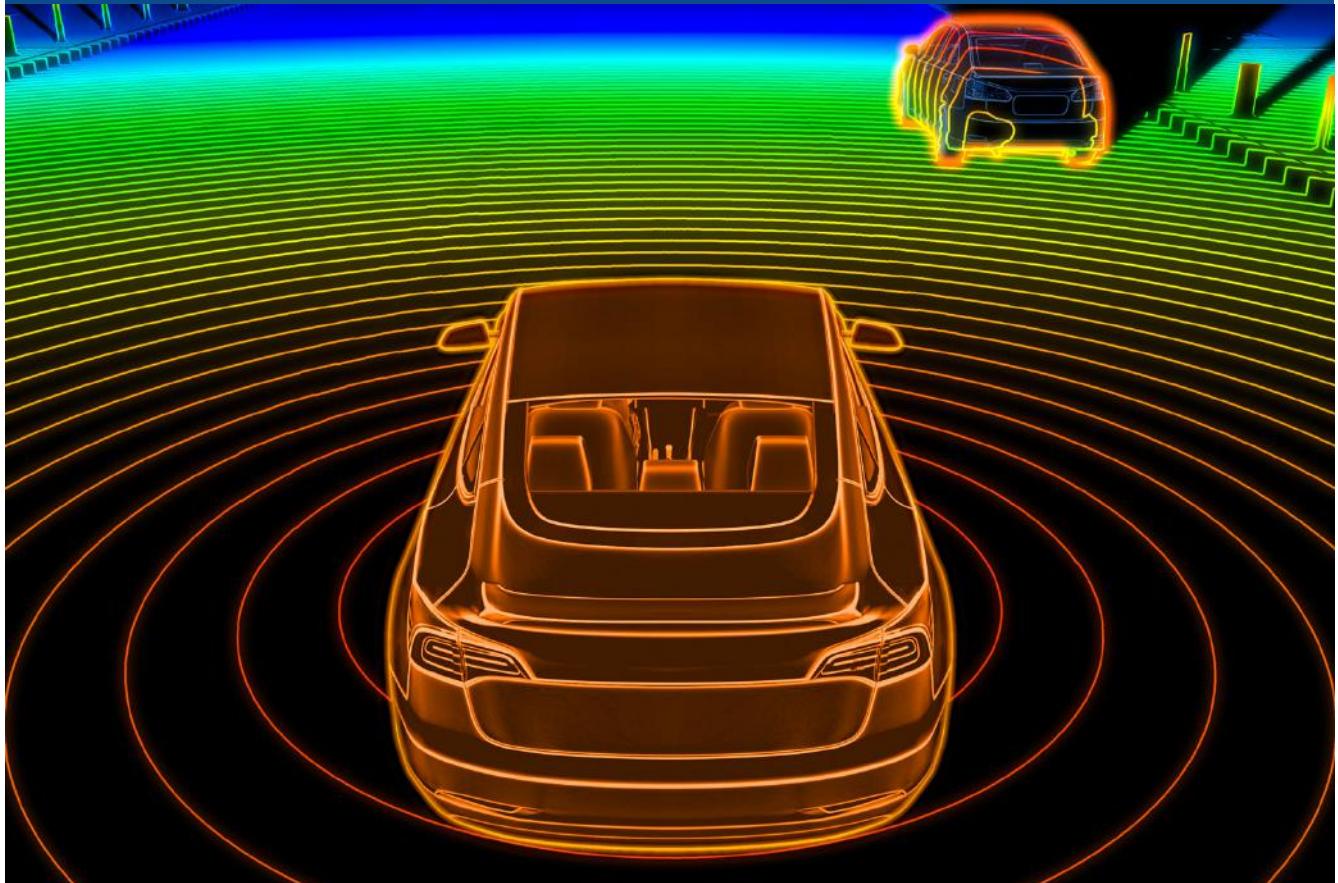




Monthly newsletter #3

JUNE 8, 2022



DVN Lidar Think Tank 2: Standardisation, Testing and Regulation



DVN LiDAR Team & Think Tank 2 live participants at the Dorint Hotel Main-Taunus-Zentrum Frankfurt/Sulzbach on May 30 – 31, 2022

Editorial · June 2022

As we announced in last month's newsletter, and in line with our ambition to create a broad lidar community, we successfully held our second DVN Think Tank seminar on 30-31 May in Frankfurt-Sulzbach, with more than 30 companies and institutes participating.

The presentations and break-out groups were centred round the topics of standardisation; testing, and regulation. In the morning session, it was especially appreciated that two Chinese presenters shared their topical views— Professor Ling Ming from Shanghai University of Engineering Science and Mr. Li Pu, Great Wall's Intelligent Driving department director. The session was completed with a talk by Adrian Zlocki from FKA / Aachen University, introducing an initiative aiming to generate a DIN/SAE standard.

Three important takeaways from this morning session:

- China is heavily pushing for a national standard of lidar systems as an enabler for autonomous vehicles;
- Even with a variety of lidar technologies still in an early innovation phase, some Chinese automakers have already integrated lidars on their vehicles to gather road and traffic situation data to build knowledge in advance of the publication of national standards or regulations, and
- Testing methods as presented by FKA Aachen, dedicated to a neutral evaluation of lidar performance, will pave the way for automotive lidar to gain traction. These testing tools can represent criteria for automakers to make the best choices for their perception systems.

Another interesting contribution to this newsletter comes from Yole Developpement, a group of French companies active in market and technology analysis and strategy consultancy. Over about a decade's time, Yole have accumulated a deep understanding of sensing technologies. This expertise enables them to evaluate markets; applications; solutions, and strategies. It is our great pleasure to present an interview with Mr. Pierrick Boulay, responsible for Yole's automotive activities, about his views on automotive lidar and autonomous driving.

Among other contributions, in the section on lidar News we continue our interview with AEye's Bernd Reichert, who addresses two core question about his company's strategy.

