

Next Generation LiDAR for Automotive and Industrial Use Cases

BY HYBRID LIDAR SYSTEMS AG

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Management Team

Unique Combination of Entrepreneurial Vision and Scale-up Expertise



DR. AMR ELTAHER

CTO and Genius

Dissertation "Electro-Optical Ranging for Short Range Applications -Design and Realization Aspects". International research activities and renowned expert. Three successful patents for Lissa. 5 years in the automotive business.



JENS GALLHOFF

COO and Tech Sales

19 years experience in the international automotive business including 9 years as project manager and sales for automotive electronics projects.



INGO DIETTERLE

CEO

11 years Volkswagen, 12 years CEO Centic Engineering, 2 years sales in the finance industry, serial entrepreneur, 15+ years as mentor and business angel in high tech.



EVGENIJ BAKULIN

CFO

Several years at PwC in M&A and restructuring, worked with various startups across different verticals such as hardware, IT and FinTech, serial entrepreneur

Why Hybrid Lidar Systems

Highest-In-Class Resolution at Low Costs



PLUGANDPLAY



Supported by:
 Federal Ministry
for Economic Affairs
and Energy

on the basis of a decision
by the German Bundestag

At a Glance

Next Generation LiDAR Technology

1

Solving pressing industry problems

- Automation/autonomy
- Computer vision
- Object classification

2

Significant benefits of our market-ready system

- Highest resolution in class
- Low costs

3

High variety of use cases for OEMs and the industry

- Passenger cars
- Smart city
- Security
- Robotics
- Wind turbines
- Trains
- Drones
- Healthcare

4

Ready-to-scale business case

- Launch in Q3 2022
- Profitability in Q1 2024



5

Renowned business partners and customers



6

Experienced founders and management team

- 50 years combined industry know-how
- Background in automotive, data science, engineering and sales

Problem

Current Mechanical and Micro-Mechanical LiDAR Proved Insufficient for Many Industrial and Automotive Use Cases

- Industrial uses often impractical due to immature technology
- BMW and Volkswagen have restated their LiDAR requirements



Today's LiDAR Systems

- Limited resolution
- Low frame rate
- Often with moving parts
- Expensive, complex manufacturing
- Inflexible

User requirements

- High resolution
- High frame rate
- No moving parts
- Commercially affordable
- Flexible for various use cases
- Precise

Value Proposition – Resolution

(Micro-)Mechanical LiDAR Are Physically Limited in Resolution

Mechanical LiDAR with rotating or non-rotating mirror



Mechanical micro mirrors on a chip (MEMS)

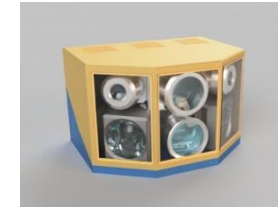


Infineon 1D MEMS mirror



InnovizOne: 2D MEMS mirror lidar (automotive grade)

Solid state LiDAR - no moving parts



Hybrid Lidar: LiSSA Automotive Tripple Sensor and LiSSA universal Industry

Mirror and micro mirror systems (MEMS) are limited by time. At 25 frames per second these systems are physically limited to a *maximum of 20,000 pixel* with one mirror.

