DVN

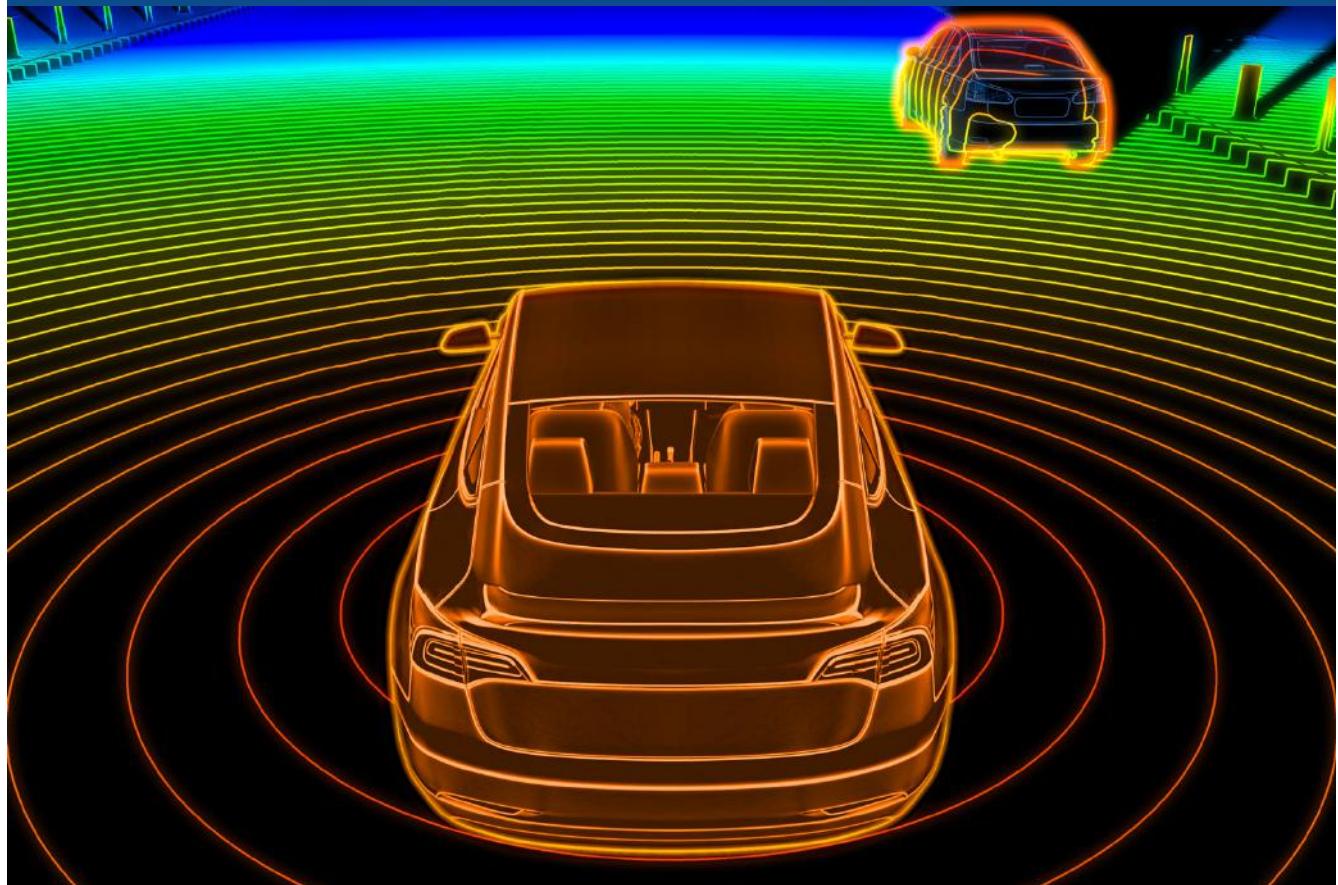**Sensing & Applications**

Monthly newsletter #5.1

MAY 7, 2025

What Hardware Will It Be For FMVSS 127?

Can a camera-only system enable a car to meet the tough FMVSS 127 requirements, or not? That was the hot topic of the DVN AEB Workshop, where the lighting and ADAS branches of the DVN community converged. In a nutshell, the ADAS teams think a camera alone is not enough to guard against false positives in high speed AEB (up to 100 km/h), and the lighting community doesn't think they can contribute much to improve camera performance. Find the details in our DVN special report.

In business and technology news, you'll find our coverage of the Shanghai Motor Show with new lidar sensors from Robosense and Hesai, and a new 4D Imaging radar from Hirain and Arbe.

Zooming out, mark your calendar for these forthcoming DVN events:

- EAC-DVN Lidar Tech Expo · Hangzhou, 4 – 6 June
- 8th Lidar Conference · Frankfurt, 19 – 20 November

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

All best,

Alain Servel

DVN-ADAS Sensing adviser

Lighting vs. Sensing at the DVN U.S. AEB WorkshopSpecial Report: DVN AEB Workshop (9-10.April in Detroit)

Paul-Henri Matha opens the workshop

DVN's Sensing & Applications business unit held a conference on 9 - 10 April in Novi, Michigan, addressing US-spec AEB (automatic emergency braking) to meet the challenging new FMVSS 127 requirements. Around 85 people from automakers, tier-1s, and technology suppliers attended, including experts in ADAS and lighting systems. DVN CEO Paul-Henri Matha opened the event with updates about DVN and our upcoming events in China and Germany.

The event marked the first time that the lighting and ADAS sectors of the DVN community engaged in a collaborative discussion to share ideas and address constraints and needs.

A third of the FMVSS 127's AEB test scenarios occur at night, some without streetlights, and with only the vehicle's low beam headlamps. Key questions include whether pedestrians can be detected with a simple front camera and current low beams, and if changes to the low beam are necessary—or even if they're possible—to avoid additional costs for the ADAS sensor kit.Current lighting standards and regulations do not appear to offer a complete solution; adequate detection by cameras would require illumination where none exists today. Jody Allen from GM highlighted the modifications which would be required in low beams to enhance camera performance, noting the challenges posed by current regulations and IIHS test protocols. These protocols prohibit the use of ADB, which means it would be difficult to get enough light to let the cameras do an adequate job without increasing glare beyond the present levels, which are already spurring pitched complaints from the driving public.

This example of a low beam pattern indicates that light is needed in specific areas for a camera to detect a pedestrian:
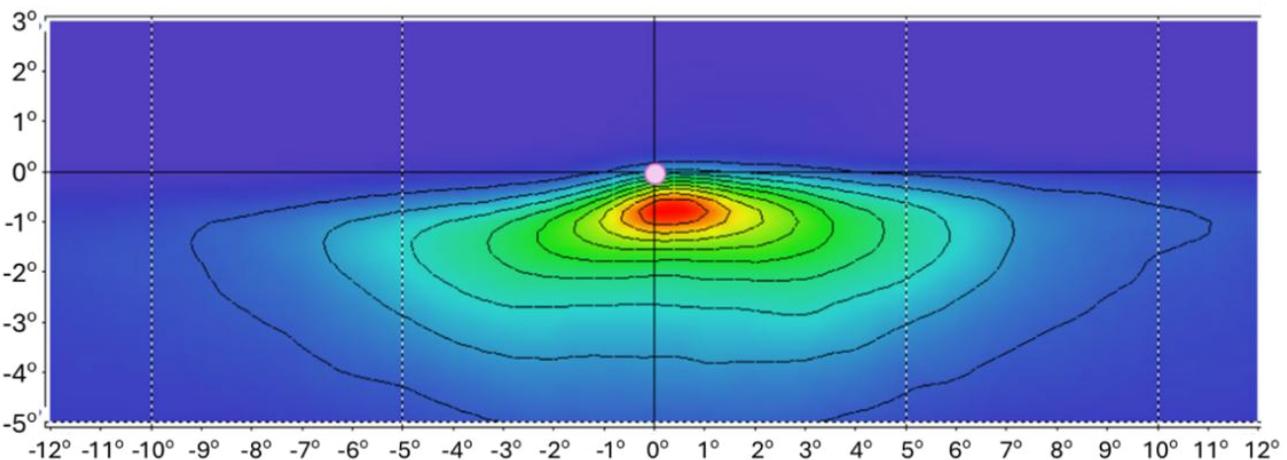
The illumination of a pedestrian along the 0° axis will vary and be partial, depending on their distance:
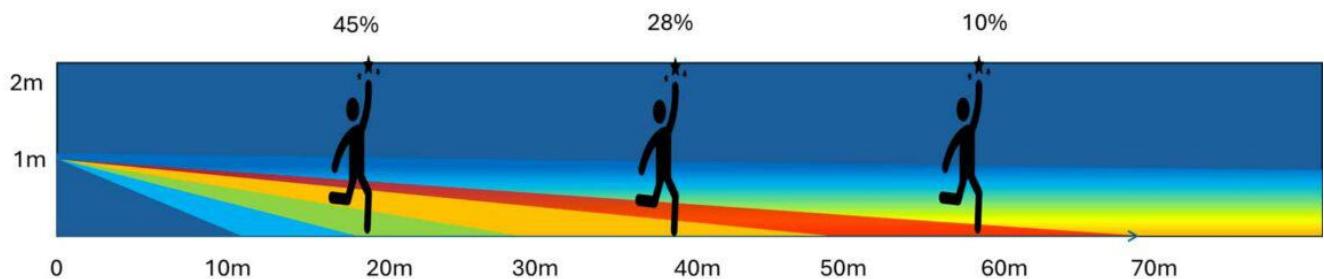

Pedestrian recognition by the camera varies with distance and azimuth position. For instance, a pedestrian 55m away and 5m to the right of the lane has an angle of 5.2°. Poor illumination hinders detection, which could be fatal by dint of too-late automatic emergency braking.

