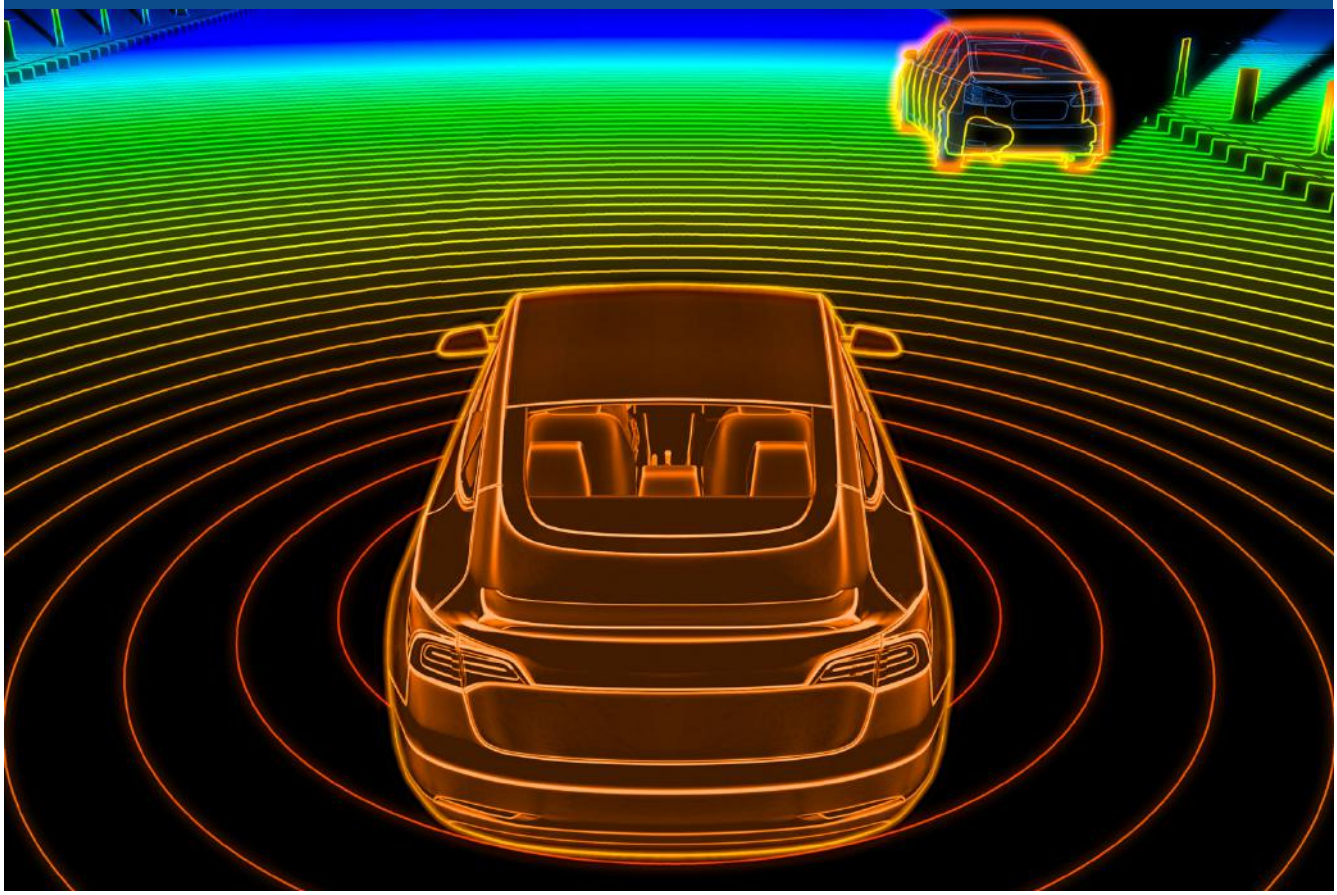
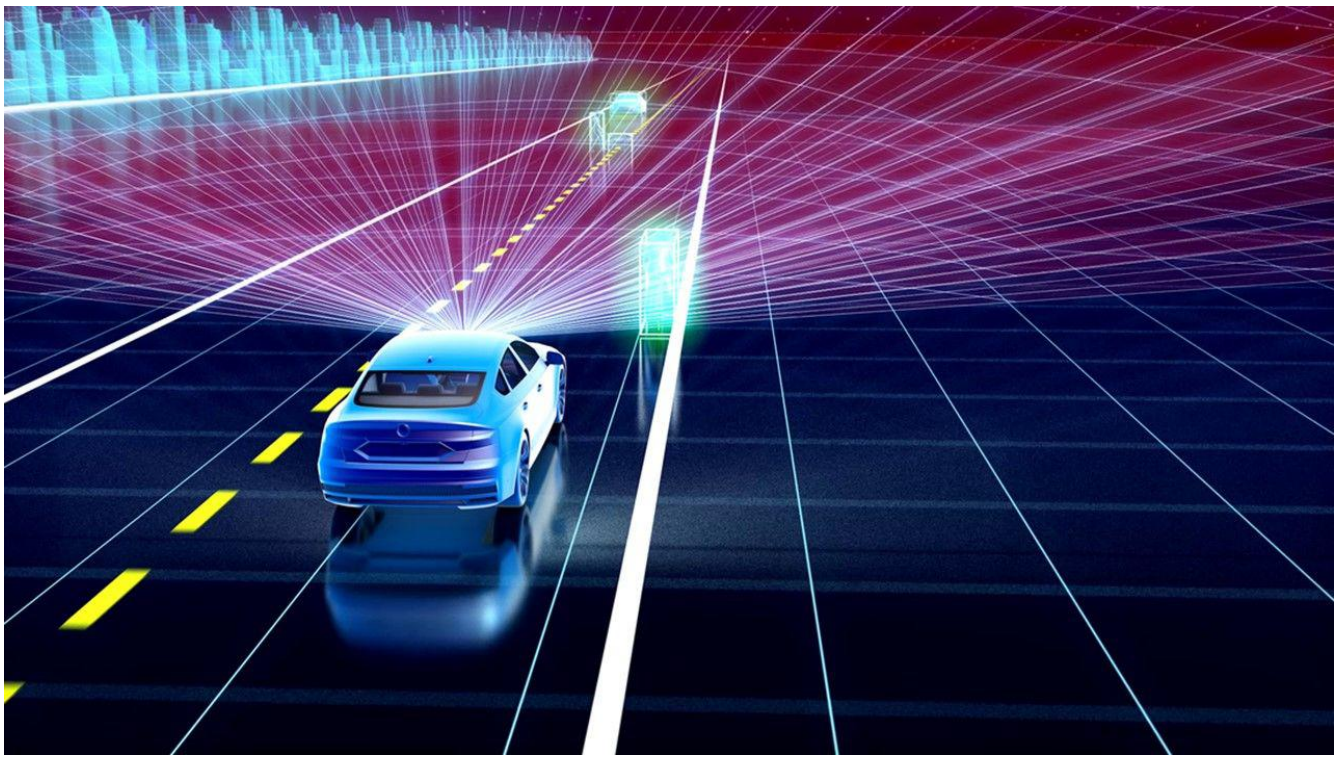
DVN
Lidar