And at the end of this month's newsletter you'll find our plans for the next DVN lidar community events. All of us on the DVN team are working diligently to bring you maximum value for your DVN-Lidar investment! Please **share your thoughts** with us—how may we best serve you?

So, welcome in this growing lidar community and enjoy this third newsletter edition.



Alain Servel

*DVN LIDAR ADVISOR
LATE OF PSA GROUP*

Interview with Yole Intelligence

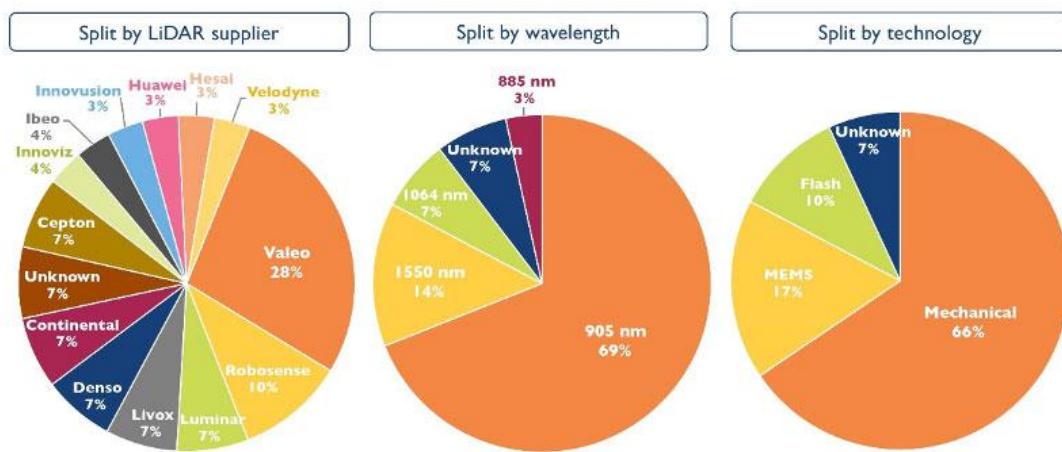


Yole Group, including Yole SystemPlus and Yole Intelligence, are recognised for their expertise in the analysis of markets, technology developments, and supply chains, as well as the strategies of key participants in the semiconductor; photonics, and electronics sectors. In the automotive field, particular areas of interest are lighting and lidar applications.

Today we interview Pierrick Boulay, a lighting and display senior technology and market analyst in Yole Intelligence's Photonics and Sensing division. Boulay holds a master's degree in Electronics from ESEO at Angers, France. He carries out technical; economic, and marketing analyses of lighting systems in general, with special emphasis on solid-state lighting. In addition, he leads the automotive activities within the company. He has authored several reports and custom analyses on topics such as vehicle lighting; lidar; sensing for ADAS vehicles, and VCSELs. Prior to Yole Intelligence, he mostly worked in R&D departments on LED lighting applications. Boulay is a highly respected speaker at DVN events.

LiDAR design wins* – Breakdown by supplier, wavelength and technology

(Source: LiDAR for Automotive and Industrial Applications 2021 report, Yole Développement, 2021)



*Total number of design wins known to date (29)



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Yole Intelligence and Yole SystemPlus offer a vast collection of reports focused on lidar and radar throughout the year. In this context, we were interested to learn more about Yole Group's approach and views on the future of the lidar market and technology. Mr. Boulay graciously granted us this interview:

DVN-Lidar: Lidar sensors are still expensive due to the early stage of the learning curves. From your point of view, which elements can generate significant opportunities for cost reduction in the next five years?

Pierrick Boulay: Today, the volume of lidar implemented is very small compared to other sensors such as radar or cameras, which benefit from the volume effect to lower their cost. Once lidar shipments are high enough, the volume effect will have a substantial impact on lidar's cost. If we look at the cost of some components themselves, those that are essential are still very expensive, such as the laser source; the photodetector, and the embedded FPGA. There are only a limited number of suppliers for these components. With more competition, the cost of these components should decrease as well.

DVN-L: From a cost perspective, will there be a tipping point after which automakers will start implementing lidar sensors in bigger quantities to improve their ADAS and AV functionalities?

P.B.: The cost of a radar or camera is between $0.1\times$ and $0.2\times$ that of a lidar. So lidar can only be implemented today in high-end cars, the E segment. It is also linked to the willingness of automakers to achieve L^3 automation. Adding a lidar is not as simple as adding another sensor to a car with its ECU; it is part of the significant change in the E/E architecture in cars evolving from a distributed architecture to a more centralised one with the end goal of data fusion. According to recent feedback, a cost between \$300 and \$500 could be an enabler for the implementation of lidar in C and D car segments.

DVN-L: Another interesting thought is the integration of lidar sensors with front and rear lamps because requirements for lidar and lighting show similarities in several areas. What are the pros and cons of such an approach in your view?

P.B.: There are multiple locations where lidar could be integrated. lidars were initially integrated into the front grille, but recently other positions—such as the roof; the windshield; fenders; bumpers, or headlamps have become possible. The main advantage of lidar integrated into the lamps is the location on the corners of the car, enabling a very large field of view. The protection offered by the lamp cover is a clear advantage, and front cleaning systems can be re-used on headlamps. Another advantage is linked to the wiring, as the wiring of the head or rear lamps can be used for the lidar. As wiring is one of the heaviest components in cars, this is something to consider. In terms of drawbacks, however, implementing lidar in headlamps would mean doubling the number of lidars necessary for L^3 , as only one lidar may be enough if placed in a central position (roof, windshield, grille). Heat issues will also have to be faced as LED modules also produce heat, and active cooling is already necessary in some cases. We also see a trend to a slim design of head or rear lamps. The integration of lidar would require the volume of the sensor to be reduced drastically, which has so far not been possible. Implementing lidar in headlamps could be possible, but only for higher levels of automation when more lidar per car would be necessary.

