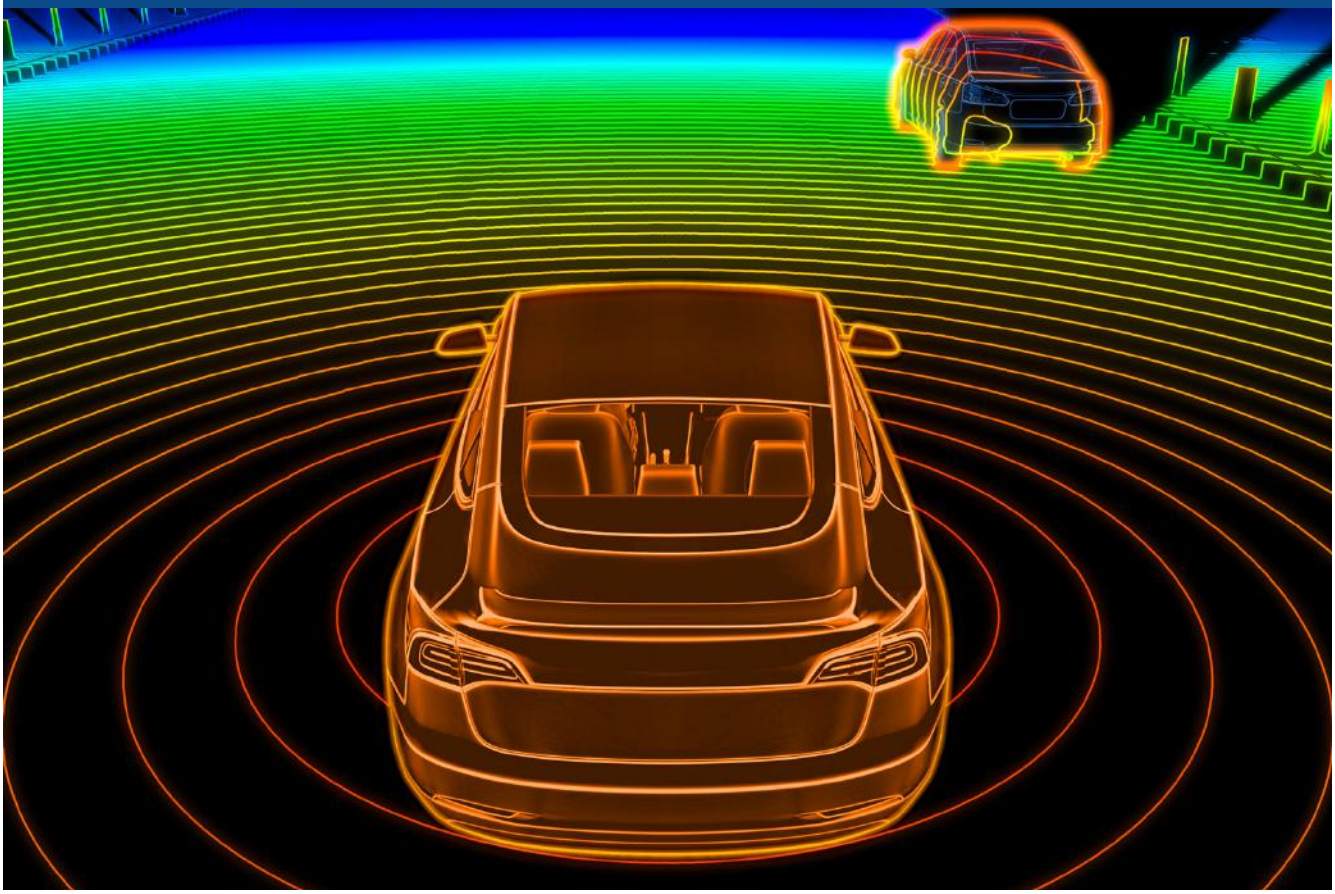
DVN
Lidar

# Monthly newsletter #25

APRIL 3, 2024



EDITORIAL

# Editorial: Generalist Automakers Also Invest in Lidar Tech

Mobileye and Volkswagen are about to launch driving functions with enhanced $L^2$ capabilities ('partially automated' driving), and are developing $L^3$ functions ('highly automated' driving). Volkswagen will also apply these features on vehicles from group brands including Audi, Bentley, Lamborghini, and Porsche.

Stellantis is investing €3.2m into SteerLight's lidar technology for improved ADAS. This lidar uses light waves to analyse the environment in four dimensions (3D + speed) with enhanced resolution and accuracy. Find more details in the Lidar Technologies section of this newsletter.

Also in this edition, you will find an interview with Robosense, who have been awarded at Tech AD Berlin for the new M3 Lidar this month. As of last December, RoboSense had 62 vehicle model design wins and started mass production of 24 models with 12 automaker and tier-1 customers.

**Remember these forthcoming DVN-Lidar events for 2024; save the dates!**

- Deep Dive 1 in Stuttgart (8-9 April)
- Deep Dive 2 in Suzhou (21-22 June), DVN co-hosts the event with Enmore
- Deep Dive 3 in Detroit (12 September)
- Lidar Conference in Wiesbaden (18-19 November)

We're ever so glad you're here with us in the DVN-Lidar community. Enjoy this 25th newsletter! All best,

All best,

**Alain Servel**

*DVN LIDAR ADVISOR*

EVENT

# DVN to Co-Host EAC Lidar Tech Expo in Suzhou This June


DVN signed a partnership with Enmore, who organize the EAC event each year. DVN's expertise will help build the program, and help Enmore recruiting speakers and exhibitors.

This is the biggest lidar exhibition in the world, and China is the biggest market for Lidar. Key suppliers in the lidar industry will promote their technologies and innovations.

This year, the theme is 'Sustainable Growth and Crafting the Future'. 1,500 attendees, over 50 speakers, and over 100 exhibitors are expected at the Suzhou International Expo Centre on 21-22 June.

The optics and lidar exhibition areas covers the likes of lidar modules, lasers, detectors, scanning components, amplifiers, ADC, DAC, main control chips, filters, collimating lens and other precision optical components, silicon photonic devices, simulation and testing, assembly patch equipment, packaging technology, heat dissipation materials, and adhesive materials.

See details on the **EAC website**, or the **DVN site**; you'll find the preliminary program of the conference, as well as registration and expo booth links. Or, if you prefer, you can also register by contacting DVN's **Eric Amiot** (Europe) or **Anne Ai** (Asia).

LIDAR BUSINESS

# Lidar Business News

**WeRide to Develop $L^4$ With Lenovo:** Autonomous driving solution provider WeRide announced a strategic collaboration with Lenovo Vehicle Computing to co-create an $L^4$ autonomous driving solution. It will leverage Lenovo's domain controller as its foundation.

**Baidu's Apollo Go fulfills over 5 million Robotaxi orders**: Baidu reported their financial results for the fourth quarter and the whole year of 2023. The report showed that by 2 January of this year, Baidu's Apollo Go robotaxi platforum had provided over 5 million rides on open roads. Apollo Go saw 49 per cent year-on- year growth in service orders in the last quarter, reaching 839,000. In Wuhan city, 45 per cent of the Robotaxi orders were completely driverless, demonstrating the increasing acceptance of autonomous driving technology in China.


**Hesai Technology announced unaudited financial results** for the fourth quarter and full year of 2023, which beat expectations in revenue, delivery volume, and overall gross margin. Total annual revenue was C¥1.88bn, with a year-on-year increase of 56.1 per cent. The company's revenue for the fourth quarter was C¥560m, with a rise of 37.1 per cent compared to the same period last year. In the last year, Hesai Technology had an overall gross margin of 35.2 per cent, and gross profit surged 40.1 per cent year over year. The company delivered a total of 222,116 lidar units in 2023, with a year-on-year jump of 176.1 per cent.

**Great Wall Motors announced strategic partnership with Hesai**. This partnership is a major step towards incorporating advanced lidar safety technology into GWM's future vehicle models, promising to raise the standards of intelligent driving. The partnership began with a strategic meeting to launch R&D on multiple lidar projects, with an agreement to mass-produce high- quality lidar units. GWM's new passenger car models will feature Hesai ADAS lidar, expected to come out later this year.

