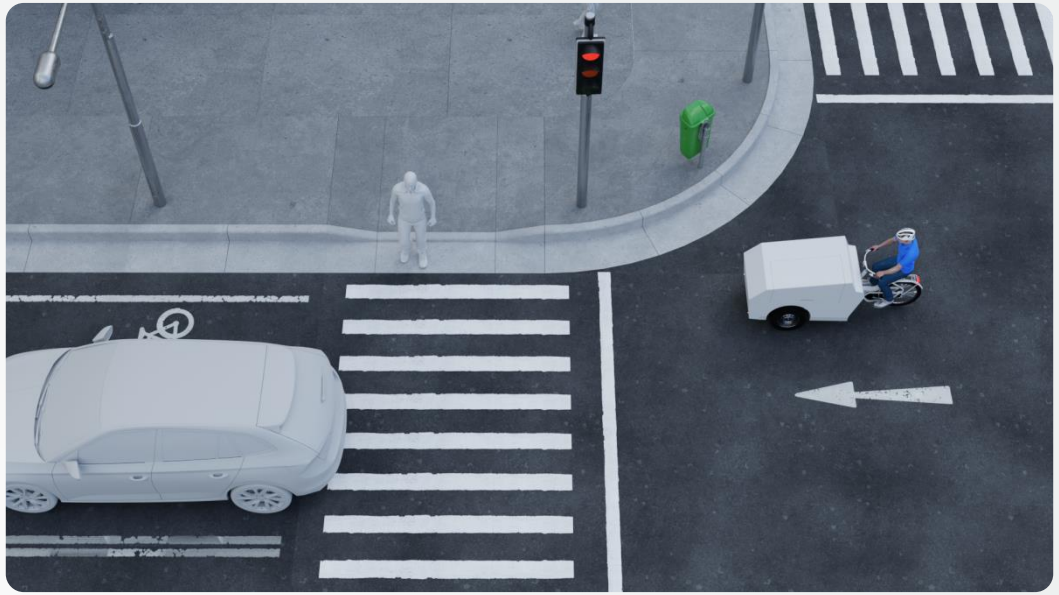
## Cargo bike

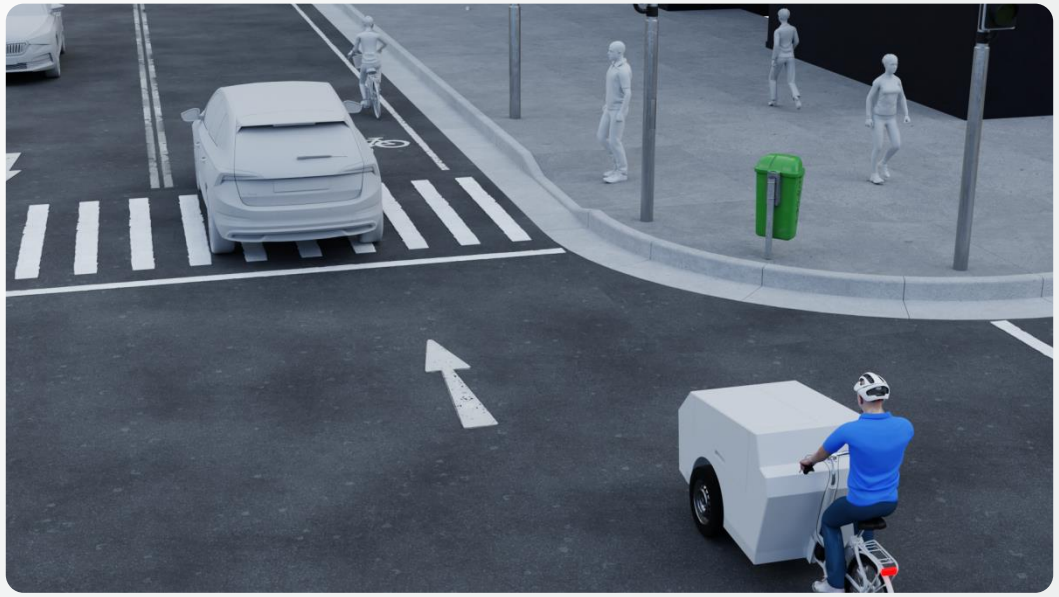
Application 1:

-Safety feature for real time detection of obstacles.

Application 2:

-Mapping of the environment and creation of a 3D map.