DVN-L: The lidar market is crowded with system and component suppliers as well as software/AI companies. Yole have mapped this ecosystem in different reports. Will this crowded field help to speed up market development of lidar sensors, do you think? Or might it have the opposite effect and be an obstacle?

P.B.: The lidar market is crowded with system suppliers, and we have counted around 60 companies targeting the automotive market. This high number of companies brings diversity in technology, whether imaging (mechanical, MEMS, flash) or ranging (ToF, FMCW, or phase shift). Everyone wants to enter the automotive market as quickly as possible to generate revenue. It is a clear technology push, and it could help with the faster market development of lidar.

DVN-L: In connection with the previous question, will industry standardisation or even government regulation be an enabler for a market breakthrough of lidar systems, or would such initiatives hinder market development?

P.B.: In our understanding, regulation cannot impose a particular technology. The ALKS regulation does not mention the type of sensor, or location, or technology, and only use cases are mentioned. Organisations like NCAP or NHTSA could reinforce the performance of specific tests in low-light conditions. But in this case lidar is not the only sensor that could be used; thermal cameras could also be used.

DVN-L: Do you expect a consolidation of suppliers in the lidar ecosystem? If consolidation happens, will technological aspects like scanning principles, range performance, and speed detection play a key role, or will there be more focus on business aspects, like coöperations and alliances or finance-like funding?

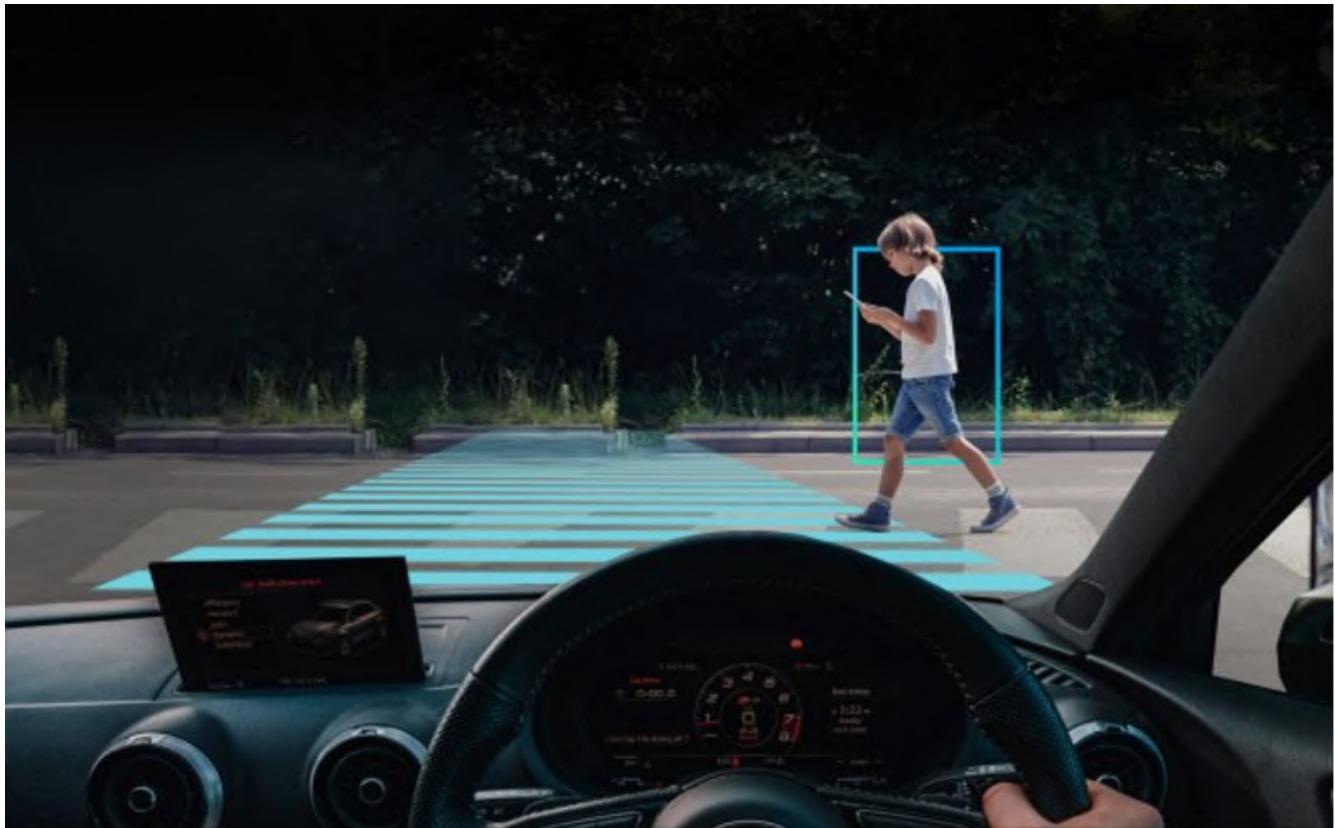
P.B.: Yes, consolidation will happen. If you make the comparison with the camera and radar markets that are quite mature, you clearly see that four or five suppliers control 75 per cent of the market. We expect a similar landscape when lidar matures. We should see more mergers between lidar suppliers, and tier-1s acquiring lidar makers. It is too soon to tell if one technology will prevail. There are still some improvements to be made at the emitter or receiver levels, and ToF lidar at 905nm is still improving. To reach long range, we have seen several lidar manufacturers using a 1,550nm architecture. More recently, we have seen interesting progress with 905nm-based lidar using a new generation of components such as VCSELs and SiPM to replace the traditional EEL (Edge Emitting Laser) and APD (Avalanche Photodiode).

DVN-L: Lidar sensors are integrated into vehicles, not as stand-alone systems, but to enable advanced ADAS and AV functionality in combination with cameras and radars—sensor fusion. Suppose this fusion progresses successfully and regulatory barriers fall. What is your expectation for L^3 -capable cars on the road in Europe, North America, China, and Japan in significant quantities? Do you foresee regional differences?