Table 23: PAEB Collision Avoidance Key Test Parameters

	Pedestrian Surrogate Reference Location	Overlap	Speed (km/h) Subject Vehicle	Pedestrian	Lighting Condition
Crossing Path	Right	25%	Any 10 – 60		Daylight
	Right	50%	Any 10 – 60		Daylight
	Right	50%	Any 10 – 60¹	5	Lower Beams
	Right	50%	Any 10 – 60		Upper Beams
	Right²	50%	Any 10 – 50	5³	Daylight
	Left	50%	Any 10 – 60	8⁴	Daylight
Stationary Along Path	Right	25%	Any 10 – 55		Daylight
			Any 10 – 55¹	0	Lower Beams
			Any 10 – 55		Upper Beams
Moving Along Path	Right	25%	Any 10 – 65		Daylight
			Any 10 – 65¹	5	Lower Beams
			Any 10 – 65¹		Upper Beams

¹ Final speed range requirements after an additional one-year phase-in.
² Obstructed, running child

Bob (dummy) 5km/h

10 to 60 km/h
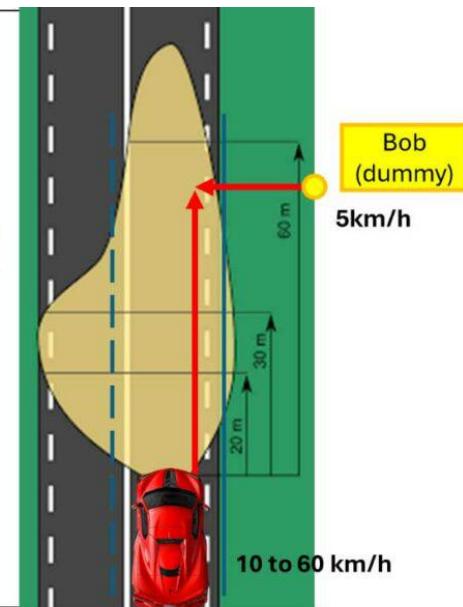
Questions arose regarding the adequacy of radar alone if the front camera falls short, the need for an additional sensor like an infrared camera for reliable redundancy, and the ASIL qualifications for nighttime functionality.

Each question seemed to generate more questions — which is typical of the current situation. It is evident that a camera alone will not suffice. Is adding radar sufficient, along with AI if it can really better classify objects and pedestrians? How will these systems perform in bad weather?

IR cameras or lidars could meet regulations and exceed expectations, even at high speeds and in bad weather or smoky environments. The cost of IR cameras has decreased significantly, targeting $100 by 2029. But concerns remain about the supply chain's capacity to produce the required quantities within four years.

Presentations covered a variety of AEB aspects. There were demonstrator cars from Compal, Valeo, Magna, Adasky, and Forvia Hella, showing impressive thermal cameras and object classification performance, as well as exhibits from Compal and Teledyne FLIR.

Key Takeaways

- FMVSS 127 was published on 2 March 2025. It's being challenged in court, but for now, the clock is counting down until the requirements come into force on all new cars.
- It will be difficult to change the rule since any change would require an approval of the US Congress.
- One challenge is the short timing applying to all new vehicles from 2029 (new and existing models). This might change.
- It seems unrealistic and very expensive to rework low beams by 2029 on all models. Any improvement would conflict with the fraught glare issue, which means the benefit will be limited. The easiest way would be to implement ADB to benefit from the high beam when it is possible.
- The high-speed AEB test scenarios are more stringent than the EU-NCAP ones, with a pass / fail criterion. This might require another sensor to augment the camera's limited nighttime performance.
- Some of the FMVSS 127 tests have been run with multiple brands and a limited number of models. Only one car passed, showing that automakers are not ready (though NHTSA took that single-car pass as evidence that the standard is technically feasible).
- Validation of false-positive avoidance will be a huge task; simulations will be necessary.
- The consensus is it should be possible to keep an ASIL B level for the system.
- The front camera has limited performance with the low beam.
- Improving the resolution of the imagers might help a bit, and then implementing split pixels or LOFIC solutions (Omnivision), but betting on a camera-only system is a serious risk. One key will be how much more performance can be squeezed out of the AI detection algorithms.
- Adding a radar might be a good solution; radar technology is cheap and might improve by using AI software which to discriminate static objects (Zendar, Perciv). Of course, there is a challenge to retrofit this into existing models.
- Magna thinks it's practical to reduce false positives by using ADB + camera + radar, all on-shelf technologies available at reasonable cost.
- Valeo suggests a scalable system to avoid betting on one technology, thus minimizing the risk of a technical dead-end.
- IR cameras give good detection performance with pedestrians, and a cost of $80 - $100 should be achievable with high volumes.
- Lidar would be good, especially FMCW lidar with doppler like a radar, but needs time before the cost becomes acceptable. If lidar is on the vehicle for other functions anyway, then it can be used for AEB.
- Some automakers are expected to go with these new technologies, mainly premium brands or those promoting high safety performance.

Here is the event program and roster of presenters. DVN members will soon have access to those presentations released for publication.

APRIL 9th - Part-I: ICE BREAKER

06:00 PM	**Welcome Cocktail & democars' test**
07:30 PM	**Standing Dinner on exhibition platform**

APRIL 10th - Part-II: CONFERENCE

08:15 AM	Opening
08:30 AM	**Keynote(s) - NHTSA Requirements & Challenges**
	• **General Motors** – Jodi Allen
	• **MAGNA** - Jan Erik Källhammer, Director of Visual Enhancement and Cognitive Systems
09:00 AM	**Q&A: NHTSA Requirements & Expected Challenges**

Session 1- Performance Lighting & Vision Systems

09:10 AM	• **APTIV** – Philippe Troia, CTO-EU - *Impact on Functional Safety of the FMVSS127 requirements*
	• **VALEO** – Joseph Thompson, Regional R&D Director
	• **OMNIVISION** - Jeffrey Morin, Automotive Imaging Solutions Specialist - *Pixel Scaling Automotive Image Sensors*
09:55 AM	**PANEL-1: Opportunities for Vision Systems**
10:10 AM	**Coffee Break**

Session 2 - Performance of Radars & Fusion

11:00 AM	• **FORVIA HELLA** - Nicholas Williams, Lead Program Manager, Advanced Driving
	• **PERCIV.ai** - Andras Palffy, Co-Founder
	• **ZENDAR** - Antonio Puglielli, VP of Engineering
	• **SABIC** - Carlos Pereira, Chief Scientist - *Optimizing radar transparency of plastics for exterior trim*
12:00 PM	**PANEL-2: Benefits of FUSION Systems**
12:15 PM	**Lunch break & democars' test**

Session 3 - Performance of IR Cameras

01:50 PM	• **ADASKY** - Bill Grabowski, Head of North America
	• **FLIR** - John Eggert, Global Head of Business Development, Automotive
	• **OBSIDIAN** - John Hong, CEO
	• **COMPAL** - Richard Seoane, General Manager

Session 4 - Performance of Lidars

	• **ROBOSENSE** - Scott Skelton, Director, Engineering and Technical Sales - *LiDAR's role in automakers meeting the latest NHTSA AEB rules*
	• **CEPTON/KOITO** - Henri Haefner, Senior Dir. Product Management
	• **Light IC** – Dr Jie Sun, Co-founder
03:35 PM	**PANEL-3: Benefits of the new technologies**
03:50 PM	**Coffee Break & democars' test**

Session 5 - Performance validation, Simulation/Calibration

04:40 PM	• **ANSYS** - Lionel Bennes, Lead Product Manager & Aaron Talwar - *Simulation-Driven Development for FMVSS 127 Compliance Using Perception-in-the-loop Testing*
	• **BURKE PORTER** – Brunno Moretti, President ADAS Solutions - *ADAS Sensors Post-Repair: A Hidden Threat To Road Safety*
05:10	**PANEL-3: Sensing Architecture & validation**
05:25	**CLOSING REMARKS**

Speakers

GM · Jodi Allen

Magna · Jan Erik Källhammer

Aptiv · Philippe Troia

Omnivision · Jeffrey Morin

Valeo · Dirk Shutle

Forvia Hella · Nicholas Williams

Zendar · Antonio Puglialli

Perciv · Andras Pallfy

Sabic · Carlos Pereira

Adasky · Bill Grabowski

FLIR · John Eggert

Obsidian · John Hong

Compal · Richard Soane

Robosense · Scott Skelton

Cepton - Koito · Henri Haeffner

Light IC · Jie Sun

Ansys · Lionel Bennes

Burke Porter · Brunno Moretti

DVN Interview: Zendar's Zach Beasley

Zach Beasley is a Senior Manager at Zendar, responsible for marketing and business development. He is an alumnus of the University of Texas at Austin, with a background in multi-disciplinary design and computer science.

DVN: Hello, Zach. Can you tell us a little about Zendar?

Zach Beasley: At Zendar, we're building a full-stack autonomous driving solution, designed to be more robust and affordable than today's systems. Zendar achieves this through proprietary radar technologies that enable safer, more reliable driving automations with lower cost and power consumption than camera-centric or Lidar-centric systems. Right now the cost of these systems limits their adoption around the globe. We aim to unlock the next level of scalability and affordability to bring the safety and comfort benefits of ADAS to more markets and more people.

From the beginning, we believed radar would be a better sensor foundation for automated driving than its more costly rival, Lidar. However, sensor size and mounting constraints have historically limited radar resolution. Furthermore, the traditional point-cloud based approach to radar signal processing has held back advances in AI perception, as this offers limited data availability to AI. We first had to develop technologies to overcome radar's limitations in angular resolution and object classification to unlock its full potential.

That vision led to the creation of our Distributed Aperture Radar (DAR), a technology that combines multiple standard radar units into a single, coherent system. DAR technology breaks the link between sensor size and performance, enabling a high-resolution, modular radar system using small, cost-effective sensors.

Building from there, we introduced Semantic Spectrum, an AI-driven perception layer that processes raw radar data to produce a high-precision object model of the environment. Together these two technologies have redefined what is possible with radar sensing in automotive, unlocking both new capabilities for radar and greater efficiency within the overall ADAS stack.

What began as a vision to reimagine radar has evolved into a scalable, software-defined perception technology—ready to meet the demands of autonomous mobility. We are now developing a full-stack solution with our semiconductor and tier-1 partners, complete with low-cost AI-enabled SoCs and state-of-the-art sensor hardware which will usher in a new era of affordability for ADAS technology.

DVN: What kinds of products are you developing?

Z.B.: We're building automated driving solutions from basic ADAS features like automated emergency braking (AEB) and adaptive cruise control (ACC) to higher levels of autonomy (L^{2+} and L^3).

Zendar's automated driving solutions leverage a high-resolution distributed radar network (powered by DAR software) and AI perception software that detects, classifies, and tracks objects in real time (even stationary or occluded ones, which traditional radar often misses). Combined, these technologies enable robust, scalable perception for ADAS and autonomous driving, especially in poor visibility and complex environments.

Our entry level product is an automatic emergency braking solution which we expect to be the lowest cost solution to meet NHTSA's 2029 AEB regulations (FMVSS 127). Zendar is also developing autonomy solutions for the L^{2+} and L^3 markets which leverage Distributed Aperture Radar and Semantic Spectrum AI.

DVN: What challenges do you aim to solve, and to what degree?

Z.B.: The performance of a sensor technology can be defined by two things: the quality of the data it produces (front-end sensing), and what the system is able to do with that data (perception back-end). The key performance indicators in radar sensing are accuracy and the capacity to distinguish between two nearby objects, also known as angular resolution.

The industry standard resolution for medium-range radar is around 4-5° in azimuth, which limits a vehicle's ability to distinguish objects, especially in dense or dynamic environments.

