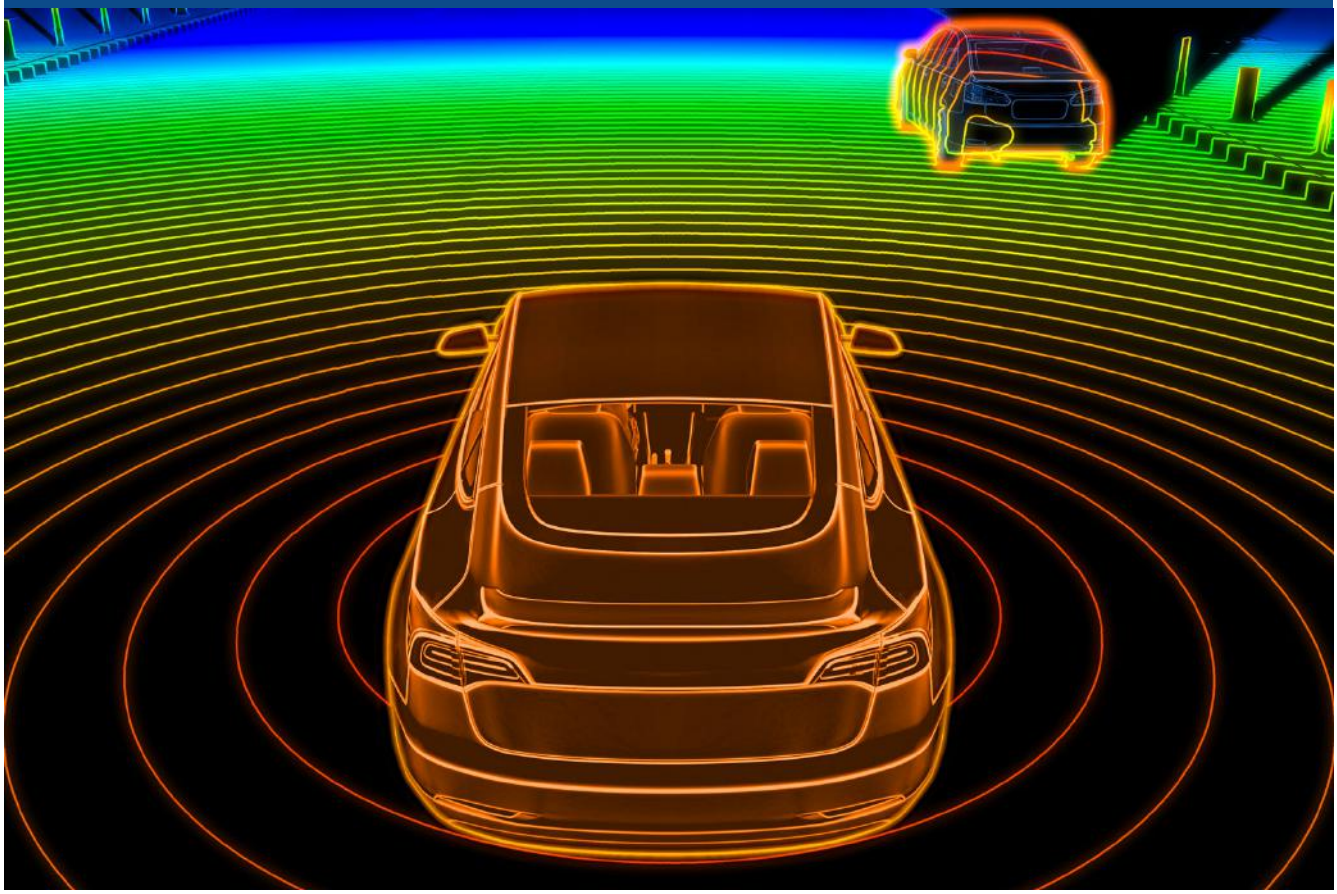
DVN
Lidar

Monthly newsletter #13

APRIL 5, 2023



EDITORIAL

Lidar is Rising in China—What Does That Imply?

Lidar is gaining traction and market prevalence on premium EVs in China, where the EV market is strongest in the world—8.5 million units a year. Chinese brands offer lidar on premium EVs to improve safety and driving assistance functions compared to pure-camera systems. As a consequence, the rest of the world's premium brands will have to follow the trend as well to compete on the Chinese market.

That, in turn, can only lead to more affordable lidars by dint of volume economy. Huawai claims they can reach USD $200 for a lidar, and Hesai announced a lower margin with the production ramp-up due to strong price competition; find more about that in this issue of the DVN-Lidar newsletter. Luminar's strategy is to design their own semiconductors to further reduce costs, with the creation of Luminar Semiconductor.

Affordable solutions are coming for short range lidars as well; see the Elmos interview in this issue. Elmos takes benefit of their long experience in CMOS automotive components and lighting to design low cost VCSELs and SPADs, leading to compact, affordable flash lidar designs. This will speed up automated parking applications.

Short-range lidar applications will be a key topic of the DVN Lidar Deep Dive II on 6 June; here in this newsletter you'll find that event's docket.

Last but not least, Valeo announced orders for their Scala^3 lidar have topped one billion Euros—quite a milestone!

Be sure and save the dates for these forthcoming high-content, high-value DVN-Lidar events:

- Deep Dive II (Europe): 5-6 June; at Dorint Pallas Wiesbaden
- DVN-L Deep Dive III (USA) : 29-30 August in San Francisco Bay area
- DVN-L Conference (Europe): 29-30 November at Dorint Pallas Wiesbaden

We're ever so glad you're here with us in the DVN lidar community, enjoy this 13th newsletter!