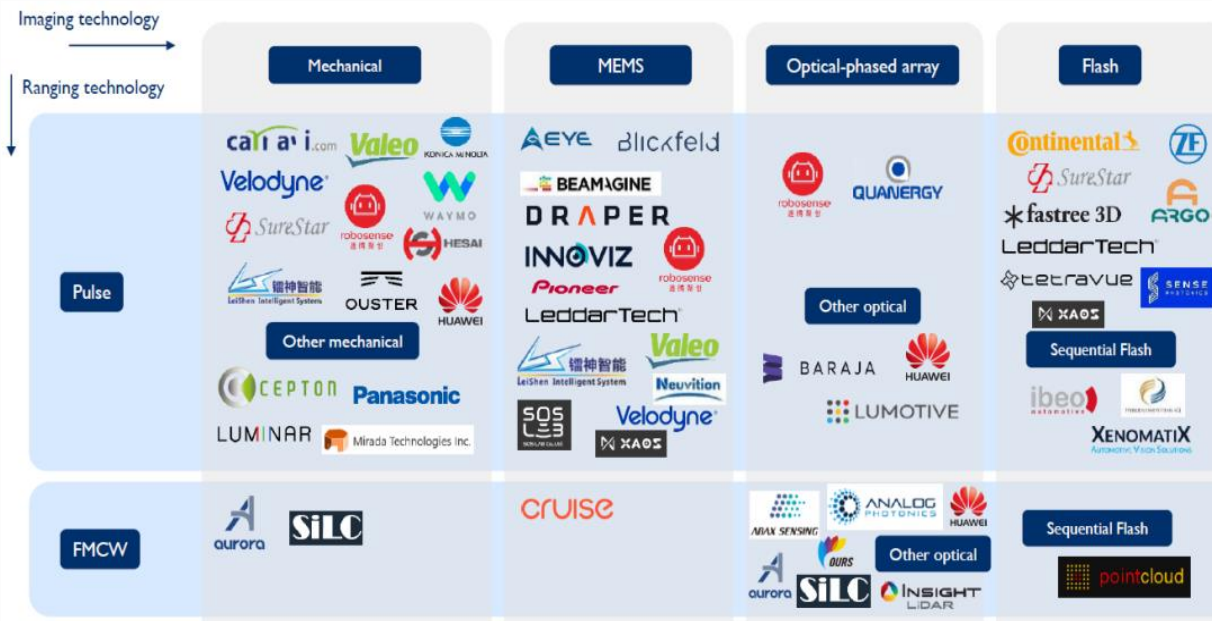
The maximum achievable resolution is only limited by the semiconductor. As of Dec/2019 40,000 pixel are possible.