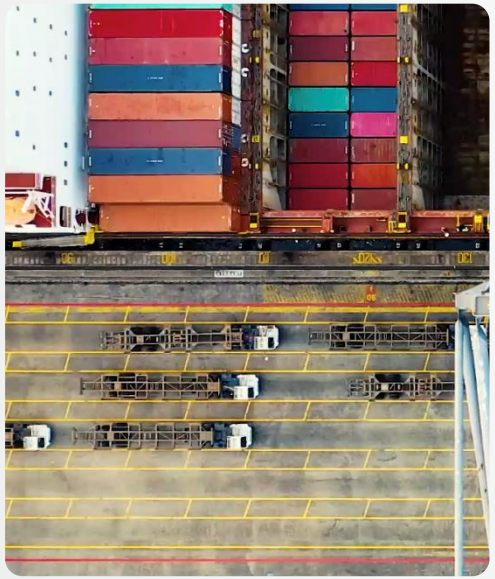




Use cases

# Autonomous Transportation Vehicles

## Autonomously Moving Transportation Vehicles



## Automated Guided Indoor Vehicles and Carts




## Last Mile Delivery



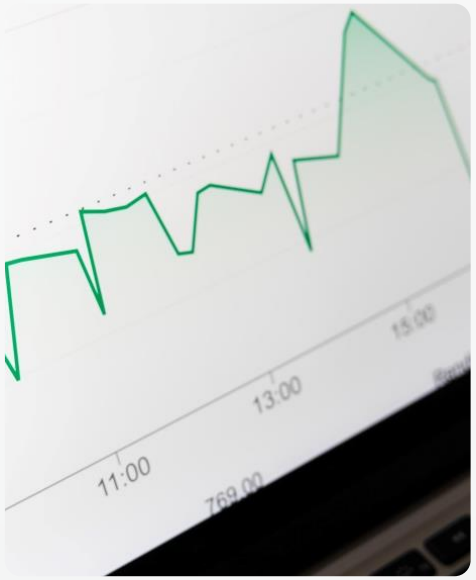
Use cases

# Automated Access Control and Security

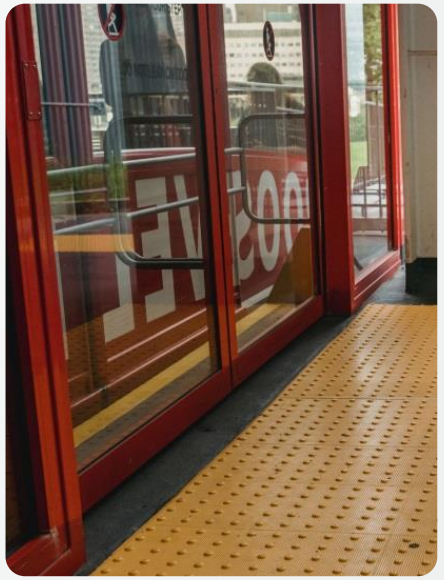
## Access Identification and Alarm




## People Counter




## Optimized Door Closing Speed



Use cases

# Indoor Navigation, Monitoring and Safety

## Navigation for Automated Vehicles and VR




## Anonymous Site Monitoring



## Ranging Assistance and Crane Payload Monitoring



# Automotive use cases

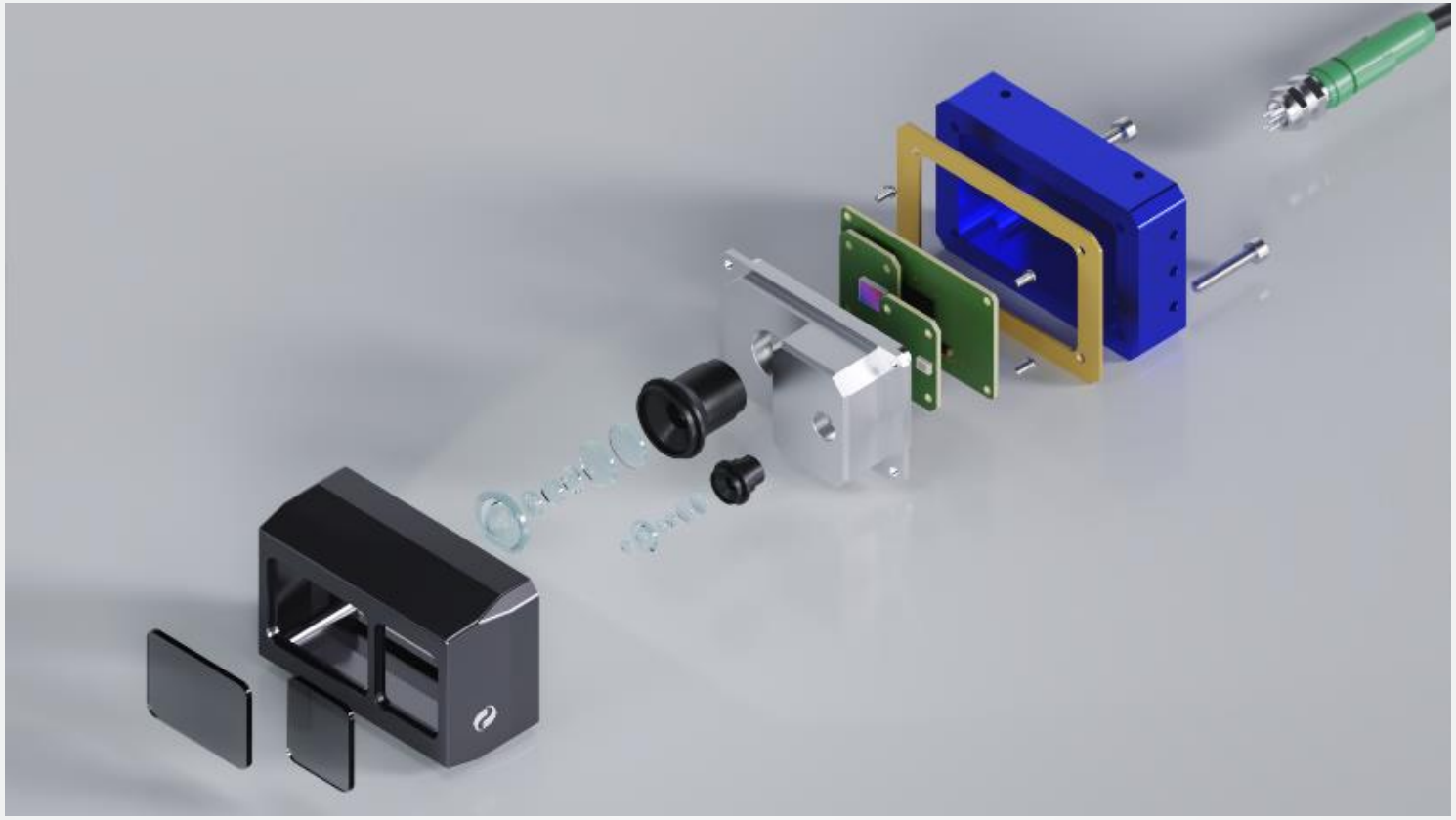
# LiSSA Automotive

**Driver assistence Systems**

**and**

**autonomous driving**

# LiSSA Automotive short range single sensor (ex. for corner)



## Product – Pure Solid State Flash LiDAR Sensors

# Competitors Are Interested in Implementing Our Technology



Valeo

Las Vegas, January 7, 2024

Clément Nouvel
Valeo LiDAR CTO
clement.nouvel@valeo.com

Dear Mr Dietterle, Mr Eltaher,

Following our recent fruitful discussions related to Hybrid LiDAR System AG technology, Valeo LiDAR management is pleased to share the following technical and business statements.

The new SPAD receiver HLS Technology is developing, where all TDCs on the chip could be exchanged by only one global counter, would provide the advantage of achieving a parallel distance measurement for an unlimited number of SPAD cells.
From a business perspective, this new SPAD receiver would require much less die size, therefore reducing substantially its manufacturing cost.

Should this new type of SPAD receiver chip be available in 2025 or 2026, demonstrating the previously mentioned advantages as well as being state of the art with respect to range and resolution with a suitable number of pixels (e.g. more that 240.000 point cloud pixels) and a proven substantial cost advantage as highlighted above, Valeo would be very much interested in evaluating this SPAD receiver for a new type of LiDAR sensor dedicated to automotive high volume production, for instance for L3 or L4 applications.

Best regards,
Clément Nouvel

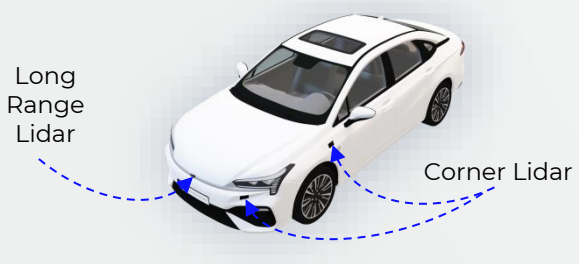
Christophe Minster
Valeo Lidar Product Group Vice president

# LiSSA Automotive short range single sensor (ex. for corner)

## LiSSA Automotive Sensor



**Automotive project bookable – SOP Automotive project from 2027 available.**



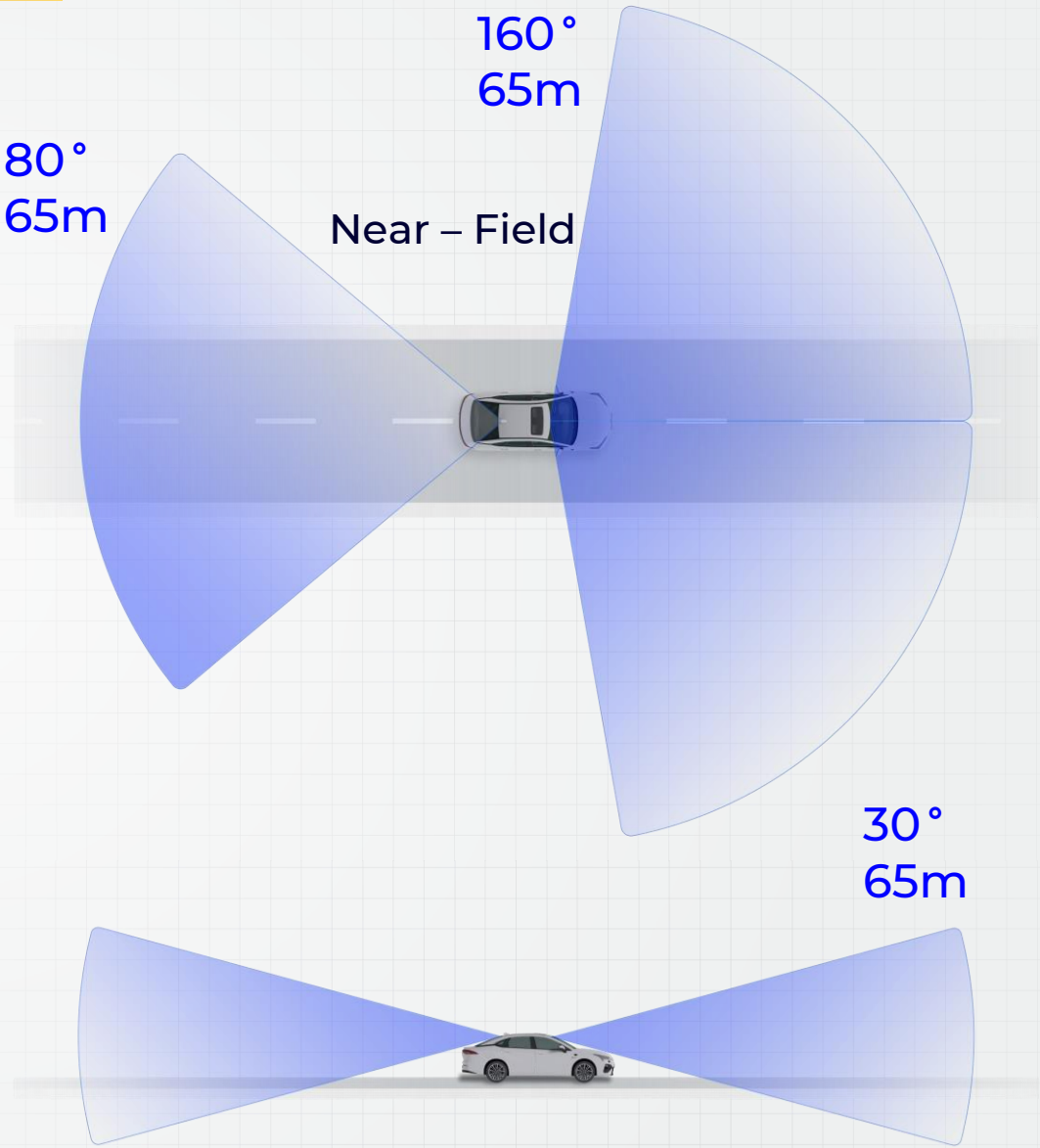

| Optical Performance | |
|---|---|
| Technology | Sequential Solid State LiDAR (no moving parts), 4D data output via ethernet |
| Wave length | 905 nm |
| Laser class | Class 1, eye - safety |
| Range (10% object reflectivity) | 100 m |
| Resolution (H x V) | 800 x 300 px → 240.000 Pixel Near-Field |
| Resolution angular | 0,15° x 0,15° (customizabel)* |
| Field of view (H x V, customizable) | 120° x 45° (cutomizabel)* |
| Number of echos | 5 |
| Frame rate | 25 fps** |
| **Mechanics \| Environment \| Consumption** | |
| Dimensions (W x H xD, customizable) | 64 x 42 x 49 mm (customizable)* |
| Weight | 300 g |
| Operating temperature range | -40° to +85°C |
| Protection class (dust, water) | IP67 (customizable)* |
| Supply voltage (customizable) | 12 V (From control unit) |
| Power consumption | <15 W |
| **Interface** | |
| Power supply | Acc. customer |
| Data | Ethernet acc. Customer* |

*Please contact HLS sales ** Can be changed via software Subject to change without notice.

## Examples for positions of LiSSA Automotive in the car

### Short range LiDAR sensor



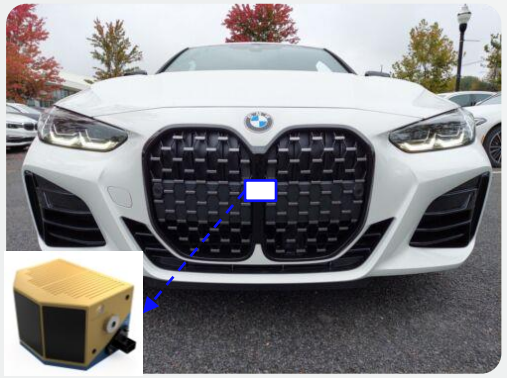



# LiSSA Automotive wide short & long range

## LiSSA Automotive Tripple Sensor



**Automotive project bookable – SOP Automotive project from 2027 available.**



| Optical Performance | Long Range (LR) | Short Range (SR) |
|---|---|---|
| Technology | Sequential Solid State LiDAR (no moving parts), 3D data output via ethernet | |
| Wave length | 850, 905 nm | |
| Laser class | Class 1, eye - safety | |
| Range (10% object reflectivity) | Up to 220 m | 65 m |
| Resolution (H x V) | 400 x 300 px | 1600 x 300 px → |
| Resolution angular | 0,1° x 0,033° | 0,1° x 0,1° |
| Field of view (H x V, customizable) | 40° x 10° | 160° x 30° |
| Number of echos | 4 - 16 | |
| Frame rate | 25 | |
| **Mechanics \| Environment \| Consumption** | | |
| Dimensions (W x H xD, customizable) | 126 x 79 x 98 mm | |
| Weight | 1290 g | |
| Operating temperature range | -40° to +85°C | |
| Protection class (dust, water) | IP6K9K | |
| Supply voltage (customizable) | 12 V (From control unit) | |
| Power consumption | <40 W | |
| **Interface** | | |
| Power supply | Acc. customer | |
| Data | Ethernet acc. customer | |