All best,

Alain Servel

DVN LIDAR SENIOR ADVISOR

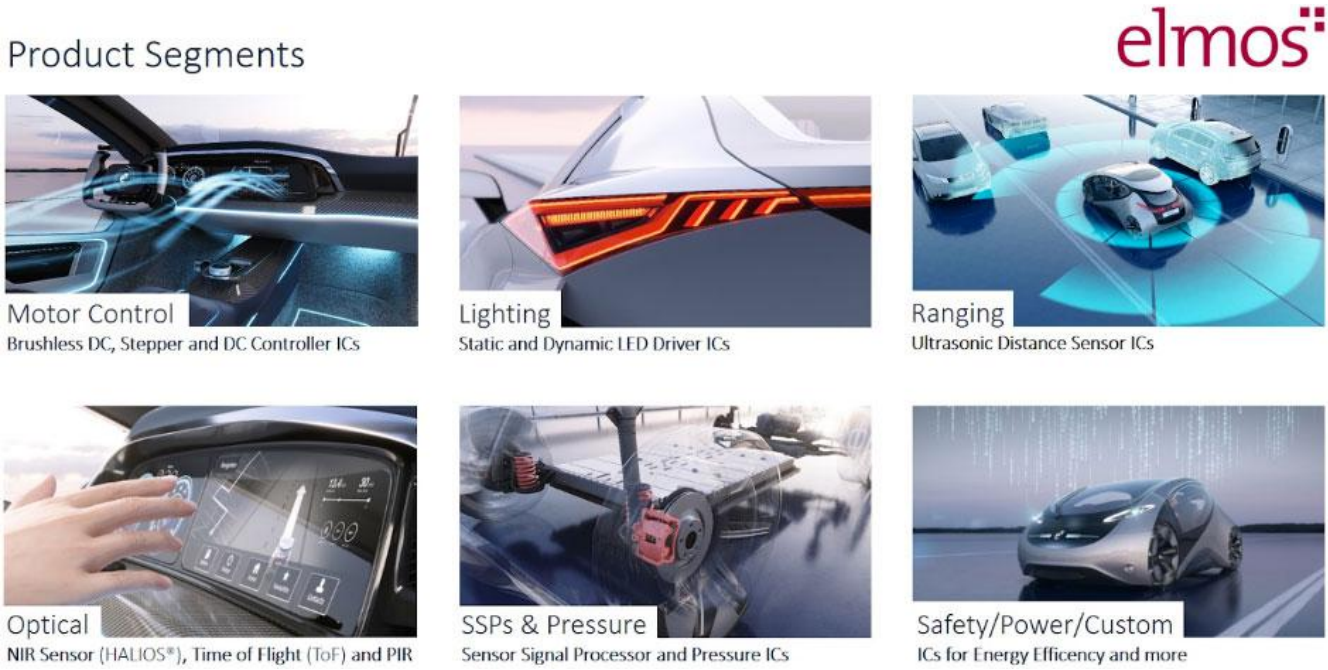
INTERVIEW

DVN-L Interview: Jan Dienstuhl, ELMOS Development & Sales VP

Dr. Jan Dienstuhl's expertise is in sales; business lines; technology, and R&D. He's been at Elmos since 2012; a member of the board since 2019. Before Elmos, he held management positions at Infineon for R&D and automotive business. He has a PhD in electrical engineering.

DVN: Hi, Dr. Dienstuhl. Tell us about Elmos' portfolio and activities, will you please?

Dr. Jan Dienstuhl: Elmos has been developing semiconductor solutions for various automotive applications for almost 40 years. With headquarters in Dortmund, Germany, we have 15 locations worldwide and over 1,200 employees. In fiscal year 2022, we generated total sales of €447m. Our focus is on developing innovative solutions that deliver added value to our customers and end consumers, specifically in the areas of autonomous driving; driver assistance systems; environmental protection via low-consumption or zero-emission drive concepts; safety; comfort, and wellbeing. Our product segments cover motor control; lighting; ranging; optical; pressure; safety, and power.



DVN: Can we zoom in on your lidar-specific operations?

Dienstuhl: To achieve more comfortable and safe driving in all conditions, a redundancy in sensors and data acquisition is essential. A sensor fusion between RGB; radar; lidar, and ultrasonic systems is a well-accepted approach. However, the price level for today's available lidar systems is still too high, which is why lidar has not yet established itself. To address this, we have started to develop new sensors and sensor ICs with a focus on solid-state lidar systems. We believe this is the right approach to gain more market share for lidar systems.

DVN: What is your technology focus and roadmap for lidar ICs; what makes Elmos different to your competitors?

Dienstuhl: Our technology focus is on automotive-qualified CMOS sensor ICs that are high-volume, cost-effective, and have a proven quality with a strong focus on functional safety. We have three major product ranges in our roadmap, which includes laser driver ICs for VCSEL and EEL for high power ultra-short pulses, single or multi-channel products, SPAD imagers with high-resolution pixel count optimized for up to 50m range, and blocking sensor-ICs to detect if the sensor entry window is affected by pollution. All of these are fully automotive-compliant and ASIL ready.

DVN: Are you working toward ICs dedicated to FMCW transmission and reception (4D lidars)?

Dienstuhl: Our focus today is on cost-effective direct ToF lidar technology only.

DVN: What are your preferences and thoughts on wavelength selection?