**Isuzu and Tier IV formed a capital and business partnership** for route buses with *L***4** autonomous driving technologies. This cooperation reflects a common vision between Isuzu, a leader in commercial vehicle and diesel engine production, and Tier IV, a pioneer in autonomous driving software, to bring vehicles with autonomous technologies to market. This effort is also a response to the urgent issues of driver shortages and the demand for sustainable, efficient public transportation alternatives.


**Seyond is working with Nvidia** to incorporate Seyond's advanced lidar solutions into the Nvidia DriveWorks and Omniverse platforms. By using Seyond's lidar technology and expertise with Nvidia's comprehensive automotive development solutions, Seyond aims to change the way autonomous vehicles are created, developed, and tested. As part of this cooperation, Nvidia's GPU hardware will be used together with Seyond's lidar to process point cloud data fast and precisely for enhanced autonomous driving abilities.

Avatr, the premium brand backed by Changan, Huawei, and CATL, put the 11 Intelligent Driving Edition onto the market featuring the Huawei Advanced Driving System 2.0. Equipped with three lidar sensors, the new vehicle provides advancd driving assistance on expressways, urban, and parking. The vehicle's intelligent driving navigation assistance, which does not rely on high-precision maps, has been activated nationwide. It covers expressways, national higways, provincial roads, county roads, as well as main roads, auxiliary roads, and branch roads within cities.

INTERVIEW

# Interview: Robosense Sales Director Gregory Poillion

Gregory Poillion is in charge of sales development in the EMEA region for Robosense, with a focus on automotive lidar sensors and perception SaaS. He has a great deal of experience in automotive, having held positions at Blickfeld (VP of Sales), Honeywell (Senior Director of Customer Management), Borg-Warner, Mercedes Benz Technologies, and Valeo. His education includes an executive MBA, ESSEC (Mannheim Business Schools) and a master's degree in mechanical engineering from Artois Engineering University in France.

### DVN: Robosense, founded in 2014, is now a well-known lidar company. What is the company size and competitive position?

**Gregory Poillon**: As we all know, the lidar market is very competitive and also offers great potential for companies to grow. According to FactMR, the global lidar market is forecast to be nearly $3bn by 2028 and grow at a 14.7% CAGR for the next 6 years. This growth matches what RoboSense is experiencing: increasing interest and adoption in automotive, robotics, and other industries such as infrastructure. We now have approximately 1,600 employees with offices in China, Germany, and the US.

We believe that success hinges on continuous innovation, the ability to mass manufacture cutting-edge products, and deep customer relationships. And RoboSense has proven, time and time again, that we deliver in these areas. In 2023, RoboSense led the lidar industry through significant milestones: we sold over 250,000 sensors, with more than 150,000 sold in the fourth quarter alone. Additionally, we sold a record-breaking 70,000+ sensors in December 2023.

How did we do this?

- Strong technology: RoboSense has 10 years of experience in lidar, but we do not rest on our laurels. We invest heavily in R&D with top engineers from around the globe who have deep experience in lidar and our industries of focus: automotive and robotics. We empower our engineers to do what they do best: develop state-of-the-art products, including our proprietary lidar-on-chip technology that enables fast and efficient product iterations. We continue to bring components in-house, particularly our chips, which removes the reliance on external supply chains, enables us to refine our already proven products, and advances our ability to deliver at scale.

- Mass manufacturing and scalability– RoboSense's ability to produce high-volume automotive-grade sensors offers a huge advantage over our competition. In fact, we are the first lidar company to mass- manufacture automotive-grade sensors. We have a CNAS-accredited lab and conduct stringent validation testing to ensure product quality and reliability. Our focus on automotive projects has enabled us to develop our mass manufacturing capabilities since these projects are long-term, predictable, and require the highest level of testing. Our experience in the automotive market is a major benefit that is passed down to other industries, such as robotics. By providing innovative, high-performance products to customers who are in the early stage of development, we can help them bring long-term solutions to market with more efficiency and speed.
- A strong customer portfolio—RoboSense began as an automotive-focused company. As of December 2023, RoboSense has obtained 62 vehicle model design wins and successfully assisted 12 automakers and Tier 1 customers in starting the mass production of 24 models. RoboSense has diversified its customer base in the automotive market through its work with North American-based OEMs, Japanese OEMs, Tier 1 companies, and mobility startups. RoboSense is also expanding its reach in the non-automotive industries, including heavy-duty machinery, warehouse robotics, and infrastructure, with 2200 customers in these areas. We are committed to working with all of our customers for critical feedback that enables us to continue innovation, deliver state-of-the-art technology, and advance scalability for all of our customers.

### DVN: You're marketing automotive MEMS lidars with no moving parts. Could you tell us more about the reliability?

**G.P.**: Our M Platform, including the M1, M1 Plus, and M2 leverages MEMS technology. We became the first company to achieve mass production for automotive-grade solid-state lidar by delivering the M1 to a North American automaker. According to the CIC, we commenced the delivery of mass-produced automotive- grade lidar more than one year ahead of any publicly listed lidar company. Our MEMS-based products have earned industry-wide recognition, and we hold a broad range of certifications, patents, and awards. Our ten years of experience as a global leader in lidar, iterative design processes, and world-class manufacturing deliver proven sensor technologies that our customers trust.

There are several reasons that our MEMS technology is reliable. MEMS lidars do not have moving parts, so they are less prone to wear and tear, resulting in increased durability. Additionally, with fewer moving parts, there's less need for maintenance or calibration. MEMS lidars are more resistant to shocks and vibrations than those with moving parts, which is key in the automotive industry and critical for rough driving conditions. Our MEMS-based lidar delivers consistent performance over time because there are no mechanical parts that could degrade or drift out of alignment. This reliability ensures that our lidar maintains accurate measurements throughout its operational life. Lastly, our M Platform MEMS lidars are more compact and lightweight than their mechanical counterparts. This streamlined design can lead to easier integration into vehicles and other applications with fewer points of failure.

### DVN: What can you tell us about the specifications of your lidars? Do you see differences between the EU market and the Chinese market, is it a problem for you?

**G.P.**: In January 2024, RoboSense launched the mid-range M2 and the M3, the M Platform's first long- range lidar. The M2 and M3 are automotive-grade products that expand the company's robust portfolio of high-performance, cost-effective lidar sensors.

The M3, our first long-range sensor, is a big step forward as we drive mass adoption of our automotive- grade sensors in *L***3+** vehicles globally. The M3 is a disruptive technology that rivals incumbent long-range 1,550-nm sensors by achieving a 300-meter range at 10-per-cent reflectivity with 940-nm wavelengths. Using 940 nm as opposed to 1,550 nm, we can deliver a more compact, cost-effective, power-efficient sensor. The M3's advanced 2D scanning technology also enables a 0.05° × 0.05° angular resolution within the region of interest (ROI) to detect smaller objects at longer distances.

Like many of our sensors, the M3 is designed on a modular platform. By enabling upgrades through chip technologies—developed in-house—the form factor, interface, and scanning technology do not change. Customers have the capability to seamlessly upgrade to the next iteration of the sensor when it becomes available without extra design changes or validation.

The M2 is a MEMs-based lidar sensor that achieves a range of up to 200 m at 10 per cent reflectivity. It evolved from the M1 and M1 Plus to deliver improved performance but unchanged form factor, easing pin- to-pin integration for automakers and tier-1 customers. The M Platform's 2D scanning and a unique "gaze function" for enhanced angular resolution of 0.1° × 0.1° in its region of interest. Developed with more than

90 per cent of the same components as the M1 Plus, the M2 leverages RoboSense's mass manufacturing capabilities.