120.000 Pixel Far-Field
+
480.000 Pixel Near-Field

↓

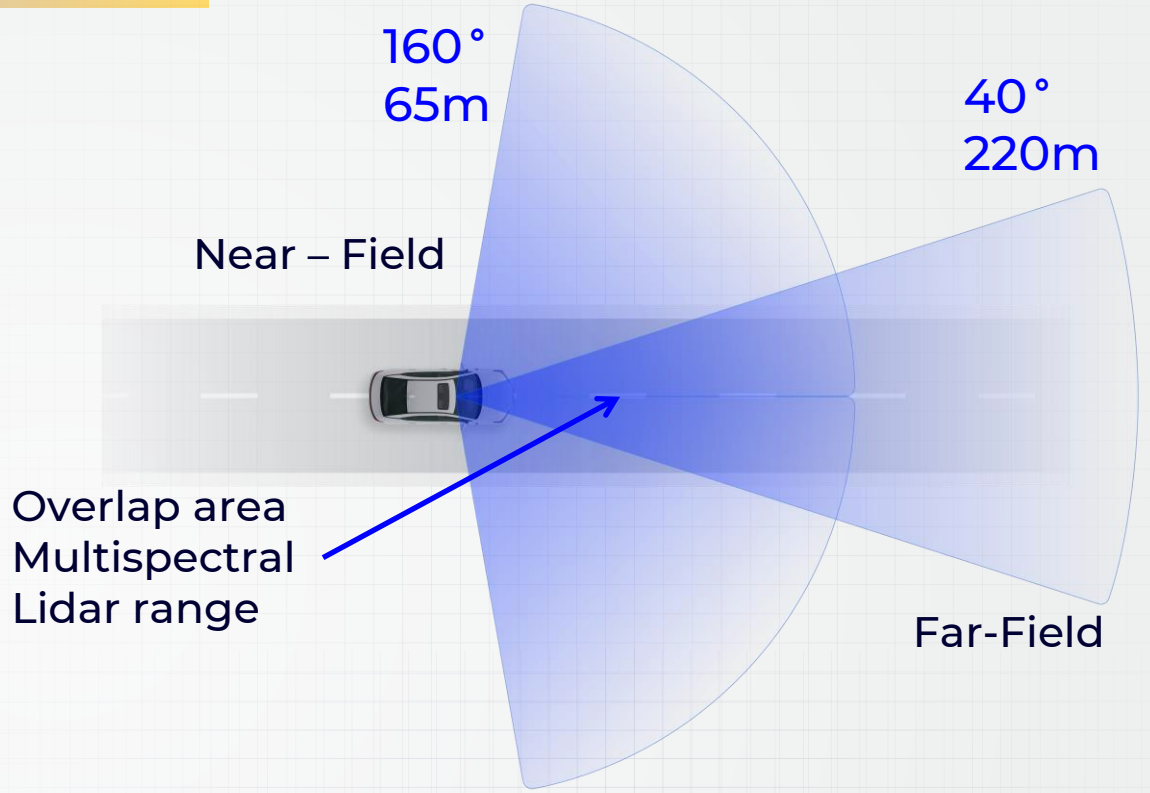
Up to 30.000.000.000 Measured points per second (25 fps)

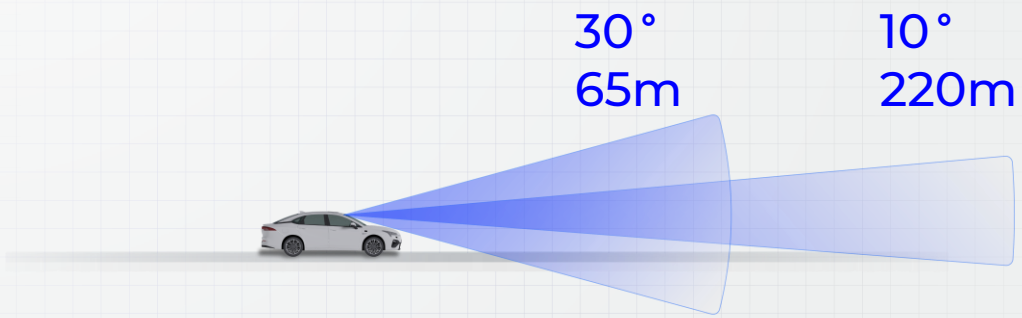
This datasheet shows the Automotive series product, which is currently under development.

## Examples for positions of LiSSA Automotive in the car

### LiSSA Automotive wide short & long range



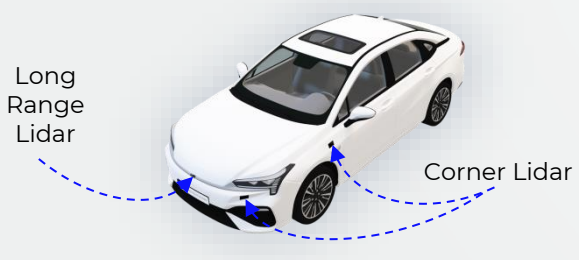



# LiSSA Automotive long range single sensor

## LiSSA Automotive Sensor



**Automotive project bookable – SOP Automotive project from 2027 available.**

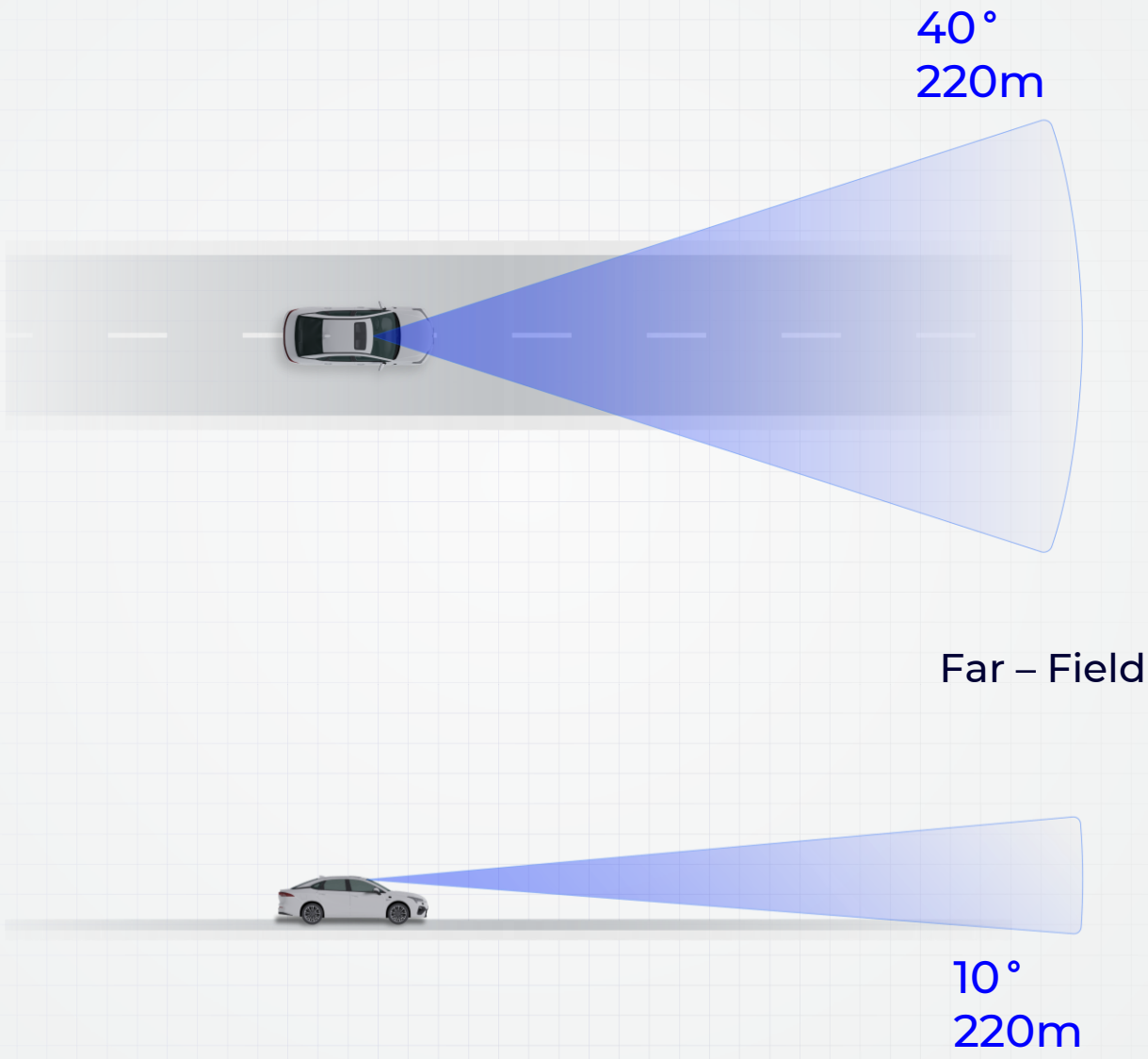



| Optical Performance | |
|---|---|
| Technology | Sequential Solid State LiDAR (no moving parts), 4D data output via ethernet |
| Wave length | 905 nm |
| Laser class | Class 1, eye - safety |
| Range (10% object reflectivity) | Up to 220 m |
| Resolution (H x V) | 400 x 300 px → 120.000 Pixel Far-Field |
| Resolution angular | 0,1° x 0,05° (customizable)* |
| Field of view (H x V, customizable) | 40° x 15° (customizabel)* |
| Number of echos | 5 |
| Frame rate | 25 fps ** |
| **Mechanics \| Environment \| Consumption** | |
| Dimensions (W x H xD, customizable) | 64 x 42 x 62 mm (cutomizabel)* |
| Weight | 300 g |
| Operating temperature range | -40° to +85°C |
| Protection class (dust, water) | IP67 (customizabel)* |
| Supply voltage (customizable) | 12 V (From control unit) |
| Power consumption | <15 W |
| **Interface** | |
| Power supply | Acc. customer |
| Data | Ethernet acc. Customer* |

*Please contact HLS sales ** Can be changed via software Subject to change without notice.