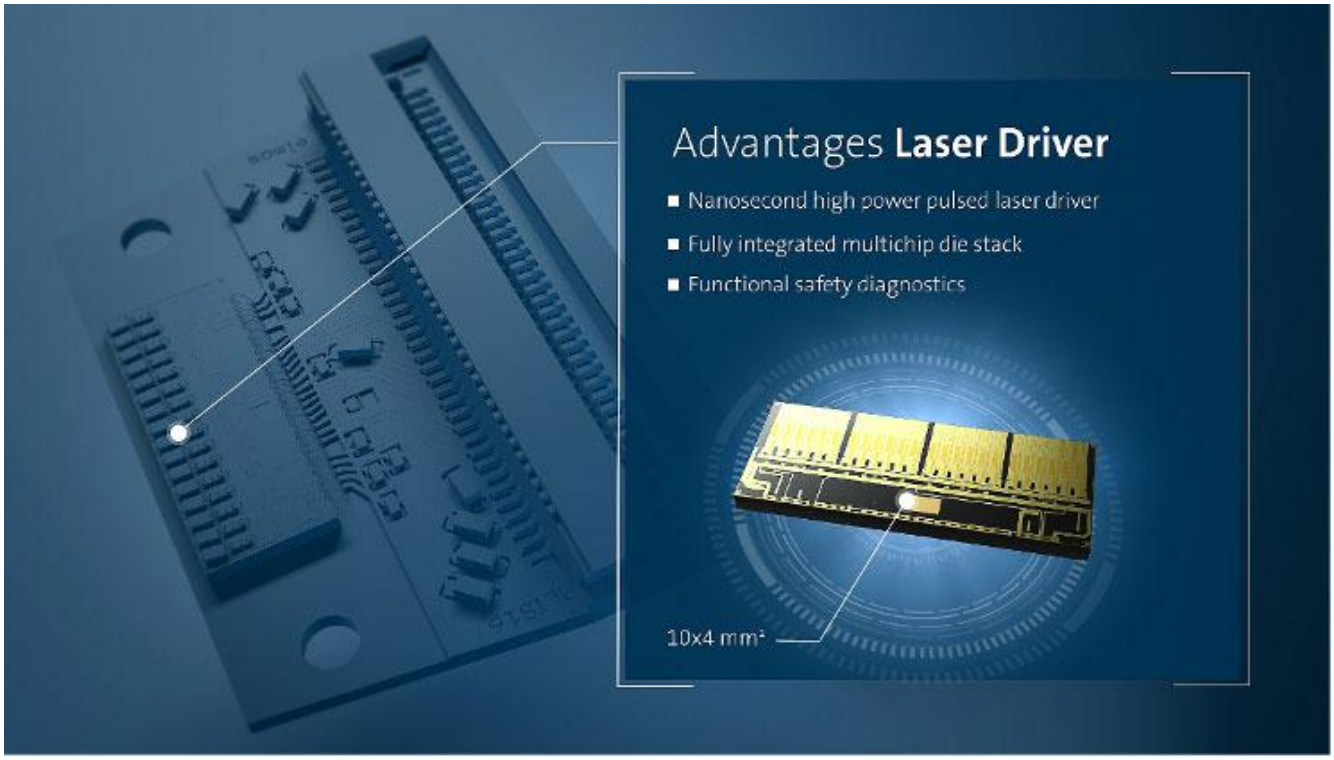
Dienstuhl: Light emitters are a significant cost driver in lidar systems. Currently, we see a great improvement for VSCEL and wavelength-stabilized EEL products in the near-infrared range of 850nm and 940nm. Another important argument for NIR wavelength is the compatibility with well-established silicon-based detectors.

DVN: What are your key development parameters?

Dienstuhl: Besides cost, power consumption is a critical parameter, especially for short-range use cases that require a vast field of view. Light emission peak power is dominating, but we are developing lidar components that will enable systems with a system power consumption of only 1-3W.

DVN: What lidar applications take top priority at Elmos?

Dienstuhl: Elmos is focusing on short-range, up to 50 meters, automotive applications, such as advanced parking assistance, valet parking, low-speed maneuvering, urban traffic, traffic jam assist and safely detecting pedestrians. We also find industrial and robotic applications quite interesting, as lidar systems are already widely used there.



DVN: Do you have some first customers interested? When do you plan the start of production?

Dienstuhl: Elmos has received strong positive feedback from the market due to our clear product strategy. Our approach is to focus on smart products combined with intelligent features on automotive grade to reduce the overall BOM cost. This opens a new field of use cases for short-range lidar systems, which will enable economy of scale. Our first serial product, the E527.50, a 4-channel laser driver with a pulse width of 1 nanosecond at 50A, will be launched in 4Q2023. Design-ins are starting now.

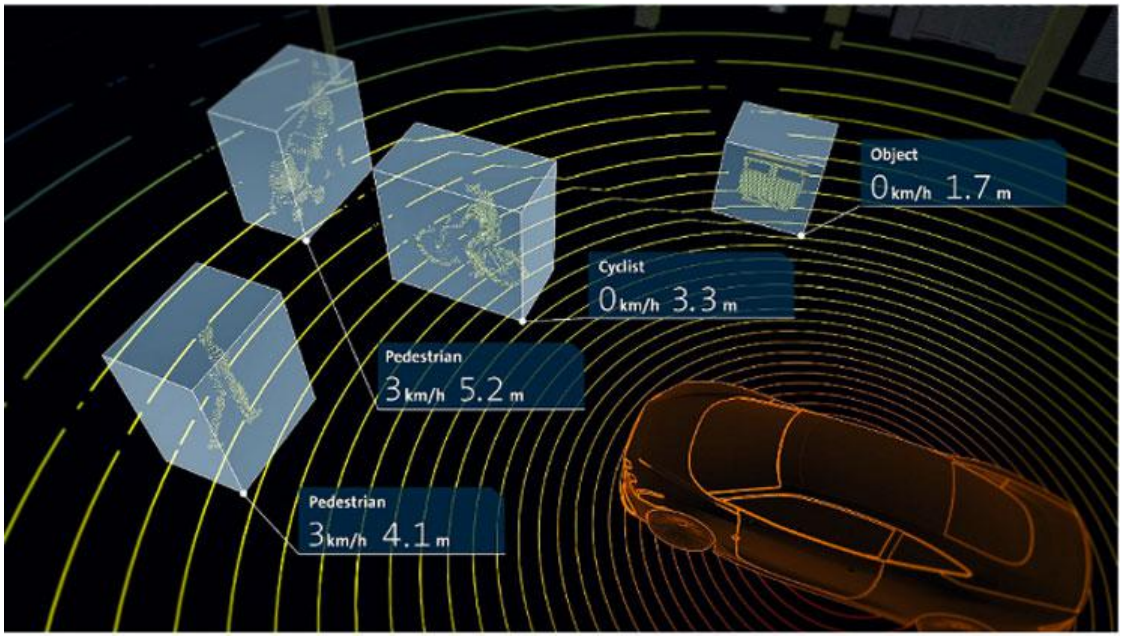
DVN: What other markets does Elmos want to address?

Dienstuhl: Elmos is a pure-play automotive company without any compromises in quality and cost. Nevertheless, there are adjacent markets that also value these important factors. We see substantial potential for our products in industrial and robotic applications as well.

DVN: What's in the way of wider deployment of lidar technology?

Dienstuhl: In order for lidar systems to become more established in the market, further steps must be taken with regard to cost reduction and system size while at the same time optimizing system performance. The optimal fusion of different sensor technologies is crucial for increasing safety and reliability in all driving situations.

DVN: How will that play out in terms of markets and applications?



