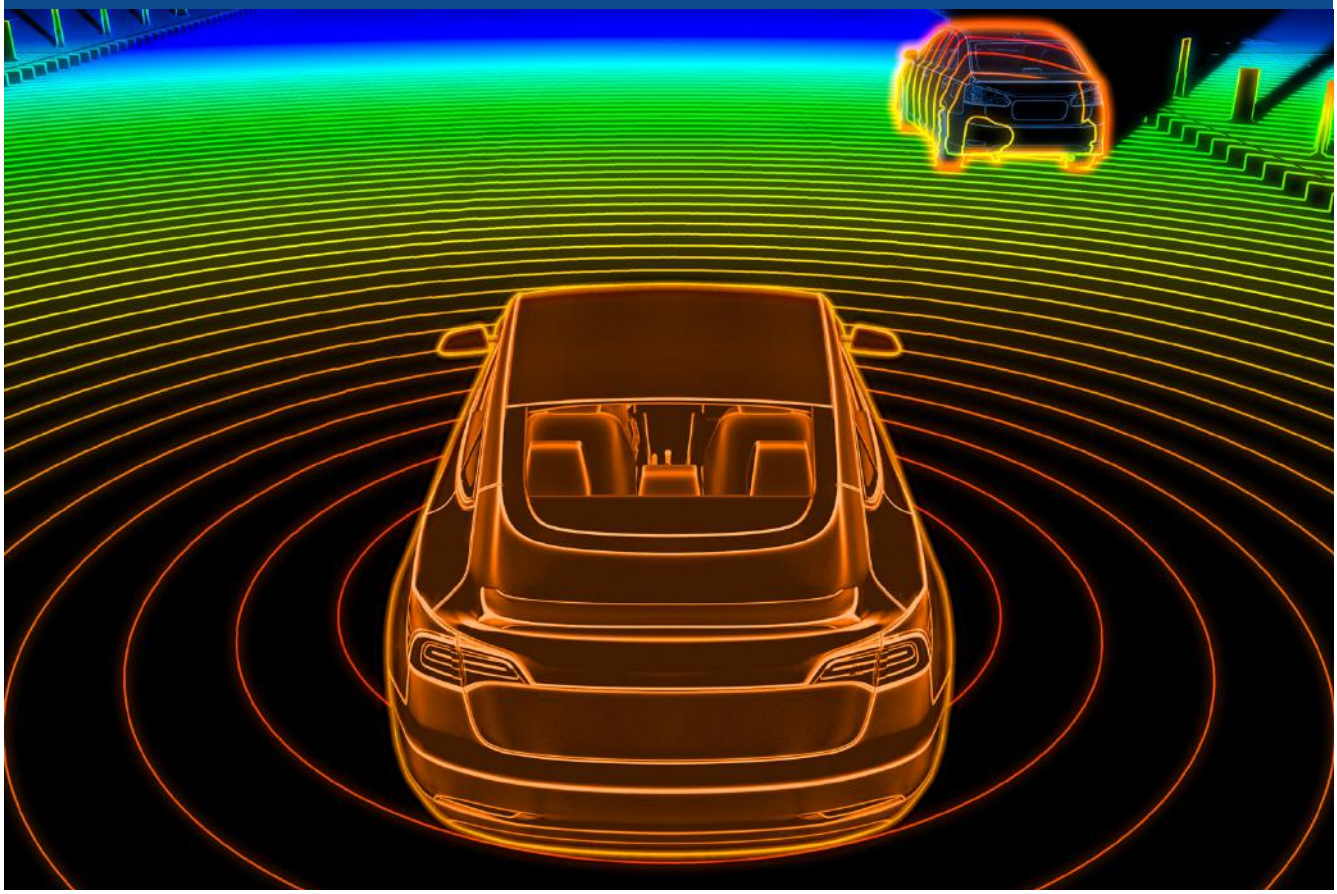
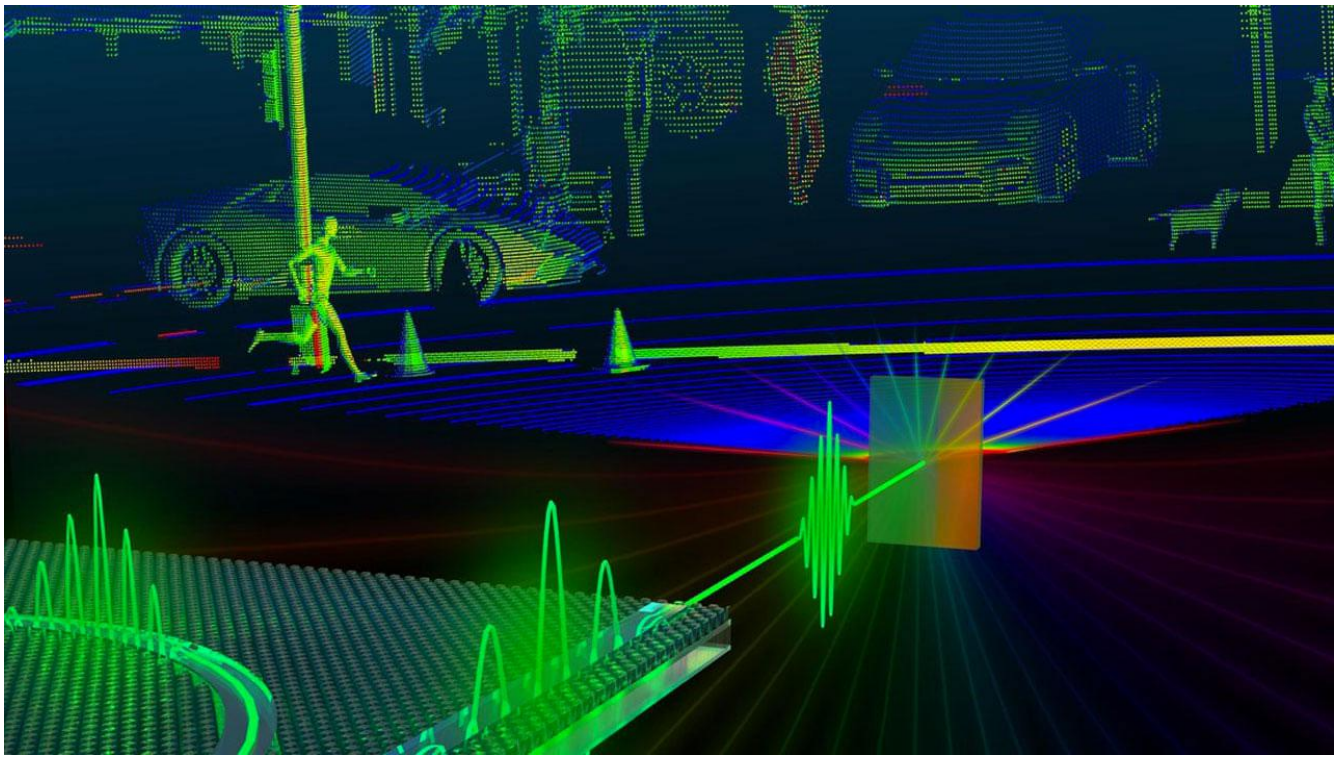
DVN
Lidar