Tendency strongly rising to >120,000 pixel

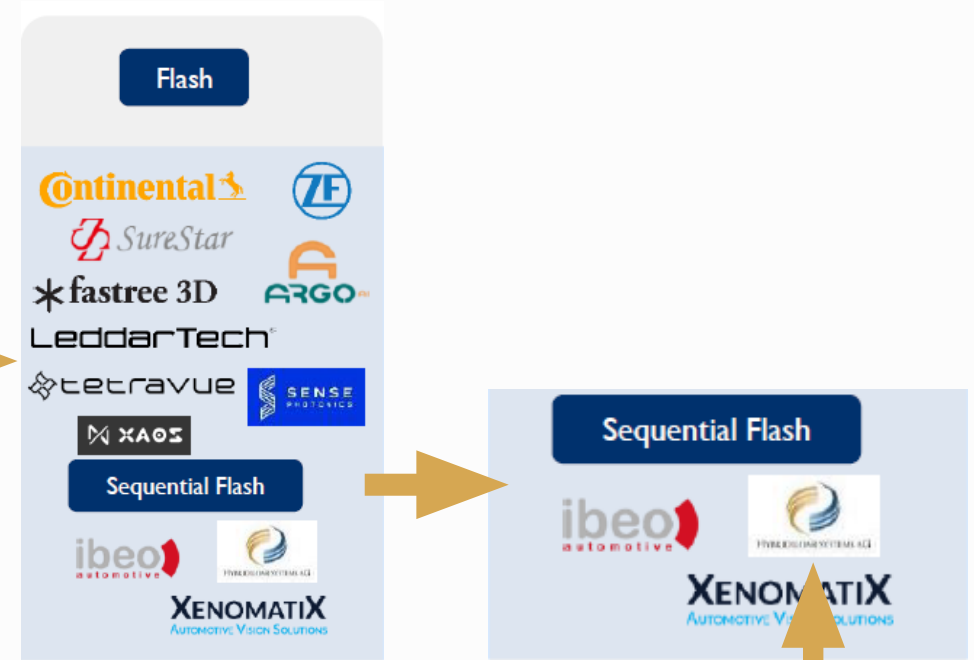
Our Technology – No Moving Parts

We Are One of The Few Who Are Developing a Solid State LiDAR

TECHNOLOGY/PLAYER SEGMENTATION FOR AUTOMOTIVE LiDAR



SOLID STATE LiDAR



Reasons for Sequential Solid State Flash LiDAR

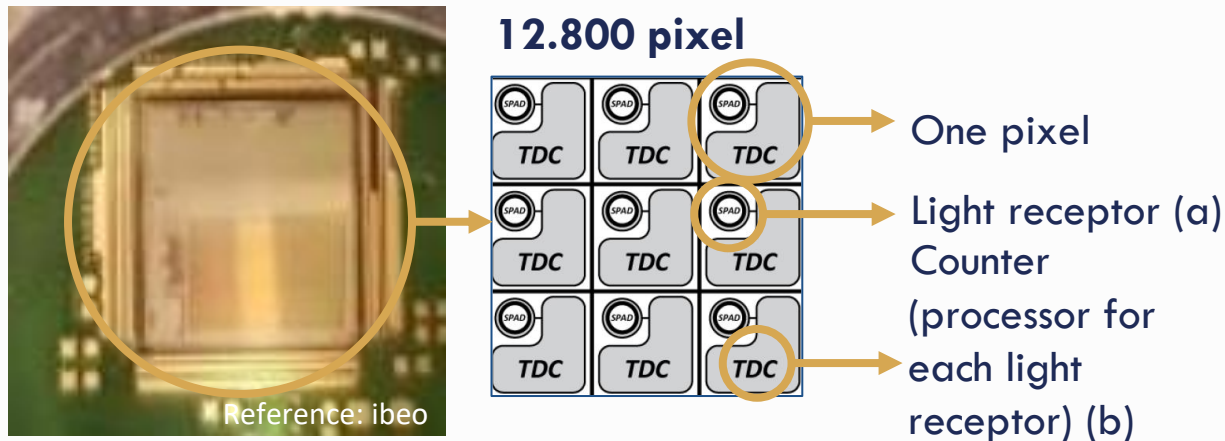
Illumination of the entire field of view | Meets resolution required by OEMs | Meets eye-safe laser class 1 | No erosion of moving parts | Vibration resistance

Hybrid Lidar Systems

Our Technology

More Pixels per Area for Higher Resolution and Lower Price

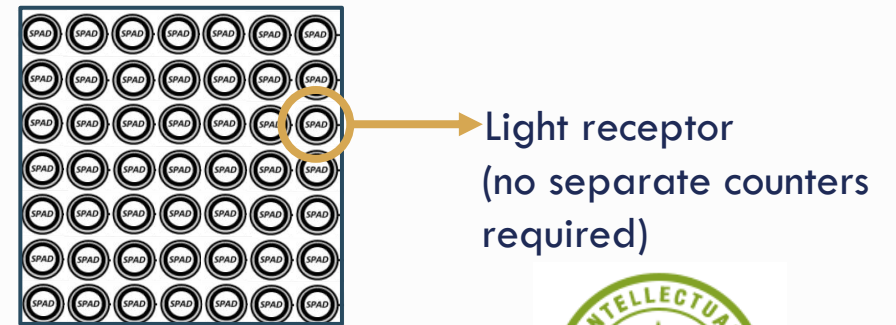
Regular Imager Chip in Solid State LiDAR



Problem: In total, the counters take 60-95% of the imager area, hence reducing the number of possible pixels and resolution.

Our Approach

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



Benefit: Almost the whole imager chip area can be used for light receptors, thereby increasing the number of pixels by 10x.

Value Proposition – Resolution

Resolution Is One of The Major Challenges for LiDAR

- Lidars scan the surrounding in 3D, creating a detailed map of roads and obstacles
- Lidar does not only detect objects, but also classifies them
- Objects of 10cm height need to be detected from 200m distance



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

Value Proposition – Resolution

Competitor Resolution:
 $128 \times 100 \text{Px} = 12.800 \text{Px}$ (Example Ibeo)



LiSSA Automotive Resolution: $400 \times 300 \text{Px} = 120.000 \text{Px}$ Farfield



Images are examples that show the different resolutions. They are not lidar images. Differences in lidar images are difficult for humans to interpret. .

If there are too few pixel, no objects can be classified.

Value Proposition – Resolution

Competitor Resolution:
 $128 \times 100 \text{Px} = 12.800 \text{Px}$ (Example Ibeo)



LiSSA Automotive Resolution: $1600 \times 300 \text{Px}$
 $= 480.000 \text{Px}$ Nearfield

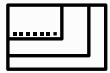


Images are examples that show the different resolutions. They are not lidar images. Differences in lidar images are difficult for humans to interpret. .