With Distributed Aperture Radar (DAR) we achieve an azimuth resolution of around 0.25° which is about 20x sharper than the medium-range radars commonly used in the industry for forward-facing applications.

The movement towards AI driven perception introduces a new paradigm for measuring the performance of radar, beyond classical resolution and accuracy specs. AI bypasses much of traditional signal processing, ingesting raw radar signals and outputting an object model of the world instead of a point cloud. While the point cloud model is defined by accuracy and resolution KPIs, the output of radar AI perception is measured similarly to camera-based AI, using precision and recall metrics which provides us an understanding of how well the system recognizes objects. We measure precision and recall of object detection across various classes of objects (cars, pedestrians, bicycles, etc) across various ranges, field of view, and scenario based groupings like driving through fog or highway versus urban drives.

DAR and Semantic Spectrum deliver enhanced perception across critical edge cases: nighttime pedestrian detection, adverse weather, occluded hazards, high-dynamic range situations, and static objects.

DVN: What is your competitive advantage versus other radar suppliers?

Z.B.: While many radar suppliers are building increasingly complex imaging radars to improve resolution, we are taking a software-first approach that avoids costly, specialized hardware. By using off-the-shelf automotive radar sensors in a modular coherent network, we keep costs low and integration simple. Zendar software then transforms these standard sensors into a high-resolution, intelligent perception system. Being inherently software-defined means our system is scalable, cost-efficient, flexible and upgradable over time.

DVN: Could Zendar's technology offer a solution for the FMVSS 127 pedestrian AEB requirements, particularly the nighttime scenarios?

Z.B.: NHTSA's latest regulation mandates pedestrian AEB systems to detect and respond to pedestrians in low-light and nighttime conditions. It also expands requirements to include a broader range of real-world scenarios: pedestrians crossing or walking along the vehicle path, emerging from occlusions like parked cars, and standing still. Systems must also operate effectively at speeds up to 45 mph for pedestrian scenarios, and up to 90 mph for vehicle-to-vehicle situations.

Camera-based systems often struggle in darkness, high-contrast lighting, and adverse weather. Traditional radar systems, while robust to these situations, tend to miss stationary or closely spaced objects due to low resolution.

Our system addresses both challenges. Radar isn't affected by lighting or weather, and with Distributed Aperture Radar, we improve traditional radar resolution to be able to solve Pedestrian AEB challenges. Moreover, Semantic Spectrum AI solves the issue of stationary object blindness, which is ubiquitous with today's medium-range radar sensors. This innovation enables a pathway to solving nighttime Pedestrian AEB test cases without the need for hardware upgrades as Semantic Spectrum is compatible with the radars already standard across the vast majority of models sold in the USA.

See this video, testing Semantic Spectrum AI against the FMVSS 127 AEB scenarios.

DVN: When will you be able to commercialize software with full validation for public roads? How will you validate?

Z.B.: Zendar anticipates SOPs starting as early as 2027 for Semantic Spectrum AI, with deployment of Distributed Aperture Radar following between 2028 and 2030, driven by new L^3 platform releases.

Our first full-stack L^{2+} system is currently being developed in India in a collaboration with a leading local OEM and Tier-1. The anticipated SOP for this system will be in 2028 for an initial deployment for the highway operational design domain.

We validate our technology using both open source and proprietary data sets, and develop our products to meet all relevant functional safety standards. As part of our partnerships with OEMs and tier-1s, we go through rigorous testing to ensure safety and reliability of our solutions.

DVN: Are you collaborating with potential customers?

Z.B.: Yesm we have active collaborations with two premium German OEMs, a leading Indian OEM, and multiple global tier-1s.

In addition, multiple OEMs have approached us exploring options for a cost-effective solution to meet upcoming AEB regulatory requirements defined by NHTSA.

DVN: How did CES go for you? What were the benefits of attending CES for your company?

Z.B.: There's no show quite like CES, and I'd say that it's a key driver of Zendar's success. We have been invited to showcase our innovations in radar software alongside our semiconductor partners for two years in a row now. The advantage of being partnered with a global semiconductor leader at CES cannot be overstated. This year we were featured in NXP's booth as part of their technology showcase. High level decision makers at OEMs and tier-1s visit the showcase to see the latest innovations in chip technology, and Zendar's software solutions are an example of what can be unlocked with NXP's radar portfolio. It's a win-win, as our semiconductor partners are able to demonstrate how their chips are enabling new possibilities in radar, while we are able to stand out from the noise and showcase the value of our technology with key decision makers.

DVN: Could your technology also be used on the likes of cameras and lidars?

Z.B.: Distributed Aperture Radar and Semantic Spectrum AI are radar-specific products. Radar has different physics than camera or lidar, therefore these technologies are not transferable to alternative sensing modalities. Zendar's innovations and sensing and perception are built specifically for radar, though being software-defined we are compatible with a variety of radar hardware and high-performance compute platforms, not just a singular hardware device.

Zendar's full-stack solution uses a fusion of radar and camera to effectively understand and navigate through the world. We do not believe lidar is necessary for safe and reliable driving automation, but it can be used in combination with radar and camera in our perception stack as well if an OEM opts for this kind of sensor fusion.

DVN: Do you think radar + camera perception systems can outperform lidars? If so, what are the relative merits?

Z.B.: Yes, radar + camera fusion can absolutely outperform lidar in many real-world driving scenarios. Lidar provides dense, high-resolution point clouds, but it has several limitations: it's sensitive to weather, struggles with occlusions, lacks inherent velocity data, and remains costly to scale.

In contrast, radar performs reliably in poor visibility — whether it's rain, fog, darkness, or glare — and is effective at detecting hazards even when occluded. We gain rich, low-latency spatial understanding of the environment from the radar, which is augmented by contextual understanding of road signs, traffic lights, and an understanding of color and fine detail from the camera.

The result is precision through fusion. With AI-driven radar + camera fusion, we combine radar's robustness and efficiency with the camera's fine resolution—creating a system that is highly accurate, while being more resilient and costing less than lidar-based systems.

DVN: Imaging radar hardware gets increasingly complex to reach adequate resolution in azimuth and elevation. Could distributed radar architecture be a solution?

Z.B.: Traditional imaging radars achieve higher resolution by packing antennas into a single sensor, which increases cost, sensor size, and power consumption — all of which make it difficult to integrate into vehicle designs. Alternatively, Zendar's approach increases radar resolution without increasing sensor size in a software-defined approach. We use multiple standard radar sensors spaced apart on the vehicle as building blocks in a modular sensor network. We then fuse their signals to operate the sensors together as a single, coherent system, creating a much larger aperture without the increases in cost or power consumption that come with a large monolithic sensor.

This method allows high angular resolution in both azimuth and elevation without the need for expensive radar hardware. OEMs can design high-performance solutions using the same hardware they use on their entry-level models, creating a truly scalable platform and unlocking economies of scale through a simplification of the supply chain.
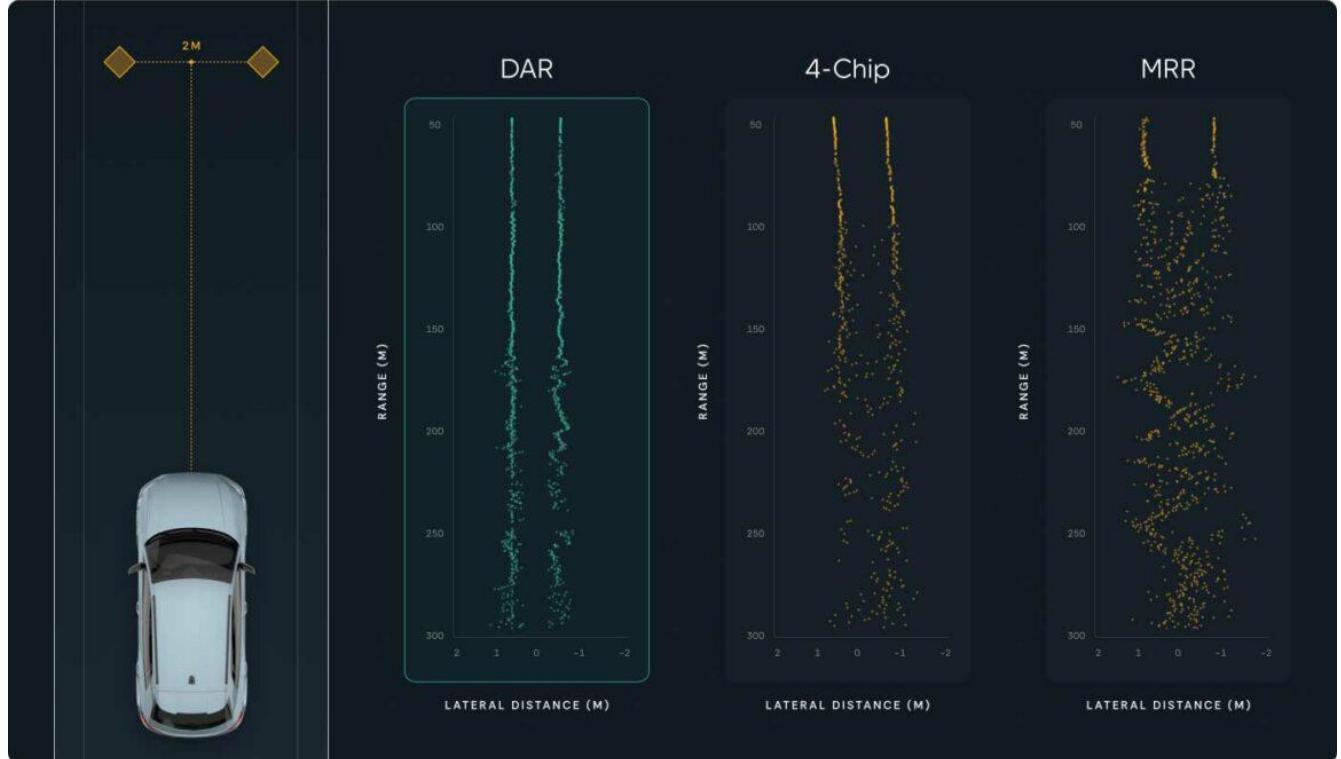
DAR resolution compared to 4-chip cascaded imaging radar and standard medium-range radar

DVN: Performance of distributed radars depends on a high phase and frequency coherence between the radar units. How do you propose to synchronise?

Z.B.: With DAR, we construct a large coherent aperture in software in order to reach the level of angular accuracy and resolution needed for higher level of autonomy. It means that we want to be coherent enough to transmit from one sensor and receive on the other. This requires aligning the radar module at several levels: at the carrier frequency, the time and phase levels.

In monolithic radars, the coherence across the aperture is achieved through hardware-intensive synchronization. Whether the sensor is using single chip or cascaded chips, several signals are then shared within the HW: a local oscillator, or LO, signal, a reference clock and a frame trigger.