Monthly newsletter #7

OCTOBER 7, 2022



Valeo technical center towards Autonomous Driving, Lidar workshop goes deeper, September's lidar news



October · September 2022

DVN monthly interview - Marc Vrecko, President of Valeo's Comfort and Driving Assistance business unit, told his thoughts regarding Valeo's competitive position, lidar market, new technologies and regulation. It was also the opportunity for DVN to visit the new ADAS technical centre in Paris, and test some automated driving cars .

DVN could test Valeo's third generation of lidar on the road - SCALA3*. It can detect small objects in the far range, and improve vehicle's localization on urban roads with SLAM (Simultaneous Localization and Mapping). In this case, the associated HD map can be fused with lidar's points clouds and stored onboard or offboard through an ad-hoc V2X system.*

DVN-Lidar Workshop report – 34 participants from OEMs & Lidar Tier1s/Tiers2 met on 12-13 September in Francfort, to go deeper in the understanding of lidar's requirements, interference risks and technologies (transmitters and detectors) including presentations from Ford, Microvision, OSRAM, Fraunhofer and two deep dive sessions in working groups.

Partnership between Lidar Tiers1 and Chipset providers – This might be a new trend: both Robosense/Qualcomm and AEye/Nvidia have announced partnerships to better process the huge volume of data generated by Deep learning software and lidar's points clouds.

Lidar applications for infrastructure – new applications to monitor the traffic at intersections. Quanergy has started a project in Paris, and Innoviz in Los Angeles. This will be the occasion to assess some of the interference risks discussed in the last DVN workshop.