Monthly newsletter #6

SEPTEMBER 8, 2022



Collaborative Lidar Launches, New DVN-L Team Member



Editorial · September 2022

In today's edition of DVN-Lidar, we bring you ongoing coverage of interesting news about the increasing adoption of automotive lidar, as well as information about how we're working to further develop the DVN lidar community.

As we keep vigilant watch over the industry to keep you well informed, we're seeing more and more announcements of collaboration among automakers, tier-1s, and lidar system suppliers. This gives the distinct impression that lidar market introductions and adoption rates will ramp up significantly over the next three years. As outlined already in earlier newsletters, the driving force is competition between legacy and new automakers actively jockeying to create and leverage competitive advantage by commercializing improved ADAS and L^3 functionality.

Examples covered in today's newsletter include GM and Cepton cooperating on long-range lidar integration; ZKW and Cepton working on short-range lidar integration in truck headlamps, and VW and Innoviz agreeing to collaborate for lidar implementation on car models from 2025.

With the galloping development of lidar applications for ADAS and AD, we at DVN are working hard to further strengthen the lidar community. We're pleased to announce Eric Amiot as a new DVN Lidar team member. Amiot will bring to DVN his long experience in the automotive industry, especially when he was responsible for Valeo's ADAS business development in Europe and Asia. Read his interview to learn more about his background and get his insights on the lidar market as linked to ADAS and AD.

In less than a week, the first **DVN-Lidar Workshop** will take place! It's on 12-13 September at the Dorint hotel Frankfurt Sulzbach. You'll find details today about this intensive workshop. There'll be presentations from the likes of Ford; Microvision; AMS Osram, and Fraunhofer IMS. We'll have a lecture by DVN senior advisor (formerly Audi's head of lighting and vision) Wolfgang Huhn, about sensor integration in headlamps.

Don't forget to save the dates for our **5th DVN Lidar conference** on 30 November and 1 December in Wiesbaden! The whole DVN team is working hard to make it a grand, worthy event!!

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

All best,

Alain Servel

DVN LIDAR ADVISOR

DVN-L Interview: Eric Amiot

Eric Amiot has joined the DVN organization to support and accelerate lidar-related activities. Today we bring you this so you can get to know him and his thoughts and ideas about lidar sensors; ADAS, and AD. Amiot has an electronics engineering degree from the University of Supelec, Paris. He has long experience in high-tech products and business development, including:

- as a radar system engineer at SAR, a startup specializing in electronically-scanned antennas, acquired by Thales in 1986;
- as a consultant at DG Conseil, a consultancy in marketing and R&D management of high-tech products for industries including telecoms; defense; automotive, and electronics; he became a partner at DG in 1990;
- At global automotive supplier Valeo from 1993 to March 2022 with diverse responsibilities in project and product line management for interior control products (Paris) then in business development for ADAS in Europe and Asia (Stuttgart, Seoul).

Amiot took active roles in the launch of two key ADAS innovations from Valeo: in 2008 with the launch of the first blind spot detection radar at GM—now almost standard for the mid- and high-range cars—and in 2018 with the launch of the first Valeo Scala automotive lidar at Audi. The second generation is now starting on the new Mercedes S-Class, the first car offering an L^3 traffic jam pilot mode up to 60 km/h.

DVN-L: Eric, we are pleased that you will support us in our ongoing work to develop an enthusiastic, active DVN lidar community. What brought you to join our team? What are your expectations in the near future?

Eric Amiot: Why joining DVN? After my retirement in April 2022, I wanted to find a way to continue some work in the ADAS field. I met with DVN at a Lidar Workshop in May 2022 and was impressed by the know-how and reputation of the DVN think tank. Starting a new activity at DVN for lidar makes sense to me since lidar is a very new technology, where there is a need to build a strong community for promotion and standardization.