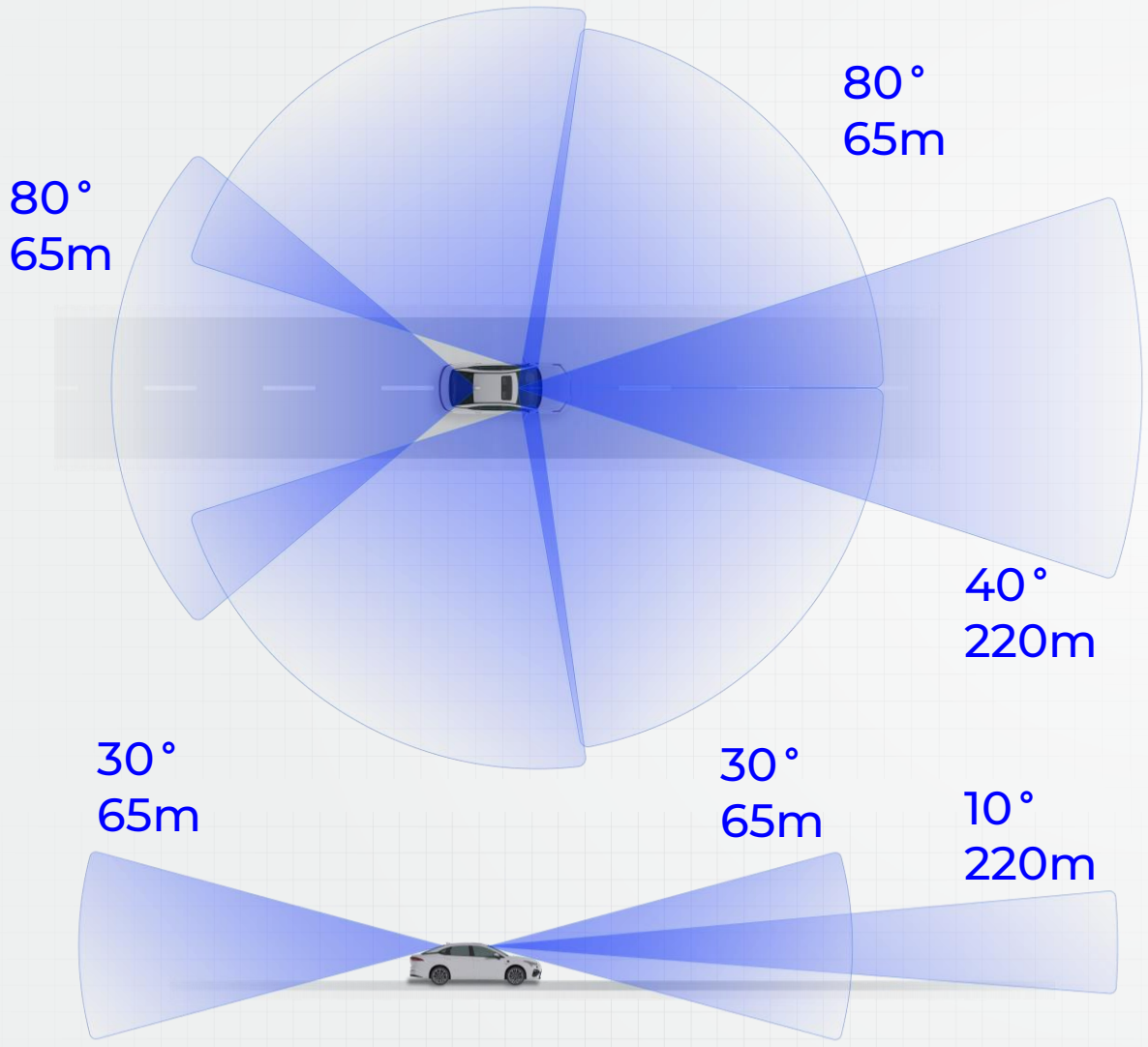
## Examples for positions of LiSSA Automotive in the car

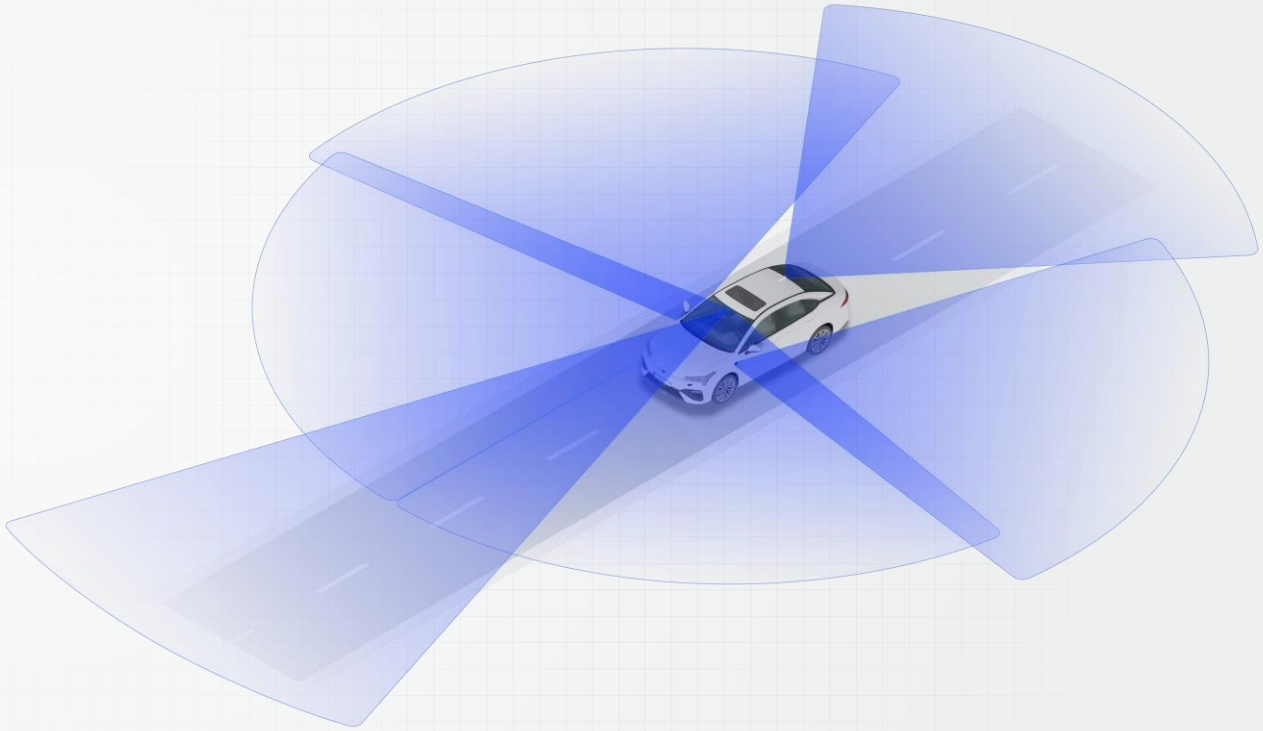
### Long range LiDAR sensor



## Examples for positions of LiSSA Automotive in the car

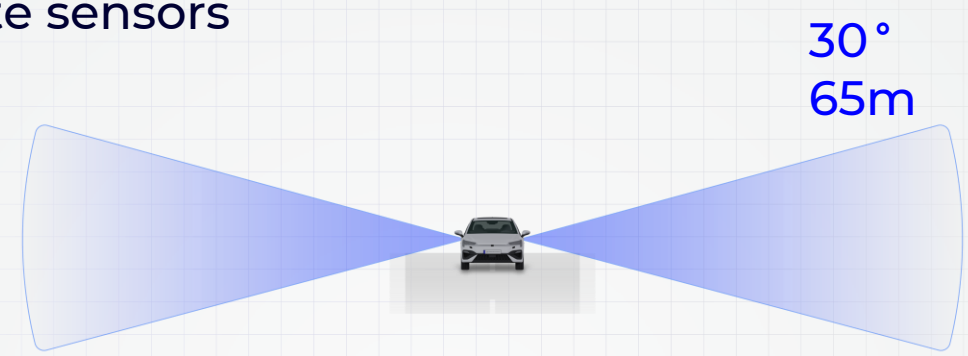
# Examples: All-Round-Scan (horizontal) with front triple sensor, rear and 2 site sensors

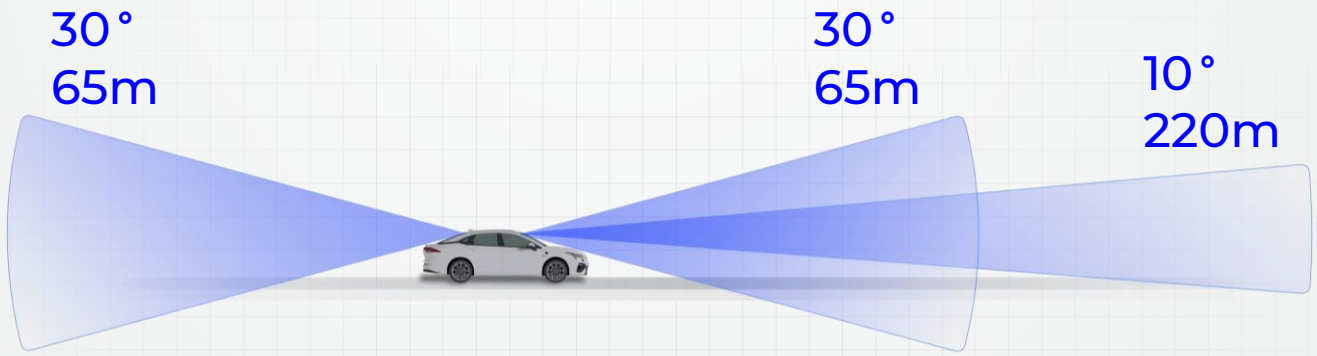


## Examples for positions of LiSSA Automotive in the car

### Examples: Scan (vertical cut) in combination with front triple sensor, rear sensor and site sensors



# Defense Use Cases

# LiSSA Industrial and Automotive

Use cases

## LiSSA for weapons




The enemy can come withhin 30 meters „and you can´t see him“, says Wowan, the unit commander

Source: Der Feind in den Wäldern ZDFDoku 08.02.2025

Use cases

## LiSSA for weapons



The LiDAR sensor provides a 3D point cloud and detects the defined target.