In a DAR architecture, the radars are physically separated. Therefore we need another way to synchronize the radar modules, in HW or in SW. There can be no shared LO signal, and we must find other ways to share a common reference clock and frame trigger.

At Zendar, we have developed synchronization approaches to achieve synchronization on each of these parameters. We synchronize radars over ethernet with a combined software and hardware approach. Coarse synchronization is achieved with hardware, at the tens-of-nanoseconds level. Further software synchronization brings that figure down under 1 nanosecond. We have also developed monitor routines to ensure the quality of the sensor alignment while operating.

Sensing Business Newsbites

RoboSense Partners with SAIC-VW for Joint Venture 2.0
RoboSense CEO Mark Qiu, at the SAIC Volkswagen Brand Day Launch Event, joined representatives from Baidu, Alibaba Cloud, and CATL on stage to jointly sign a 'Technology & Ecosystem' strategic cooperation agreement with SAIC Volkswagen.

Aumovio is New Continental Brand for Automotive Biz
Continental Group's Automotive Business will be renamed Aumovio'. The new branding aims to leverage Continental's market position and expertise to drive innovations in future mobility. Aumovio will focus on electronic products and advanced solutions for software-defined vehicles, autonomous mobility, and connected driving. According to a Berylls report, the automotive value of these solutions per vehicle is expected to grow by 4.7 per cent per year through 2029.

Bosch Mobility Grows SDV Biz in China

Bosch Mobility grew 4 per cent to C¥116.6bn (€15bn) in China last year, surpassing the market's growth of 3.7 per cent in vehicle production. In 2024, China produced 31.3 million vehicles, including 27.5 million passenger cars and 4 million commercial vehicles. Bosch's prospects are strong, with over 65 percent of new orders in electrified powertrains and software-defined cars.

Automotive Lidar Market to Reach $1.83bn by '28

Allied Market Research has a new report out: 'Automotive Lidar Market Size, Share, Competitive Landscape and Trend Analysis by Application, Technology, Range and Vehicle Type: Global Opportunity Analysis and Industry Forecast, 2021-2028'. It forecasts the global automotive lidar market, valued at USD $221.7m in 2020, will reach $1,831.9m by 2028, with a CAGR of 30.3 per cent.

Innoviz, Fabrinet Partner for Lidar Production

Innoviz has partnered with Fabrinet, a global leader in precision manufacturing. This collaboration aims to mass-produce Innoviz's advanced InnovizTwo lidar platform. By leveraging Fabrinet's automotive-grade manufacturing expertise, Innoviz is preparing to meet the rising demand for high-performance lidar systems. Fabrinet's facility has passed audits under the German automotive VDA 6.3 standard, ensuring reliability and precision critical for automotive applications.

Hesai Enters Partnerships to Expand Lidar Applications

Hesai Technology has announced partnerships with Manycore Tech, KargoBot, and Kutting Technology to expand the use of lidar in spatial intelligence, autonomous freight, and smart garden equipment. Hesai and Manycore will create a solution for robot simulation training by combining Hesai's lidar with Manycore's SpatialLM model and SpatialVerse solution for precise 3D spatial modeling and property labeling.

RoboSense EMX 192-Line Digital Automotive Lidar

RoboSense's new EMX digital lidar boasts true 192-line resolution and advanced digital architecture. CEO Qiu Chunzhang discussed the company's progress alongside the automotive industry's smart evolution, from the R platform to mass-production with the M platform, chip-level innovation with the E platform, and now the customizable EM platform.


Zeekr 007GT Has Hesa Lidar

Zeekr is putting Hesai's ATX lidar in the new 007GT luxury sedan. Plans are to put Hesai's lidar technology into more Zeekr models, as well.

Automotive Camera Market to Reach $25.7bn by '33: Report

Emergen Research's report, 'Automotive Camera Market by View Type, Technology, Level of Autonomy, Vehicle Type, and Region Forecast to 2033' predicts the market will grow from USD $8.9bn in 2024 to $25.7bn by 2033, at a CAGR of 12.5 per cent. This growth will be fuelled by the rising demand for ADAS and autonomous driving technologies, along with increased adoption of high-resolution cameras for vehicle safety and surveillance.


RoboSense, DiDi AD Partner for L^4 Robotaxi Production

RoboSense and DiDi Autonomous Driving have entered a partnership to develop L^4 autonomous driving technologies. DiDi's first L^4 robotaxi model, co-developed with GAC AION, will use RoboSense's E1 digital lidar sensor to improve perception capabilities and expand application scenarios.
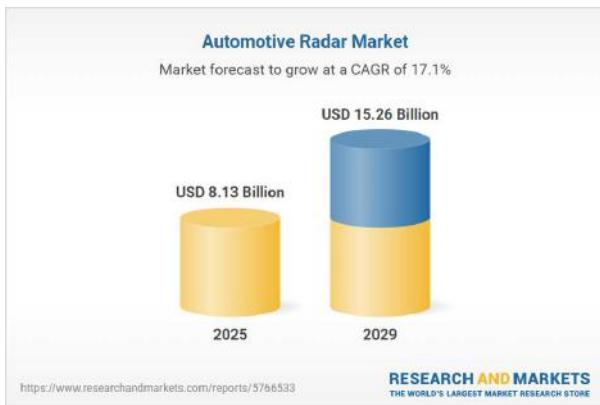
Auto Radar Market to Reach $25bn by '34: Report

Research and Markets has published their 'Automotive Radar Market Opportunity, Growth Drivers, Industry Trend Analysis, and Forecast 2025-2034'. The market was valued at USD $6.5bn in 2024, and is predicxted to reach $25bn by 2034, rising at a CAGR of 14.6 per cent. This growth is being driven by the continuous advancement of radar technology, including innovations such as 4D imaging radar, digital beamforming, and AI-powered radar processing. These are improving range, resolution, and interference suppression, making radar systems more effective for ADAS and autonomous driving.
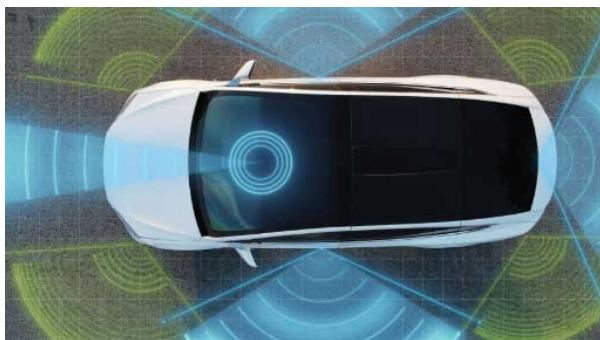
Stradvision to Launch MultiVision II in '27

Stradvision has published their three-year roadmap to innovate in autonomous driving. They aim to develop SVNet MultiVision Gen 2 by 2027, with a prototype debuting at CES 2026. This system will integrate perception, planning, and control for higher reliability and autonomy. It features 11 camera channels and HD-mapless capability, enhancing precision and adaptability without relying on high-definition maps.

Leapmotor, Hesai in Smart Driving Domain Pact

Leapmotor has announced a partnership with Hesai, under which Leapmotor will purchase about 200,000 of Hesai's ATX lidar sensors starting this year. Hesai remains the exclusive lidar supplier for Leapmotor.

Uisee, Seyond Partner for AV Solutions

Uisee and Seyond have agreed a partnership to improve autonomous vehicle applications, starting with airport buses and UiBox models. This collaboration will support L3-4 autonomous vehicles in all-weather, all-time, and all-scenario operations. Uisee's U-Drive driving system integrates advanced self-driving algorithms into automotive-grade controllers, featuring a complete sensor layout, cloud connectivity, and a big data platform for continuous upgrades.

RoboSense Revenue Grows 47.2% YoY
RoboSense's 2024 financial results highlight substantial revenue growth due to the rise in autonomous driving and robotics. The company earned approximately C¥1.65bn, a 47.2-per-cent year-on-year increase, continuing three years of strong growth. The company's Lidar sales rose 109.6 per cent to about 544,000 units.

Lidar Technologies News

RoboSense's New 192-Beam Digital Automotive Customizable Lidar

RoboSense has launched the EMX, their new 192-beam high-performance automotive digital lidar. They describe it as setting a new industry benchmark, accelerating the mass adoption of digital lidar with unmatched performance, integration, and customization capabilities.

The compact EMX features an upgraded intelligent 'gaze' function, and supports extensive customization. With RoboSense's EM platform digital advantages, the EMX delivers 192-beam high-density scans, producing 2.88 million points per second, with global angular resolution of 0.08° × 0.1°, and detection capabilities within 300 meters. It can detect objects such as black vehicles and traffic cones within 200 meters.

It integrates RoboSense's proprietary scanning technology, combining control algorithms with scanner dynamics for scanning rates up to 20Hz — exceeding industry standards, and significantly cutting response latency to improve the equipped vehicle's ability to react to pedestrians or execute fast lane changes safely. With up to a 140° FOV, the EMX can dynamically increase horizontal angular resolution up to six times.

It functions well under challenging environmental conditions, with features like anti-reflectivity interference, noise reduction for rain, fog, and dust, and resistance to contamination and water stains. It uses SPAD-SoC and VCSEL chips to provide high detection sensitivity and maintain data integrity, improving spatiotemporal synchronization and fusion perception outcomes. It measures 120 × 80 × 30 mm, making it one of the smallest digital automotive main lidar units.

The EMX product design has received industry recognition and earned design wins from multiple automotive OEMs upon launch. Production will start within the year.

RoboSense provides comprehensive lidar capabilities including emission, scanning, and data processing. Their digital lidar portfolio supports various automotive and robotic applications. This year, they introduced products such as E1R and Airy for robotics, and EM4 and EMX for automotive use.

For example, the ID.ERA, SAIC Volkswagen's first range-extended full-size SUV concept car, debuted at Auto Shanghai 2025 with an EM4 Lidar. The model has a range of over 1,000 kilometers (CLTC) and includes an intelligent assisted driving system that covers high-speed, urban, and point-to-point navigation without requiring maps. The design features 'German simplicity' and 'Eastern aesthetics', integrating intelligent sensing components like lidar into the car body for a futuristic appearance. The production version of the ID.ERA is anticipated to launch in 2026.

These products establish industry standards and allow RoboSense to customize solutions quickly. For instance, the EMX has up to 384 beams for advanced driving, while the EM4 meets high-end needs with up to 2,160 beams, providing ultrahigh-definition options. The EMX launch expands RoboSense's digital lidar portfolio, offering customizable solutions that support continuous innovation in automotive and robotics sectors.