The job of DVN is to report the significant improvements of the lidar technology, which is becoming mature for luxury cars applications, and which has a potential to change the game in vehicle safety. As we see with Tesla's Autopilot, it is difficult to build a robust system with a pure vision system.

DVN-L: How do you assess as a newcomer to DVN—but experienced veteran with outside view on the lidar ecosystem—the initial steps of the DVN lidar community? What is your view on the way forward, and how do you foresee your contribution?

E.A.: DVN's package—the newsletter; access to two think tanks; one workshop, and one conference—is a good way to build the community. I see the need to bring more information and go deeper in understanding the key factors for lidar deployment. DVN should report not only the news related to lidar technology itself (tier-1 and -2), but also bring sharp views on the lidar market environment and usage. The future of lidar is linked to the future of vehicle safety and automated driving. My experience in ADAS will help building this overall picture and bring some deep analysis.

DVN: A clear success element of the DVN-Lidar activities are the yearly conferences gathering regularly more than 200 participants in a live, in-person event. What do you expect from this year's 5th DVN-Lidar Conference at the Dorint Pallas Hotel in Wiesbaden (Frankfurt)?

E.A.: I already know the DVNewsletter and Workshops. The Conference will be new to me; the success of the Conference last year has shown there is a need to build a strong community with all parties: automakers, tier-1 and -2 suppliers. DVN's job is to organize the communication around the future of lidar; vehicle safety, and automated driving to get the automakers interested. The expo booths will be the occasion to get more personal talks between automakers and suppliers, and promote the brand new technologies.

DVN: Now let us turn to some questions about your view on the future development of lidar sensors. What are the key parameters influencing the market introduction and adoption rate of lidar systems?

E.A.: I see two key points: first, lidar must deliver the minimum performance to support automated driving cars on highways up to 130 km/h, with a good resolution. Many products should be on the market by 2025. Second, it should also increase the vehicle safety in urban conditions; lidar should enable the zero-accident car. I believe active safety will become more important than passive safety in the future. At a certain point, automakers will have to reduce the weight of the cars: EVs are extremely heavy (2 to 2.5 tons) to transport a single human, most of the time over a short distance.

In short: performance maturity first; cost second which will improve with volumes—this was at least my experience with the BSD radar, whose cost was divided by five in 15 years. You simply cannot sell products with bad performance for safety and automated driving systems.

DVN: With respect to lidar adoption, what is your opinion about regional differences?

E.A.: I see different markets. I expect China to be a big player. China is using Lidar for L^{2+} systems (L^3 regulation will not be ready before 2025-26) and many brands are already launching lidar systems. Moreover, end users believe lidar can do some magic and are ready to pay for it. On the contrary, Lidar deployment in EU/US is more cautious, based on L^3 modes, with a regulation in place for traffic jam pilot (< 60 km/h) and one for highway pilot (< 130 km/h) coming early in 2023.

Regarding the new mobility players like delivery droids and urban shuttles, it is easier for these systems to get approval and go on the market. The demand is not big today but might increase very fast in future. And many systems are using several lidars to operate safely in urban environment.

DVN: As a final point, which message would you like to give to the DVN lidar community?

E.A.: I see DVN on a good path to build a new community for the lidar technology, it should work the same way as in the past for the lighting systems.

DVN: Eric, we thank you for this interview and we are pleased to welcome you as a team colleague and promoter of lidar sensor technology!

Cepton, Newly Public, Now Motoring Along

Silicon Valley lidar company Cepton went public this past March. In addition to their active cooperation with GM on the Ultra Cruise program, they are cooperating with lighting supplier ZKW on a truck headlamp prototype including lidar sensors.

Cepton lidar sensors for GM's Ultra Cruise program

The Ultra Cruise program is a cornerstone of GM's strategy to commercialize L^3 and higher levels of automation. Ultra Cruise is expected to be released next year, starting with certain Cadillac models. It is intended to enable door-to-door hands-free driving in 95 per cent of all driving scenarios in North America. At launch, it will cover more than two million miles of paved roads.

GM will use Cepton lidar components in the first nine 2023-24 models to offer Ultra Cruise —such as the 2024 Cadillac Celestiq EV—and the companies are collaborating on potential additional models that will be introduced in 2025 and beyond.

For the Ultra Cruise application, the lidar sensor will be placed behind the windshield, as shown here.

A key element in winning the Ultra Cruise program was Cepton's production partnership with Koito, the world's № 1 vehicle lighting tier-1. This partnership has made Cepton relatively resilient in today's supply chain turbulence, and also leverages economies of scale for components and production facilities. Cepton CEO Jun Pei (photo) says "Koito knows how to manage the supply chain and has negotiating power to drive everything from chips to other components. They are a tremendous anchor to have the supply chain under control". Reciprocally, Koito invested USD $100m in Cepton. In a recent second-quarter conference call with investors, Pei said Cepton is in the final stage of "hardware verification with production intent " and production readiness is expected by the end of this year; Cepton is sending 400 sample pieces to Koito for "final assembly, calibration, test and sample delivery to the automaker".