Lidar Tier1 Robosense - wins a new business at GWM - WEY

5th DVN Lidar conference on 30/9-1/12 in Wiesbaden - don't forget to save the date!
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 at Valeo CDA with Marc Vrecko: Amazing Technologies!

DVN visited the new Valeo's ADAS technical centre in Paris. As part of our visit, we interviewed Marc Vrecko, president of Valeo's CDA (Comfort and Driving Assistance) business unit.

Valeo's Comfort and Driving Assistance Activities

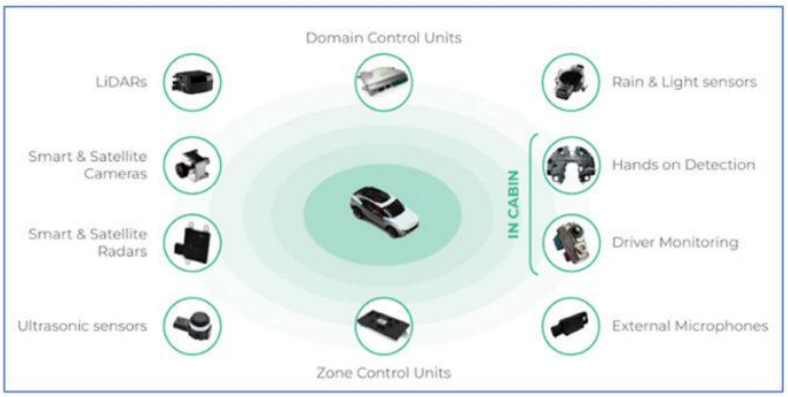
This is one of Valeo's four business units, focused on solutions for intuitive controls, connectivity, and driving automation to make mobility safer and more enjoyable. They've produced 1.5 billion sensors over the last 30 years and are on track to produce another 1.5 billion sensors in the next five years!

The business group has three product lines:

- ADAS, producing AD and AV technologies and systems including lidars (200,000 Valeo lidars have already been produced for the automotive market); cameras (including 100 million surround view cameras and front cameras), radars, and ultrasonic sensors

- Interior control, working to enhance the vehicle-interior experience through intuitive and interactive solutions including hands detection and driver/occupant monitoring
- Connectivity, devising innovations for telematics car access control; car sharing, and acoustics.

Valeo's Machine Perception Portfolio & VMTC center



VMTC – Valeo Mobility Tech Center, in Paris

To speed-up research projects for AD and ADAS, all technical and human resources are located in the same place to offer a collaborative work environment, facilities to equip test cars and even test tracks.

Live Demonstrations at Valeo's ADAS R&D Centre

• **3rd-generation Scala lidar –** see Valeo lidar team with B. Fleury and H. Fratty on the right

The demo-car had a Scala3 mounted on the roof. The resolution is about 0,05° in azimuth, with a 150° field of view. It can detect and classify a small, dark object on the road up to 150 m range (i.e tire), and a vehicle up to 250 m range. It can also detect road markings and road (pavement) borders.

A precise location of the vehicle is achieved using the SLAM technique. The precision is even better than the one offered in urban conditions by a GNSS (subject to the propagation of satellite waves).

Scala3 will be available in two versions: one for integration above windshield (same as Volvo cars), one for integration in the front grill, dimensions are close to 40H × 200W × 80D mm.

• **Valeo's L4 Drive4You system**

This autonomous car can support L4 Highway Pilot; Traffic Jam Pilot, and Urban Pilot.

Vaeo AV team incl. Benazouz Bradai (2d on the left) and his team gave us a live demo of L4-AD modes

The vehicle has six Scala lidars—three in front and three in the rear; four corner radars; a front tri-focal camera; four panoramic cameras; two side lidars, and 12 ultrasonic sensors. This impressive sensor suite is used to validate a robust perception system for L4.

See video at https://www.youtube.com/watch?v=ZxqBKqEQpZ8&t=1s

We could experience many critical use cases: overtaking; stopping at a roundabout, restarting according to priority rules; stopping and starting at traffic lights and slowing down and stopping at pedestrian crossings. We could see, in real time, the visualization of vehicles detected by the sensors all around the car.

DVN Interview: Marc Vrecko, Valeo CDA President

Marc Vrecko, graduate of the INSA Lyon Engineering school, started his career at Saint Gobain in France in 1990, serving in various plant management positions, before moving to Asia where he stayed for close to 15 years.

In 2008, he moved back to France to take charge of the Saint Gobain Abrasives business, in addition to serving as Vice-President, Thin Wheels/Construction Products Worldwide.