### DVN: How does your lidar do in bad weather, compared to a camera or a radar?

**G.P.**: Our lidar systems perform well in adverse weather conditions because they emit their own light source. Therefore, they are less affected by ambient light conditions, like darkness or fog. Additionally, lidar delivers precise, high-resolution data of its environment for accurate object detection. In contrast, cameras require visible light to capture images, making them susceptible to poor visibility conditions caused by fog, heavy rain, or darkness. In these situations, the images captured by cameras may be obscured or distorted, affecting their performance for object detection and recognition tasks. Radar waves can penetrate through these kinds of weather elements, allowing radar systems to detect objects even when visibility is reduced. However, unlike lidar, radar struggles with accurately detecting smaller objects or distinguishing between different types of objects compared to lidar or cameras.

**DVN: What about vehicle integration: power, size? Do you see the integration behind windshield as a key factor to speed up the market's growth?**

**G.P.**: We have worked in partnership with automakers all over the globe to match their integration needs, whether it be behind the windshield or in other areas around the vehicle. Our deep technical expertise and achievements in mass manufacturing enable us to develop lidar that is higher performance, smaller, more power-efficient, and more cost-effective. These are all key factors to meet customer demand and speed up market growth.


For example, Lotus, a company dedicated to innovative engineering and cutting-edge technologies, chose RoboSense's automotive-grade M Platform sensors to advance the Emeya's intelligent driving systems. Enhanced by RoboSense's lidar technology, the Emeya's Adaptive Driving Beam technology delivers low- light perception capabilities and helps shield drivers from oncoming glare. In homage to the pop-up headlights of the Lotus Elan, the company's iconic sports car, RoboSense's lidar integration in the Emeya highlights the vehicle's combination of classic design and groundbreaking technology.

**DVN: What will be the market size for lidars in China in 2025? What is your expectation for the European and US markets; do you see Robosense becoming a key player in those places?**

**G.P.**: We're very excited about what we have accomplished in the North American market and the possibilities in front of us. RoboSense was successfully listed on the Hong Kong Stock Exchange in 2024, providing the capital for global expansion and advancing our North American footprint.

Our North American headquarters, which includes our center of excellence, is in Michigan. It is important to us to be at the center of the automotive industry as we deepen partnerships and develop our technology with key automaker customer feedback. In fact, as we mentioned, we became the first and only company to achieve mass production for automotive grade lidar. It feels fitting to note that we did so by delivering our M1 to a North American automaker, demonstrating our growing leadership in the US.

In addition to our Michigan HQ, we have a satellite office in California in the heart of Silicon Valley, where we work with a variety of automotive, mobility, and robotics companies. We are localizing design capabilities and leveraging our rich global manufacturing experience to advance our ability to scale and offer high- quality, cost-effective solutions in the United States. Looking ahead, we will also be bringing multiple products and solutions to the market. These include long-range, mid-range, and short-range lidar, ground truth systems, and perception software.

Recently, we became members of MCity, a public-private mobility research center led by the University of Michigan. This collaboration provides us the opportunity to partner with a diverse community of MCity industry members, government partners, and academia, including Toyota, Ford, Honda, Denso, the U.S. Department of Transportation, and the Michigan Department of Transportation. It is an exciting time as we grow our team and expand our business!

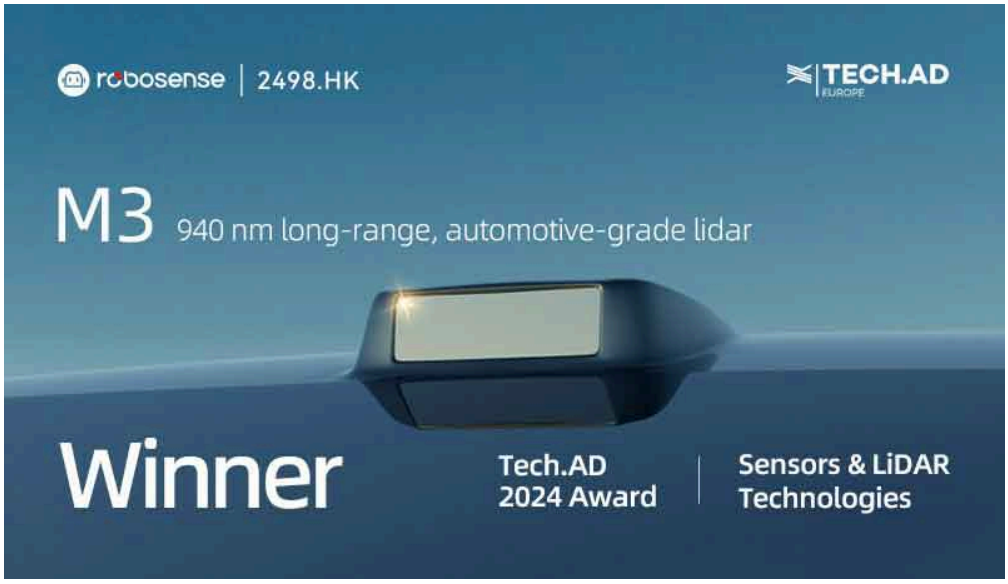
### DCN: What about the cost road map for lidars? Do you expect the same curve will apply, with the cost divided by 5 over a decade's time for blind spot radars?

**G.P.**: While difficult to predict the exact trajectory, our lidar becoming increasingly more cost-effective. Factors such as improvements in semiconductor manufacturing, optics, and signal processing techniques enable cost reductions in lidar systems. Additionally, increased adoption of lidar technology in various industries, particularly in automotive applications, could drive economies of scale and further cost reductions. Ongoing advancements led by RoboSense as well as market forces will play a significant role in shaping the cost roadmap for lidars in the coming years.

### DVN: How do you see the applications and market segments regarding lidar range? Do you see a new market emerging for short range lidars?

**G.P.**: Our robust portfolio of lidar technology spans ultra-short range to long range. Short-range lidar addresses markets that need precise detection of close objects, including industrial automation, where robots such as autonomous forklifts need to navigate complex indoor environments. Additionally, short- range lidar is required in the automotive industry for applications such as blind spot detection.

Here is an overview of some of the products we offer and they applications they address:




Cutting-edge solid-state lidar:

- The M3 is our new long-range automotive grade sensor, designed to meet the *L***3+** autonomous driving need of automaker and tier-1 customers globally. The compact, affordable M3 is a disruptive technology that rivals incumbent long-range 1,550-nm lidar by using 940-nm wavelength to achieve 300 m range at 10 per cent reflectivity.
- The midrange M2 is the upgraded version of our M1, the world's first automotive-grade solid-state lidar in mass production. Our M Platform lidar are deployed by automakers globally for advanced driver assistance and autonomy.
- The E1, developed with RoboSense's proprietary chip technology, provides superior blind spot detection to enhance navigation capabilities and advance safety in vehicles and robots. This

compact, solid-state lidar offers 120°H and 90°V FoV and short-range detection of ≤15 cm to eliminate blind spots.

Mechanical lidar innovations:

- The Ruby Plus is an upgraded 128-beam sensor designed for *L***4** autonomous vehicle commercial operations.
- The Bpearl, with an ultra-wide 360°H × 90°V FoV, delivers precise short-range detection of ≤ 10cm to cover blind spots and enhance navigation capabilities for vehicles and robots.
- The versatile Helios series, including 16- and 32-beam lloffer several vertical FoV options, object detection of ≤ 0.2 m, and have passed critical validation tests to ensure reliability. These sensors are designed to meet a broad range of customer applications, including robotics, intelligent vehicles and V2X.

Advanced software solutions:

- HyperVison is a full-stack system that combines RoboSense lidar and software to deliver comprehensive data analytics for critical decision-making, enabling customers' development of better, safer solutions.

### DVN: What's the technical future of lidars? Will FMCW technology come soon?

**G.P.**: RoboSense's decade of experience in lidar has enabled us to make significant technological advancements, including in resolution, range, size, cost-effectiveness, and development of our proprietary perception software.

As mentioned, we recently launched our M3 sensor, which rivals incumbent long-range 1,550-nm sensors by achieving a 300 m range at 10 per cent reflectivity with 940-nm wavelengths. By using 940 nm, RoboSense delivers a more compact, affordable, and power-efficient sensor for intelligent driving applications.

RoboSense continues our research into various technologies, including FMCW lidar technology. However, FMCW remains immature and has supply chain limitations that our technologies, including flight time, do not.