P.B.: European car makers were the first to implement lidar with Audi in 2018 and now Mercedes and BMW. Then others followed—Honda in Japan; GM in the US—and now many new EV automakers targeting high-end cars are implementing lidar for L^3 . Today there is a clear move from Chinese new EV automakers towards L^3 . What is interesting with these Chinese automakers is that they are implementing multiple lidars per car together with the necessary hardware to reach L^3 , but there is currently no regulation to enable this automation level. So, lidar is not activated yet and is only used to collect data for the automakers. As soon as the regulation is in place, automakers will be able to activate new automated driving features by OTA (over the air) updates. Regarding historical automakers, recent moves from Stellantis and Nissan have been observed to implement L^3 functionalities and therefore integrate lidar. Other automakers could be in a wait-and-see mode or directly leapfrog L^3 to build real autonomous cars.

DVN-L: Mr. Boulay, we thank you kindly for this open interview. You've provided great insight about the automotive lidar market and we hope to meet you again at one of our next DVN events!

AEye's 4Sight at AutoSens Detroit

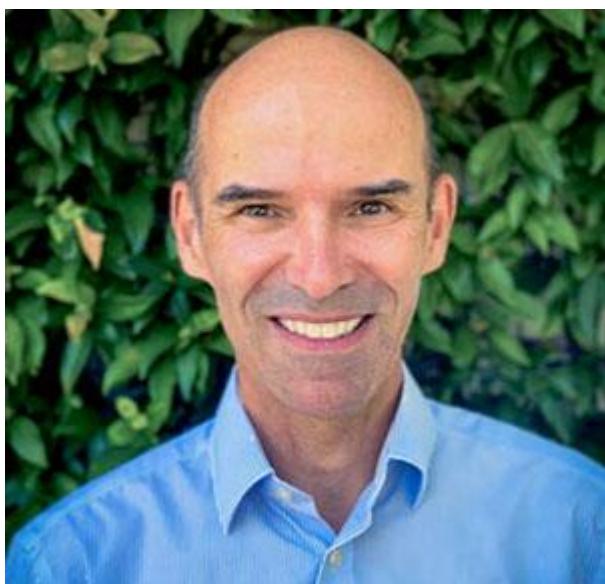


AEye presented the compelling features of their 4Sight lidar sensing platform concept at AutoSens Detroit. According to the company, their 4Sight™ Intelligent Sensing Platform can be configured via software for different vehicle placements. This achievement of using a single platform, configurable through software and working in multiple mounting locations, provides automakers significant vehicle design and aesthetic flexibility. This concept can help to further advance the pursuit of software defined cars including over-the-air updates to improve safety features over time without having to replace the lidar sensor hardware.

AEye cofounder and automotive general manager Jordan Greene says, "AEye customers gain the distinct advantage of a single platform that can be modified for any vehicle model and application, increasing adoption and deployment across automaker platforms and reducing engineering costs. Moving AEye sensor hardware from one location on a vehicle to another does not require a mechanical adaptation, as the sensor's performance parameter can be configured by a simple software operation. This provides our go-to-market partners, like Continental, the ultimate flexibility in design, without compromising top-end performance in the process".

As automakers shift towards software-driven business models, they are looking to software-defined hardware to absorb new technological advancements, and to deploy new, innovative services. AEye's adaptive sensor platform can be configured via software for different vehicle placements, use cases, and markets to help automakers realise their vision of smart assets and software definable vehicles.

In this context we put two key questions to AEye senior automotive VP Bernd Reichert:



DVN: Your company's mission is to drive the future of safe autonomy. How do you see the role of lidar sensors in this context and especially the lidar technology of AEye?

BR: The first electromechanical lidar sensors, with big rotating mirrors, have been developed and deployed in different automotive applications (for instance, the Audi A8 and the Mercedes S-class).

We see a shift to solid-state MEMS-based products, which are much more robust to meet the requirements of both passenger and commercial vehicle manufacturers, combined with higher performance regarding range, resolution, and field of view. Knowing that the transition of the automotive industry will require new ways to develop such technology, AEye created a configurable software-defined lidar solution. It is the only lidar on the market that supports the development of the software-defined vehicle.

So, our solutions and roadmaps are in line with the ambitions of the European automakers, which have defined clear strategies about how they want to master this transition, where the car becomes a data-centric mobile device, similar to a smartphone.

DVN: Will you share your view on the development of ADAS and AVs in this decade? Where in the world will the automotive community see the broadest progress? How will passenger cars compare to trucks, delivery service vehicles, robotaxis, etc?

BR: Let me start by pointing out the massive investment governments across the world are making in Smart City technology and infrastructure. This is happening across Asia; the Middle East; the EU, and North America. In parallel, the entire automotive industry is moving toward EV fleets in a matter of years. For EVs and smart cities, this means software enables new features, such as ADAS, and the updates and upgrades of those features over time. What is most exciting is that the addition of these features can all happen through software updates—no change in hardware needed. We also see an increasing shift towards software-defined EVs happening in commercial vehicles and, really, any machine that moves.

A couple of years ago, we saw strong enthusiasm for AVs and robotaxis on the streets. While we anticipated this to happen much earlier, we know that regulation has been a major bottleneck to the adoption of autonomous vehicles. The first L^3 traffic jam pilots, in which autonomous systems will control driving and monitoring in some situations, have already received regulatory approval. The first applications of L^4 highway pilots, with a higher degree of automation and higher speeds than traffic-jam pilots, will be possible by 2024 for private cars.

These highway pilot applications require lidar sensors with longer range, improved scan patterns, and focus on the corresponding region of interest to make fast decisions and focus on the important data.

Early highway pilots will be on commercial vehicles for hub-to-hub automation, most likely limited to certain well-mapped highways, but excluding operational design domains such as merging highways or crossing highways. Multiple truck automakers and autonomous system providers are conducting pilots in North America with fully autonomous trucks driving on highways. They still have the back-up of a safety driver on board. Favourable regulations in the southern United States, combined with good weather conditions, help accelerate the progress in autonomy for the commercial vehicle segment.