EMX versus EM4

|	EMX	EM4
Wavelength	905 nm	905 nm
Distance range	300 m @ 10% albedo	300 m
Distance separation	0.1 m	0.1 m
H FOV	140°	120°
H separation	0.08°	0.05°
V FOV	20°	27°
V separation	0.1°	0.025°
Update rate	20 fps	20 fps
Size (mm)	120 × 80 × 30	120 × 80 × 30
Connectivity	Eth 1GB/s	Eth 1GB/s

🔖 DVN comments

RoboSense's market success stems from market-driven collaboration and ongoing innovation. By March 2025, RoboSense partnered with over 30 automakers and tier-1 suppliers like BYD, Zeekr, and IM, securing more than 100 vehicle models. In early 2025, RoboSense supported the launch of 15 models, including Toyota bZ3X, GAC Trumpchi S7, and Geely Galaxy E8. According to Yole Group's report, RoboSense held a 26-per-cent global market share for passenger car lidar in 2024, ranking first in market share, annual ADAS lidar sales, and cumulative shipments from 2018 to 2024.

Hesai's Infinity Eye Lidar For L^{2-4} AD Systems

Hesai's Infinity Eye solution comes in three configurations: A for L^{4+} autonomous systems, B for L^3 conditional autonomous driving, and C for L^2 assisted driving.

Infinity Eye A: UltraHigh-Definition, Zero Blind Spot Perception for L^4 Autonomous Driving
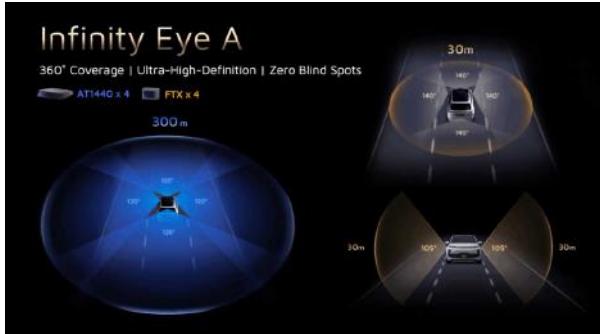
Infinity Eye A combines four ultrahigh-definition AT1440 lidars with four solid-state FTX lidars to offer full 360° coverage with zero blind spots. This configuration provides both long-range and short-range detection, ensuring comprehensive awareness for autonomous applications like robotaxis and robotrucks.

Infinity Eye B: Extended Range and Comprehensive Perception for L^3 Autonomous Driving

Tailored for L^3 conditional autonomous driving systems, it has a forward-facing, long-range ETX lidar and two FTX lidar for blind-spot detection. This multi-lidar configuration balances extended ranging capability with wide-angle field-of-view perception, essential for L^3 driving tasks, where the vehicle self-drives in certain situations while allowing for human intervention.

Infinity Eye C: Compact and Powerful Lidar for L2 ADAS

Infinity Eye C is designed for L^2 ADAS and includes the ATX lidar, with a 200-meter ranging capability at 10 per cent reflectivity, up to 256 channels, and an angular resolution of 0.1° × 0.1°, which allows for the detection of distant obstacles. The ATX uses Hesai's Intelligent Point Cloud Engine (IPE) to filter out over 99.9 per cent of environmental noise, providing stable perception in all weather conditions. Its compact design and low power consumption enable flexible integration into the vehicle body or behind the windshield.

Alongside Infinity Eye, Hesai offers three additional automotive-grade lidar products:

AT1440 ultra-high definition lidar

This long-range lidar is the world's highest-channel-count automotive-grade ultra-high-definition lidar. Powered by Hesai's fourth-generation proprietary chip, it features 1,440 channels and a ranging capability of 300 meters @ 10% reflectivity. It uses cutting-edge high efficiency photodetection and parallel processing technology, increasing lidar channel count by 10 times compared to similar products on the market. With a point rate exceeding 34 million points per second, the AT1440 delivers over 45 times the point cloud density of mainstream automotive lidars. This enables highly precise perception of small objects on complex urban roads, as well as subtle surface changes like bumps and dips. The AT1440 will enter mass production in the second half of 2025, debuting on Kargobot's first-ever future transport robot, and will also be deployed in Kargobot's mass-produced L^4 autonomous truck platooning solution, supporting the large-scale commercialization.

FTX solid-state blind spot lidar

The FTX is the world's widest field-of-view fully solid-state lidar, featuring an ultra-wide 180° × 140° field of view. It delivers over twice the resolution of its predecessor, while reducing the exposed window area by 40 per cent. It effectively covers blind spots around the vehicle and accurately detects low-profile obstacles such as curbs, pets, and other small objects to enable precise automated parking. It can monitor fast-approaching vehicles from the rear and sides in real time, providing critical support for safe lane-change decisions.

ETX ultralong-range lidar

The ETX automotive lidar boasts the longest range for L^3, with a 400-meter range at 10-per-cent reflectivity, thanks to Hesai's Photon Vector Technology. It offers eight times the resolution of the AT128 lidar with 0.05°H × 0.05°V angular resolution. The ETX is compact, maintains Class 1 eye safety, and reduces size and power consumption. It has secured multi-year nominations from a leading European automaker, with mass production to start in 2026.

	AT 1440	FTX	ETX
Wavelength	905 nm	940nm	905nm
Distance range	200 m @ 10% albedo	30 m @10% albedo	400 m @ 10% albedo
Distance precision	0.03 m	0.03 m	0.03 m
H FOV	120°	180°	120°
H separation	0.1°	256 pixels (0.7°)	0.05
V FOV	20°	140°	20°
V separation	0.1°	192 pixels (0.7°)	0.05
Update rate	20 fps	20 fps	20 fps
Size (mm)	100 × 100 × 30	74 × 50 × 44	137 × 120 × 36
Connectivity	Eth 1GB/s	Eth 1GB/s	Eth 1GB/s

🔖 DVN comments

Hesai is leading in the fast-growing ADAS passenger vehicle market, especially in China. Since 2018, about 120 vehicle models have adopted lidar, with nearly 40 new models launched in the last two years. Lidar is moving beyond luxury vehicles to more affordable models, including C-segment cars around $25,000. This democratization resulted in a 68-per-cent growth in the ADAS passenger car lidar market year-on-year in 2024, a significant industry milestone.

Camera Technologies News

Thermal Imaging to Boost Pedestrian Safety

Vehicle vision solutions built on IR sensors are ramping up, with the aim to help reduce nighttime pedestrian fatalities. For developers of IR sensors and cameras, the race is on to position SWIR and LWIR technologies for mass adoption by the automotive industry.

A scene as seen by a standard camera (L) and a thermal camera (R)

Last year, the NHTSA finalized FMVSS 127, which requires automatic emergency braking (AEB), including pedestrian AEB (PAEB), to be standard equipment on all passenger cars by September 2029. New vehicles will have to have PAEB systems to help nighttime drivers avoid collisions with other vehicles when traveling at 62 mph (~100 km/h) and pedestrians when traveling at 37 mph (~60 km/h).

A car equipped with PAEB traveling at 37 mph needs about 148 ft (45 m) to stop. It is possible to achieve high-confidence detection of a pedestrian at this distance with a low-resolution thermal camera (<0.1 megapixels). According to Sebastien Tinnes, global market leader for IR detectors designer and manufacturer Lynred, a 12-µm pixel pitch quarter video graphics array resolution thermal camera (320 × 240 pixels) can fulfil all FMVSS 127 requirements.

Currently, thermal imaging and lidar are the leading technologies to meet the PAEB requirements, but other technologies exist as well; the ADAS in most vehicles primarily use radar, and some also include visible cameras.

Strengthening synergies among detection technologies will be crucial for complying with FMVSS 127. While ADAS work well during clear weather conditions, their effectiveness diminishes in poor weather and darkness. Teledyne FLIR has seen increased demand from automakers to expand sensing capabilities, often adding a thermal camera to existing solutions.

Sensor fusion combines multiple modalities into a common system, but it's still evolving in the context of ADAS. Last fall, Teledyne FLIR partnered with Ansys and Valeo to integrate thermal cameras for night-vision ADAS, enhancing functions like nighttime AEB for various vehicles.

Teledyne FLIR's next-generation automotive thermal camera will be smaller and lighter, with a resolution of 640 × 512 pixels, surpassing previous systems. Comparisons between thermal and visible sensors highlight advantages such as size, cost, and performance. Lynred plans to introduce a product with an 8.5 µm pixel pitch within the next two years.

Many of the technologies involved in autonomous mobility and automotive safety systems are well established. Sensing and imaging in the SWIR band, for example, is often used in harsh environments and nighttime settings. This approach provides high-resolution images in such challenging conditions. Solutions for industrial manufacturing, surveillance, counterfeiting detection, and food inspection use SWIR sensing and imaging.

Israeli startupTriEye is developing a CMOS-based SWIR sensing solution for ADAS. TriEye's detection and ranging platform uses a CMOS-based high-definition SWIR sensor that combines the functions of a camera and lidar into one modality, offering 2D and 3D mapping capabilities. Unlike LWIR sensors, TriEye's SWIR technology can be placed behind standard glass windshields and headlamps. Windshield glass is opaque to LWIR light, preventing system integrators from positioning many thermal cameras behind standard windshields due to the limitations of incoming and perceived light.

"The compatibility of SWIR camera outputs with existing computer vision algorithms simplifies the integration process, avoiding the need for extensive training of new deep learning algorithms required by thermal camera systems due to their unique heat-based imagery," said Nitzan Yosef Presburger, head of marketing at TriEye. Presburger stated that SWIR illumination, compared to MIR and LWIR illumination, is less affected by external environmental conditions. SWIR cameras rely on a photodiode effect that produces detailed views distinct from those based on thermal differences measured by bolometric sensors commonly found in LWIR cameras. Additionally, thermal imaging's extended wavelength (~10 µm) may reduce resolution by enlarging pixel sizes and limiting pixel density. Larger pixels also necessitate larger lenses for thermal cameras compared to visible light counterparts.
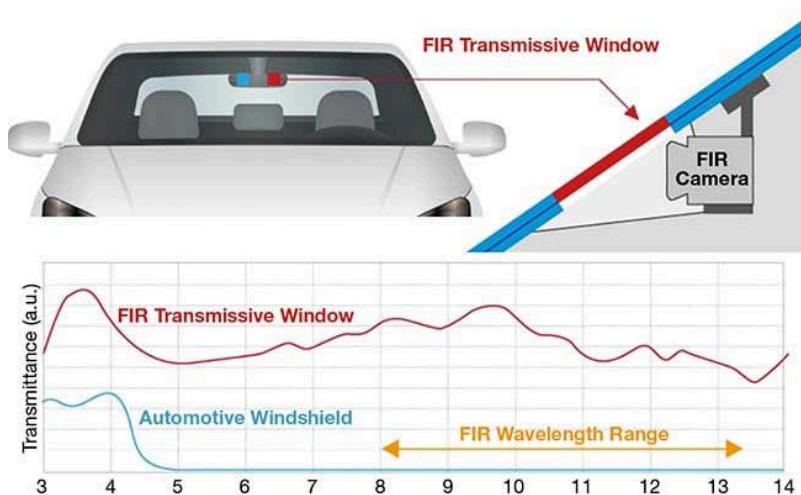
TriEye's technology seeks to address the challenges posed by traditional windshields while taking advantage of the benefits of SWIR imaging.