### DVN: Are lidar and imaging radar competing or complementary? Do you think the radar/lidar performance and cost gaps will narrow?

**G.P.**: Depending on the application, a customer may need redundant sensors. Each has its strengths, and they can be used together to enhance capabilities in various applications such as autonomous vehicles, robots, and intelligent infrastructure.

In terms of performance and cost, we believe that our advancements in lidar technology and the demand for our products are narrowing the gaps between radar and lidar systems. RoboSense's hyperfocus on R&D contributes to this narrowing, enabling continuous improvements in sensor design, manufacturing processes, and development of other solutions, including our software.

SPECIAL REPORT

# Special Report: Tech AD in Berlin


This event on 11-12 March was focused on applications and sensing technologies, and validation processes for AVs.

**Radar:**

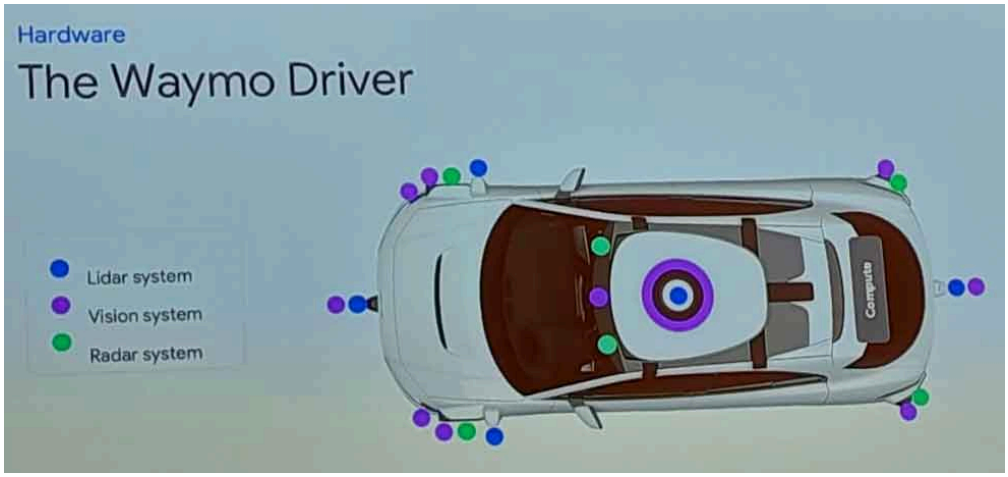
Mercedes-Benz's Dr Jürgen Dickmann gave interesting feedback on the state of the art of the radar technology and the lessons learned from the development and launch of the 'Drive Pilot' feature on the S- class (traffic jam pilot up to 60 km/h):

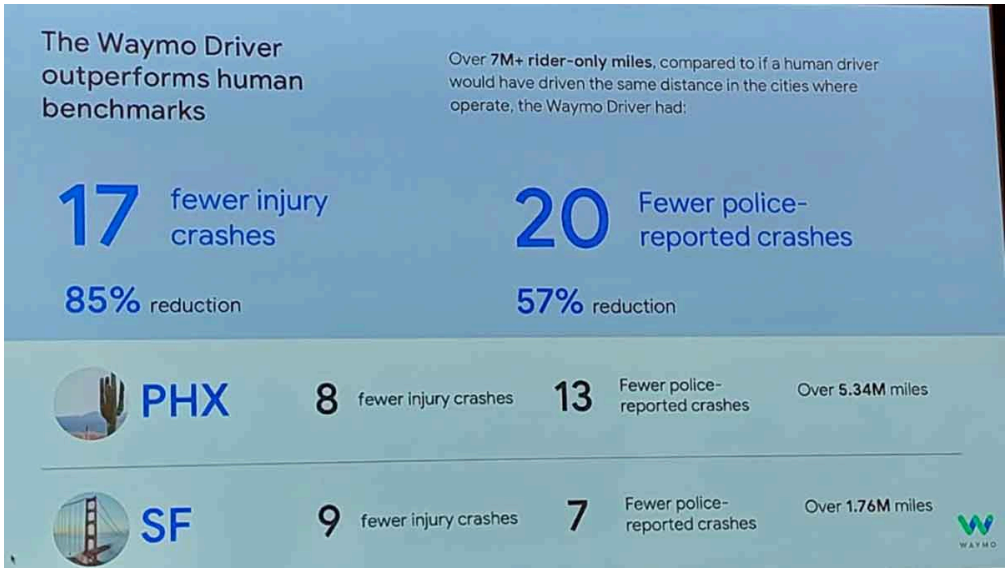
- Radar is a key sensor to build a robust $L^3$ feature, and provide a 360° sensing information (10 radars on the S-class)
- There are two types of radar on the S-class: a high-resolution long range imaging radar (iLRR), a many mid-range radars (MRR)
- An imaging radars require a minimum network of 32 × 32 elements to support an $L^3$ feature
- In the future, Mercedes expects to have only one type of radar—the MRR—and to achieve the performance of the current imaging radar through a virtual antenna combining many MRRs (distributed aperture radar)
- Advanced signal processing and AI allow to clean the detections to a level similar to the one achieved with the Lidar technology and its high-resolution imaging capability.

**Robotaxis:**

Waymo's Senior AD Product Leader Shweta Shrivastava gave the status of the validation process and safety records of the Waymo $L^4$ robotaxis:

- Waymo relies on camera, radar and lidar technologies to achieve a robust $L^4$ feature and to optimize the ODD (Operational Design Domain), covering many environmental and road conditions.
- Waymo validations required Millions of miles on public roads and billions of miles of simulations. The current system is the 5th generation.
- After over 7 million customer rides, the Waymo Drive has a good safety record and allows to reduce, in theory, the number of crashes by 85 per cent.
- Waymo will continue to enhance the performance of their $L4$ features, with a step-by-step deployment to guarantee a safe approach of $L^4$validations
- Road Safety could be one of the benefits using robotaxis, with each year 50 million injuries and 1.35 million deaths on the road, half of which are vulnerable road users (pedestrians, motorcycles, cyclists...).