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Our Solution

Our Proprietary Technology Meets OEM's Requirements



Highest-In-Class Resolution

The hybrid method allows to use more area of the image sensor for actual imaging, resulting in much higher resolution than comparable systems



Inexpensive

The hybrid method employs market-available components allowing low costs for commercialization at scale



No Moving Parts

The solid state 3D sequential flash technology is vibration resistant and has longer life cycles. This is one of the major OEM requirements



High Frame Rate

Far- and near-field scans can be performed at the same time using the same hardware, resulting in more images per minute



Precise

Fast scanning speed, simultaneous scans and regions-of-interest scans increase the number of data points and allow for precise measurements

Industry Touchpoints

We Are Creating Pilots for Several Industrial Applications



Safety solution for Subsea7 fleet; projects signed



BMW Startup

GARAGE

Pilot project; scheduled to start after funding round



Automatically moving commercial vehicles; person recognition



Concept phase for moon rover



Automatic doors concept/pilot phase

Projects (extract):

- Signed contract to equip the cranes of the Subsea 7 fleet
- Preparing contract with logical safety for a safety solution for cranes

Automotive Touchpoints

High Interest from the Industry and Top Car Manufacturers



Volkswagen AG

Dr. Dominik Vock

Dr. Heiko Gustav Kurz

Group Research

Automated Driving:

The experts are impressed by the measuring principle; they are interested in seeing next development stage.



CJLR (Chery, Jaguar, Land Rover)

Mr. Sun Li:

Highly interested and awaiting next development stage.



Eltek Group

Tier 1 Automotive Supplier

CEO F. Cerutti:
NDA and discussions on cooperation.



BMW Group

Dr. Karsten Baumann, Dominik Pfeiffer:
NDA for further cooperation for the project "LiDAR 2025".



On Semi/SensL

John Murphy:
NDA signed. Further cooperation in the development of LiDAR chips. Implementation in industrial product.



Fraunhofer Institute Duisburg (IMS)

Prof. Dr.-Ing. Holger Vogt:

Very high interest in the measuring method for further applications.

Our Technology – Price

Our Technology Allows a Commercially Viable Price for OEMs

Hybrid Lidar Systems Manufacturing Costs
Based on 300k Units

- 10€ ASIC (sensor-matrix)
 - 18€ laser
 - 16€ remaining BOM
 - 12€ assembly
-
- **56€ total manufacturing costs**

Selling Price to OEMs



Low Complexity

Low production costs are the result of the patented hybrid approach, which reduces the complexity of calculations and does not require expensive computing parts.

Our Contribution to a Sustainable Future

LiDAR Is Improving Sustainability in Mobility and the Industry



- Less traffic injuries and fatalities (improved driving assistance)
- Less congestion (optimized road exploitation like platooning)
- More travel and transportation (optimized road exploitation)
- Increased ride sharing (autonomous driving)
- Less fuel consumption and CO2 output (efficient driving practice)
- Improved smart city solutions (IoT)
- Optimized industrial processes (automation and human assistance)

Market

LiDAR Is Scheduled to Become the Biggest Vehicle Sensor Market by 2022.