For robotaxis, we see the deployment at scale starting in the middle of the decade, maybe 2026, with a focus on megacities that have a higher volume of bookings. The US and China will lead this market.



DVN comment

Thank you, Bernd, for this enlightening interview. We wish you great success with your enterprise and hope to meet you in person at one of our DVN lidar events.

Valeo's Tokyo L4 Test Drives



Valeo forecast about 30 per cent of all new premium vehicles will be capable of L^3 automated driving by 2030, with the global lidar market topping USD \$50bn. So they're developing a more advanced version of their Scala lidar system, for launch in 2024, which they say will offer twelve times greater resolution; triple the range, and a considerably wider field of view. In a recent real-life test in Tokyo, Valeo demonstrated a test vehicle with L^4 capabilities even under urban conditions. Scala lidars and a front camera, combined with vehicle-to-infrastructure communication, allowed the test car to autonomously steer through crowded streets while avoiding pedestrians. The installation on the roof of the test vehicle and the screen image transferred to the driver are shown in the pictures (the system is L^4 -capable, but operates in L^2 during public-roads testing, with a Valeo engineer in the driver's seat to take control immediately if needed).



During the test drives, the self-driving system of course also encountered uncomfortable situations. Most common were “negotiating scenarios” that require bending traffic rules — such as leaving a lane to go around idling trucks or bicyclists. Also steering and especially braking turned out to be more rough than expected with a human driver.

The system is planned to be developed further by Valeo with the target to address such borderline scenarios in an improved manner. On the other hand, the driving dynamics as steering and braking are in the court of the vehicle manufacturers specification. Valeo's technology is focused on perceiving and interpreting the world around the vehicle.

The current Valeo product line-up comprises Scala 1 which has been installed among others on Audi A8 and Honda Legend. Up to now close to 200 thousand systems have been produced. The second-generation Scala 2 system hits the market in the new Mercedes-Benz S-Class as part of that car's Drive Pilot system, now available in Germany. Valeo say their 3rd-generation setup, the new one planned for 2024, will facilitate autonomous emergency maneuvers at road speeds up to 130 km/h, and will be able to "see" objects about 200 metres ahead. It will also be able to track vehicles not within human seeing distance, and track raindrop density to calculate proper braking distance.

Valeo designs and manufactures both the hardware and software for their Scala lidar systems. Production location for their lidars is their Wemding plant in Germany where about 300 engineers are working on the technology.



DVN comment

Valeo are clearly striving to push the boundaries of autonomous driving. Successful test drives in megacities like Tokyo will broaden the catalogue of delicate traffic situations significantly. This is a clear prerequisite as input for software and hardware engineers to improve their systems. Additionally, the added value and performance of lidar sensors can be evaluated. Another striking statement is the lidar market value of about 50 billion USD in 2030. This figure means that the automotive lidar market will have the same order of magnitude as the vehicle lighting market.

XPeng Dip Toe In European Market Waters



XPeng, a Chinese EV maker, have decided to tentatively enter the market in certain European countries: their P5 car can be ordered in Denmark, Sweden, and The Netherlands. The rationale behind this choice is that in these countries electromobility is relatively far developed compared to the other European countries. With a price starting at €48,000, the P5 sedan showcases advanced functions; innovative cabin design, and an attractive exterior.



The P5 is delivered in its highest grade with a very advanced driver assistance system. Along with cameras and radar sensors, the system also uses lidar. According to the company, the P5 can distinguish objects within a range of 150 metres and can operate autonomously on Chinese roads, but still under the supervision of a driver. XPeng source their lidar sensors for the P5 from Livox, an affiliate of Chinese drone maker DJI. The G9 SUV will come with two lidar sensors provided by Robosense, a lidar startup backed by SAIC and BYD. The G9 is scheduled for delivery in the third quarter of this year.

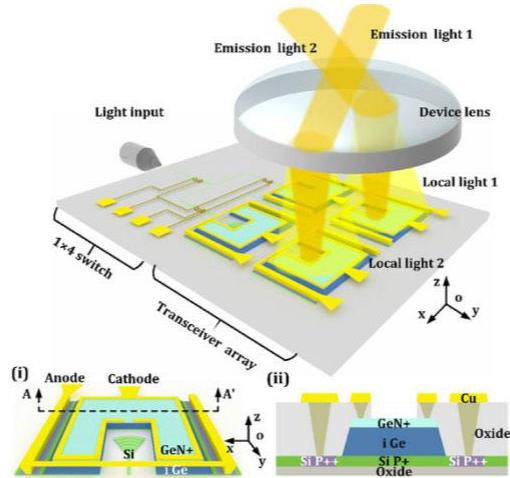
XPeng CEO He Xiaopeng told investors that the company are testing lidar technology from multiple suppliers and aren't bound to one maker—a position in alignment with the fact that XPeng recently led a fundraising round for Zvision, another Chinese lidar startup. Zvision plan to use the funds to accelerate the development and mass-production of their automotive-grade lidar sensors, including improving their production line and supply chain, but they have yet to publish a timeline.



DVN comment

The XPeng P5 underlines that Chinese EV makers are equipping their cars with a bunch of latest technologies and comfort elements. Especially advanced ADAS and autopilot functions are high on the agenda. This trend opens up a significant opportunity for market introduction and improved market adoption of lidar sensors. In line with this trend, the Chinese automotive industry is not relying on a limited number of lidar suppliers, but is clearly nurturing newcomers in the field.

Monolithic FMCW Chip Demonstration Shows Feasibility



A research group comprising members of the Laboratory of Advanced Optical Communication Systems and Networks at Shanghai Jiao Tong University and members of the China Aerospace Components Engineering Center at Beijing have recently demonstrated a monolithic FMCW chip. The lidar chip with integrated transceiver array is based on LABS (lens-assisted beam steering) technology.