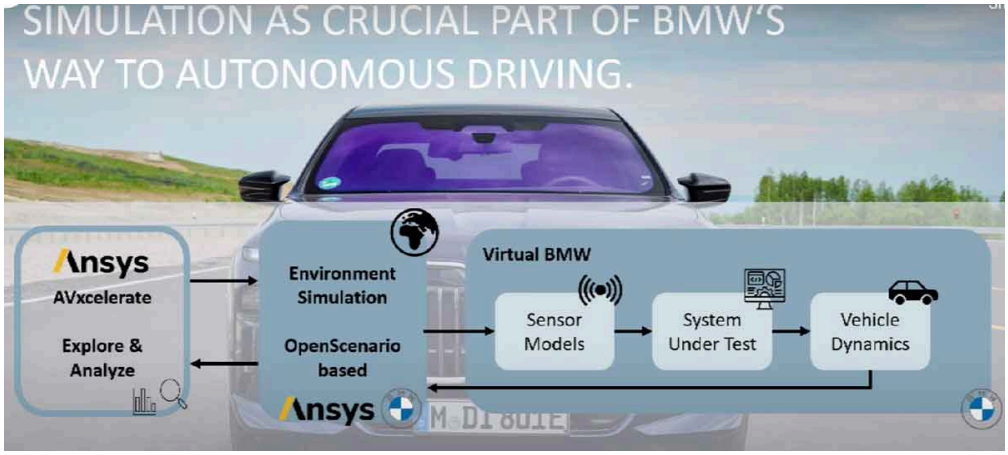


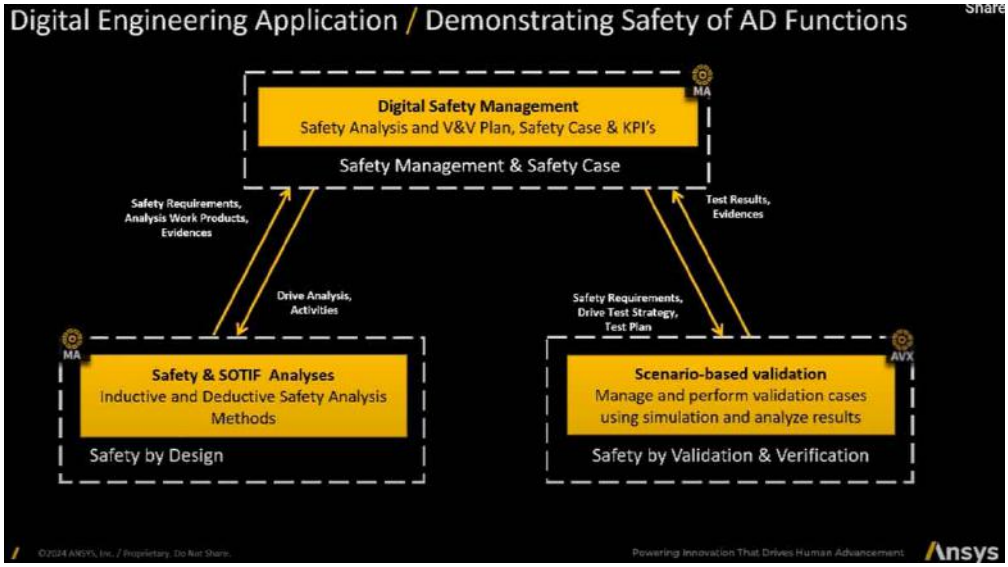



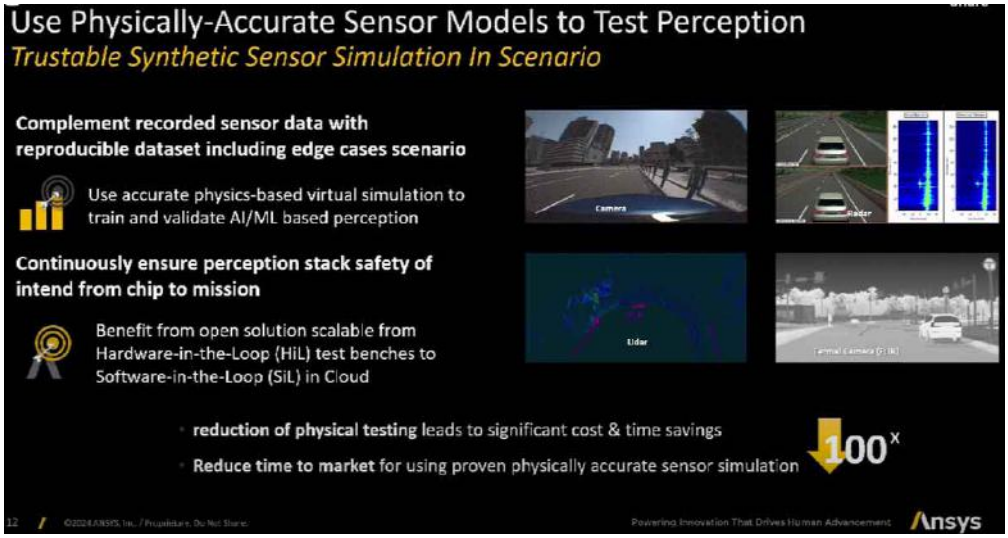
## $L^3$ features

BMW introduced the 'Personal Pilot $L^3$' on the new iX7 (highway traffic jam pilot up to 60 km/h)

- The validation process was managed with Ansys as a partner
- BMW collected 24.5 million km of test data with simulations and performed thousands of acceptance test to validate the feature for the end user
- The functional tests were based on NCAP, ALKS scenarios

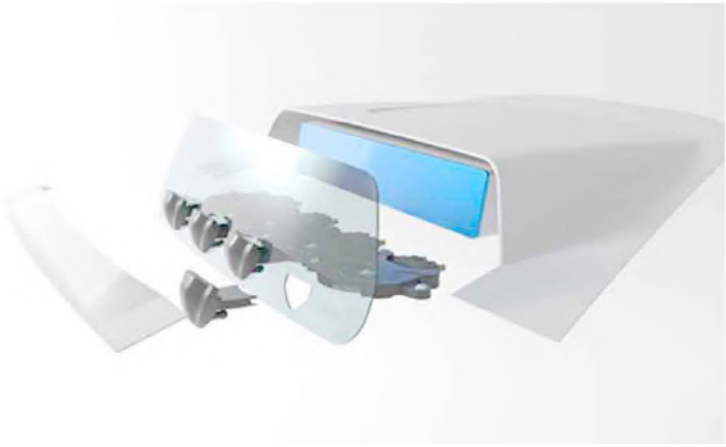


LIDAR AND IMAGING RADAR TECHNOLOGY NEWS

# AGC-Wideye White Paper on Testing, Analysis of Sensor Cleaners



Safety remains the key technical challenge to ensuring autonomous cars live up to their theoretical safety benefits. The ability to detect data from a multitude of sensors such as lidars, radars, time-of-flight sensors, visible light cameras, and infrared cameras, and process the data through AI algorithms to observe their environment is also at the core of ADAS and AD vehicle development.

No matter how advanced, sensors can lose functionality when challenged by weather, heat, and other impacts, threatening safety and performance by providing outputs that cannot be trusted. To achieve high autonomy, all optical perception sensors must be cleaned while ensuring efficient electrical power and cleaning liquid consumption.

In this context, Wideye and Actasys have collaborated to tackle this challenge using strengths from both companies to combine Wideye's unique glass solutions and Actasys' innovative cleaning system. For the project, Wideye provided glass that includes a water-repellent coating. This coating is also a product developed by AGC and is already used in the automotive industry for front door glass.

Actasys performed testing in different conditions thanks to their unique solution, Actajet, which allows low energy and water consumption. In addition, Wideye and Actasys are developing packaging definitions and guidelines to create a seamless, integrated system for autonomous vehicles.

DVN comment

The white paper has been uploaded on the DVN website; subscribed members can read it there.

LIDAR AND IMAGING RADAR TECHNOLOGY NEWS

# Stellantis Invests in Lidar Tech for Advanced Driver Assistance Systems


Stellantis has invested in SteerLight, the developer of a new generation of high-performance lidar sensing technology.

Employing silicon photonics technology, which combines a universal semiconductor material with the speed of photons, the SteerLight lidar senses the surrounding environment in three dimensions with higher resolution and precision, and at a lower volume production cost, than currently available lidar systems.

The technology has the potential to give drivers of future Stellantis brand vehicles better performance in a variety of ADAS and AD.

SteerLight, a spinoff of the French CEA-Leti technology centre, employs FMCW lidar based on silicon photonics technology that puts the system on a microchip. The system has no moving parts and is compact, maximizing flexibility for vehicle engineers. It overcomes challenges of today's lidar technology for vehicles, size and cost. The FMCW technology provides highly accurate depth and velocity data while resisting interference from the surrounding environment and other users.

Since its inception in 2022, Stellantis Ventures has invested in twelve startups and one mobility fund, focused on developing cutting-edge technologies that will improve outcomes for individual customers and society as a whole. Stellantis Chief Engineering & Technology Officer Ned Curic says, "A central aspect of our Dare Forward 2030 initiatives is identifying groundbreaking technologies that deliver substantial value to our customers on a large scale. Automated driving enhancements remain a top priority at Stellantis. The game-changing work at SteerLight can enable enhanced and widespread ADAS applications".

And SteerLight cofounder and CEO François Simoens says, "We see a great benefit from having Stellantis' corporate venture fund recognize our innovation so we can unlock large-scale adoption of lidar for industrial and mobility applications. Our new lidar technology is key to support new services in the automotive industry, and we are looking forward to working together to advance the next generation of vehicles".

LIDAR AND IMAGING RADAR TECHNOLOGY NEWS

# VW Group, Mobileye Strengthen AD Collaboration

The Volkswagen Group is intensifying their cooperation with Mobileye; the two companies want to bring new automated driving functions into series production.