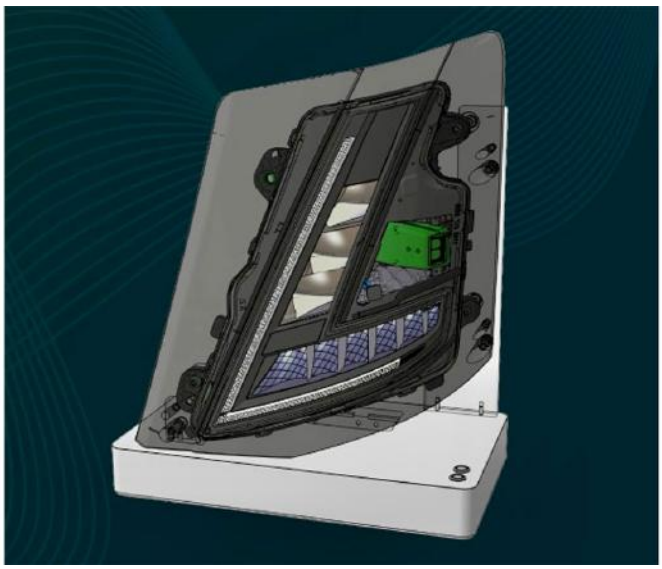
One differentiator of Cepton's lidar is the ability to place the sensor behind the windshield like this due to its small size and low power consumption. According to Cepton, many windshields have a similar shape and therefore a lidar sensor behind the windshield, nestled behind the rearview mirror, will allow platform carryover and thus can be used on multiple vehicle models with minimal incremental cost.

Another substantial activity is Cepton's in-house development of an application-specific integrated circuit (ASIC, shown here), which will drive further performance enhancement and cost reductions, while securing manufacturing capabilities and capacity.

The company also just completed the architecture design for their second ASIC with tape out expected by the end of the year. This is a scalable companion chip to Cepton's first ASIC with an emphasis on electronics component integration that reduces cost and dependency on the electronics supply chain.

Cepton continues to invest in developing their portfolio of products and technologies, including their Nova near-range lidar. B-samples were recently shipped to multiple automakers and tier-1s for evaluation. A special project with this product type is the cooperation with ZKW described below.

Cepton, ZKW Showcase Lidar-Inbuilt Truck Headlamps



Cepton, in cooperation with ZKW will showcase a lidar integration solution for automotive headlamps later this month at the IAA Transportation conference. The ZKW Group has a reputation as an innovative lighting system supplier for all vehicle segments; one specialty is their involvement in advanced heavy truck lighting. Through cooperation with ZKW, Cepton demonstrates how their short-range Nova lidar can be easily fitted into headlamps—a compelling location for lidar integration. This particular integration features discrete embedment; a cleaning mechanism, and sensor protection in a single package to offer maximum elegance and ease of maintenance. It also enables a dual sensor design for cut-in detection. The lidar sensor is green in this rendering of the prototype headlamp.

IAA Transportation will take place from 20 to 25 September in Hannover, Germany. It is one of the most recognized trade shows for heavy-duty vehicles. On account of the Covid pandemic, this year's will be the first live event in several years.

A live demonstrations of Nova's near-range 3D sensing capabilities will be available to visitors. Short-range lidars like this are meant to cover blind spots. Advantages of this technology include miniature size; high resolution, and superior vertical and horizontal fields of view. The sensor's compactness allows flexible integration possibilities around the vehicle to provide complete 360° perception. Integration of lidar with lamp units is a logical step, as enthusiastically discussed at DVN Lidar Conferences.Multiple Nova sensors help the AD or ADAS vehicle to accurately detect very close objects such as pedestrians; bicycles, and the likes of sidewalk edges. Nova lidar can also play a role in simple ADAS functions like blind spot detection to enhance the protection of vulnerable road users—a function that is beginning to become practically mandatory. According to Cepton, their patented Micro Motion Technology (MMT) lidar technology creates lidar sensors with unparalleled energy efficiency, making them suitable for all types of consumer and commercial vehicles. The company says MMT enables an optimal balance of compactness; performance; reliability, and affordability.

DVN comment

Clearly, synergies can be found to optimize lidar operation by taking advantage of the windshield cleaning system and headlamp-specific protections. The compactness of Cepton lidars, particularly their Nova, allows a multitude of integration solutions. Since ZKW is strongly engaged with the heavy-trucks market, an interesting and speedy market introduction in this segment may be expected. Major impetus here is the strong pressure on heavy trucks and buses to avoid accidents with pedestrians and bicyclists, especially at city road crossings.

Innoviz lidar integrated in VW vehicles from 2025

Innoviz will supply lidar sensors and perception software to all Volkswagen-group vehicles with automated driving capabilities. In this partnership Innoviz will work directly with Cariad SE, VW's automotive software company, to integrate their technology into upcoming vehicles.

Innoviz says their affordable InnovizTwo lidar, with its 905-nanometer laser, provides up to 300 meters of visual range with 0.05° of resolution. VW has been making several moves toward boosting their ADAS and autonomous driving capabilities since the beginning of this year. In January, Cariad and Bosch teamed up to develop software for automated driving for VW, and in May, VW chose Qualcomm's Snapdragon Ride platform to power their ADAS and automated driving.

This selection of Innoviz as a tier-1 supplier to VW represents the lidar supplier's third design win with a carmaker; in April, BMW announced Innoviz lidar will be on the 2023 BMW i7 EV, and last May Innoviz was selected in an autonomous shuttle program.

Innoviz will have a forward-looking order book of USD $4bn for this partnership with VW, for total estimated sales of up to $6.6bn.

DVN comment

This major cooperation between Innoviz and VW shows that Innoviz has reached a sufficient level of maturity to be considered a tier-1 by VW. This maturity was certainly acquired through their preceding cooperation with BMW on a similar product. It shows also that MEMS-based lidars are gaining the same level of confidence from carmakers as macro mechanical lidars.