The system enables beam emitting, steering, receiving and coherent detecting on a single chip with simultaneous distance and velocity detection. The integrated transceiver is designed with a composite structure of a Bragg grating in the middle and a u-shaped photodetector surrounding it. For proof-of-concept demonstration, a chip with 2×2 switchable transceiver array was fabricated. A monolithic coherent LABS Lidar system with a scanning angle of 2.86° , and a scanning speed of 5.3 microseconds is implemented for 5-metre ranging and 0.45-m/s velocity detection.



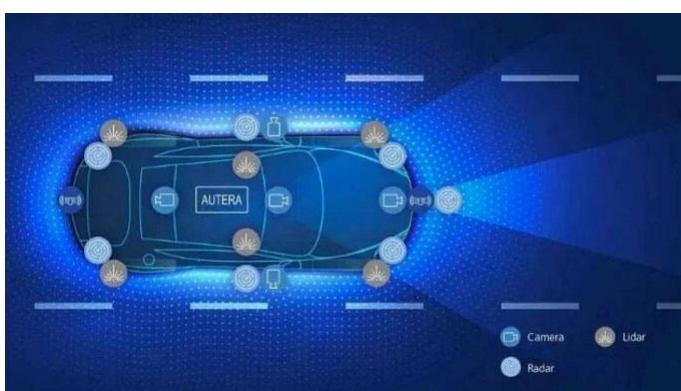
DVN comment

This university research project underlines the efforts which the Chinese industry and government are striving to devise small, cheap lidar sensors. As usual for university research, the results unveil a technology in an early conceptual state and industrial application will take several years of R&D. Nevertheless this proof-of-concept can support the way to a single-chip lidar system.

RoboSense, dSpace in Sensor Pact



RoboSense have announced a strategic partnership with dSpace, whose simulation and validation solutions will support RoboSense for the integration of their lidars and other sensors in the dSpace simulation and validation tool chain. Such development tools are now practically required to accelerate the development, testing and validation of lidars in ADAS and autonomous driving applications.



The two partners will focus on sensor simulation, testing, and validation for ADAS and AD systems, using RoboSense's lidar hardware and perception software and dSpace's Autera data logging system and Aurelion sensor-realistic simulation software to jointly develop and adapt, and to deepen industry-research collaboration and market coöperation. In the future, the two companies will work together to leverage resource concentration and closely coördinate in the application of the large-scale series production of autonomous driving systems.



DVN comment

The integration of lidars in the perception system of AD vehicles is strongly supported by end-to-end development tools. This supposes that such tools, like the dSpace tool chain, can host a representative simulated model of the lidar and its virtual vehicle and road environment before any real tests on roads. For automakers, this allows acceleration of the development of the complete AD system, and delays as much as possible real tests on real roads.

LeddarTech's LeddarSteer for Solid-State Beam Steering



LeddarSteer™ DBS

by LeddarTech

LeddarSteer is designed to augment LiDAR FoV and maximize performance.

LeddarTech have released LeddarSteer™, a digital beam steering solution designed for lidar smart sensor developers and automotive suppliers.

Digital beam steering deflects the transmitted laser pulses in a lidar. A stack of alternating liquid crystal cells and polariser gratings enables to steer light at different angles at a specific wavelength, to augment the lidar's field of view while maximising its performance.



LeddarSteer is available to lidar makers and tier-1 suppliers for the design and production of long-range, high-resolution lidars in a complete solid-state form—with no moving parts to wear out or to be affected by shocks and vibrations present in an automotive environment.

LeddarSteer can be integrated into an existing lidar to expand the field of view, and in clean-sheet new lidar system designs. Signal-to-noise ratio is improved by concentrating laser power on a small region of interest; while size, cost, and complexity can be reduced with equal or greater pixel count and resolution.

Another interesting feature is "Flex View", which can alter the FoV; the resolution, and the number of acquisitions on a specific tile during operation on a frame-to-frame time basis. This provides a valuable advantage when dealing with hazardous objects or adverse conditions such as fog; rain, or snow. It is also perfect for switching between a highway and city setting.

LeddarTech also announced the official opening of their Sensor Fusion and Perception Development Centre in Tel Aviv, Israel, on 9 June. The event was hosted by CEO Charles Boulanger with VP and ADAS-AD sensor fusion and perception general manager Ronny Cohen. Dr. Ami Appelbaum, Chairman of the Innovation Authority and Chief Scientist at the Ministry of Economy and Industry in Israel, gave a guest lecture entitled "Smart Mobility—Israel's Potential, Opportunities and Risks.



DVN comment

Numerous laser beam deflecting solutions are proposed currently by lidar component manufacturers. It is a broadly-held opinion that in the medium term, mechanical systems will be pushed aside by solid-state technology, suppliers of which offer a broad range of technical approaches. As yet it is unclear which will be the winning candidates. Robustness; reliability; longevity, and cost will filter down the options to the ones best suited for automotive scanning lidars at feasible pricing.

Quanergy: 250-Metre Range With OPA



Quanergy say their OPA (Optical Phased Array) technology has successfully achieved a range detection of 250 metres—a big increase over the range demonstrated earlier this year, and fully 2.5× the range demonstrated only 15 months ago. The improvement marks significant advances along the path towards commercialisation of their S3 lidar, a true solid-state sensor using an industry-first, scalable CMOS silicon manufacturing process designed for affordable mass-market production.

This test was conducted with a solid-state lidar S3 test platform with a single OPA emitter module. The system represents a complete optical link of the emitter output on the transmission end, the detector sensitivity on the receiver end and the signal processing for range readout. Different from the scanning mode, this ranging mode test has the laser beam shooting at the same direction on a target with 10 per cent reflectivity to simulate difficult-to-detect objects. The target positioned at 250 metres was successfully detected under bright sunlight.