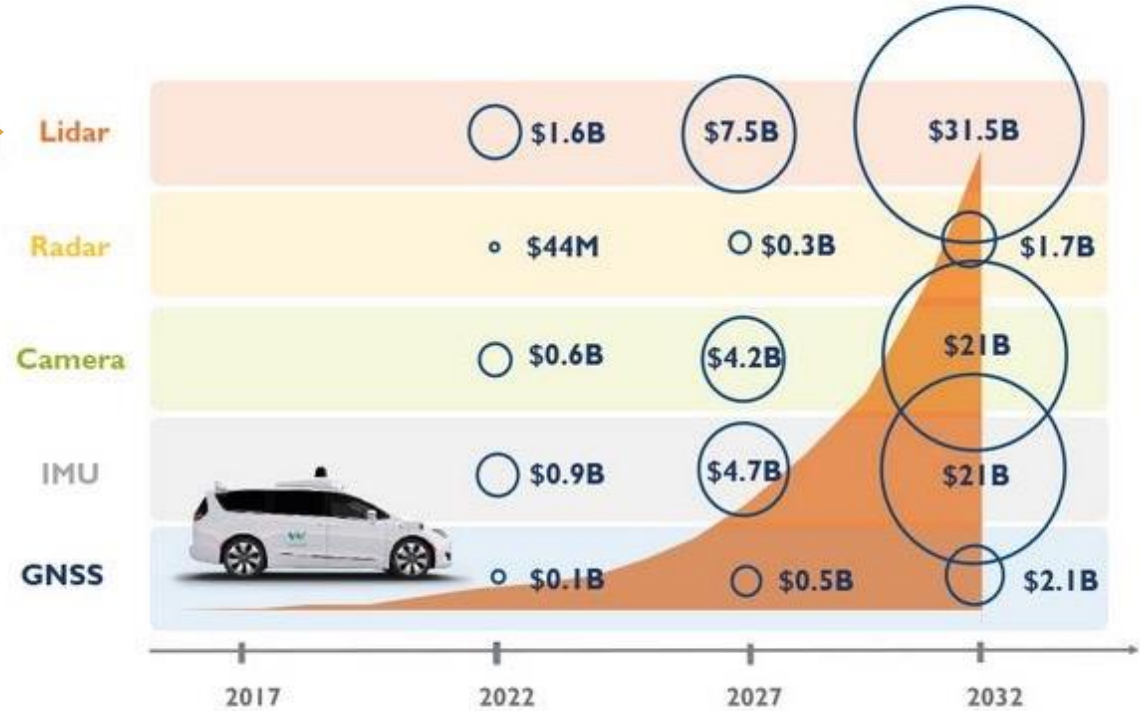
High volume significantly reduces production costs and opens markets for numerous further LiDAR applications:

Commercial vehicles and agricultural machinery, drones, waste disposal, machinery and plant construction, building automation, steel and heavy industry, ports and logistics, wind industry, etc.



Robotic vehicle sensor volume and revenue forecast

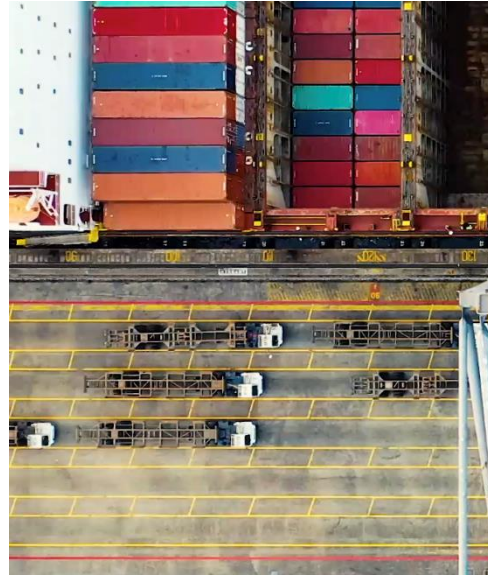
(Source: Sensors for Robotic Vehicles 2018, Yole Développement, February 2018)



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**



Further application areas of our Hybrid LiDAR LiSSA



Smartphones & Tablets



augmented reality



Smartcity solutions



Drones



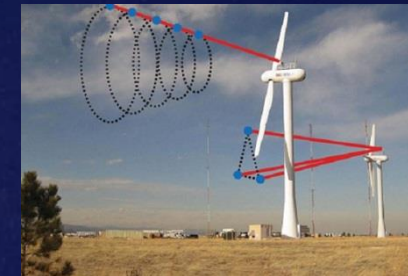
Servicerobotik



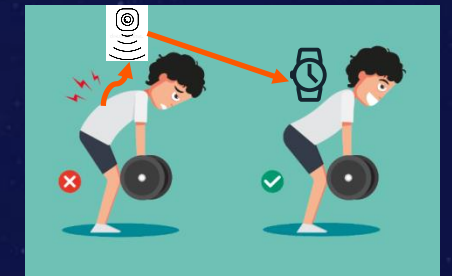
Autonomes Trains



Logistic



Wind turbines



Healthcare & Sports

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