Sick, Aeva Partner on 4D Lidar for Industrial Applications

Aeva and Sick have announced a strategic multi-year collaboration to bring Aeva's FMCW 4D lidar to a variety of industrial applications including long-range sensing.

"We are pleased to partner with Aeva and work closely together to bring its FMCW technology to high performance industrial sensing applications," said Dr. Niels Syassen, Member of the Executive Board responsible for Technology and Digitization at Sick. "We are convinced that their unique approach to FMCW technology, which includes instant velocity detection and long-range performance, will provide new opportunities for us and our customers in a variety of industrial sensing applications where traditional time of flight lidar technologies are challenged".

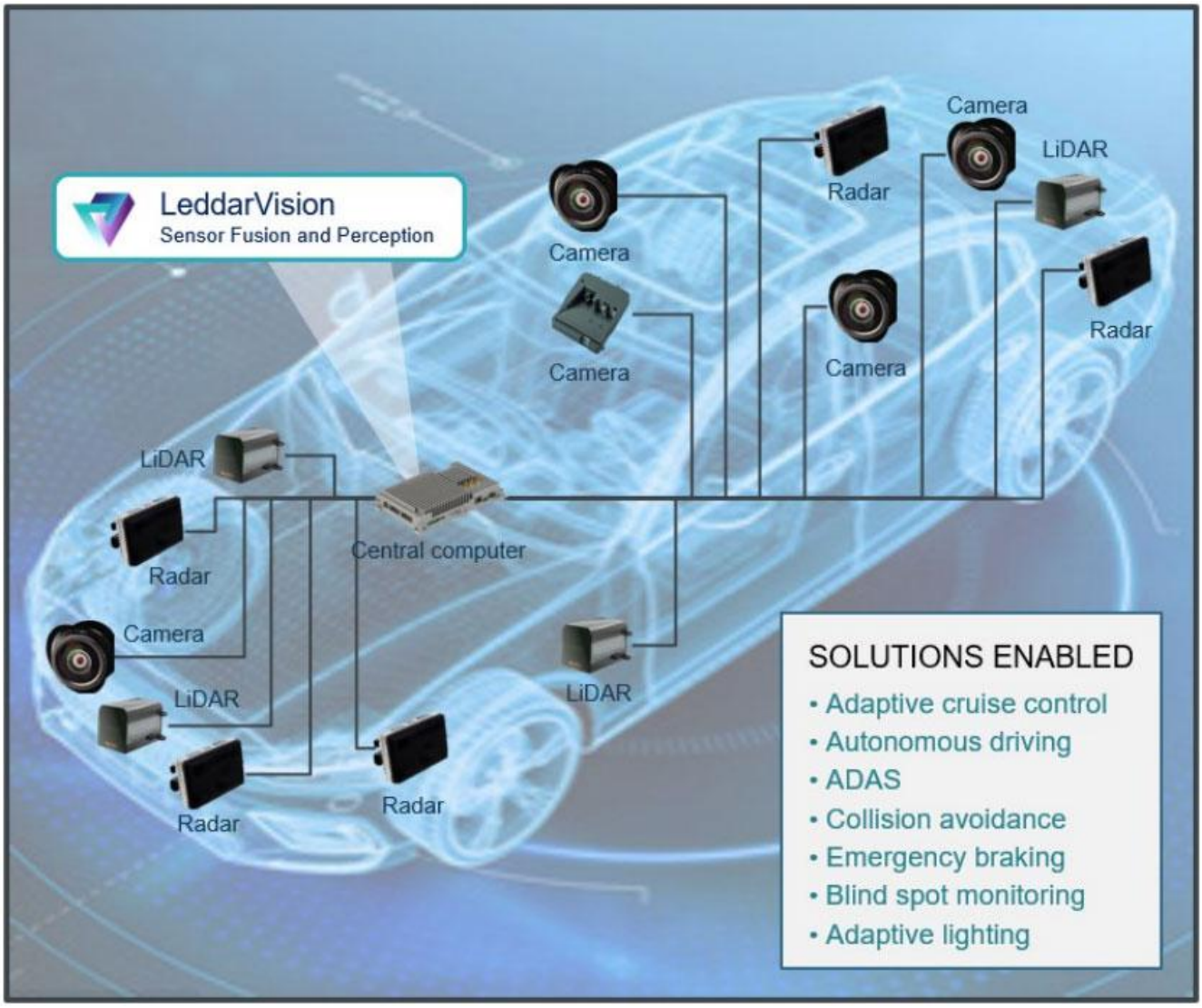
Aeva says their FMCW 4D lidar provides unique perception advantages over the likes of cameras and legacy 3D lidar sensors—better dynamic range performance to perceive low and high reflectivity targets within the same measurement without edge effects, for example, allowing automated machinery to transition easily from indoor to outdoor operation. They say their 4D lidar is immune to blooming and ghosting from retroreflectors, so equipped machines will have clear perception when highly reflective objects such as safety vests; cones, and tape are in the field of view of the sensor, so low- and high-reflectance objects can both be easily detected.

Aeva CEO and cofounder Soroush Salehian says "Sick is one of the foremost leaders in industrial sensing solutions and today's partnership is a major step forward for the advancement of high performance and reliable FMCW-based sensing across a broad set of industrial applications. This strategic collaboration is a testament to the industry-leading performance and versatility of our unique 4D lidar technology for scaled deployment in industrial applications".