Quanergy say their OPA is the most flexible; robust, and affordable technology specifically designed for advanced mobility applications. With electronic beam steering and no moving parts, OPA-based S-series sensors are ideal for heavy vibration transportation applications such as autonomous trucks; mining; construction, and agriculture since they are designed to provide more than 100,000 hours' lifespan (MTBF).



DVN comment

Even if the mainstream production of automotive lidars is still represented by macro mechanical scanning solutions such as Valeo's Scala, it is reasonable to predict that solid state scanning solutions will eventually come to dominate if and when they will demonstrate fully-debugged maturity. Radar sensors also proceeded along this kind of evolutionary path—remember the most accurate scanning solutions of early 2000s were also based on moving parabolic or Cassegrain antennas.

Second DVN Lidar Think Tank



The DVN Lidar team put on the second Think Tank seminar on 30-31 May, to promote the development of our lidar Community further in line with our roadmap. The event gathered about 50 people, representing 30 companies and institutes. It must be noted that Chinese automotive industry was represented by 12 companies—nine automakers and three tier-1 suppliers.

Here's a recap of the docket and events

First Day: 30 May

18:30: Welcome of Participants

19:00: Cocktail

20:00: Dinner

Second Day: 31 May

Welcome by Hector Fratty, DVN CEO

Introduction of participants:

Based on the list of participants, Leo Metzemaekers asked the in-person as well as online attendees to introduce themselves. The picture shows the a group photo of in-person attendees.

Live: Jennifer Ruskowski (Fraunhofer IMS); Eric Amiot (Valeo); Michael Kiehn (Ibeo); Adrian Zlocki (FKA); Uensal Kabuk (Huawei); Clemens Hofmann (AMS Osram); Thomas Sommer (Lumentum); Achim Freiding (Hyundai); John Peek (KSLD); Thomas Luce (Microvision); Andre Malz (Opsys); Bircan Taşlıca (TÜV); Leo Metzemaekers/Ralf Schäfer/Geoffrey Lebrun/Alain Servel (DVN)

Online: Li Pu/Jiang Haipeng (Great Wall), Shuangni Wang/Weichao Wang/Zhilei Zheng (Hycan); Yongping Sheng/team (Voyah); Kaiwei Hu (Chery); Fengwu Su/team (BYD); Huahai Luo/ZHI Feng Xie (Hozon Auto); Mingwei Tan/Hongliang Han (FAW); Zikui Han/Yu Yang (Xiaomi); Weibao Wang/Xudong Shi/Heng Zhao (Jidu Auto); Andreas Printz (Aeye); Gregory Poillion/Juergen Scherschmidt (Blickfeld); Henri Haefner (Cepton); Motohiro Komatsu (Koito); Matthew Everett/Thomas Sommer (Lumentum);Matthew Webb (Luminar); Yang Zhi/Jin Hui (Mind); Xiangyong WANG (Xingyu); Meng Han (SLD); Min YE (Sunny Optics); Ann Ai/Tylon Zu/Hector Fratty (DVN);

Recap on DVN lidar Community Leo Metzemaekers and Ralf Schaefer made a recap on last evolutions or events in the community since the first Think Tank in February:

- Growing number of participants / companies in the lidar community
- First two newsletters published
- More interviews and announcements will follow
- Additional activities are being scheduled

The slide deck of this event can be downloaded from the DVN website.

Morning Presentations

Prof. Ling Ming : Shanghai University of Engineering Science(SUES)/ Professional Committee on Beidou Application of Standards and Regulations Working Committee of CAAM (working group of vehicle Lidar)

"The Progress of China's Vehicle lidar Standard"

(you can watch this [video](#) on the DVN Website)

Professor Ling Ming gave a comprehensive overview of the lidar standardisation situation in China, especially the target to attain GB standards for lidar as early as 2024-25. Driving force is the ambition to launch L^{3+} vehicles massively in China. After his presentation and to answer participant's questions, Pr Ling Ming pointed out that China's standards organisations are ready to work on harmonisations with SAE or UN, and that while Chinese standards are targeted to be ready before 2025, some Chinese automakers may produce lidar equipped vehicles before then.

Dr. Adrian Zlocki : Head of Automated Driving at FKA / Aachen University

"Specification and Test Framework for Automotive Lidar Sensors"

(*this presentation* can be downloaded from the DVN website)



Partner



FKA can assess lidar sensors not only in lab testing, but also on highways under adverse weather conditions. Examples of such diverse rain test scenarios were shown. The goal of the project is to generate a platform which allows comparable performance characterisation of lidar sensors. The final target of the project is to establish a DIN/SAE standard. Such a standard, although not a regulation, can help automakers as well as suppliers to have a firm ground to stand on.

After the presentation and to answer some questions, Dr Zlocki said:

- Their tests are based on typical road scenarios supplied by their customers, but they don't use specifications associated with lidar under tests.
- In case of rain-effect tests, they use protocols (drop size, density...) similar to those used for lighting tests.
- FKA can make tests for one automaker on different lidars separately for benchmarking, but results are limited to point cloud outputs; target clustering and tracking algorithms efficiency are not evaluated.
- Test results or benchmarks are not published.
- Tests of perception systems including different sensors and artificial intelligence and/or deep learning, is not in the scope of FKA.
- Sensor's environment simulations are not in their scope.

Li Pu, Department Director Intelligent Driving Platforms at Great Wall Motors

"Automaker Message on Lidar"

(this presentation can be downloaded from the DVN website)



After the presentation and to answer some questions, Mr Li Pu pointed out that lidar sensors are used in context of L^{2+} functions only activable on highways—traffic jam pilot, for example. Urban functions are not still deployed, due to the complexity of urban scenarios.

Afternoon session

After lunch three working groups broke out to consider assigned topics:

WG1: Can standardisation and testing support market development of lidar for ADAS and L^{3-4} ?