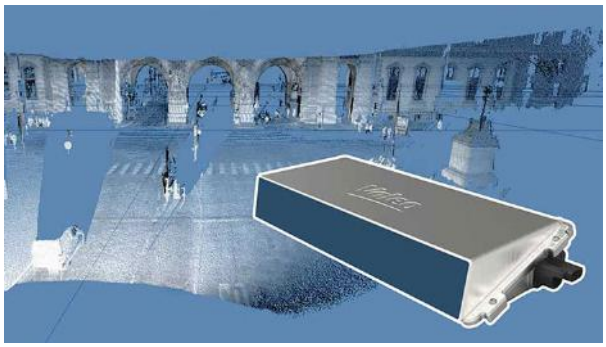
Dienstuhl: Today, the industrial segment is still the biggest segment for lidar applications since lidar products have been introduced here first. However, with further improvements in cost and size, automotive lidar applications will pick up and will show more dynamic growth, providing strong potential for ADAS and autonomous driving systems in the future. To stimulate growth, the target price needs to be further reduced to make lidar more accessible and widely used in the market.

Find more information on Elmos' lidar activities in their **online expo booth**.

LIDAR BUSINESS

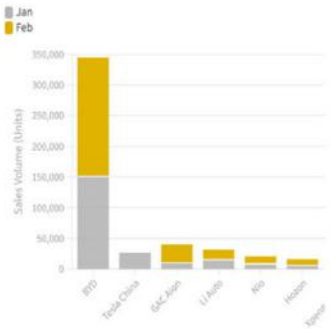
Lidar Business Overview

Here's where you get quick, efficient news as the industry works to find the balance between cost and revenue to achieve a profitable growth.



Valeo announced two new major contracts for their third-generation lidar. Scala^3 lidar has been chosen by a leading Asian manufacturer and a leading American robotaxi company. Valeo has now registered orders worth more than a billion euros for Scala^3.

Chinese lidar sensor startup **Hesai** saw a big drop in their gross margin, from 52.4 to 30 per cent in Q4-2022, after shifting their focus to producing more affordable lidar sensors for production cars. Their shipments over the quarter rose to 47,515 units as Li Auto, a major client, ramped up delivery of their L8 and L9 models equipped with Hesai laser sensors. Hesai also supplies sensors to AV developers such as Baidu, one of Hesai's major shareholders.



Speaking of the Chinese EV market, **BYD** has maintained strong growth heading into 2023 over a traditionally low season and amid China's EV subsidy phase-out. A 31-per-cent annual growth is expected for passenger EV sales, to 8.5 million units this year—of which about 1.5 million will be premium EVs; that's a lot of non-premium ones! **Li Auto** and **Nio,** both offering lidars for ADAS on premium cars, are expected to deliver around 23,200 and 12,300 vehicles respectively in their best-case scenarios for March, as delivery guidance for the first quarter reached 55,000 and 33,000 units.

In America, **Cruise** says their new Origin autonomous vehicle will help make robotaxi services profitable. With room for six passengers, it is slated for ride-hailing use starting later this year. It allows ride-pooling: trips of multiple customers with similar routes in a single vehicle. That will maximize the utilization of each vehicle and provide the ability to deliver rides cheaply at scale. Waymo's similar vehicle is a Chinese Zeekr.

Back to Europe now, where **Clevon** and **ZF** are partnering to deploy driverless last-mile delivery services. The collaboration brings together Clevon's Autonomous Robotic Carrier technology and ZF's Scalar, the world-leading real-time AI-based fleet orchestration platform.

Flexible shuttles complement bus and train. Is this the solution to enable a life without a car in the countryside? In 2030, 200 million passengers are targeted in on-demand traffic, according to German railway (Deutsche Bahn) boardmember Evelyn Palla. These services should then provide every second kilometre of travel by Deutsche Bahn in rural areas.

Clevershuttle says the 'everywhere shuttle' can be feasible. In the first seven months, 35,000 passengers used the five minibuses in eleven municipalities in the district of Rosenheim, Germany, and the trend is rising sharply. Clevershuttle plans to double their current 18 on-demand systems in the near future, the contracts for which are already in place.

In the United States, **Nuro** is making strides in last-mile delivery with custom-designed electric delivery vehicles to operate in local communities in Texas; Arizona, and California. Nuro announced a USD $40m investment to develop two new facilities in southern Nevada—an end-of-line manufacturing facility and world-class test track—to commercialize and scale production of their third-generation autonomous vehicle. Nuro has partnerships with Domino's Pizza; Kroger supermarkets, and FedEx.

Also in the U.S., **TuSimple** has announced their trucks have cumulatively driven over 10 million miles through testing; research, and freight delivery. TuSimple is known for achieving the world’s first fully autonomous, 'driver-out' semi-truck run on open public roads. TuSimple has operations in Arizona; Texas; Europe, and China.

LIDAR NEWS

Hyundai to Launch L3 Cars This Month

Hyundai-Kia will launch, this month, versions of their Genesis G90 and Kia EV9 with Highway Driving Pilot (HDP), an L^3 autonomous driving suite of technologies.
The new G90 is the first Korean mass-produced model equipped with L^3 autonomous driving technology, and will launch with a maximum speed of 80 km/h.
Hyundai added a lidar sensor to the grille for HDP operation of the 2023 G90. HDP works with data from the lidar; as well as front-side-rear cameras and front and side radars.
L^3 autonomous driving allows a car to change lanes on its own as it navigates to its destination, and allows the driver to take their hands off the steering wheel. Drivers can do other things while driving, such as crossing their arms or looking at their phones.
Officially certified vehicles with L^3 technology in the global market are the Mercedes-Benz S-Class and EQS, and the Honda Legend. Drive Pilot, Mercedes-Benz's system, is usable at speeds up to 60 km/h.
The Honda Legend obtained its L^3 certification from the Japanese Ministry of Land, Infrastructure, Transport, and Tourism in 2020; Honda has been selling the L^3 Legend since March 2021.

DVN comment

The Korean HDP system is based on Valeo's Scala2 lidar; cameras; radars, and Mobileye tech.

LIDAR NEWS

Cadillac Celestiq: 20+ Sensors For Hands-Off Driving, Including Lidar

General Motors has announced that Ultra Cruise1, the company's next-generation advanced driver assistance system to ultimately enable hands-free driving in 95 per cent of all driving scenarios, will have a 360-degree view of the vehicle through a unique sensor suite when it launches on the Cadillac Celestiq 3.

The whole-trip hands-off system will use a blend of cameras; short- and long-range radars, and lidar behind the windshield.