He joined Valeo in 2011 as President of the Comfort and Driving Assistance Systems Business Group,.

“On a more personal side, I must admit I am rather busy, so my priority is to take care of my family, with 3 boys full of energy and projects. I enjoy tennis, golf, reading and international travel.”

DVN: Tell us about your BG. What are the facts and figures, the prominent activities? What makes your BG unique?

Marc Vrecko: CDA has been the first organization in T1 industry putting under the same roof the automated and connected activities. Back in 2011, it wasn't as obvious as it is today, where we see an incredible level of product synergies between our ADAS and Interior Experience/ Connectivity activities. CDA is a €4 billion revenues organization with close to 30.000 associates worldwide, with 28 manufacturing locations and 17 R&D sites. We are enjoying an exceptional commercial momentum thanks to our unique positioning, and we expect to more than double our revenues in the next 5 years, which is rather unique in the industry. For instance we have produced since early 90s around 1.5 Bio ADAS sensors… we will produce as many in the 5 years to come, which is a sign of exponential growth.

Questions on ADAS - Valeo competitive position

DVN: In the European market, Valeo is seen today as the clear leader for automotive lidar sensors. How do you see your position in Asian and NA markets? What are your top 3-5 competitors?

Marc Vrecko: Thanks to Valeo's 360-degree lidar cocoon, composed of 5 SCALA sensors and a central computing unit, Honda was able to achieve in Japan the first ever lv3 passenger vehicle in the world, for this achievement Valeo received a supplier award from Honda early in 2022, which is rather rare for non-Japanese suppliers.

Mercedes has received type approval for its Drive Pilot system in Europe and Valeo has contributed significantly with our 2nd generation SCALA as well as system/software to achieve this certification. Other markets will follow. We will soon launch with an Asia-based global manufacturer, and you've surely followed our announcement on the global business win for our 3rd generation lidar with Stellantis.

About competition, there are many new lidar companies which have achieved important valuation levels but so far, apart from some Chinese players, none of them has ever delivered a lidar for a passenger vehicle.

We are used not to name our competitors… but if we would, we would answer Luminar, Innoviz & Cepton. Also, Hesai & Robosense if we include Chinese

DVN: You have Radars, Vision, Ultrasonics and Lidars in your portfolio. In terms of market, what is the current situation of these Valeo's sensors?

Marc Vrecko: With almost 200,000 sensors in the market, we're the leader in Lidar, with the Valeo SCALA® equipping the two first & only OEMs in the world to be certified at SAE Level 3 of autonomy. We also just signed a key contract with Stellantis for our 3rd generation SCALA®.

Ultrasonic Systems: we're the market leader for with more than 45% market share.

In Surround Cameras we just celebrated our one hundred millionth camera (100,000,000) produced at our Irish site, at Tuam (in April 2022). In Front Cameras we are the largest partner for Mobileye who leads the market and therefore are also becoming the leading Tier 1 in this segment.

Plus, we have strong ambitions in Radar with two recent awards for a complete ADAS system using our front camera and up to 5 Valeo radar sensors.

Following our strong expertise in control units for sensor fusion, we just got an award for the next generation of ADAS Domain Controllers from BMW, and we also provide perception stacks for all our sensors and cameras, offer state-of-the-art computer vision algorithms for surround cameras.

We are the recognized leader in parking and low-speed maneuvering and offer safety and assisted driving functions for our smart front camera systems.

Questions on Lidar – Technology

DVN: How do you see the market evolution of solid-state vs mechanical lidars in the next years?

Marc Vrecko: First I'd like to clarify the difference between mechanical lidar in which sender & receiver elements are in the rotor, and rotating mirror lidar in which only the mirror rotates leading to a very robust design, proven by Valeo with nearly 200.000 lidars on the road. The advantage of a spinning lidar is that it can provide a long detection range combined with a large field of view and a high resolution.

Solid state technology such as flash lidar is very well suited for short range, but not for long range. To achieve a long detection range, it can only provide a narrow field of view, essentially requiring several sensors to cover a wide coverage area.

DVN: Up to now automotive lidar is mainly using ToF (Time of Flight) technology. Some companies state that Frequency Modulated Continuous Wave (FMCW) will be the winning technology for the future. What do you think?

Marc Vrecko: FMCW is a promising technology, and we are very familiar with it from our expertise in radar, which we can leverage in for our lidar developments. We expect this technology to be mature enough for an automotive SOP by 2026 at the earliest, more likely later.

DVN: Do you see the next generations of Lidar capable of robust performance in bad weather conditions?