According to a press release, Mobileye will provide technologies for partially and highly automated driving based on their SuperVision and Chauffeur platforms. VW Group brands including Audi, Bentley, Lamborghini, and Porsche want to use this technology to quickly introduce new driving functions with all drive types. These include assistance systems for highway and city traffic, including autonomous overtaking in permitted areas of multi-lane roads, automatic stopping at red lights and stop signs, as well as assistance at junctions and traffic circles.

Mobileye is to supply further technology components for autonomous driving for Volkswagen Commercial Vehicles. According to the press release, Volkswagen is focusing on its own complete system in the long term: the partnerships with Bosch and Qualcomm and with Horizon Robotics in China will be continued in a focused manner. And all driver assistance systems will be based on the software architectures developed by the VW subsidiary Cariad.

To achieve *L***4** functions, the Volkswagen Commercial Vehicles brand will eventually be supplied with software and hardware from Mobileye. Following an extensive pilot phase with road tests in Germany and the USA, the VW Group company Volkswagen ADMT has concluded a cooperation agreement with Mobileye.

According to the press release, the core of the agreement is the use of a self-driving system for a special version of the ID.Buzz, which has been under development for autonomous driving since 2021. The system is capable of providing *L***4** autonomous driving, and is based on various software and hardware components, including two independent high-performance computers as well as 13 cameras, nine lidar and five radar units. Each of these sensor networks can provide 360-degree coverage of the surrounding area. The autonomous vehicles are always online for safe and efficient control.

The development goal of Volkswagen ADMT is to be able to offer the fully electric autonomous ID.Buzz AD mobility and transportation services from 2026.

## DVN comment

Mobileye will offer production-ready functions for the new E3 1.2 premium-oriented software architecture managed by Cariad. The collaboration between the Volkswagen Group and Mobileye could bring significant advancements developing ADAS technologies for cross-brand deployment, particularly among Audi, Bentley, Lamborghini, and Porsche.

## LIDAR AND IMAGING RADAR TECHNOLOGY NEWS

# RoboSense M3 Recognized for Advancing Safer, Smarter Drive Systems


Robosense's long-range, automotive-grade M3 lidar won the Tech.AD Europe Award 2024, which recognizes outstanding achievements in the automotive industry. RoboSense's M3 was honored in the Sensors & lidar Technologies category for its lidar innovation that is powering the future of intelligent vehicles.

RoboSense is a product-driven company that is hyper-focused on research and development, which enables it to iterate on proven technologies and bring products to scale quickly. The pinnacle of these efforts is the long-range M3, which marks a significant step forward as RoboSense drives mass adoption of its automotive-grade sensors in *L***3+** vehicles globally. The M3 is a disruptive technology that rivals incumbent long-range 1,550-nm sensors by achieving a 300-m range at 10 per cent reflectivity with 940 nm wavelengths. By using 940 nm technology, RoboSense can deliver compact, affordable, power-efficient sensors. The advanced 2D scanning technology enables a 0.05° × 0.05° angular resolution within the region of interest (ROI) to detect smaller objects at longer distances.

Like many of RoboSense's sensors, the M3 is designed on a modular platform. The platform is built to be upgraded through in-house developed chip technologies while maintaining the form factor, interface, and scanning technology. This is critical for automakers as they iterate on their advanced driver assistance (ADAS) and autonomous driving (AD) systems; they now have the capability to seamlessly upgrade to the next generation of the sensor when it becomes available, without extra design changes or validation.

RoboSense has a CNAS-accredited lab and conducts stringent validation and testing to ensure quality and reliability. As of December 2023, RoboSense has obtained 62 vehicle model design wins and successfully assisted 12 automaker and tier-1 customers in starting the mass production of 24 models, including the new fully electric Lotus Emeya. RoboSense has diversified its customer base in the automotive market through its work with North American and Japanese automakers, suppliers, and mobility startups.

## DVN comment

The M3 lidar represents a significant leap forward in automotive sensing technology. By operating at 940nm wavelengths, the M3 achieves a remarkable 300-meter range at 10 per cent reflectivity together with compactness, cost-effectiveness, and power-efficiency. It can challenge incumbent long-range 1,550-nm sensors.

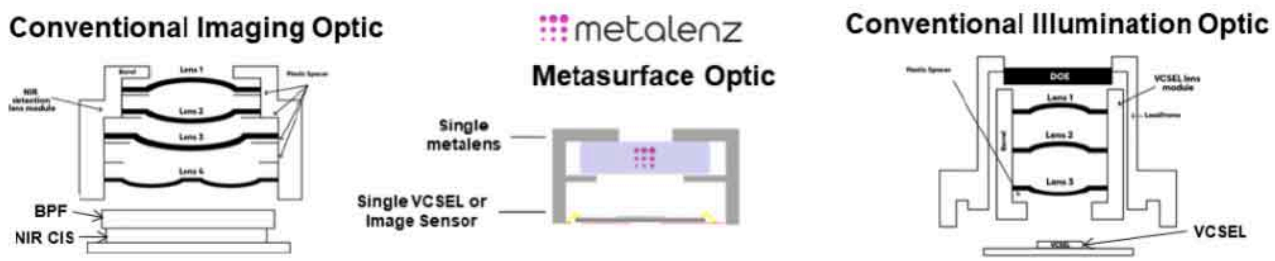
LIDAR AND IMAGING RADAR TECHNOLOGY NEWS

# Metasurface Optics Applications in Automotive Lidar

Metalenz is commercializing metasurfaces – a new optical element that allows complete control over all aspects of light (phase, wavelength, intensity, and polarization) with a single, planar semiconductor layer. Comprised of subwavelength nanostructures, a single metasurface can carry out optical functions typically requiring four or more conventional refractive and/or diffractive optics. This document will explore the different scenarios in automotive sensing systems – both external lidar and in-cabin driver monitoring – where a solution with Metalenz's innovative optical metasurfaces (meta-optics) can provide cost and performance improvements over traditional optics and whole new insights into the environment that current cameras and machine vision systems cannot capture.

While lidar systems contain various high-level tradeoffs, certain component-level choices can provide distinct advantages. The optics of many lidar systems use a combination of traditional refractive lenses and a diffractive optical element (DOE) for the transmitting (Tx) optics and refractive lenses for receiving (Rx) optics. As mentioned previously, automotive requirements dictate that optical systems operate across a very large temperature range and collect as much light as possible. Since the optical properties of traditional lenses vary with temperature, a complex optical assembly requiring many elements is typically required to athermalize the system. These additional system complexities and added costs can be overcome by using metasurface optics to replace refractive lenses and DOEs on the Tx and Rx sides of an automotive lidar system.

Meta-optics can combine the optical functions typically found in multiple refractive or diffractive optics into a single planar optical element.



For example, a single Tx metasurface optic can simultaneously perform the collimating functions of a refractive lens stack and the pattern metalenz.com generation function of a DOE and achieve similar or better optical performance. Alternatively, a single Rx metasurface optic can simultaneously perform the collimating and focusing functions of a refractive lens stack, again with similar performance. These meta optics can improve optical performance by improving light collection and contrast, reducing noise, and allowing wider field of illumination (FOI) and field of view (FOV) using single optical elements. In addition to their multifunctional design and performance enhancing capabilities, meta-optics have higher thermal stability than conventional optics, enabling them to maintain performance in the demanding automotive environment. Meta-optics also benefit from the proven semiconductor industry processes which are used to fabricate them, ensuring high part-to-part repeatability and reasonable scale- up to automotive quantities. These advantages make metasurface optics an attractive solution for automakers and tier-1 suppliers.