Working Group 1: LiDAR standardisation and testing

Many companies claim to be the Hero. Better to work together,

If we went to standardisation, would that help the market development of ADAS and L3 and L4

- Standardisation of what?
 - Performance data
 - Interfaces
- What to achieve through standardisation? Mandatory (type approval)
 - Mandatory: Eye-safety
 - Mandatory: interference with police LiDARs for speed enforcement
 - No electro-magnetic bands for LiDAR like for e.g., Radar
 - Wavelength regulation: NIR/SWIR, bands for different applications?
 - No standard: Interference between LiDARs
 - This is a known issue and will become an issue even more once we have more LiDARs on the street
 - Define test methodology
 - Test all LiDARs: not possible. Test only own LiDARs: not enough. No solution available yet, too many LiDARs out there in the world.
 - Working group in China: tests interference with own LiDARs systems

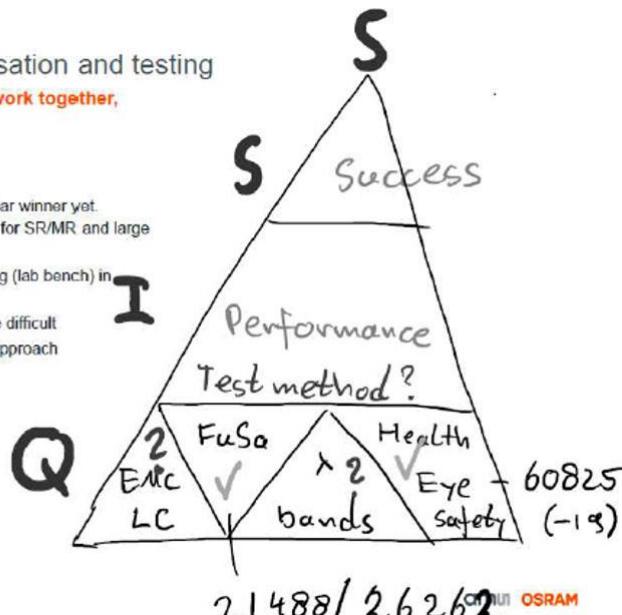
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Working Group 1: LiDAR standardisation and testing

Many companies claim to be the Hero. Better to work together,

- Technology standardisation
 - Still many different technologies out there, not clear winner yet.
Possible: FMCW for long range, small FoV, dToF for SR/MR and large FoV
 - Do interference testing (LC) similar to EMC testing (lab bench) in combination with emission maxima
 - Ensure basic performance, 100% certainty will be difficult
 - Includes emitter, detector & software: black box approach
- Essential Requirements
 - Quality (standardisation)
 - Image
 - Success
 - Sustainability



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WG2: Regulation and Standardisation—threat or opportunity?

Results:

- Regulation is a must for safe introduction of lidar. Set minimum requirements and build on them in the years to come. Harmonisation of regulation is better for business worldwide.
- Regulation is a great opportunity for growing the business worldwide. Pedestrian safety must be regulated.
- China is ahead with regulation and does not wait for a UN initiative. Eye safety must be regulated. Group standards should be pushed. China would like to work towards harmonisation with UN and hopefully also with SAE. Group standards should target at high reliability, and for sufficient performance. Otherwise, realistic cost targets cannot be met.
- Regulation is an opportunity for growing the business, but pace should not be too fast. Maybe ranking next to regulation may help the industry.
- What needs to be regulated? Safety; redundancy of safety systems; double lidar in combination with camera. Environmental requirements? Regulation should be technology-neutral.
- Different dimensions, regulation of sensors (eye safety / glare) should be sufficient for the time being. At the safety stage we are still in, the industry needs freedom to operate.

WG3: How to Create the Best Lidar Newsletter?

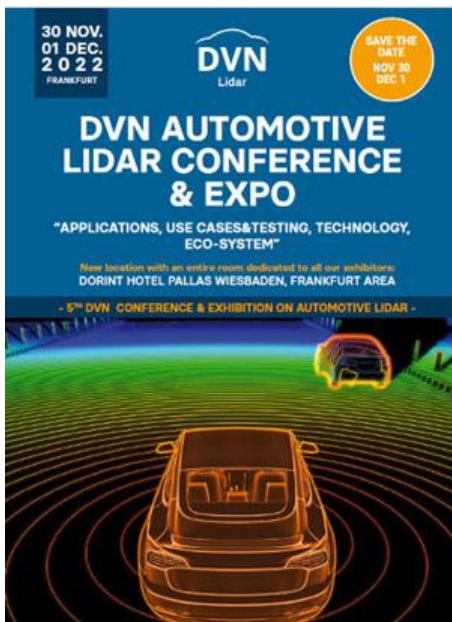
- To resume discussion of participants, this newsletter would:
- Be distributed monthly on a specific website, with a specific name and logo
- Be a social network between members of lidar community
- Focus only on the automotive market and applications
- Share lidar news from the different regions: Europe, Asia, US...
- Be neutral in term of interviewed companies and selected news
- Periodically focus on standards in progress (DIN, UN, SAE, ISO, GB...); lidar and system environment (AI, Fusion with other technologies...); lidar physical integration, and activities of community members.

Next Community Events

- **Lidar Workshop:** Planned for 26-27 September in the Frankfurt Area; date and venue to be confirmed.

- **DVN 5th Automotive Lidar Conference:** 30 November–1 December, Frankfurt area (Wiesbaden) with excellent conferencing and networking facilities

Our DVN lidar conferences are becoming a real tradition: this year already the 5th version will take place. We plan our conference to be a live-only event, so we recommend you register as early as possible.



The rubrics for this year's event are Applications

- Use Cases & Testing • Technology & Ecosystem

The event will be at the Dorint hotel in Wiesbaden, close to the central hub of Frankfurt and with excellent conferencing facilities to network and to host our exhibition.

Participants consistently appreciate our DVN Lidar events, especially our high-quality presentations and good networking opportunities. We're striving to exceed all expectations with this, our fifth conference.

If you are interested to join as participant or want to be a speaker or an exhibitor, or for more information, please email [Geoffrey Lebrun](#), [Leo Metzemaekers](#), or [Ralf Schäfer](#).