However, SWIR solutions may be costly, and according to Merrill, these cost concerns are pushing automotive industry customers away from SWIR and towards LWIR. SWIR sensing and imaging's reliance on active illumination also makes it susceptible to interference from living light sources. The additional light sources needed to support SWIR sensors add costs to current solutions as well as creating power concerns in some instances.

"If all cars are equipped with SWIR illuminators, it creates a similar effect to headlamps for visible cameras: the camera can be overwhelmed by other illuminators from other vehicles," Tinnes said.

System integrators have historically positioned LWIR thermal cameras on the grills of vehicles due to their inability to function effectively behind a standard windshield. These exterior-situated cameras do not benefit from windshield wipers that clean water and debris from the lens. However, methods such as hydrophobic coatings, air blasts, and spray nozzles are often employed to clear the window, as noted by Merrill.

In response, several automotive industry suppliers have developed windshields conducive to LWIR. For instance, last September, Lynred, in collaboration with glass experts Saint-Gobain Sekurit, introduced a design that integrates visible and thermal cameras. This windshield features a section that is transparent to longwave radiation, allowing a sensor fusion that enhances daytime detection rates through redundancy and extends the operational design domain of PAEB at night. This third-generation windshield with improved integration was showcased by the collaborators at AutoSens USA 2024 in Detroit, according to Tinnes.

Furthermore, Tokyo-based glass technology company AGC has developed a far-IR (FIR) sensor-enabled windshield. Windshields are typically composed of a single material and must adhere to stringent standards, including those for reliability and safety. Introducing a FIR-conducive material posed several challenges, such as ensuring resistance to scratching from sand-mixed water drops and ultraviolet light damage. To address these issues while minimizing glare, AGC created an optical coating film and anticipates integrating FIR windshields into new vehicles by 2027.

Many LWIR cameras benefit from designs that optimize these imagers for military use. However, these cameras may not offer levels of adaptability that make them suitable for the wide temperature ranges demanded by automotive standards, said Raz Peleg, vice president of business development at smart thermal sensing technologies developer Adasky.

This quality makes athermalization, or the consistent performance in varying environmental conditions, critical, he said.

Adasky has developed a shutterless LWIR camera that is designed to withstand the harsh automotive requirements of −40 to 85 °C (−40 to 185 °F). Adasky's camera weighs <50 g and is sized at 26 × 44 mm. Similarly, Teledyne FLIR's forthcoming automotive thermal camera is specified to operate athermally from −40 to 85 °C ambient temperature, Merrill said. However, Adasky has designed their solution to be located outside the vehicle. It is envisioned to be paired with a heated lens to prevent frost. "LWIR is a camera-based modality. The camera needs to stay clean, and the OEM is responsible for cleaning it," Peleg said. He said that the small size of the camera supports high mounting, such as on the roof of the vehicle. This positioning would help to minimize the effects of debris and reduce damage, according to Peleg.

Though the Adasky and Teledyne solutions differ in the specifics of how they are to be deployed, both reflect the advantages of harnessing the LWIR band for automotive. According to Merrill, tests conducted at Sandia National Laboratories' fog facility in 2021 showed that LWIR sensors provided the best overall visibility through various fog types and densities. The Teledyne FLIR-Sandia tests compared LWIR results to those obtained via visible, MIR, SWIR, and lidar sensors.

Whether the automotive thermal cameras are integrated inside or outside the windshield, they still face cost challenges. As designers pursue cost-effectiveness, autonomous intelligence, a subset of AI, is already making inroads in that direction. Chuck Gershman, CEO and cofounder of Owl Autonomous Imaging in Fairport, New York, says the three biggest roadblocks facing cost reductions to thermal cameras are converters that turn sensor analog outputs into digital data; the processor that subjects the sensor data to nonuniformity corrections; and the need to provide flat image data via a mechanical shutter for defining the correction factors.

Owl has developed a thermal HD camera system that performs the necessary digitization and corrections in a readout circuit in a semiconductor layer below the microbolometer array. As a result, the mechanism bypasses the costs that are typically associated with a mechanical shutter. This design also supports improvements in resolution that are most straightforward, reducing the need for high amounts of circuitry around the sensing area. While most LWIR cameras perform digitizing, correction, and interfacing in circuitry on several PC boards, Owl's design leverages the sensor device to perform many of those functions. This supports a single-board camera with designs similar to its visible light counterparts.

"Properly executed internal corrections for nonuniformity and temperature remove the need for additional preparation of the image for the classification and range-finding tasks," Gershman said. "AI, therefore, is needed only for tasks directly related to extracting the data used by the ADAS, not for fixing bad images."

Owl AI's software identifies hundreds of objects at frame rates of 30 per second. Currently, the AI can identify several types of objects, including pedestrians, cyclists, some animals, and various types of vehicles. It can accurately process thermal signatures to ~40 m, and Owl aims to extend that range to 180 m with their next-generation system.

At the same time, Adasky's shutterless LWIR offering has also incorporated generative AI in its synthetic thermal data set. This incorporation has enabled the company to advance detection (≥100 m) as well as classification.

🔖 DVN comments

The tests conducted in 2021 at Sandia National Laboratories showed that LWIR sensors provided the best visibility through different types and densities of fog. These tests compared the LWIR results to those obtained via visible, MIR, SWIR and lidar sensors. Automotive thermal cameras, whether inside or outside the windshield, face cost challenges that delay their integration in new vehicles. Nevertheless, the cost of IR cameras has decreased significantly, targeting $100 by 2029.

Omnivision's New 1.5-mpx DMS Sensor

Omnivision has a new OX01N1B image sensor for in-cabin automotive driver monitoring systems (DMS). Part of the supplier's Nyxel near-infrared (NIR) technology family, it is a 1.5-megapixel RGB-IR or monochrome BSI global shutter sensor with a pixel size of 2.2 µm and an optical format of 1/4.51". It was showcased at Auto Shanghai from April 23-May 2, 2025. Key features include 36 per cent NIR quantum efficiency for low-light performance, high MTF for improved image quality, low power consumption, and compact camera module design. Using OmniPixel 4-GS technology, it accurately reproduces rapid motion without distortions.

"With DMS becoming mandatory in Europe by 2026, and increasing adoption globally, OMNIVISION introduces the OX01N1B as a mainstream solution balancing performance, size, and cost," said Dr. Paul Wu, head of automotive product marketing. The OX01N1B's chip size is smaller than its predecessor but retains the same optical path, with added image signal processing. It offers flexibility for OEMs to place the DMS camera in various vehicle designs."

Smart Eye CEO Martin Krantz praised the sensor's performance and compact format for their integrated DMS innovation, the AI ONE camera.

The OX01N1B has integrated ASIL-B and cybersecurity features, meeting industry standards. It comes in an OMNIVISION a-CSP package, and is available in a reconstructed wafer option for bare die assembly. Samples are available now, with mass production slated to start in Q3 2026.

🔖 DVN comments

The automotive CMOS image sensor market is projected to grow at a 5.4-per-cent CAGR through 2029, mainly driven by in-cabin applications like driver monitoring systems (DMS), occupant monitoring systems (OMS), facial recognition, and gesture recognition. Driver eye-tracking utilizes global shutter pixels to capture fast-moving pupils without distortion. Smaller pixel size of 2.2μm offered by this new retina provides higher resolution but face challenges such as slower shutter speeds and noise from miniaturized circuits.

Indie's New Vision Processor Family
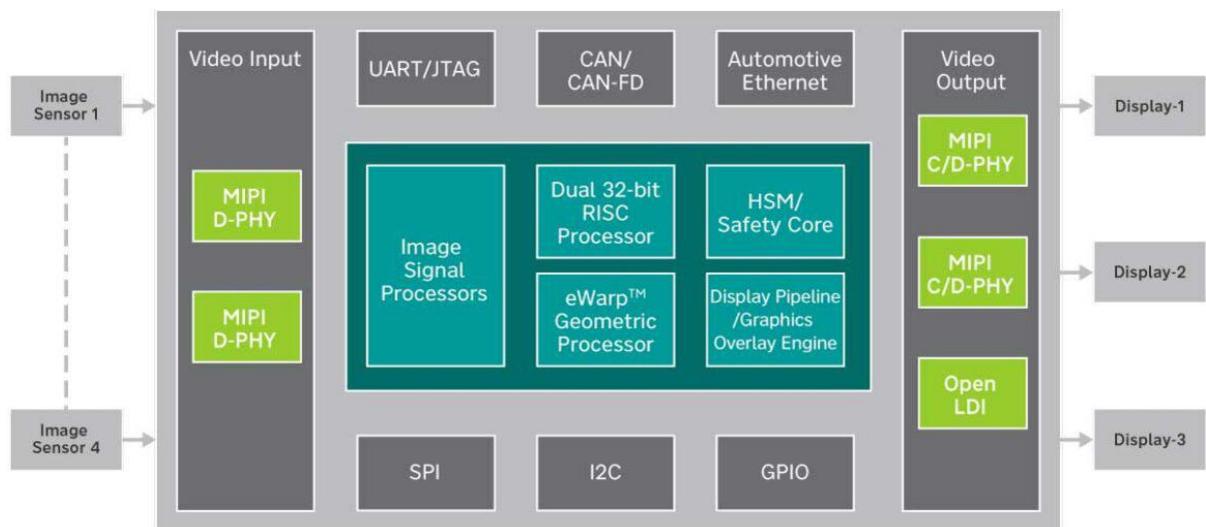
Indie Semiconductor has launched the iND880xx vision processor product range for ADAS and driver vision applications, such as surround-view systems and electronic mirrors.

These new processors augment Indie's portfolio of visual, lidar, radar and ultrasound sensing solutions. The new sensors deliver low-light and high dynamic range sensing to improve perception performance. They support real-time image signal processing for four simultaneous sensor inputs, including emerging sensor types like infrared. This capability enables simultaneous human viewing and ADAS sensing within a single system-on-chip (SoC) platform.

Key applications of vision sensing include automated emergency braking (AEB), lanekeeping assist, blind spot detection, driver and occupant monitoring, smart reverse, and vulnerable road user protection—that lattermost one the subject of FMVSS 127, which includes stringent testing requirements for pedestrian AEB under low-light and nighttime conditions without streetlights.

An automotive camera, to deliver usable images, requires an effective lens, a high-fidelity digital image sensor, and an advanced video processing engine to retain, extract, and highlight relevant information about a vehicle's environment.