There are additional benefits to using a metasurface optic in an automotive lidar system, particularly on the Tx side. For line scanning applications, a single meta-optic can generate many (greater than one hundred)

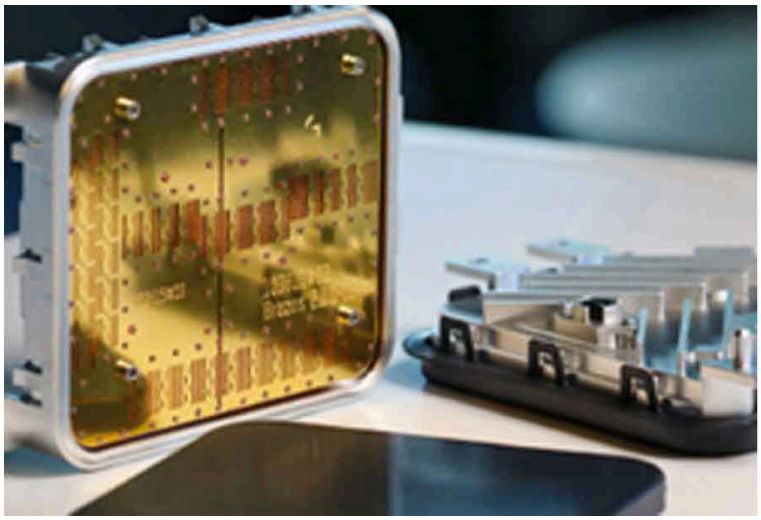
lines without a complex optical system and with a wide FOI (>150°). For diffuse patterns where a metasurface optic would replace a DOE and a refractive stack, precise control over the intensity throughout the FOI is possible in a single optic. In dot pattern applications for direct time-of-flight lidar systems, a meta- optic from Metalenz can generate highly uniform spots with high contrast ratio throughout the relevant FOI. As demonstrated by these examples, a key advantage of metasurface optics is their design flexibility due to their precise control over the characteristics and properties of the incoming light. Meta-optics from Metalenz have a particular design advantage for short- to midrange lidar systems for autonomous vehicles. Wide FOI optics are particularly desirable for peripheral sensing applications such as metalenz.com blind spot detection or lane assist, where shorter range lidar systems excel. Additionally, transmitting patterns rather than flood illumination can improve signal-to-noise ratio for these short-range applications. Metasurface optics from Metalenz can combine these desirable functions in a single optical element, saving cost while not compromising on performance. Metalenz’s optics are fabricated in state-of-the-art semiconductor foundries using well-established production techniques perfected over decades.

DVN comment

**Whereas automotive optical systems must operate reliably across a wide temperature range, traditional lenses exhibit temperature-dependent optical properties, necessitating complex assemblies to maintain performance. Meta-optics, with their inherent thermal stability, can replace efficiently refractive lenses and diffractive optical elements (DOEs) in lidar systems, simplifying design and reducing costs.**

## LIDAR AND IMAGING RADAR TECHNOLOGY NEWS

# Gapwave Guide Tech for Automotive Radars



An undisclosed tier-1 customer, with whom a collaboration started in Q1 2023, has placed a first big new order with Gapwaves, with more to follow.

Planar solutions based on PCB technology are often used for RF distribution and radiation. They have been good enough for most applications at low cost with easy integration. This was also the case for automotive radar in the previous lower frequency bands and the first generations of the new 77-GHz band. However, at mmWave frequencies, problems such as low bandwidth, high losses and expensive RF substrates become significant, and the limitations of PCB create opportunities for other technologies.

Some of the other possible technologies include traditional waveguides, substrate integrated waveguides (SIW), low temperature co-fired ceramics (LTCC) and lens antennas. Automotive radars have switched to the 76- to 81-GHz band, which is now required by international rules. The main advantages are more accurate distance measurement because of the wider band and the easier integration of sensors on the car because of the smaller size. At the same time, the growing functions of advanced driver assistance systems (ADAS) and the emergence of autonomous driving (AD) require more capable and accurate sensors. Along with the other sensors on the car, such as cameras and lidars, radars are expected to keep playing a significant role because of their low-cost and all-weather operation. However, they must keep improving their performance while meeting the strict cost, size, thermal and reliability requirements. To achieve a precise and complete perception of the vehicle's surroundings, different types of radar sensors exist In ADAS applications, one can differentiate between short-, mid- and long-range radars, depending on the distance and FoV needed for the functions, such as blind spot detection, lane change assist and forward collision warning, respectively. These sensors are specialized and increasingly common, with large volumes dominated by a few big tier-1 suppliers. They usually have between eight to 16 channels in a small form factor and cost is a key factor. The main performance challenge here is to achieve the desired range and FoV. On the other end of the spectrum are the more powerful and flexible high-resolution sensors, used for example in AD systems. They are also called imaging radars because they can provide camera/lidar-like perception through high resolution. These more advanced and premium sensors, with 30 to 100 channels, target a young market with many players and smaller volumes.

The main performance challenges are to realize low loss routing and complex large antennas with a lot of channels. Clearly, the wide range of sensor types means a wide range of priorities and optimal solutions that need to be addressed.

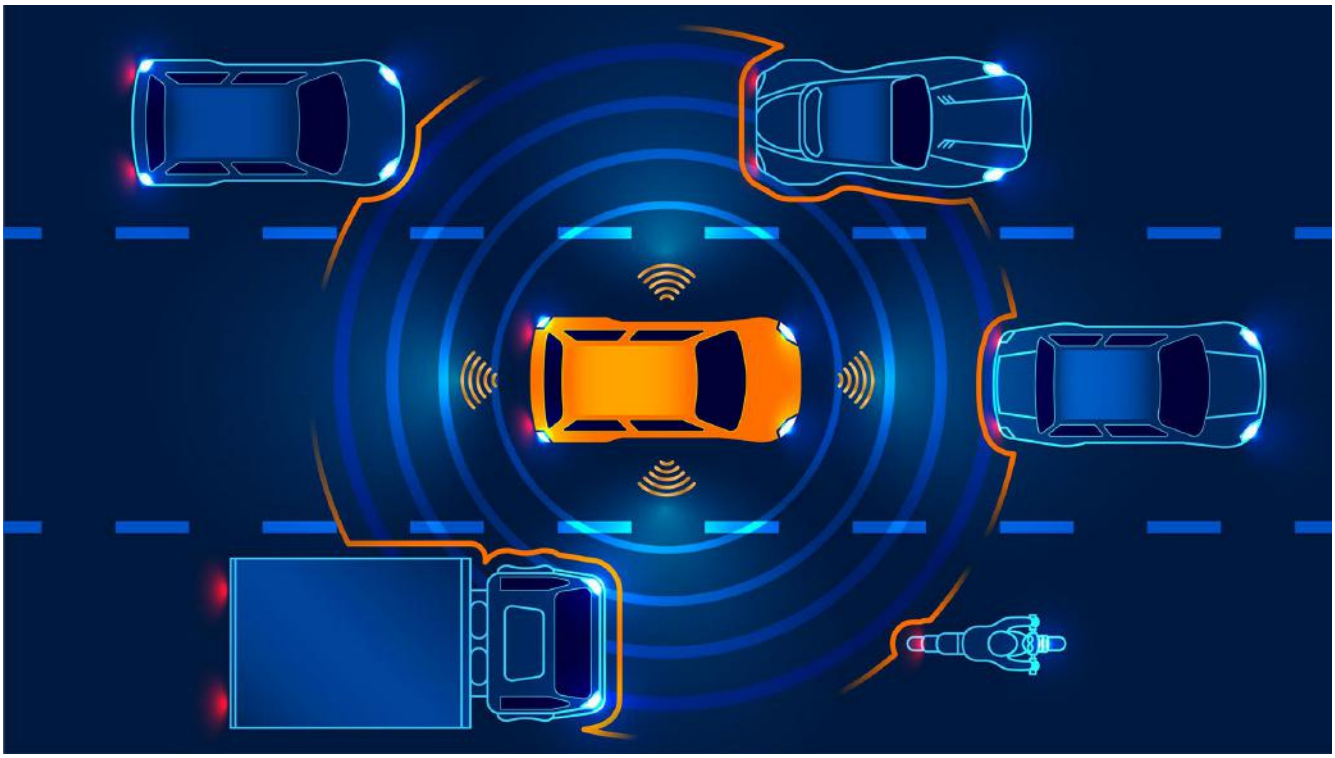
There are three main benefits of RF performance: strong pattern control, wideband operation and high efficiency. Waveguide antennas can create both very broad and focused patterns, as well as customized ones, very well. A good option is vertically aligned resonant series-fed slotted waveguide antennas, because they are flexible, simple and low profile. They have naturally broad and stable radiation patterns in the horizontal E-plane, which are better than patch antennas, and they allow easy control in elevation by their length and number of slots. This is ideal for short-range radars where a large azimuth FoV is important and spacing down to half-lambda is often needed. For applications that need focusing on the azimuth plane, such as for maximum range in long-range radars, columns grouping or hard surfaces are used. Customized beams, such as in corner radar where the direction of the maximum range is at about 40 degrees, can be achieved by careful phase and amplitude control. In terms of operational bandwidth, unlike PCB patch solutions, waveguides can support the whole 76- to 81-GHz automotive band easily. This gives flexibility in frequency allocation and more precise distance measurement. For this purpose, both impedance and, more importantly, radiation patterns must be well-behaved, which is harder the narrower the beamwidth. High efficiency is the most famous advantage of the technology. At the antenna level, losses are the least significant even for high gain elements. When it comes to routing, typical losses at E- Band are around 0.01 to 0.02 dB/mm (0.25 to 0.5 dB/in.) depending on the design and material characteristics, much lower than typical microstrip solutions. This is especially beneficial for large and multi- layer sensors such as imaging radars, where the antenna size and layout may require routing lines that are tens of centimetres long, including crossovers. Of course, designing and manufacturing large sensors with several channels is a challenge.