Improved variant.

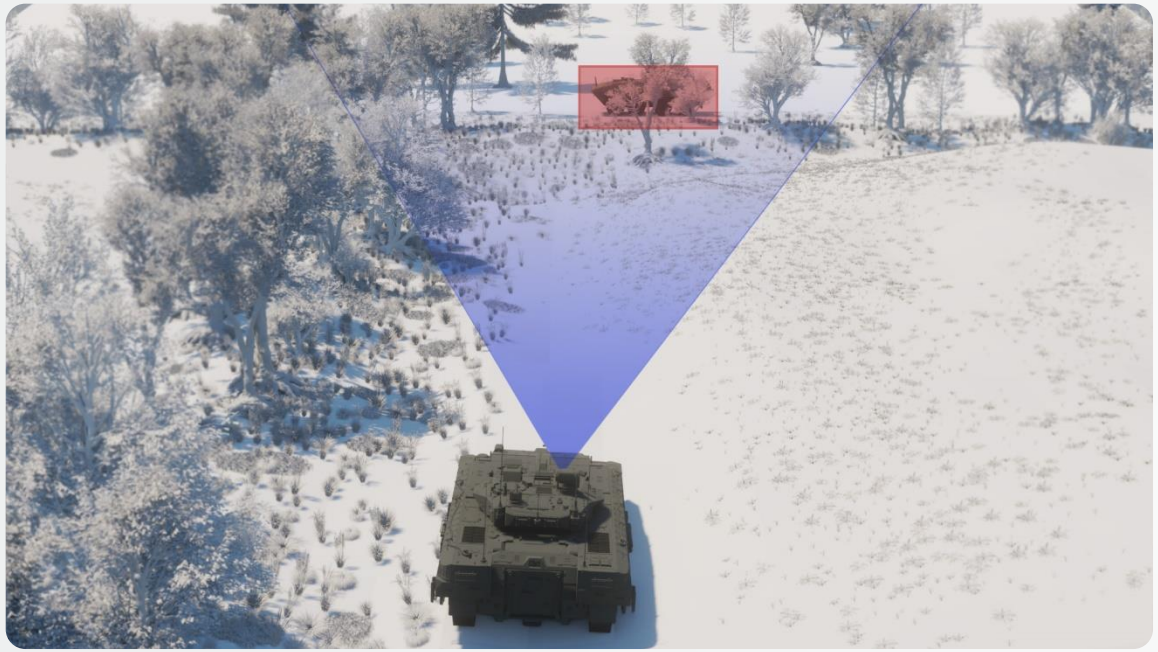
The shooter only moves the weapon and it fires autonomously as soon as the defined target is detected.

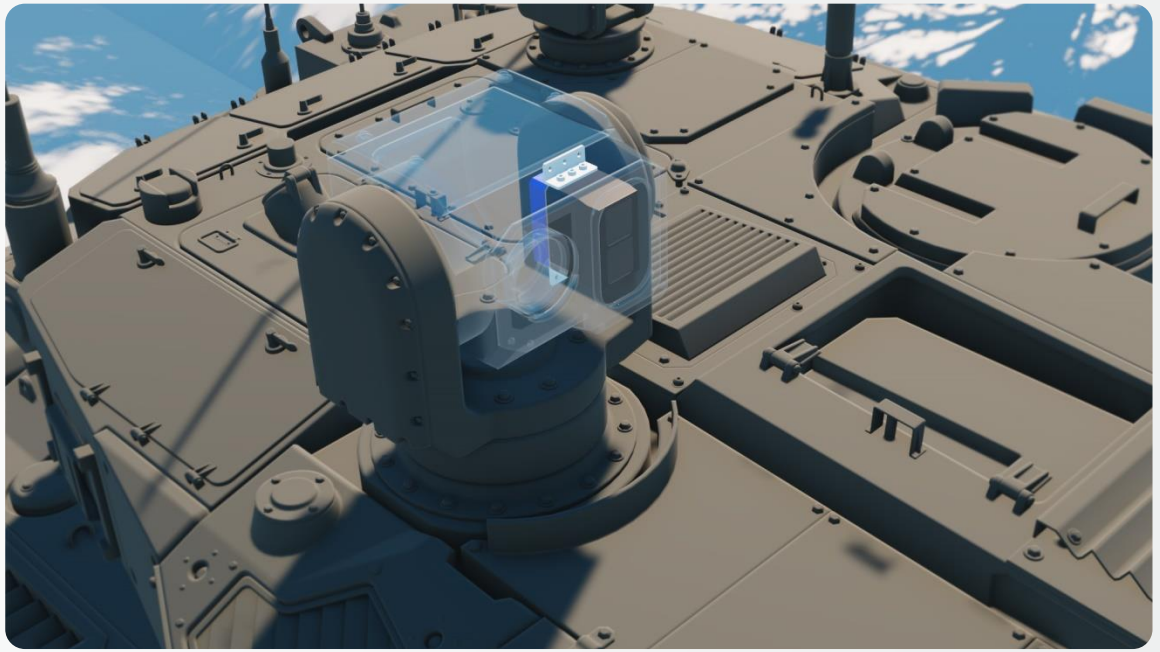
Autonomous variant.



## Use cases

# IFV





active LiDAR sensor for target detection

Use cases

# Drones

The lidar can detect objects and generate their distance and coordinates.

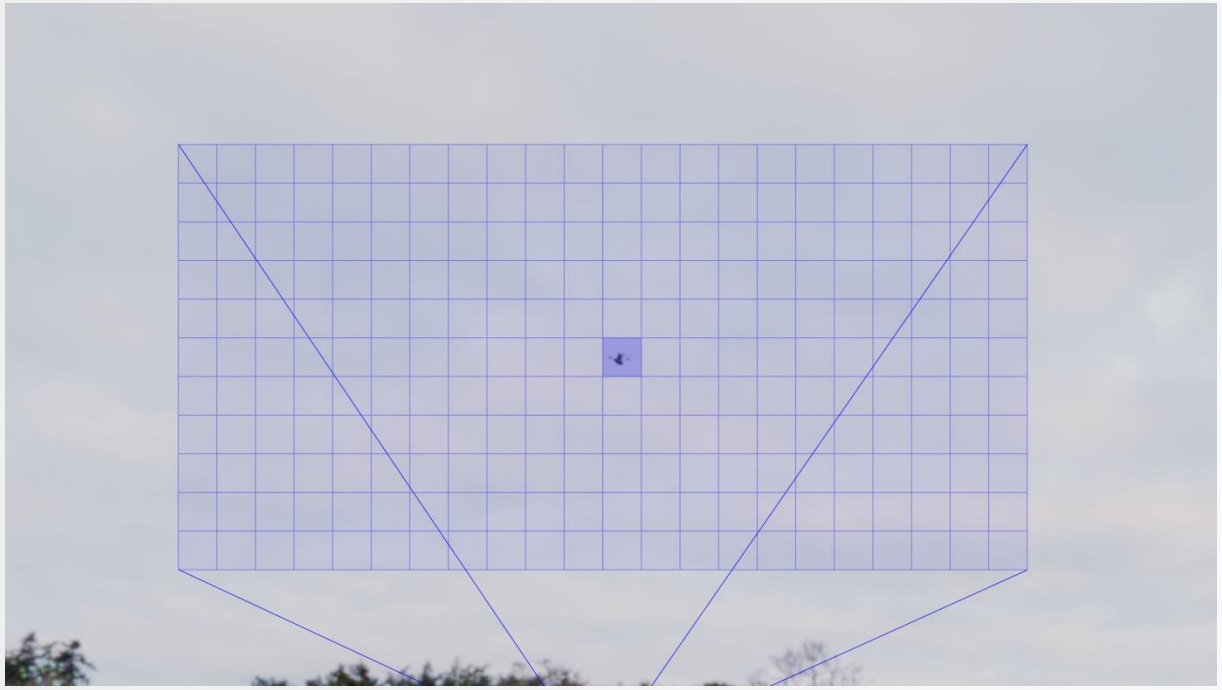
On the ground and in the air.
Lidar can see through forests and also detect camouflaged objects.