Central to the video processing engine is the image signal processor (ISP). Several attributes contribute to a reliable ISP. It should use the image sensor's capability to see farther while ensuring near-real-time responses to changing road and environmental conditions. The ISP should not be affected by bright lights, yet it should preserve features in dark regions of a scene. It should support various image sensor technologies and spectral combinations while maintaining color fidelity. Additionally, it should support both human vision applications such as surround view, backup assist, and e-mirrors, and machine vision sensing applications used in ADAS. These applications can have different requirements and may require support for multiple video streams concurrently at high pixel throughput rates.

The new Indie iND880xx video processor SoC family excels in image signal processing for both viewing and sensing. It addresses low-light performance and color differentiation, crucial for perceiving traffic signals.

The ISP pipeline supports simultaneous processing of four sensor inputs with a throughput of 1,400 MP per second. Key features include a 24-bit processing pipeline for HDR up to 144 dB, support for various CFAs (RGGB, RCCB, RYYCy, RGB-IR), and proprietary eWarp technology for correcting image distortion from wide-angle lenses.

Indie's chief product officer Abhay Rai calls the new processors "a major advancement in automotive vision processing, meeting growing ADAS demands and consumer expectations in challenging environments."

🔖 DVN comments

Indie is involved in developing semiconductors, photonics, and software platforms for the automotive industry. The company focuses on creating technology for ADAS, in-cabin user experience, and electrification applications. Their mixed-signal SoCs support edge sensors including radar, lidar, ultrasound, and computer vision. Their embedded system control, power management, and interfacing solutions enhance the in-cabin experience and support automated and electrified vehicles. Indie is a recognized vendor to tier-1 partners, and their solutions are used by major automakers worldwide.

Radar Technologies News

## Radar With China's First HD Waveguide Antenna

HiRain Technologies, a supplier of intelligent driving systems to the Chinese automotive market, announced the launch of their LRR615, a production-intended long-range imaging radar system powered by the Arbe Robotics high-performance chipset. Designed to deliver ultrahigh resolution and reliability in all weather and lighting conditions, the LRR615 is now available for automaker evaluation.
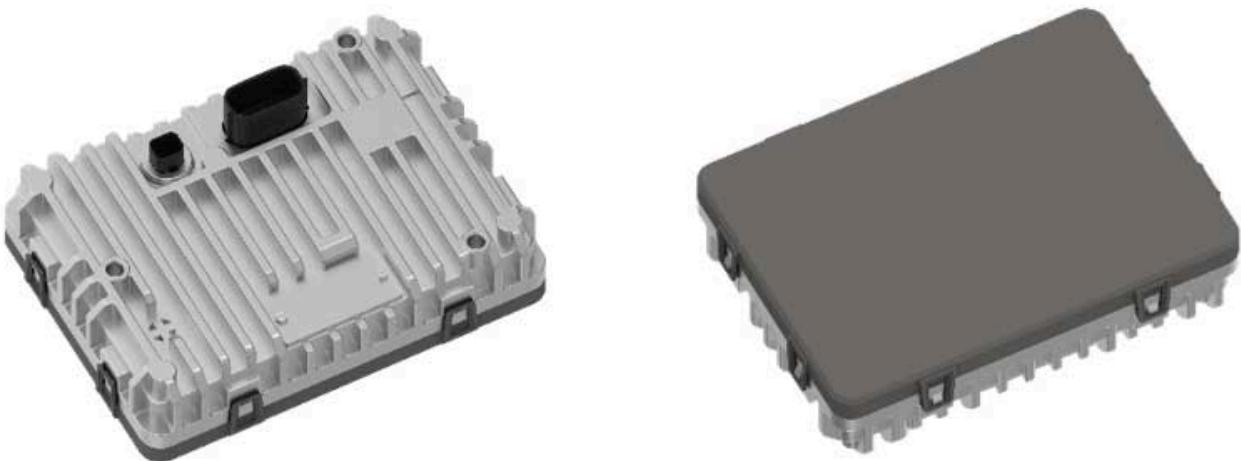
The LRR615 is the first radar system in China to feature a high-density waveguide antenna for improved image clarity and increased sensitivity and signal integrity. With its ability to detect at long ranges and maintain high resolution in challenging environments while minimizing false alarms, the scalable imaging sensor complements cameras and offers a less expensive alternative to lidar. The radar system is tailored for the growing demands of the Chinese autonomous driving market, delivering 10 times the detection capabilities compared to current radars on the market.

Notable functions and features include:

- Massive channel antenna array
- High angular resolution: 1.25°H × 1.8°V(real aperture)
- Dense point clouds: Over 10 kilopoints per frame on urban roads, providing a clear target outline
- Ultralong-distance detection: >100m for pedestrians, >250m for motorcycles, >350m for cars
- High dynamic detection range: capable of detecting weak targets near strong ones
- Long-distance early warning: reliable detection of stationary objects like tires and barrels over 100m
- Precise free-space detection
- Classification of traffic participants and infrastructure
- True imaging radar solution based on Arbe chipsets
- Time-frequency coding waveform design for improved target detection
- 2,034 virtual channel uniform arrays for a high dynamic detection range
- High-performance processor supporting imaging-level point cloud output
- AI algorithm extension for imaging radar applications
- Flexible communication interfaces (two CAN-FD and one 1,000-Mbps Ethernet)
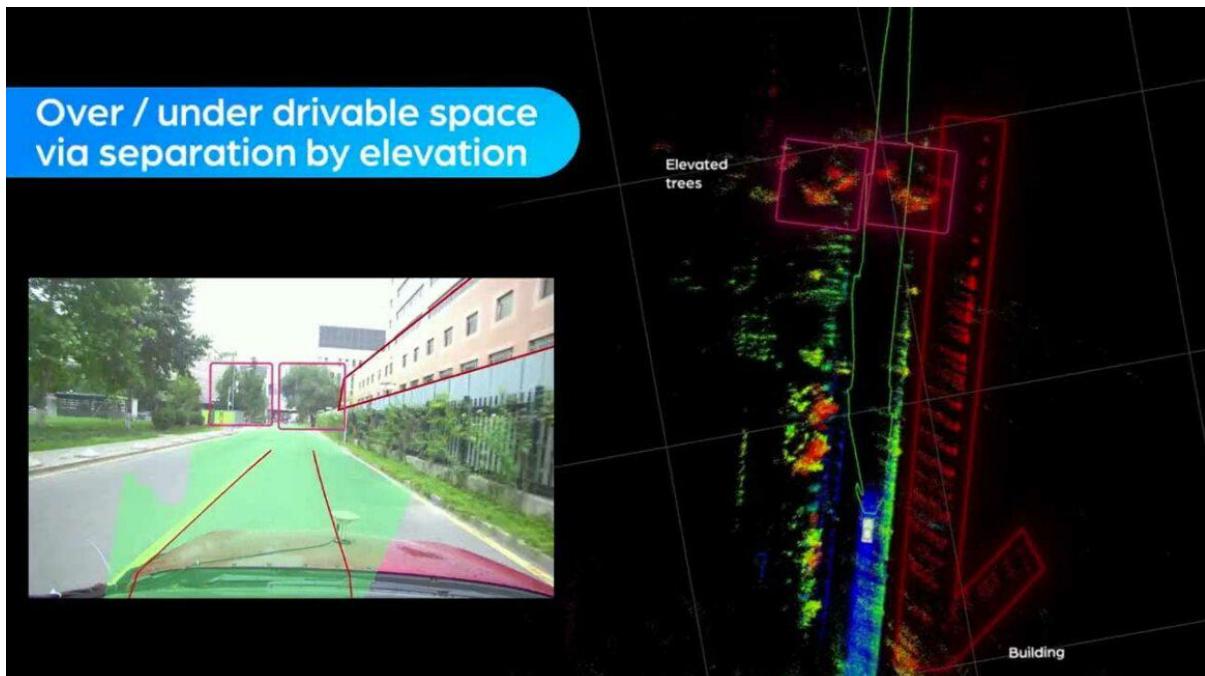
4D imaging point cloud from LRR615

HiRain Technologies CTO Fan Chengjian says, "Arbe's cutting-edge radar chipset enabled us to develop one of the most advanced and production-ready radar systems in China. The LRR615 sets a new benchmark for performance and cost-efficiency, and we are proud to bring this next-generation solution to OEMs preparing for L^{2+} and L^3 autonomy."

The new radar system complements HiRain's existing autonomous driving platform, which integrates cameras and radar to deliver comprehensive L^{2+} and L^3 driving capabilities. HiRain has completed full system integration, calibration, and validation of the LRR615, and they're preparing to ramp up production capacity to deliver tens of thousands of units annually.

Arbe CEO Kobi Marenko says, "HiRain's launch of the LRR615 system marks an exciting milestone for Arbe's expansion in China. Their ability to industrialize a radar system of this caliber, based on our chipset, reinforces the critical role high-resolution radar plays in the future of autonomous perception."

Arbe and HiRain exhibited at the Auto Shanghai show on 25 - 26 April.

HiRain Technologies, founded in 2003, is a system provider of intelligent driving solutions to automakers in China, focuses on providing customers in the fields of automobile and unmanned transportation with electronic products, R&D services and overall solutions for high-level intelligent driving. Headquartered in Beijing, HiRain has established modern production plants in Tianjin and Nantong, forming a comprehensive R&D, production, marketing, and service system.

Specifications of LRR615

|	LRR 615
Frequency GHz	76-81
Distance range (m)	300m
Distance separation	0.095m @36m, 0.6 @ 300m
H FOV (°)	100°
H separation	1.25°
V FOV (°)	30°
V separation	1.5°
Update rate	30 fps
Size (mm)	143x127x38
Connectivity	Eth 1Gb/s, CAN-FD

🔖 DVN comments

The global automotive 4D imaging radar market is expected to grow to USD $3.35bn by 2030. The high-resolution imaging capabilities of the 4D radar enable precise location and classification of objects, facilitating NOA, AEB and autonomous driving. Nevertheless, the current costs of 4D Imaging radars makes that generalist OEMs are still septic about their integration in sensing systems. The main market is midrange radars.

Imec's Photonic Multiplexing 144-GHz Distributed FMCW Radar

Imec, a research and innovation hub in nanoelectronics and digital technologies, has successfully developed and tested a proof-of-concept photonics-enabled code-division multiplexing (CDM) frequency-modulated continuous wave (FMCW) 144-GHz distributed radar system. This system ensures coherent chirps to remote radar units and demonstrates successful range measurements, paving the way for multi-node radar systems with better angular resolution compared to single-node setups. This technology has potential applications in driver assistance solutions and other high-precision sensing applications.