Marc Vrecko: Yes, robustness in bad weather is at the core of our technical choices for SCALA gen 3. The usage of 905 nm wavelength which is very robust to water absorption combined with higher resolution and utilizing several echoes per point allows SCALA gen 3 to achieve very good performance on adverse weather conditions.

DVN: Concerning short range corner lidars, do you have investigations or developments on such technology and particularly on its integration in headlamps?

Marc Vrecko: Yes, integration of lidar in headlamps or behind windshield is under investigation. However, such integrations come with multiple challenges. Lidar sensors are sensitive to any surface that could alter the optical path. Managing the heat dissipation is another concern. We also must not forget that most headlamps are subject to a facelift after a few years. Having to revalidate the lidar perception would significantly increase the effort for this.

Questions on Lidar - Market & Regulation

DVN: The UNECE has just released a new regulation allowing level 3 automated driving under controlled conditions up to speeds of 130 km/h. What does this mean for the sensor suite? Will it mean that under practical conditions lidar sensors become (quasi) mandatory?

Marc Vrecko: Absolutely. Lidar is quasi-unanimously considered mandatory for level 3 automation and higher. While the SCALA gen 2 is a key enabler for Level 3 Traffic Jam Pilots (up to 60 kph), our SCALA gen 3 is designed to enable Level 3 functionality at high-speed. Thanks to a detection range of up to 300 meter, a vertical resolution of 0.05°, and matching perception algorithms, the sensor is able to reliably determine small debris on the road at high speed.

DVN: For Lidar, volume growth is somehow linked to the Automated Driving market. EU has released the first L3 regulation this year and plans to release a L4, L5 regulation next year. Do you think CN / USA will follow soon?

Marc Vrecko: In the U.S. authorization for Level 3 functions are done on a state level. First systems are expected to launch in California, Nevada, and Florida within the next 6-12 months. In China, regulations for Level 3 and 4 are expected for 2023. Several provinces already licensed vehicle testing.

DVN: Lidar's volume growth can be also linked to the UN regulation that requires the deployment of AEBS from 0-60 km/h. Some AEB scenarios like pedestrian detection in urban conditions could take advantage of the use of short-range solid state lidars. These sensors have a much better resolution than existing corner radars. Do you think that it could be also a good trigger for Lidar's deployments and consequently for a drastic cost reduction?

Marc Vrecko: We are fully committed to eliminating road fatalities and road accidents ultimately and are closely monitoring developments in this regard. The cost of lidar sensors will come down as volumes continue to grow. However, a lidar sensor will remain more expensive compared to camera and radar for the foreseeable future, which of course also continue to improve. We don't see lidar to replace other sensing technologies – at least not on a broad scale – but rather complementing them to advance performance and reliability of the overall function.

RoboSense Adds GWM WEY to Its List of Design Wins on Top of 50+ Models

At the 25th Chengdu International Auto Show, RoboSense has announced it will provide LiDAR for Great Wall Motor WEY Mocha DHT-PHEV LiDAR Edition.

RoboSense, together with Haomo and Qualcomm, have jointly created the urban driving assistance solution NOH for WEY. RoboSense second-generation smart solid-state LiDAR (RS-LiDAR-M1) is integrated under the headlights on both sides of the vehicle to give an accurate perception capability and provide a safely redundancy in the perception system. With these 2 lidars, Mocha DHT-PHEV can perceive, think and make decisions like a human driver allying comfort and safety in the automated driving behaviour. Mocha DHT-PHEV's intelligent driving application scenarios can cover all kinds of high-speed and urban road conditions. Complex road conditions will bring various challenges to LiDAR.