Over time, GM expects customers will be able to travel truly hands-free with Ultra Cruise across nearly every paved public road in the U.S. and Canada—including city streets; subdivision streets, and rural roads, as well as highways. Vehicles equipped with Ultra Cruise hardware will get incremental enhancements through over-the-air software updates. Ultra Cruise's sensor suite comprises:

- The physical hardware, powered by a scalable compute architecture from Qualcomm;
- Seven long-range 8-megapixel cameras on the front; corners; back, and sides of the vehicle, providing expanded fields of view;
- Four short-range corner radars to help sense a radius of up to 90 meters, like pedestrians crossing the street or vehicles in surrounding lanes;

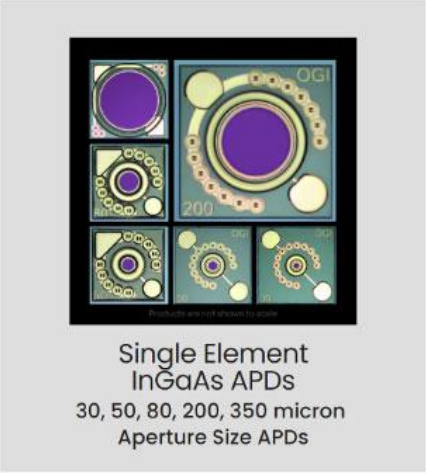
- Three long-range 4D radars on the front and back of the vehicle for adaptive cruise control as well as lane change maneuvers at highway speeds, and
- A lidar behind the windshield to produce an accurate three-dimensional view of the scene, enabling more precise detection of objects and road features such as vehicles and lane markings.

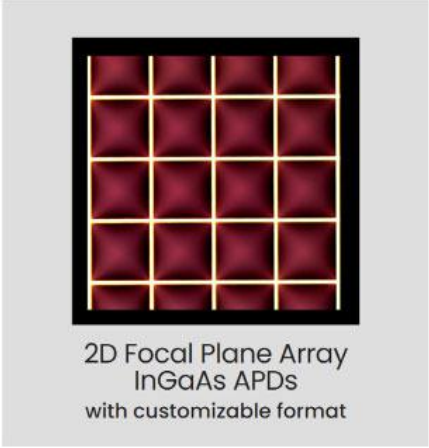
DVN comment

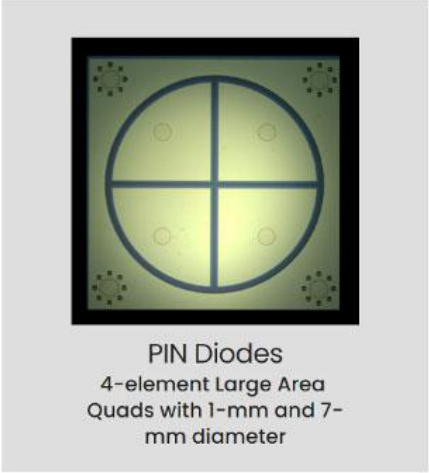
During Cepton's quarterly earnings report and call, they confirmed they will be supplying lidar sensors to GM.

LIDAR NEWS

Luminar's New Semiconductor Entity, Product Roadmap







Luminar Technologies announced the consolidation of their chip design subsidiaries Black Forest Engineering; Optogration; and Freedom Photonics into a new entity named **Luminar Semiconductor**. The company also announced a new commercial agreement with Pony.ai and a new insurance program with Swiss Re.

Luminar went also into detail over their business plan and roadmap for the next decade. The next-generation Iris+ lidar sensor that will improve resolution and performance at 300-meter range while offering a slimmer form factor. Iris+ will be manufactured in a New Mexico facility with the scale to produce millions of units.

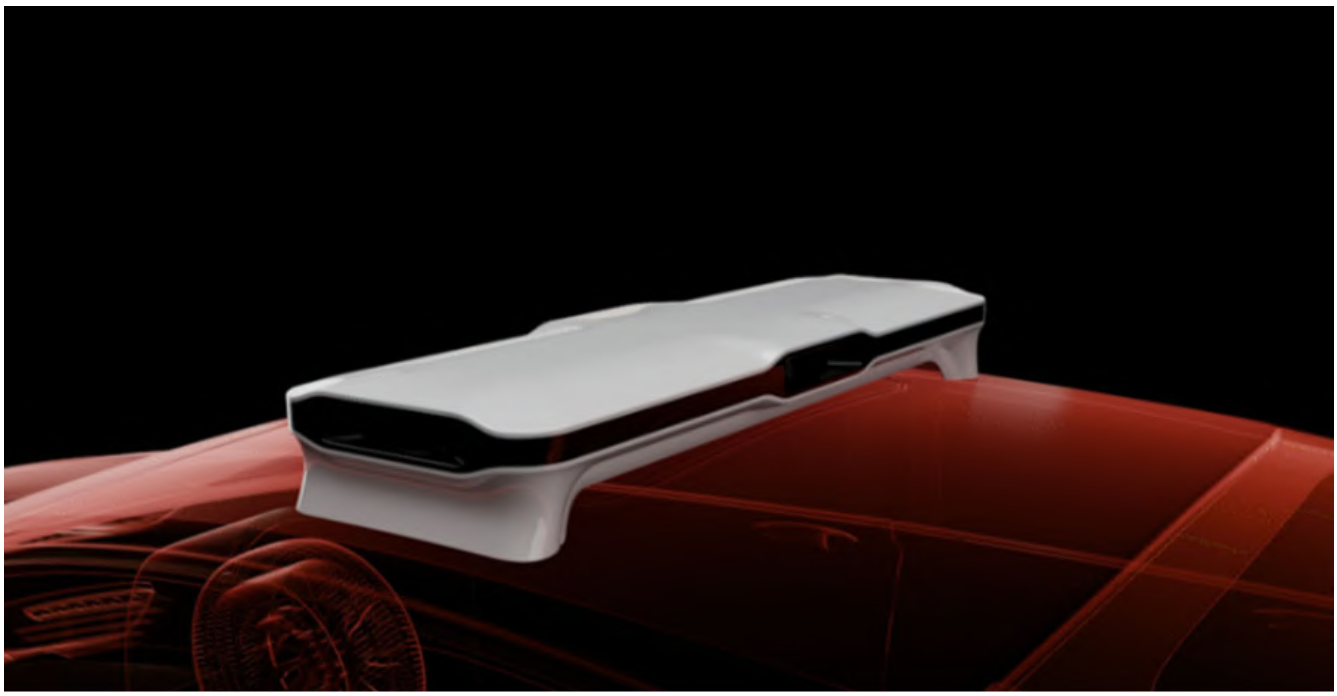
Luminar acquired the lidar division of Seagate, along with the apposite lidar IP; assets, and a technical team to strengthen their next-generation lidar development beyond Iris+; their automated manufacturing processes, and their cost-cutting initiatives.