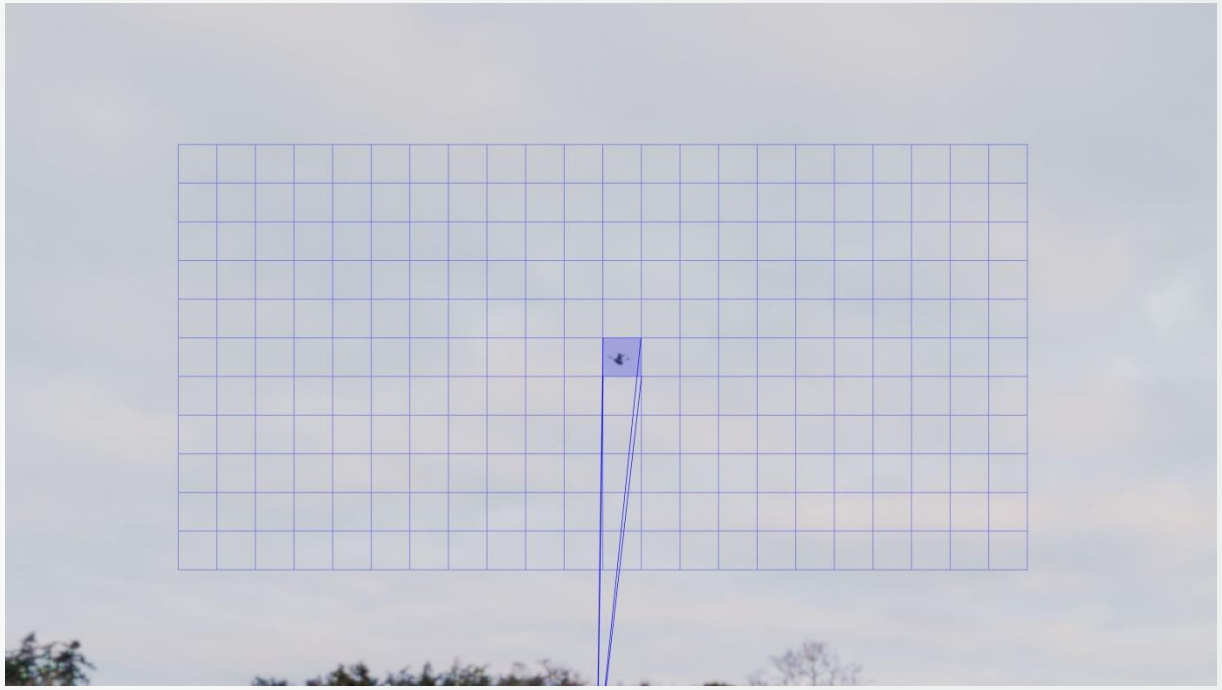
Use cases

# Drone (object) detection



Overview LiSSA LiDAR Scan

First wavelength



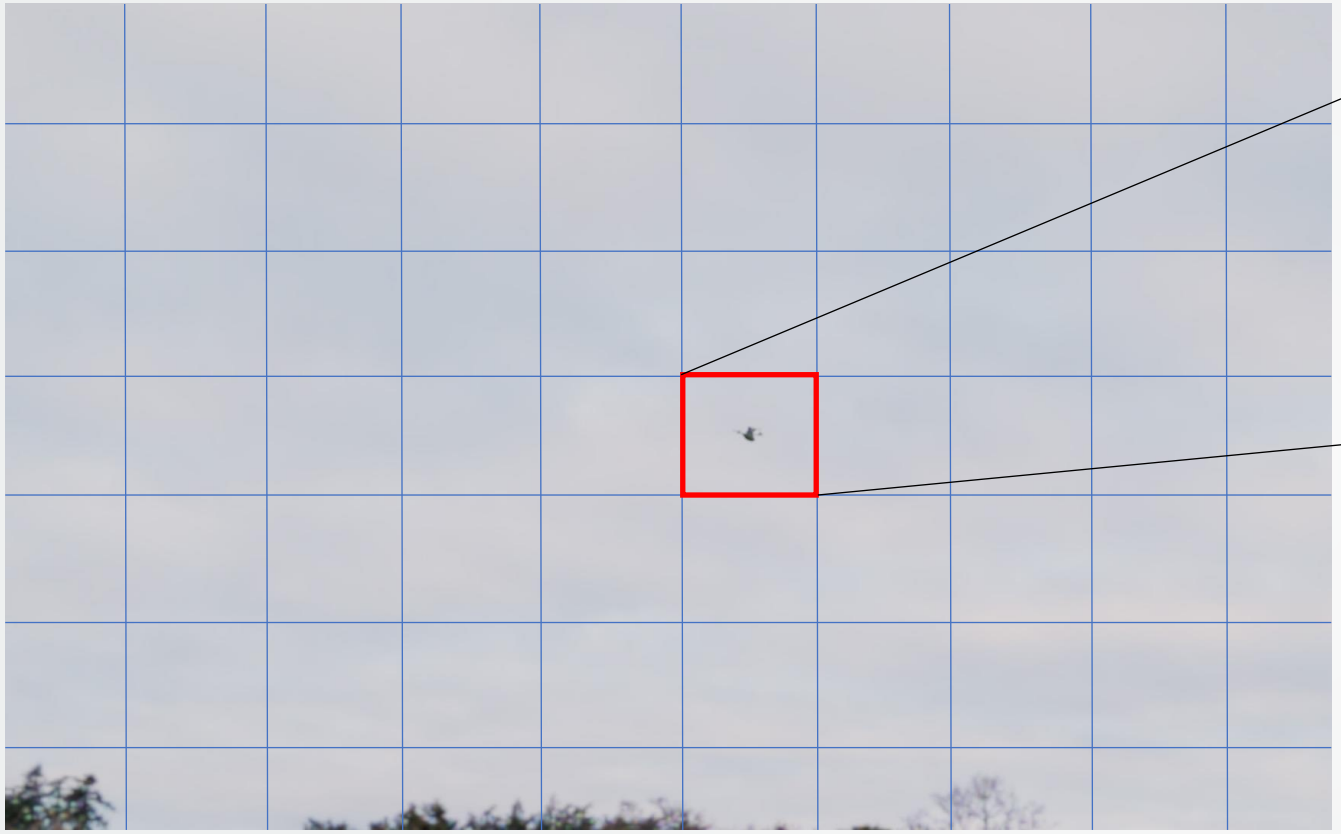
Detail View LiSSA LiDAR Scan (ROI)

Secound wavelength

The use of multiple wavelengths in a single field of view is another patent held by Hybrid Lidar.

Use cases

## Drone (object) detection





Overview LiSSA LiDAR Scan:

- The entire field of view is scanned with one wavelength.
- When a moving object is detected, a ROI (region of interest) is activated.

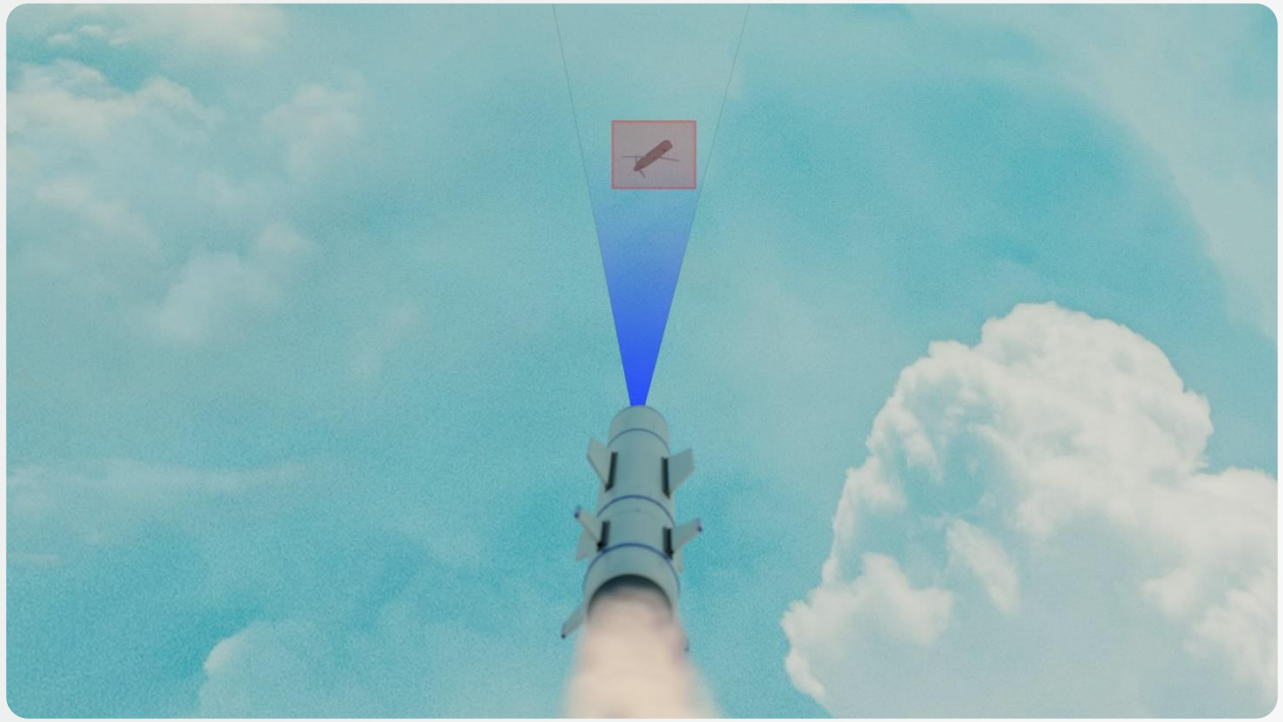
Detail View LiSSA LiDAR:

- and only the relevant quadrant (ROI) is scanned in detail with another wavelength to classify the object.

The use of multiple wavelengths in a single field of view is another patent held by Hybrid Lidar.

Use cases

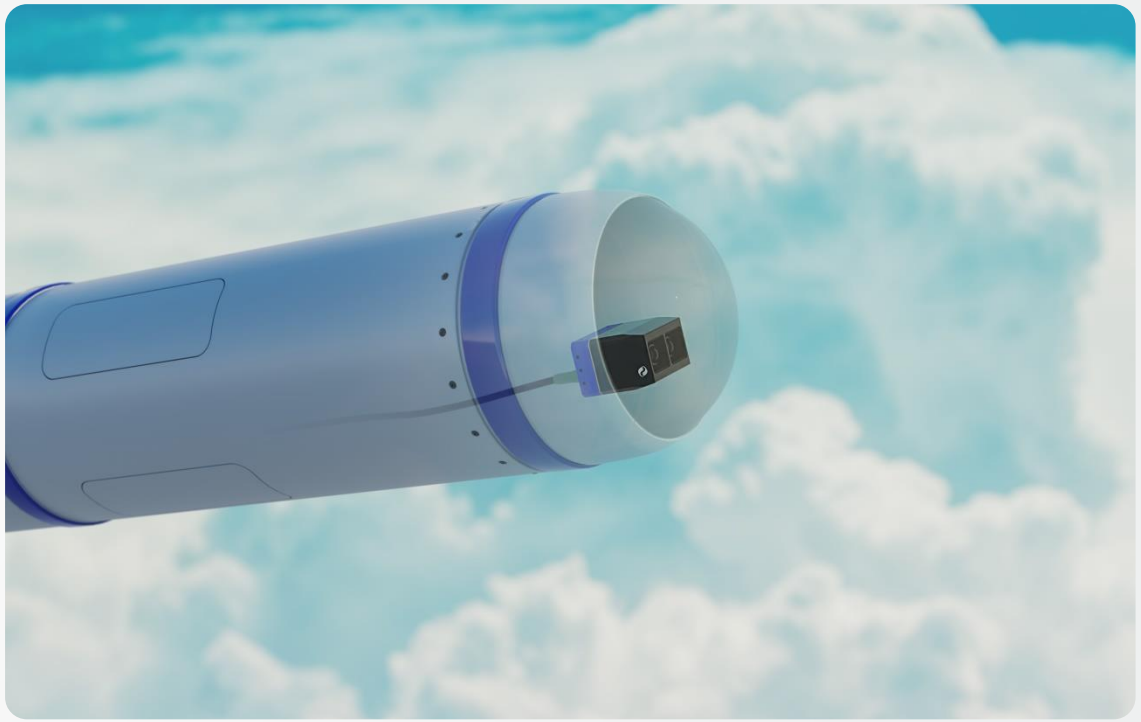
## Missile detection



Overview LiDAR Scan:

Detecting a very fast flying object

(hypersonic missile)



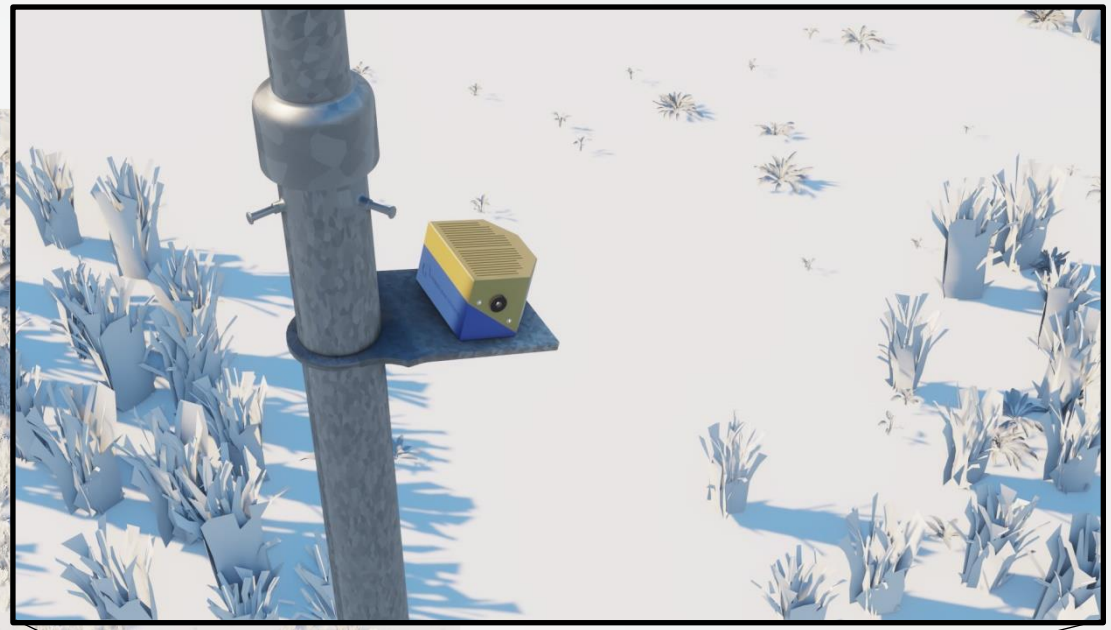
Detail:

and only the relevant quadrant (ROI) is scanned in detail with a different wavelength to classify the object.

The use of multiple wavelengths in a single field of view is another patent held by Hybrid Lidar.

Use cases

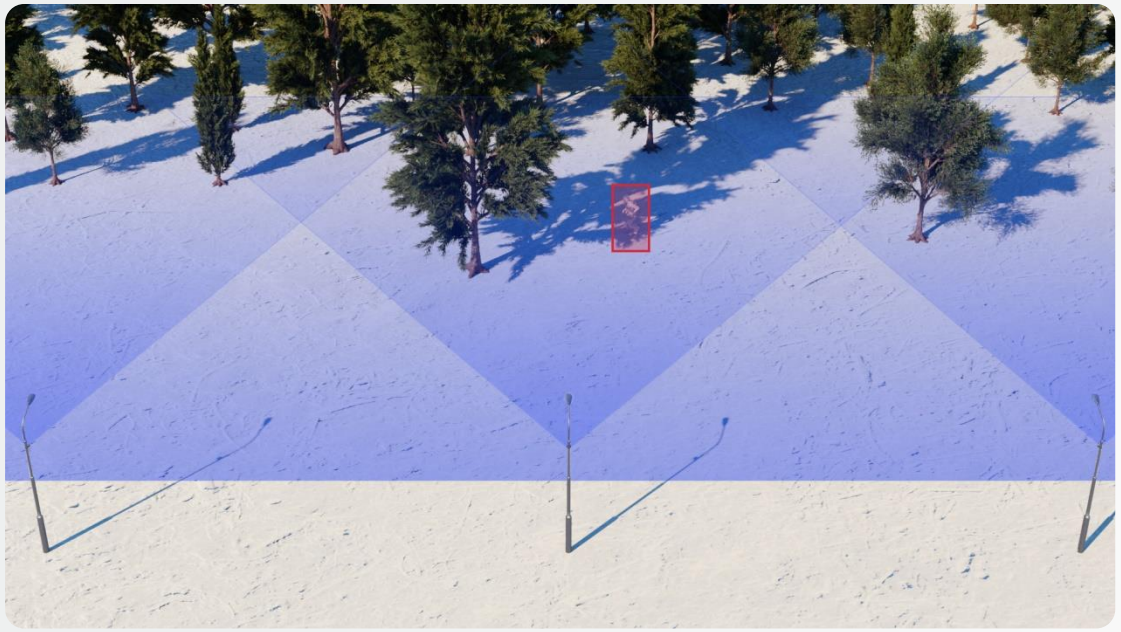
# Border security

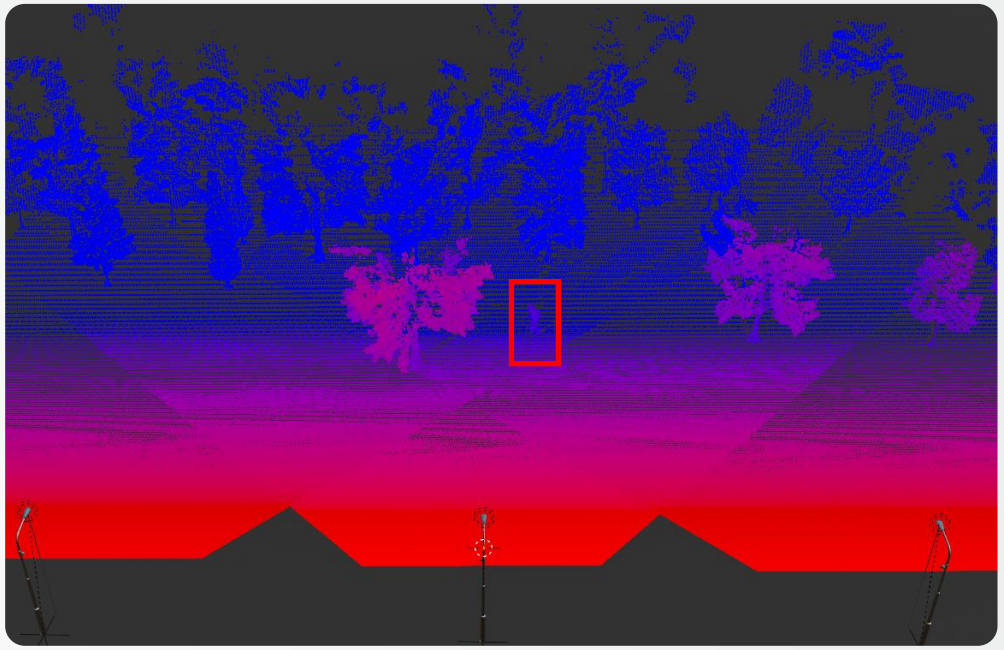


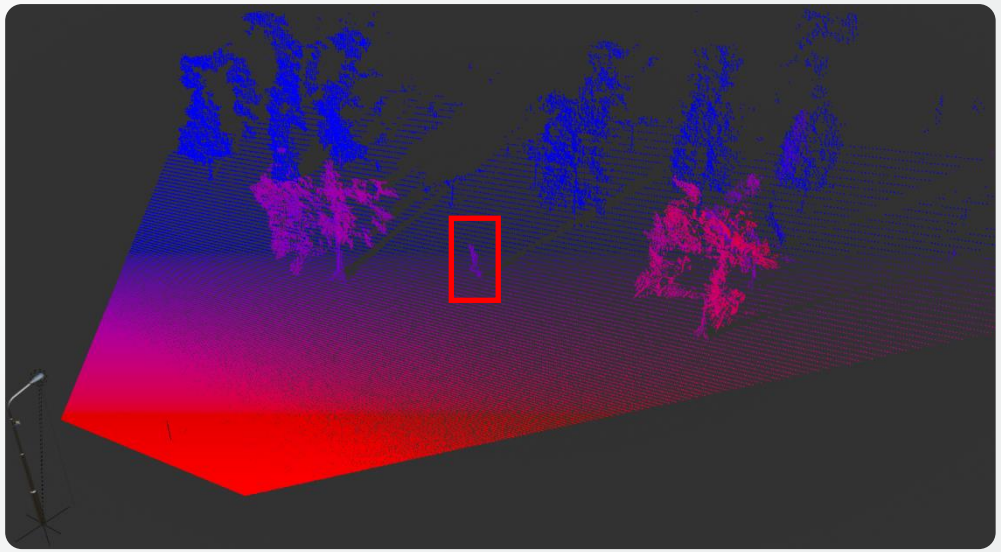
- passive border security
- no fences necessary
- a complete zone is monitored