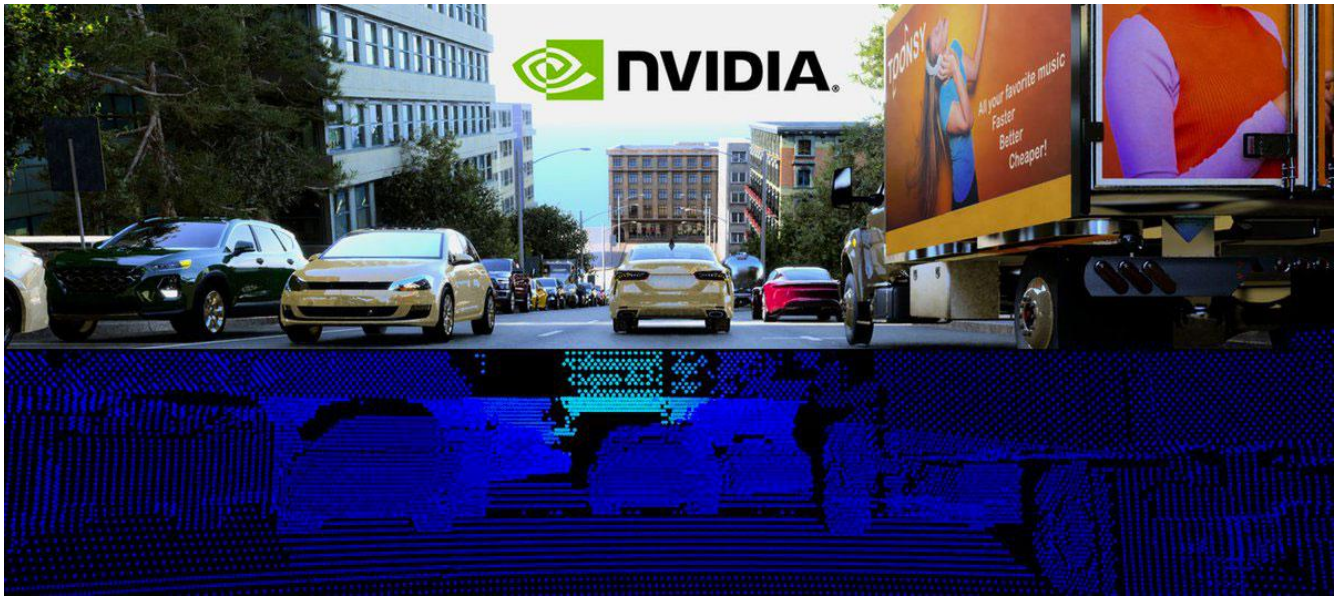
RS-LiDAR-M1 has a highly integrated design and has passed a series of reliability tests in accordance with strict passenger vehicle standards, including mechanical shock, random vibration, high-pressure water impact, high and low temperature operation, high and low temperature damp heat, solar radiation, EMC, chemical anti-corrosion, salt spray and other tests. It fully meets the safety, reliability, and service life requirements of Mocha DHT-PHEV in complex high-speed and urban road scenarios.

RoboSense has still obtained design wins for more than 50 models from companies including Great Wall Motor, BYD, FAW Hongqi, GAC AION, ZEEKR, WM Motor, Lotus Cars, Lucid Motors, Inceptio Technology and Zhito Technology.

DVN comment

GWM has won several RFQs and is now one of the big players in China.

AEye Introduces Industry's First Adaptive Lidar Simulation Suite on NVIDIA DRIVE Sim



AEye has announced that Continental's HRL131 Long Range Lidar, based on AEye's patented architecture, is now available for testing and development on the NVIDIA DRIVE Sim™ platform. Continental and AEye, will use the NVIDIA DRIVE Sim platform to enable AV and ADAS customers to quickly simulate a fully adaptive lidar system in a variety of autonomous driving edge cases and environments. This saves OEMs time during development and testing, accelerating time-to-market for commercial deployment.

The adaptive nature of Continental's HRL131 Long Range Lidar is capable of using multiple scan patterns, including different fields of view (FOV), for different driving conditions and use cases. By integrating with NVIDIA DRIVE Sim, developers can simulate different scan patterns in order to specify and optimize each of them, and further refine the performance of the HRL131 to match specific requirements.

This is especially important for high-speed highway driving, where even a small object can make a big impact. NVIDIA DRIVE Sim supports the creation of obstacles in many shapes and sizes, with accurate physical based rendering, in complex highway environments. With a digital twin of the HRL131, and various environments and differing conditions of its usage in NVIDIA DRIVE Sim, OEMs and AV developers can determine which performance modes are more suitable for the application, and solve complex critical use cases. Once identified and tuned, performance modes can be swapped on-the-fly using external cues such as speed, location or vehicle pitch.

With the HRL 131, vehicles can be detected at more than 300 meters, and pedestrians at more than 200 meters. Continental is integrating the long range lidar technology into its full sensor stack solution to create the first full stack automotive-grade system for Level 2+ up to Level 4 automated and autonomous driving applications.

DVN comment

Building partnerships between Lidar suppliers and ECU Chip-sets suppliers might be a new trend since it is not the only case we see. It allows for sure a better management of the huge volume of data coming from machine learning algorithms and multiple point clouds incl. the one of the Lidar.