DVN comment

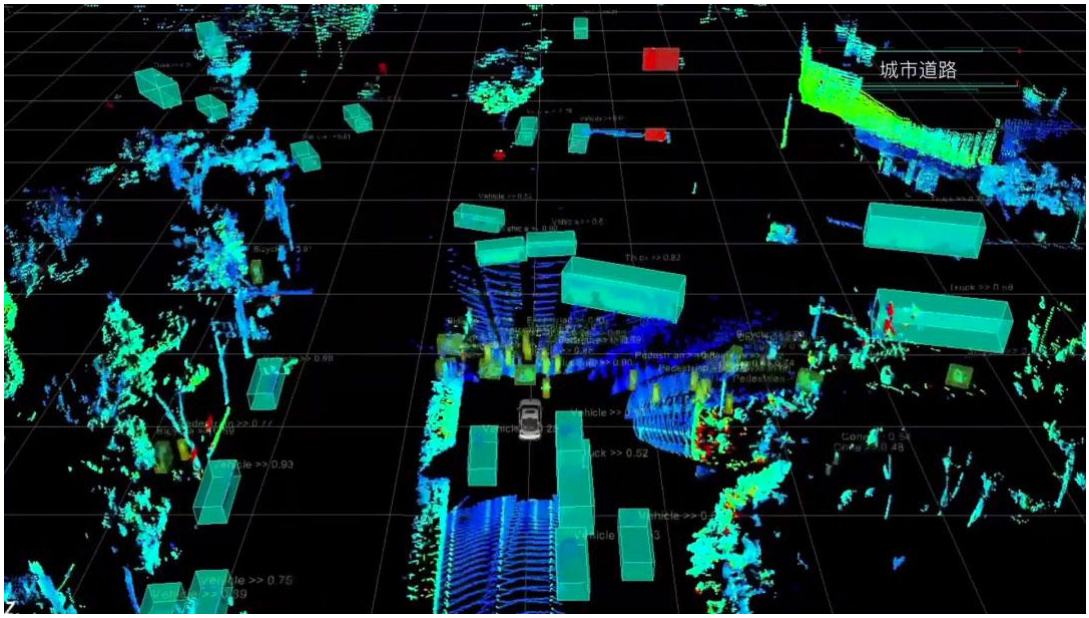
Luminar Technologies bought Black Forest Engineering in 2018; Optogration in 2021, and Freedom Photonics in 2022. These companies are respectively expert in ROICs; APDS photo detectors, and laser sources. The integration means Luminar engineers and manufactures all major components of their system from the chips on up, including lasers, receivers, scanners, and processing electronics.

LIDAR NEWS

Robosense's Solid-State Lidar L4 Perception Fusion System



RoboSense has released their first automotive-grade solid-state lidar perception solution, the RS-Fusion-P6, for L^4 autonomous driving. The P6 offers precise environmental perception capabilities, enabling autonomous vehicles to easily navigate complex driving scenarios, reduce costs, and increase efficiency. RoboSense says it perfectly integrates hardware based on two-dimensional MEMS scanning technology and software based on artificial intelligence technology.



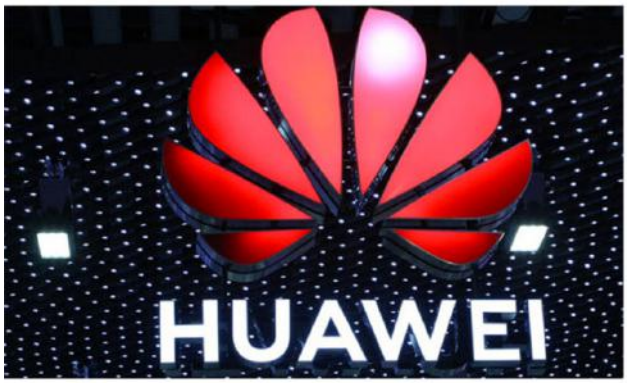
The P6 is flexible and scalable, making it suitable for a wide range of autonomous driving applications and can be customized to meet specific vehicle platforms' needs. It offers high-performance perception capabilities for full-scene environments from start to finish, making it ideal for all driving scenarios, including city streets, highways, and more. It has four M-series solid-state lidars, and offers dynamic switching and high-resolution long-distance detection capabilities to detect traffic conditions up to 200 meters away.

DVN comment

With the P6, RoboSense further expands their product portfolio, which includes mechanical and solid-state lidar sensors; perception software, and integrated sensing solutions.

LIDAR NEWS

Huawei's $200 Lidar is Shipping in Jihu Vehicles



Last year, Huawei Technologies, in patent claims, said they can combine the characteristics of two lidars in one box to simultaneously operate with short- and long-range detection functions. It's done with two sets of different transceiver signal components in one lidar.

Now the idea is in production on vehicles from Chinese automaker Jihu, including the Alpha S; Avita 11; Mecha Dragon, and Nezha S.

The procurement cost of the lidar is about USD $200—very affordable relative to other available automotive lidars.

DVN comment

The possibility to integrate short- and long-range lidar in one box allows to optimize the performance of each type of lidar, in regard with functional specifications. That allows also to use the same ICs, especially for all that concern signal processing. This is another manner to decrease the global cost of putting lidar technology in cars.

LIDAR NEWS

MicroVision's New Validation Suite, JLR Signs On

MicroVision, specialists in MEMS-based solid-state automotive lidar and ADAS solutions, has launched their new Mosaik validation suite which enables automaker and tier-1 customers to validate their ADAS and AV platforms. Following prior engagements with makers like BMW and Vinfast, MicroVision has added Jaguar Land Rover (JLR) as a customer for the Mosaik software suite.