DVN comment

Through this collaboration with Sick, Aeva will take advantage of many industrial sensing applications still deployed by their new partner. Until now lidar technologies operated by Sick are mainly based on legacy pulsed lidars. The adoption of FMCW technology will create a new scope for Sick's applications and in parallel expand the market of Aeva's products. Although in general industrial applications do not involve big volumes, this cooperation can be a stepstone to gather production and field experience for their FMCW lidar. A solid data base of production records and reliability data for FMCW technology in the industrial field can help to pave the way to automotive series applications.

LeddarTech's Data Fusion Technology Deployment Widens



LeddarTech has developed their LeddarVIsion platform for raw data fusion of sensor suites.

The company says LeddarVision is a flexible, robust, affordable, sensor-agnostic and scalable automotive-grade solution that delivers highly accurate 3D environmental models. In addition, the software supports all SAE autonomy levels by applying AI and computer vision algorithms to fuse raw data from sensors employed in L^{2-5} on- and off-road autonomous vehicle applications. This industry-first solution is sensor-agnostic and scalable, enabling automakers to scale up to L^{5} autonomy on the same platform. Here's a depiction of the system concept:

The specific feature of this fusion platform is its ability to analyze and and interpret sensor raw data instead of combining pre-processed object data of the different sensors. This past summer, the VW Group recognized these achievements with an innovation award during their "Konnect and Cariad Startup Challenge" in Tel Aviv.

Cariad's head of AI Jan Zawadzki says "We were impressed by LeddarTech's professionally prepared pitch and proposal of a proof of concept. We were intrigued by their technical capabilities, which fit our general ADAS strategy, and we're looking forward to creating an AI safety-related [concept] with their product". LeddarTech was selected in the final round of the competition after judges from Konnect; VW Group's Open Innovation Hub, and VW Commercial Vehicles screened more than 30 Israeli startups.

And two weeks ago, a similar award was bestowed by The Shenzhen Automotive Electronics Industry Association, founded in 2010 as a non-profit organization with over 500 members representing auto electronics and related parts technology companies across China. LeddarVision was recognized with the Automotive Electronics Science and Technology Award for Product Innovation Excellence. The award highlights scientific research and technological innovation in the auto electronics industry. The winning companies were determined after advanced engineering judges from the automotive industry and R&D experts from leading domestic automotive companies assessed more than 250 products.

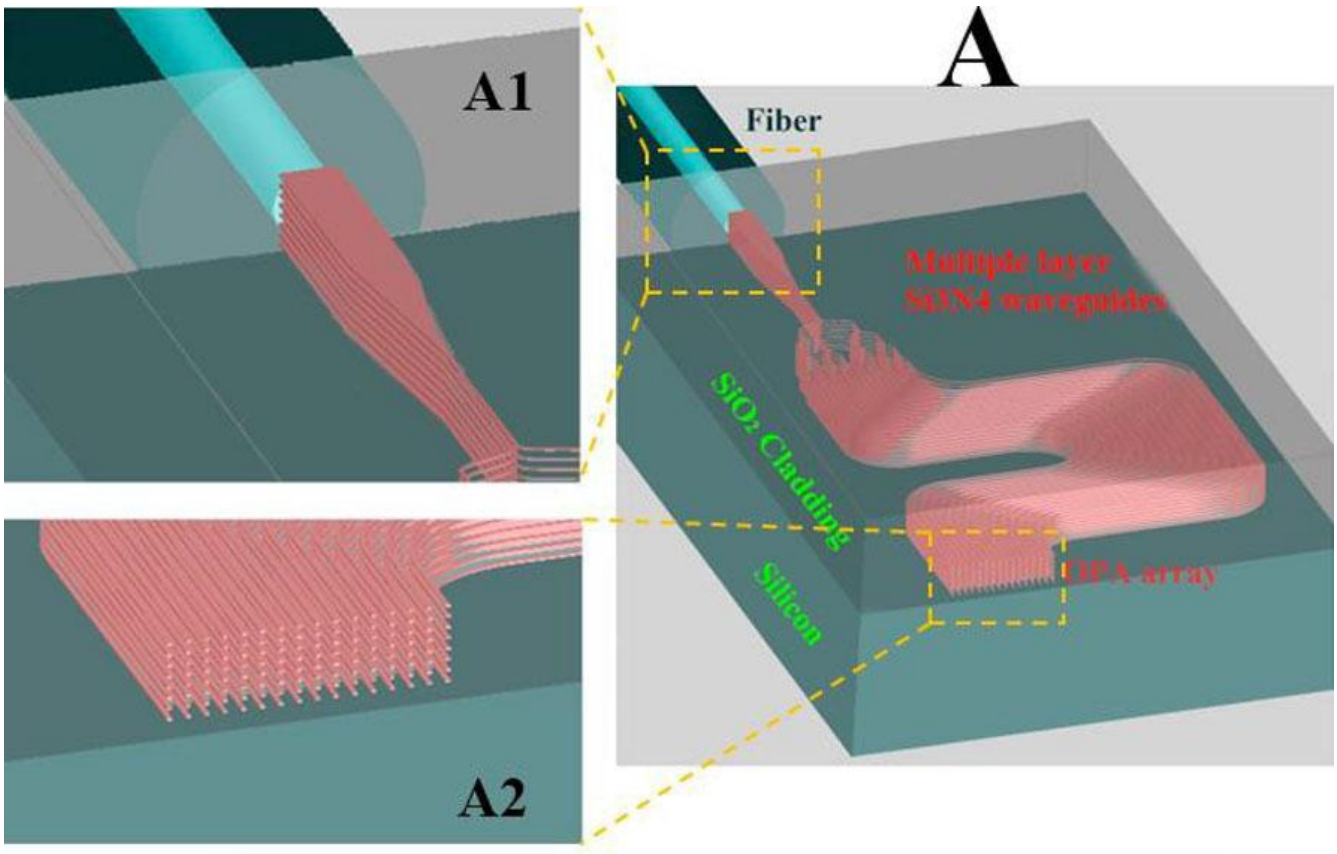
LeddarTech CEO Charles Boulanger, reacting to the two awards, said they represent "a profound acknowledgment of the expertise and challenging work of the sensor fusion and perception engineering teams led by our R&D center in Israel and our employees around the world who support these efforts. These awards are greatly appreciated and acknowledge our industry differentiation, commitment to win-win partnerships and, most importantly, our mission to enable ADAS and AD products that improve safety and the quality of life of drivers and the general public".