Quanergy and PARIFEX Collaborate for First Compliant LiDAR-Based Speed Enforcement System

Quanergy Systems announced last month that PARIFEX's solution has been certified by a French testing body as the first compliant speed enforcement system based on 3D-LiDAR technology.

Quanergy's M-Series 3D LiDAR sensors are integrated into PARIFEX's Double-Side VIGIE solution, which is used for highway speed monitoring and enforcement. The fully automated Double-Side VIGIE monitors multiple lanes of traffic to detect, classify and identify speeding vehicles. The solution simultaneously measures the speed of all vehicles and can identify which ones are speeding with an optimal detection rate.

With certification from Laboratoire national de métrologie et d'essais (LNE), which works under the trusteeship of the French Ministry of the Economy and Finance, this technology becomes the first LiDAR-based speed enforcement solution approved for use by French law enforcement. This certification paves the way for the use of speed enforcement systems based solely on 3D LiDAR as opposed to the current Doppler system. This also offers far more advanced functionalities for road safety.

Franck Peyré, CEO, PARIFEX, said: "We're proud to be the first company to offer an innovative speed enforcement system that includes 3D LiDAR sensors. We chose Quanergy's LiDAR for our Double-Side VIGIE solution to strengthen long-range detection at high speeds. Certification by LNE paves the way for us to continue building more and better ways to improve road safety."

DVN comment

This is a new application of the Lidar, with a higher complexity compared to the stationary speed measurement systems already on the market and used by the police. We will see how robust are these system in regard to the risk of interference between multiple lidars.

Innoviz Technologies and Sensagrate Launch Smart Corridor at University of California, Los Angeles (UCLA)

Innoviz Technologies, and Sensagrate, a leader in smart city technology that enables real-time traffic, pedestrian, and cyclist safety on roadways, announced a joint smart intersection corridor pilot at UCLA.

Sensagrate integrates InnovizOne LiDARs with SensaVision, a computer vision platform, fusing them with data from radar and camera to create a smart corridor at an intersection at the UCLA campus. Innoviz and Sensagrate will tackle smart city challenges across Arizona through partnerships with government transportation departments to pilot emerging technology using LiDAR sensors.

The SensaVision Platform, gathers data on traffic volume and other roadside safety metrics for root cause analysis of pedestrian-related incidents, improving pedestrian and automobile safety. The smart corridor will test smart sensing for intersections powered by Innoviz and Sensagrate via (I2V) and vehicle-to-everything (V2X) applications, all powered by NVIDIA jetson edge computing. In addition, the platform is further connected with UCLA's autonomous vehicle, enhancing V2X analytics. Results and insights are expected ahead of October, which is National Pedestrian Safety Month.

InnovizOne LiDAR fits for smart city applications because it provides accurate data despite adverse weather and reduced lighting conditions, and has a long lifetime. InnovizOne LiDAR does not impinge on privacy, unlike other sensors that may have difficulty complying with GDPR and other privacy laws.

Innoviz's projects in smart city applications is a new demonstration of its innovation capability, following its significant automotive design win with CARIAD SE for Volkswagen Brands in August 2022.