Achieving higher radar accuracy through enhanced angular resolution requires multiple radar nodes working together. A major challenge has been coherently distributing the shared local oscillator (LO) signal across these nodes over long distances without interference or attenuation.
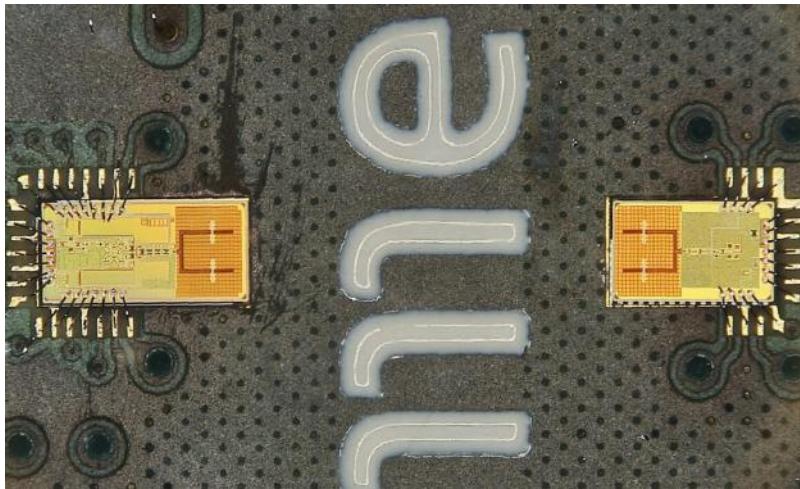
At the Optical Fiber Communications conference, Ilja Ocket, who manages Imec's automotive sensing portfolio, announced the functional proof-of-concept prototype. By combining analog radio-over-fiber technology with an efficient multiplexing scheme, this system ensures that radar units can work together seamlessly.

Imec's innovation relies on a phase encoder using code-division multiplexing. Each node is assigned a unique code sequence for slow-time binary phase modulation, which allows multiple radar nodes to transmit signals over the same bandwidth simultaneously. This approach offers straightforward implementation and superior scalability for distributed radar systems.

Additionally, Imec's optical signal distribution method integrates the phase encoder directly into the optical distribution network and uses analog radio-over-fiber technology, enabling low-loss transmission of the LO signal over long distances. This reduces electromagnetic interference while maintaining the signal integrity necessary for coherent multi-node radar operation.

The proof of concept demonstrated successful range measurements and the ability to separate monostatic and bistatic responses, validating both the setup's potential and the viability of CDM for coherent photonic distributed radar systems. Imec plans to expand the system from two to four radar nodes to evaluate improvements in angular resolution and scalability.

Potential applications of this technology include high-resolution, 360° radar sensing for ADAS, as well as indoor sensing, biomedical imaging, and vital sign monitoring.

🔖 DVN comments

The development of distributed radars improves radar system resolution without the costs of imaging radars. However, precise synchronization between different radar front ends remains crucial. Zendar uses Gbit ethernet links for this synchronization. Imec's solution uses high bandwidth provided by fiber optics. This technology is now well adapted to in vehicle environment.

Sensing Architectures & Integration News

New Bosch Radar for Assisted, Automated Driving

Bosch ADAS product family goes into serial production in mid-2025

The midrange equipment variant will start production in China later this year. Users will benefit from an assistance system linked to navigation, aiding maneuvers like freeway lane changes. A high-segment version is set for production in summer 2025, with several new customers like BAIC, Dongfeng, and Jetour.

New radar sensor with Bosch SoC

Radar sensors are essential for driver assistance systems, and modern vehicles rely heavily on them. Bosch has developed their new radar sensor completely in-house, including the system-on-chip. Using RF CMOS technology, the new sensor efficiently integrates high-frequency and digital circuits on a single chip. The 22-nanometer transistor structure makes the chip both powerful and efficient. Bosch is the first tier-1 supplier to use this technology in serial production.

FR6 and SR6 Bosch radars are equipped with SX601 / SX600 SoC

	FR6	SR6
Frequency GHz	76-77	76-81
Distance range	302m car	210m
Distance separation	0.4m	0.1m
H FOV	120°	150°
H separation	1°	4°
V FOV	24°	30°
V separation	1°	-
Speed resolution	0.17m/s	0.08m/s
Update rate	20 fps	20 fps
Size (mm)	143x110x30	56x76x19
Connections	CAN-FD + Eth 1GB/s	CAN-FD + Eth 1GB/s

Various functions take benefit from this new SoC and waveguide antennas, to offer a better sensitivity than previous radars.

Long-range front detection (ACC, AEB): pedestrian detection close to guardrail up to 400m
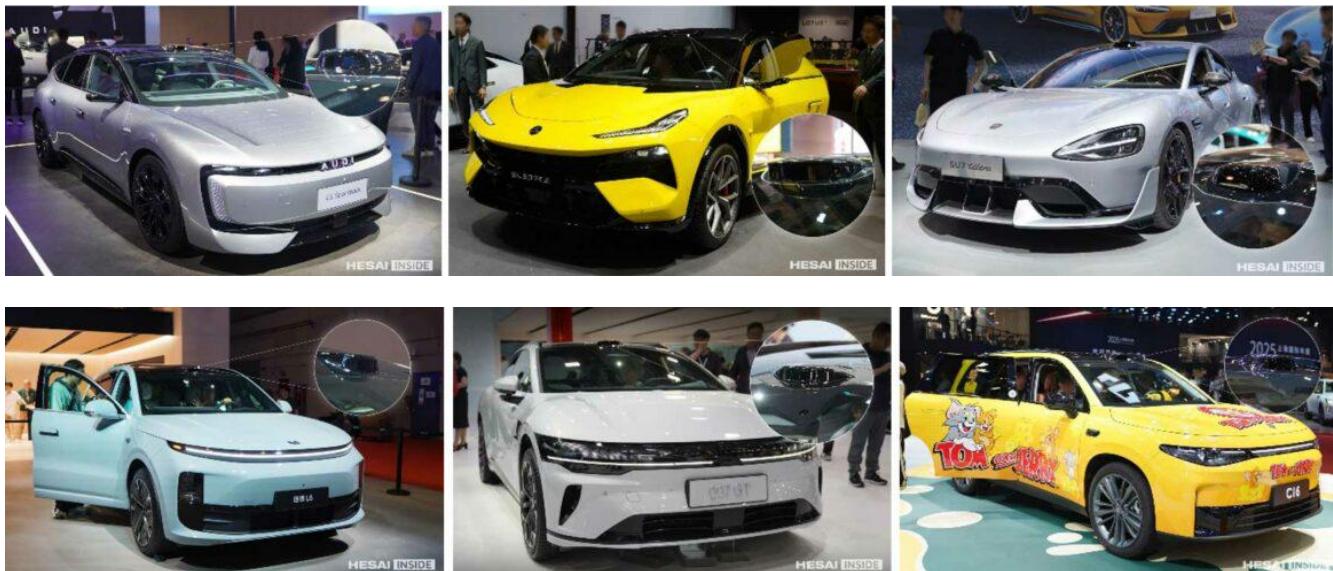

Rear detection: motorcycle detection up to 250m

Hesai Lidar Showcase at Auto Shanghai

At Auto Shanghai, Hesai's lidar technology was featured in vehicles from Audi, Cadillac, Lotus, Xiaomi, Li Auto, and others. The solutions are also used in several L^4 autonomous vehicle displays, demonstrating applications of smart mobility.

Lidar integration on the roof

Lidar integration behind the windshield @ GM

The industry-first behind-the-windshield lidar solution, co-developed by Hesai and GM, integrates the AT series long-range lidar in the Cadillac Vistiq's cabin, enabling precise environmental sensing even in challenging conditions such as rain, snow, or dust, all while preserving the vehicle's sleek exterior design. The in-cabin placement also reduces the risk of damage to high-value components during minor collisions, offering both functional and aesthetic advantages. The Vistiq is one of Cadillac's recently-unveiled family of electric SUVs, and introduces the automaker's latest L^2 full-scenario driver system, powered in part by Hesai lidar.

Waymo's Gen-6 Robotaxi – Lidar with wipers

Waymo's latest robotaxi is based on a Zeekr minivan. Reducing cost of the hardware was a primary goal, so front and rear lidars have been removed; the corner lidars now cover a wider field of view, and the system has HD radar. Another improvement was to better weatherproof the sensors; there are now wiper blades on the cameras These cars are already testing in San Francisco and other markets.

Next DVN Event: Lidar & ADAS Conference @ Wiesbaden
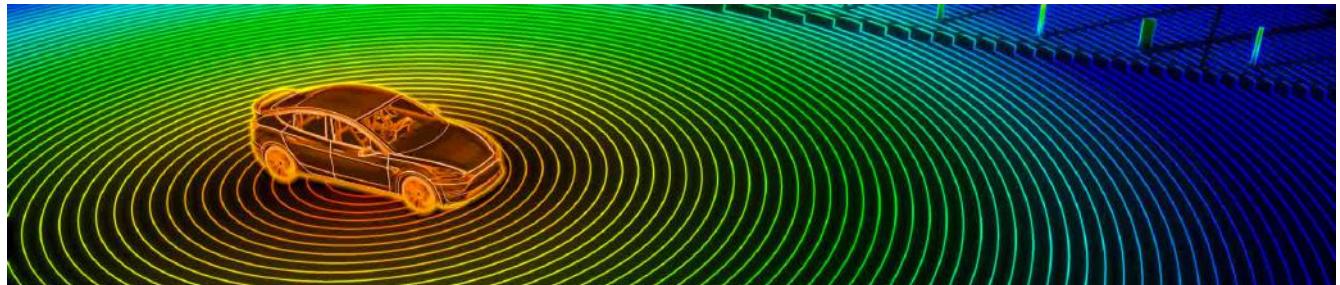
We will soon start promotion of the 8th DVN Automotive Lidar & ADAS event, which will take place in Wiesbaden on 19 - 20 November, 2025. The theme is Emerging Markets: L^{2+}, L^3, and Robotaxis. Here's the preliminary docket:

SESSIONS - DAY1 (Applications + Vision,Radar, AI Perception SW)	
Key-notes	
1	Applications (part1): L2+,L3 and Robotaxis => incl. OEMs
2	Applications (part2): L2+ & beyond - Market, Regulation, Safety
Deep Dive	*L2+ Test Report: NOA Systems in CN*
3	Vision systems for L2+,L3 applications
4	Radar & Fusion for L2+,L3 applications
5	AI & Perception Software
6	Validation & Simulation

SESSIONS - DAY2 (New technologies + Sensor Integ. & Manufacturing)	
Key-notes	
7	Sensors & Car Integration => incl. OEMs
8	Sensors Manufacturing & Testing
Deep Dive	*New Technologies: Localization & Mapping*
9	New technologies (part1): IR & Gated Cameras
10	New Technologies (part2): Lidar incl. FMCW
11	New Technologies (part3): Components

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