Sumit Sharma, MicroVision's CEO, says "As OEMs seek to internally validate their ADAS and AV systems, our auto-annotation software allows them to efficiently process high volumes of reference data against ground truth data to validate a wide range of sensors and solutions." The Mosaik validation suite offers hardware and software to validate ADAS and AV systems. In addition to auto-annotation and reference software modules, the validation solution may include MicroVision lidar sensors.

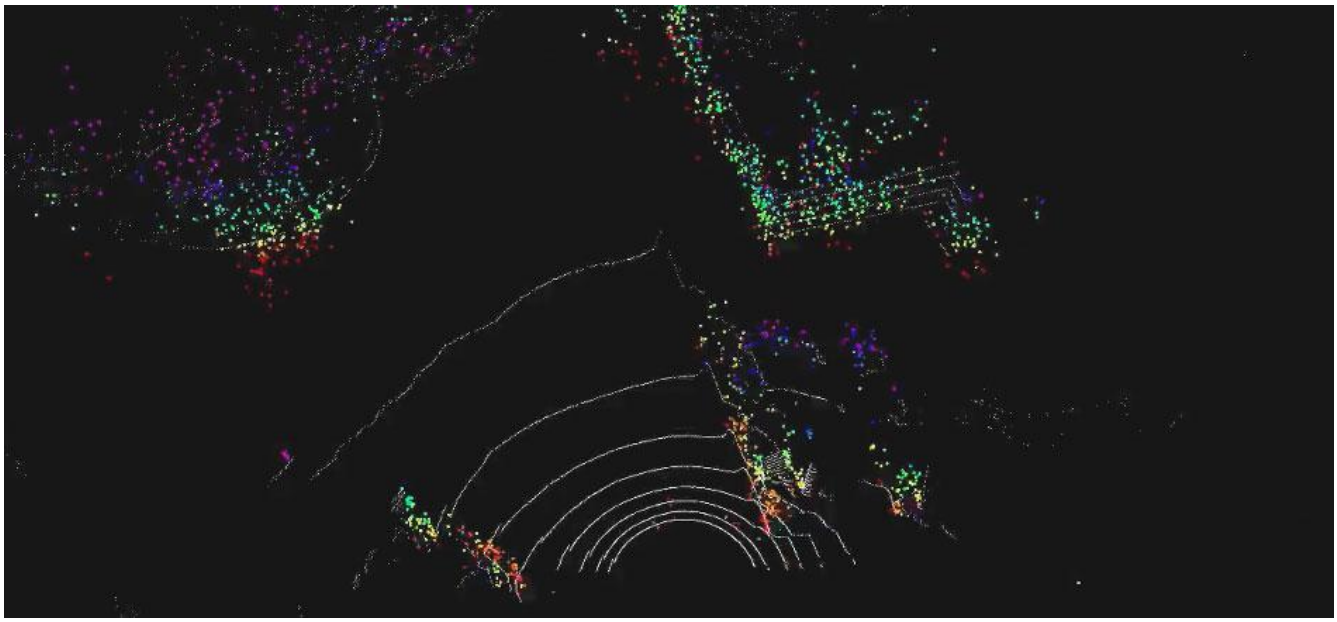
"We're thrilled to demonstrate the synergies of the asset acquisition so quickly after closing [the acquisition of Ibeo assets] as our team worked diligently to accelerate the delivery of our products to market," added Sharma. "This unique product line will enable our customers to advance their validation needs and allow MicroVision to continue advancing our perception features."

DVN comment

Since the Ibeo acquisition, Microvision has gathered over 350 employees in Redmond; Detroit; Hamburg, and Nuremberg. They design and produce MEMS-based laser beam scanning technology that integrates MEMS, lasers, optics, hardware, algorithms and machine learning software into its proprietary technology to address existing and emerging markets.

LIDAR NEWS

Zendar 4D Imaging Radar: Promises and Reality



The next big thing in automotive radar will be the 4D imaging radar. It has limited adoption but started shipping for production vehicles in 2021.
The 4D imaging radar will generate a true point cloud that will be monitored point by point, cluster by cluster, frame by frame, to help classify (and track) objects, in addition to getting their relative position, distance, and velocity.
The basic idea is to collect more data points and do more with them, rather than filtering.

The current performance announced by Zendar about this 360° awareness are:

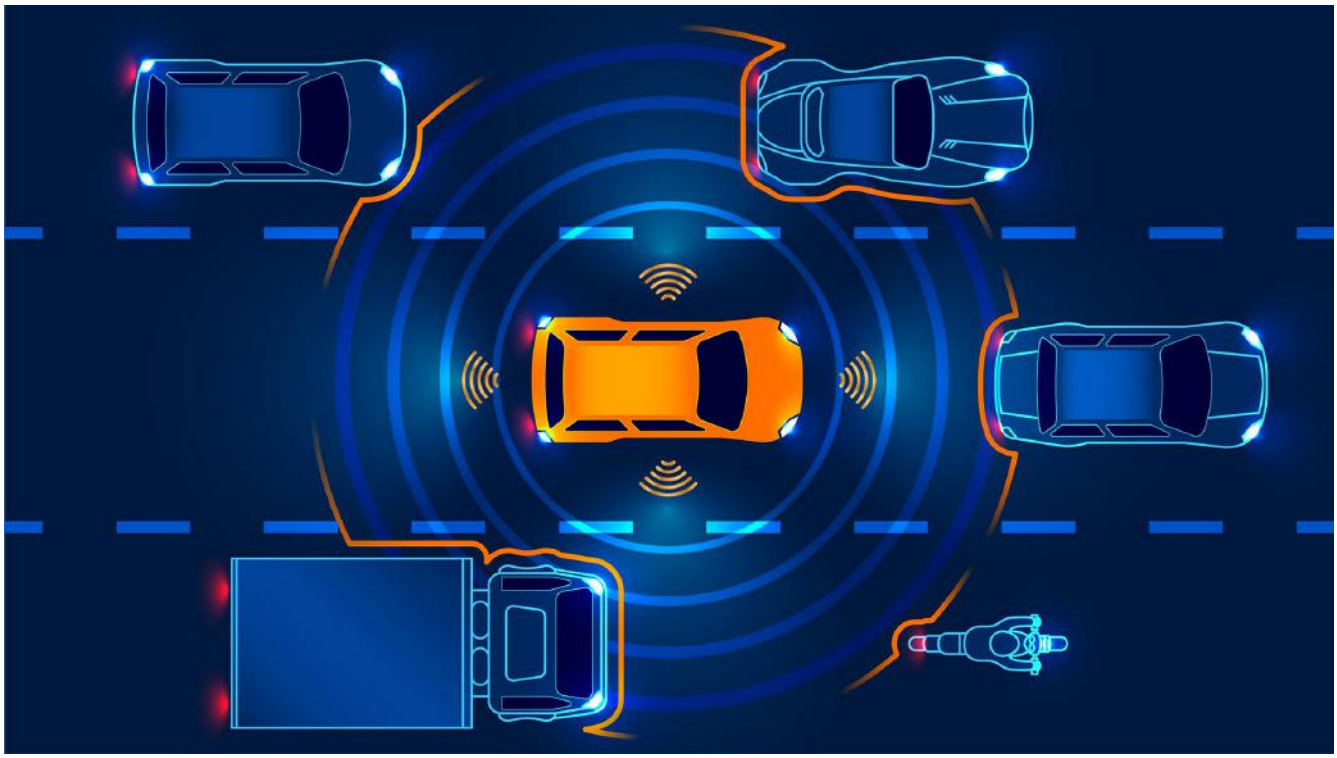
- Range: 350 m in frontal sector on 10m^2 RCS objects
- Horizontal angular resolution: 0.1° in frontal sector
- Vertical resolution: 1.65° all around