LeddarTech is (and has been) promoting their raw data fusion technology at events including the New Energy Vehicle International Forum in Shuzhou, China (August) and the ADAS and Autonomous Vehicle Technology Expo and Conference in San Jose, California (this month).

DVN comment

A new manner to fuse sensing technologies like radars, cameras and lidars, consists of low-level fusion algorithms based on raw data, in contrast to legacy fusion algorithms which are based on pre detected objects from each sensor. LeddarVision's concept based on AI allows to quickly adapt any sensing system architecture to a 3D environmental model. This concept can accelerate the development, but the repeatability of such environment modelling has to be verified before any secured deployment on AD vehicles.

UMichigan Claims 1st Multilayer 3D Optical Phased Array

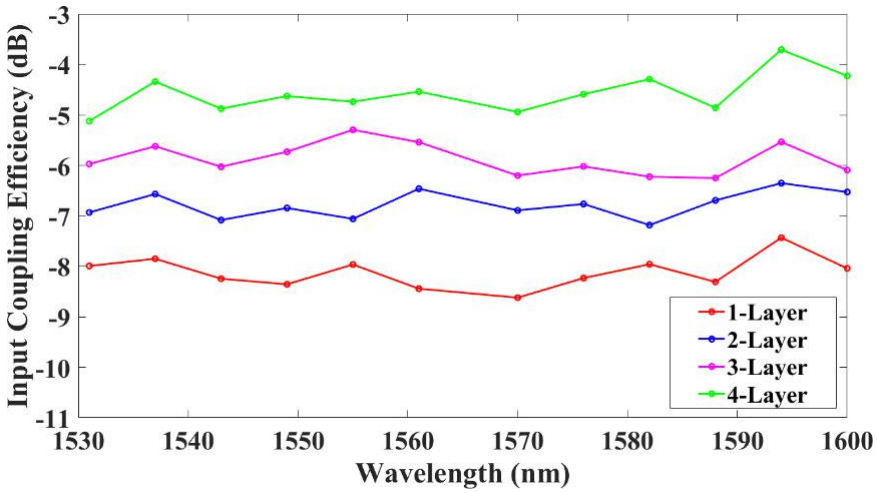


Traditional PICs (photonic integrated circuits) inherit the mature CMOS fabrication process from the electronic integrated circuit industry. But this process limits the PIC structure to a single waveguide layer. A research team from the Integrated Nano Optoelectronics Laboratory at the University of Michigan in Dearborn and the Energy Institute at the University of Michigan in Ann Arbor have explored the possibility of PICs with multiple waveguide layers. The team has developed a prototype of a true 3D OPA (optical phased array) device, with the light exiting from the edge of the device, based on a multilayer Si_3N_4/SiO_2 platform technology. The pictures show schematically the construction of the device.

An optical fiber couples light into the device (picture A) and the waveguide width at the coupling region is enlarged to ensure the best mode matching (picture A1). A 2D, 8 × 16 OPA is formed at the edge of the device as an outcoupling unit (picture A2).

The multi-waveguide-layer configuration offers the possibility of using edge couplers at both the input and the emitting ends, to achieve broadband high efficiency. The team has studied the new concept by numerical simulation as well as measurements of proof-of-concept samples with one to four waveguide layers.

Typical measurement results for the Input coupling efficiency are shown in the diagram.