## Use cases

# Border security





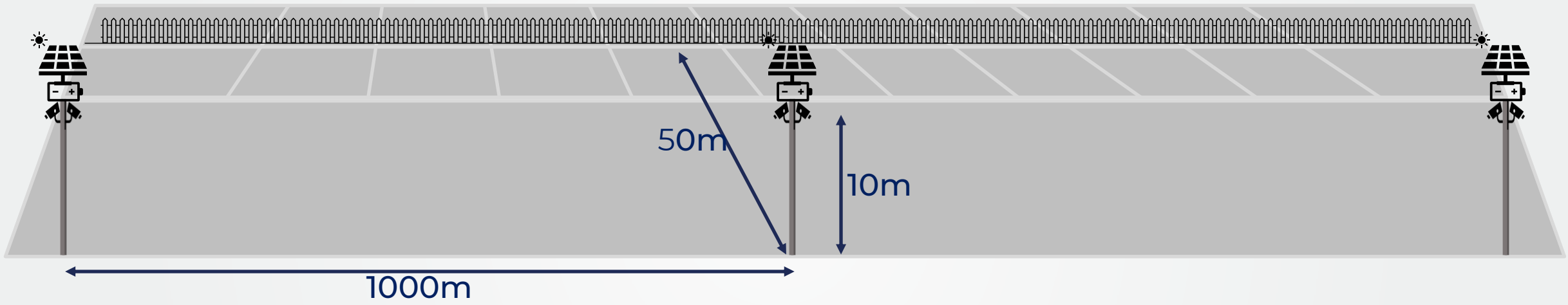


Complete 3D Scene

Use cases

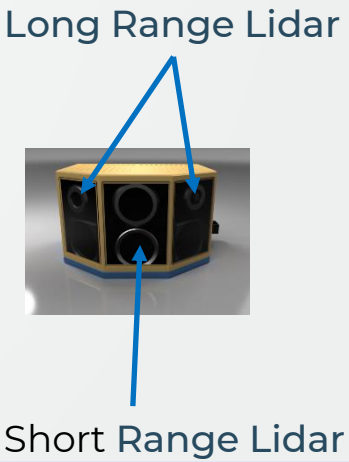
# Border security

## Scanning and detection at borders with Lidar sensors




**Tripple Lidar sensors:**

- Mounted on poles
- Distance of the masts 1000m (mounting position at approx.10m height)
- Range of the two long range lidars 500m (short range lidar 50m)
- Emergency power supply by means of solar cells and rechargeable battery (Battery capacity 6.5 kwh net for 72h operating time)



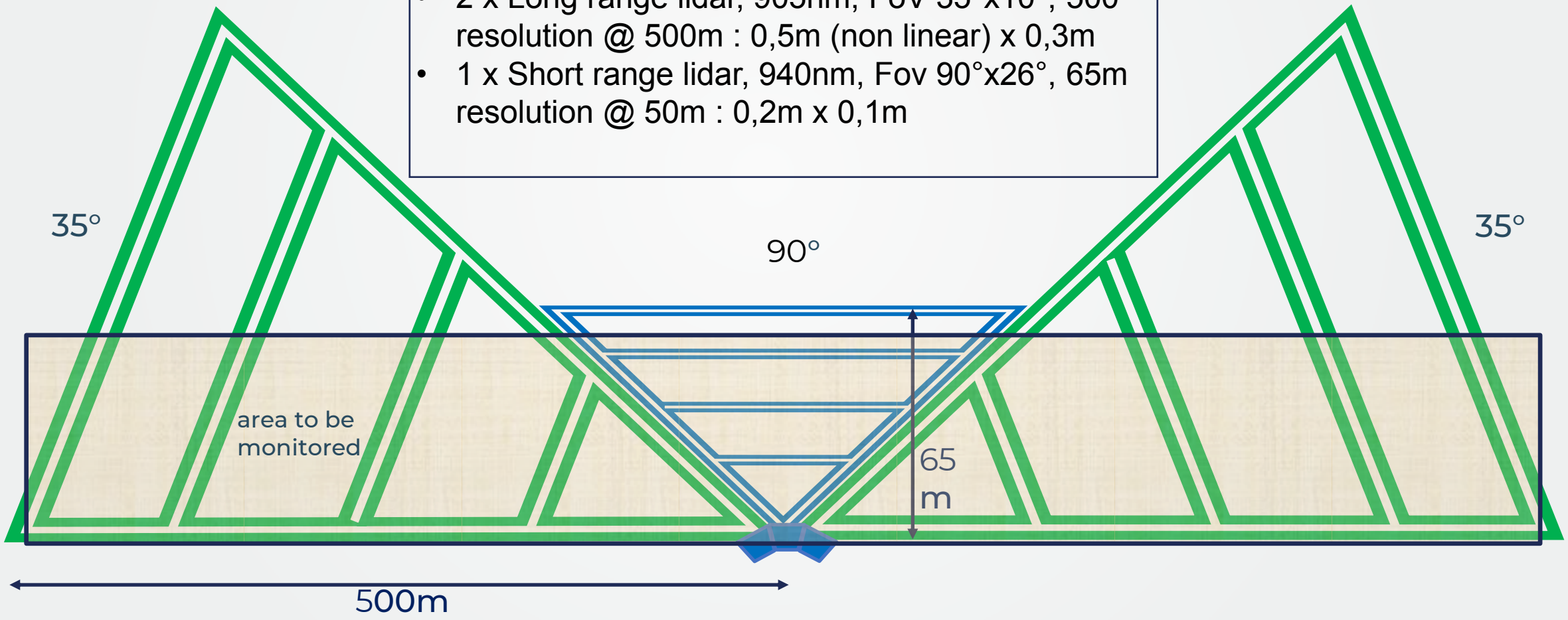
Use cases

## Border security

### Field of View (Top view, tripple Lidar sensor)

**Tripple Lidar sensor:**

- 2 x Long range lidar, 905nm, FoV 35°x10°, 500 resolution @ 500m : 0,5m (non linear) x 0,3m
- 1 x Short range lidar, 940nm, Fov 90°x26°, 65m resolution @ 50m : 0,2m x 0,1m



# Consumer use cases

# LiSSA Consumer

**(planned from 2028)**

# Further application areas of our Hybrid LiDAR LiSSA

The modular design of our patented technology allows us to derive the consumer version from the automotive imager.



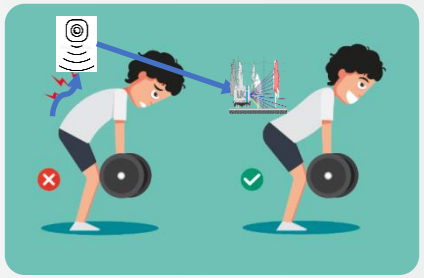

Smartphones & Tablets

In exchange with Samsung UK Tech Scouting and Sony Japan



Augmented reality

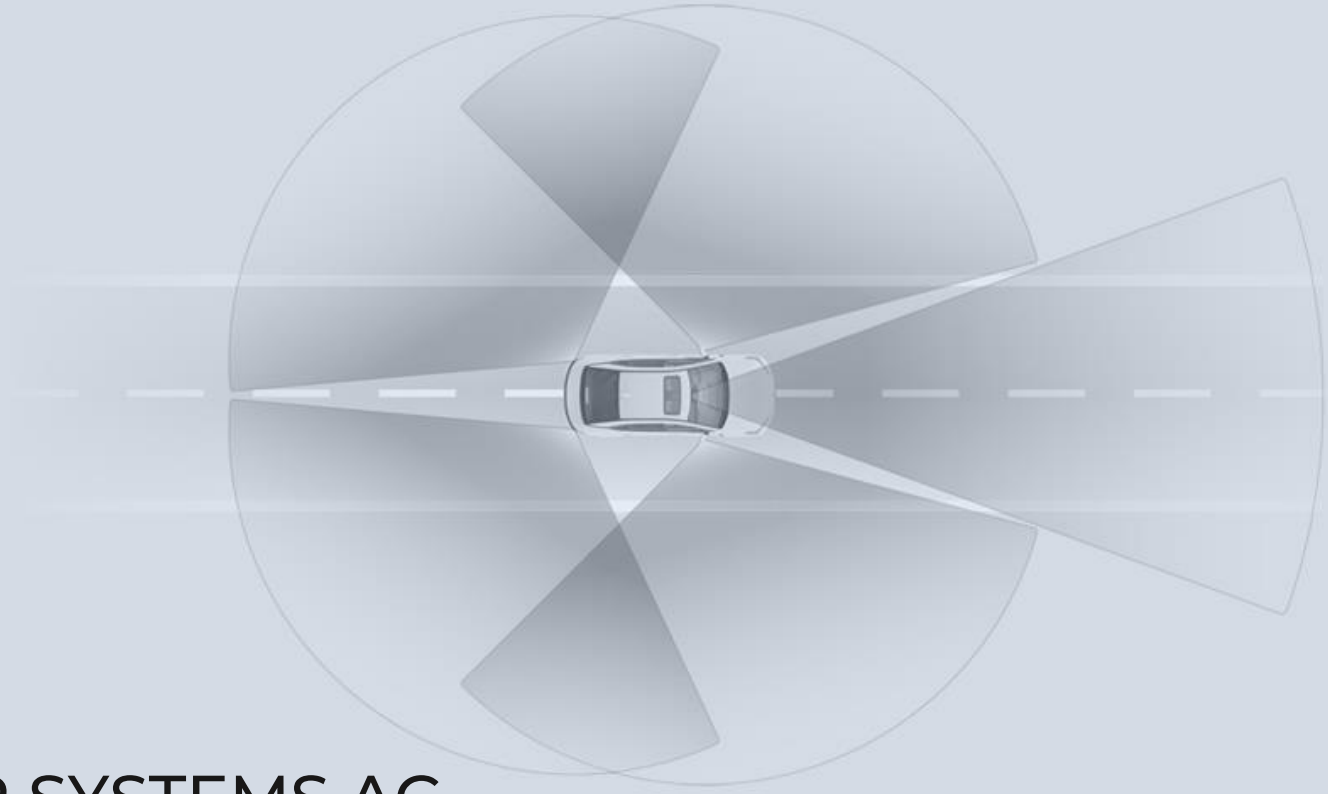
Initial concept studies with Paul from Vuzix



Healthcare & Sports

Initial concept studies

HYBRID LIDAR SYSTEMS AG



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