DVN comment

Zendar is a 2017 startup developing high-definition software-defined imaging radar. Zendar fuses information from multiple radar frontends distributed around the vehicle with proprietary Distributed Aperture Radar (DAR) technology to produce radar resolution comparable to that of lidar but at much lower cost. Zendar has raised $22.5m including the latest $4m from Hyundai Mobis.

AUTOMATED DRIVING

Automated Driving is Coming. Let's Try it Now!



The future of lidar is partly linked to autonomous driving. In this chapter, you can get a bit of end-user experience to understand what autonomous driving means and where you might use it in the near future.

In the U.S., **Cruise** Driverless robotaxi services open to the public now operate in San Francisco. Cruise began taking fares last June and charges a little less than Uber or Lyft. Waymo is allowed to operate around the clock but is awaiting permission to charge for driverless rides. Other cities where the companies operate similar driverless ride-hail services include Phoenix (both Waymo and Cruise) and Austin (Cruise).

In Germany, **Deutsche Bahn** and partners will test automated shuttles for local public transport in Darmstadt and the district of Offenbach, starting next month. The shuttles will eventually operate without a driver at normal speeds in regular traffic. The program aims to address the economic limitations of providing public transport in rural areas with low demand and a shortage of bus drivers.

Chinese **Baidu's Apollo Go** has accumulated a total robotaxi service volume of more than 2 million rides. In August 2022, Apollo Go obtained the permit to operate fully driverless Robotaxi service to the public in Wuhan (100 vehicles now) and Chongqing. In December, the company was green-lighted to start tests with fully driverless robotaxi in the Beijing High-level Automated Driving Demonstration Area.

Also in China, **WeRide** hasdeployed a self-driving bus fleet in Huangpu District, Guangzhou. The self-driving bus line uses a dual-motor controller architecture and adopts a fully driverless design without steering wheel and cockpit, with a speed up to 40 km/h. It fully supports V2X functions and is said to be able to perform L^4 on urban open roads all day long. The existing fleet of self-driving taxis and is currently available in Guangzhou, Beijing , Shenzhen, Nanjing, Wuxi, Boao, Riyadh and other cities

Still in China, **Nissan Mobility** has started a robotaxi trial operation in Suzhou**.** The project is based on Nissan's first mass-produced all-electric model, the Nissan LEAF, and uses the advanced autonomous driving technology provided by **WeRide**, a global leader in autonomous driving and mobility services.

Back to the States now,where **Cruise** has released their 2022 Impact Report: Cruise launched fully driverless commercial ridehail operations in San Francisco, expanded to Phoenix and Austin, and grew its delivery partnership with Walmart in 2022. Cruise carried nearly 26,000 passengers, covering 846,000+ driverless miles across San Francisco, Austin, and Phoenix. 94 per cent of riders reported trust in Cruise, while 89 per cent said the Cruise AV is a good driver.

Tesla has recalled 362,758 vehicles over 'Full Self-Driving' software safety concerns: the FSD Software could allow vehicles to act unsafe around intersections and cause crashes. Tesla will release an over-the-air software update, free of charge, to fix the issue. Tesla vehicles come standard with an L^2 driver-assistance system branded as 'Autopilot'; the 'Full Self Driving' ADAS costs an additional $15,000, and is the subject of much regulatory scrutiny.

Speaking of which, it's been determined that 'Full Self Driving' was indeed engaged during last Autumn's Bay Bridge pile-up, caused by a Tesla Model S suddenly braking for no reason in the fast lane of traffic. That caused an 8-vehicle crash. NHTSA initiated a special crash investigation, confirming the driver's assertion that Tesla's Full Self-Driving Beta (FSD) system was engaged at the time of the crash and actually caused the accident.

DVN-LIDAR DEEP DIVE

DVN-L Deep Dive II Docket

The second DVN-Lidar Deep Dive workshop of 2023 will take place this coming 5-6 June at the hotel Dorint Pallas in Wiesbaden. Here's the docket in its current form:

5 June

18:30 Welcome of live participants
19:00 Cocktail
20:00 Dinner

6 June

08:30 Opening and introduction of participants

Session 1: Lidar Applications
09:00 Lidar applications for the EU/US market
09:20 Lidar applications for the CN market

Session 2: Short-Range Lidars
09:40 Lidar sensors - short range
10:00 Lidar sensors - short range
10:20 Conclusion: questions to the community

10:25 Coffee break

10:50 Four breakout groups, each discussing two questions
11.50 Breakout group reporting and discussion

12:15 Lunch break

Session 3: Innovations in Optics
13:50 Innovations & micro lens optics
14:10 Innovations & standard optics
14:30 Conclusion: questions to the community
14:35 Four breakout groups, each discussing two questions

15:30 Coffee break

16:00 Breakout group reporting and discussion
16:30 What did we learn together?
17:00 Closure