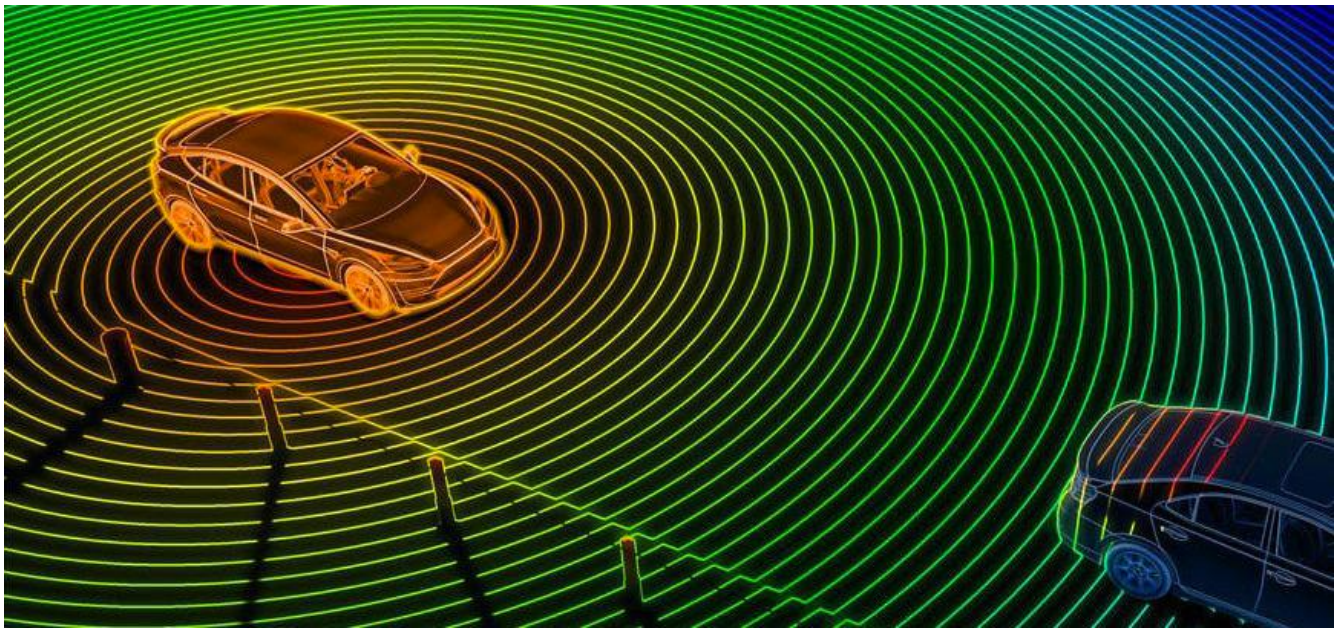
These encouraging results confirm the expectation that with multiple waveguide layers the coupling efficiency can be significantly improved.

According to the research team, this is the first experimental proof-of-concept of a true 3D OPA with multiple waveguide layers and compatible with CMOS manufacturing technology.

DVN comment

This research is another interesting contribution pushing OPA development. Though OPA is still in an embryonic phase, research departments of industry lidar suppliers should keep a close eye on this technology. DVN will regularly keep you updated on our observations in this technology segment.

DVN Lidar Events



DVN Lidar Workshop, 12-13 September

The first DVN-Lidar Workshop will take place as a hybrid (live + online) event on 12-13 September at (and from) the Dorint Hotel in Frankfurt Sulzbach. The DVN team faced an unexpected difficulty about this workshop: the AutoSens Congress is on the same week in Brussels. Of course, a number of our community members and prospectives invited to our workshop had already long-term commitments and appointments for the event in Brussels. Therefore we will miss about 10 live participants.

Despite this, we will still gather 20 live participants and about the same number of online participants from America and Asia. This encourages us to proceed with our workshop to promote lidar activity. Next time we will be more alert about parallel events; this time we are working to arrange video recording of as many presentations and sessions as possible, so as to make them available to the community and to new prospects who could not attend personally or by online participation.

Below is the latest version of the Workshop docket. As an interesting new element, we have added a presentation of DVN senior advisor (and former Audi lighting and vision development chief) Wolfgang Huhn, who will propound on the integration of lidar and lighting.

First Dvn Lidar Workshop: A Deep Dive In Four Topics
Agenda, *Times In Cet*

12.09.2022

18:30 Welcome of Live Participants
19:00 Cocktail, including speech by Wolfgang Huhn / Senior Advisor DVN, former Audi Lighting Manager
20:00 *Dinner*

13.09.2022

8:30 Opening and introduction of live and on line participants
9:00 Deep Dive #1 Presentation including key question(s) to the workshop group / P. Zegelaar, Ford Motor Company " The role of lidar sensors in the (partially) automated driving stack "
9:30 Deep Dive #2 Presentation including key question (s) to the workshop group / T. Luce , Microvision, "lidar sensor interference "
10:00 *Coffee Break*
10:30 Three Break-Out groups, each group 2 questions
11:30 Reporting of Break-Out Groups and discussion

12:15 *Lunch*

13:30 Deep Dive #3 Presentation including key question (s) to the workshop group / C. Hofmann, AMS Osram, “ Lidar emitters “

14:00 Deep Dive #4 Presentation including key question (s) to the workshop group / J. Ruskowski, Fraunhofer IMS, “ Lidar detectors “

14:30 Three Break-Out groups, each group 2 questions

15:30 *Coffee break*

16:00 Reporting of Break-Out groups and discussion

16:30 What have we learned together ?

17:00 Closure

5th DVN Lidar Conference

Preparations for the lidar conference are well under way, with a docket of 28 speakers and two panel discussions. Highlights will be two keynotes covering not only lidar, but the broader range of lidar implementation as a tool for automated driving. Here's a program outline:

The 5th DVN Automotive Lidar Conference
30 November – 1 December

DAY ONE 30.11.2022

11:30 Registration and quick lunch
13:00 Opening and key note 1
13:45 Session 1 : *Applications part 1*
15:00 *Coffee Break*
15:30 Session 2 : *Applications part 2*
16:45 Session 3 : *Lidar Eco System*
17:45 Panel Discussion
18:15 *Break*
19:00 Cocktail
20:00 Conference Dinner

DAY TWO 1.12.2022

8:30 Key note 2
9:00 Session 4 : *Technology part 1*
10:15 *Coffee Break*
10:45 Session 5 : *Technology part 2*
12:00 *Lunch Break*
13:30 Session 6 : *Use Cases and Testing part 1*
14:45 *Coffee Break*
15:15 Session 7: *Use Cases and Testing part 2*
16:30 Panel Discussion
17:00 Closure

The Conference will be at the Dorint Pallas Hotel in Wiesbaden, close to Frankfurt. This spacious hotel will handily accommodate our expected high attendance count, while offering great interactive space for participants and exhibitors.