DVN comment

Gapwaves' waveguide technology gives automotive radars unmatched performance potential. Some of the main advantages are strong pattern control, full band support, minimal losses, and smaller, cooler, and shielded sensors. These benefits could help any new radar sensor to improve its performance and assist sensor makers to meet the requirements of L3 and L4 driver assist and autonomous systems.

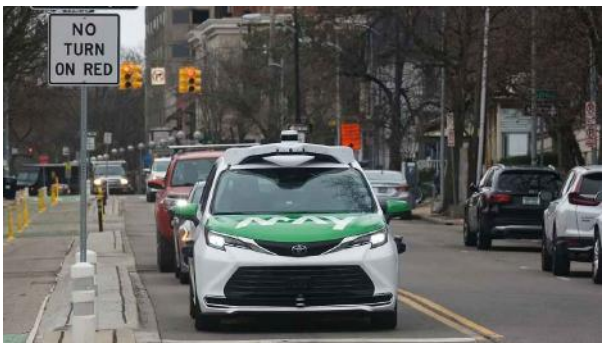
## AUTOMATED DRIVING

# AD NEWS



**IHS Launches New Rating Program for Partial Driving Automation Systems:** The U.S. Insurance Institute for Highway Safety has started a new rating program to test to encourage automakers to improve their safety measures as they develop more advanced automation technologies. The first evaluation of 14 systems showed awful results: only one system got an acceptable rating, showing that the industry still has a lot to do to make sure that drivers and roads are safe while using automation systems.

**KargoBot, an autonomous driving truck solution provider supported by DiDi**, was recently granted the first heavy-duty truck autonomous driving road test license by the Kangbashi district government of Ordos city, Inner Mongolia. This is the first time that region has allowed autonomous driving heavy trucks to test on public roads.




**May Mobility's Vision for Urban Transportation:** Tokyo Century Corporation, a major investor in May Mobility, a company in the US developing AV technology, has made a large investment in the firm. This strategic action intends to accelerate the launch and use of AVs, in North America and Japan.

**Zoox Improves Robotaxi Service:** Zoox has made some updates to make operations better in Las Vegas and Foster City. The company's new achievements include driving without human controls and carrying passengers on public roads.

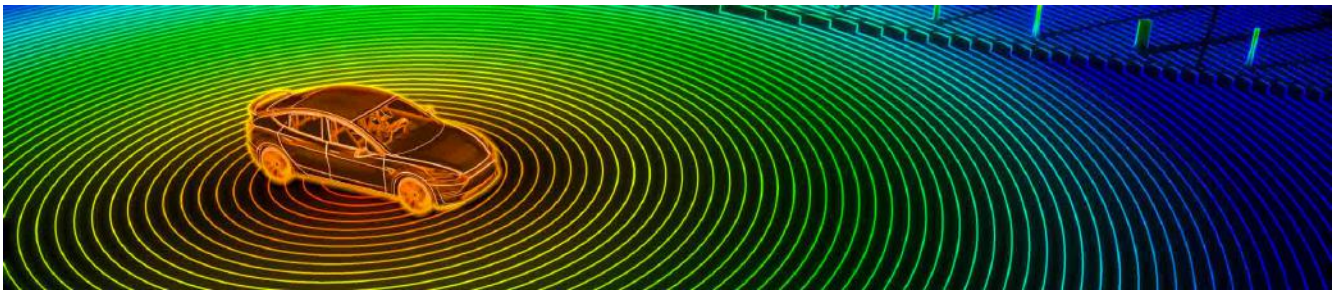
**Waymo Expands in Four Cities:** Waymo is set to extend their fully autonomous ride-hailing service to the public across four major cities within the year.

**Applied Intuition has a new automated parking** solution that aims to improve the performance and dependability of AD and ADAS. This novel solution stands to greatly accelerate the development, testing, and implementation of automated parking systems (APS), reaching speeds up to 12 times faster than existing methods.

**Waabi** has introduces Copilot4D, a novel foundation model which uses generative AI for a major advance in enabling machines to deal with and operate within a changing world, offering improved abilities for autonomous vehicles, robotics, and more.

DVN-LIDAR DEEP DIVE

# DVN-Lidar Deep Dive 1 @ Stuttgart: Final Docket



The workshop—almost fully booked—will focus on four key topics:

- Leading applications for Lidar such as *L*2+ and *L*3
- Regulation which allows a deployment of *L*2+, *L*3
- Current and future Lidar scanning technologies
- Key sensors & fusion concepts for AVs

## 8 April – Evening

19:00 COCKTAIL & WELCOME DINNER

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## 9 April – Full Day

08:20 Opening of the Deep Dive

### 08:30-09:30 SESSION 1 • APPLICATIONS 1 - LIDAR FOR L2+ & L3 APPLICATIONS

**Robosense** - Felix Yang, “Navigating Urban Landscapes: Exploring LiDAR’s Role in NOA”
**Hesai** - T ilman Gasche, "From Vision to Reality: Integrating LiDAR into SAE-Level 2 & 3 ADAS Programs"
**Continental** - Wolfgang Schultz “Far Distance Object Detection for L2+ to L4 fusion systems”
**Q&A**

### 09:40-10:15 SESSION 2 • APPLICATION 2 - AD REGULATION STATUS L2 + L3

**GRVA** – Francois Guichard “Update on recent regulatory activities at UNECE related to Automated and Connected Vehicles”
**Q&A**

10:15-10:50 Start-up Pitch & Coffe Break

**Ommatidia** – Eduardo Margallo - “Massively Parallel Coherent LiDAR for high resolution solid-state imaging”

### 10:50-12:00 WORKING GROUPS & SHARING

12:00-13:15 LUNCH BREAK

**13:15-14:15 SESSION 3 • TECHNOLOGY 1 - SCANNING TECHNOLOGIES & SOLID STATE**

**Microvision** - Hanno Holzhüter, "Scanning Technology Overview and position of MEMS"
**Scantinel** - Oliver Ramoli, "Realizing the needs for Autonomous Driving with a SingleChip FMCW LiDAR Technology"
**Cepton** - Henri Haefner, "Scanning by Micro Motion Technology (MMT)"
**Q&A**

**14:15-15:15 SESSION 4 • TECHNOLOGY 2 - AV SENSORS & FUSION – LIDAR, RADAR, IR**

**Tanway** - Guanjie Xhu, "Sensor Evolution: Hardware level EarlyFusion drives Perception Performance to Next Era?"
**Valeo** - A. Aaddaj El Oudrhiri, "High-definition sensors redundancy for AV' extended ODD"
**VANJEE** - Zhao ZHAI, "How will VanJee LiDAR+C-V2X solution create vehicle with utmost safety?"
**Q&A**

15:15-15:35 COFFEE BREAK

**15:15-16:35 WORKING GROUPS & SHARING**

**16:35-16:40 Closure**

16:40-18:00 Option: Visit Porsche Museum