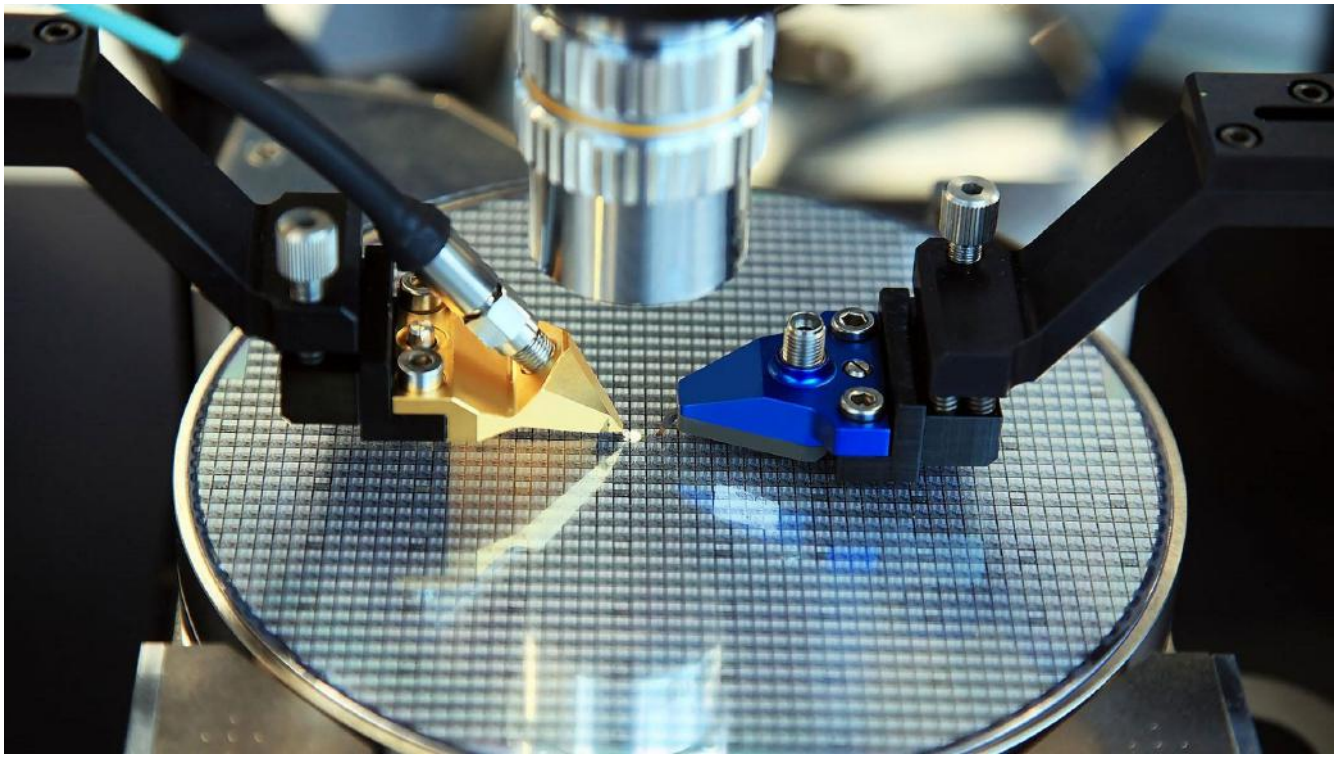
About Sensagrate

Sensagrate is a computer vision software company that provides traffic AI solutions on the edge to bring state-of-the-art innovation solutions that provide real-time, predictive analytics to decrease congestion and emissions, and improve public safety. SensaVision intelligent transportation system products include computer vision software, computer vision on the edge, and traffic and safety data and analytics. For more information, visit www.sensagrate.com.

DVN comment

This is a new application of the Lidar, with a higher complexity compared to the stationary speed measurement systems already on the market and used by the police. We will see how robust are these system regarding the risk of interference between multiple lidars.

Quanergy Partners with Fabrinet to Expand Global Manufacturing of LiDAR Sensors



Quanergy Systems has announced that the company will partner with Fabrinet, a leading provider of advanced precision optical and electronic manufacturing services for the production of Quanergy's LiDAR sensors.

Fabrinet is a trusted partner of the world's most demanding original equipment manufacturers (OEMs), they will Help Quanergy Scale to meet growing demand. Their proven track record of customer service, flexibility and skill in managing complex operations aligns with Quanergy's commitment to maintaining high quality and industry standards in manufacturing. With Fabrinet, Quanergy will be able to expand its global manufacturing and scale as demand increases, to deliver greater efficiency for customers.

Quanergy's customers can be confident that their sensors are high-quality and built by a trusted, seasoned manufacturer with extensive, relevant certifications, including ISO9001, IATF16949 and ISO14001.

Kevin Amiri, Quanergy's Senior Vice President of Operations, said: "LiDAR is revolutionizing how many businesses operate across the IoT and automotive industry. Fabrinet's global supply chain expertise, in-house failure analysis and reliability testing, and direct fulfilment result in the efficiency, dependability, timeliness, and cost-effectiveness that Quanergy's customers need."

DVN comment

Some lidar suppliers have their own fab, some not. Lidar "design for manufacturing" is even more important in that case to avoid complications regarding responsibilities when you have issues at SOP, especially when it is the first project.

DVN workshop 12-13/09 – What happened

34 participants incl. OEMs (x5), Lidar Tier1s (x14) & Tier2s (x10), Research Institutes/Test entities (x5).

Lidar Workshops give OEMs & Lidar Tier1s/Tiers2, the opportunity to go deeper in the understanding of Lidar requirements and market trends, through presentations - then discussions in working groups.

Morning: presentations from OEM (Ford - P.Zegelaar) & Tier1 (Microvision - T.Luce)

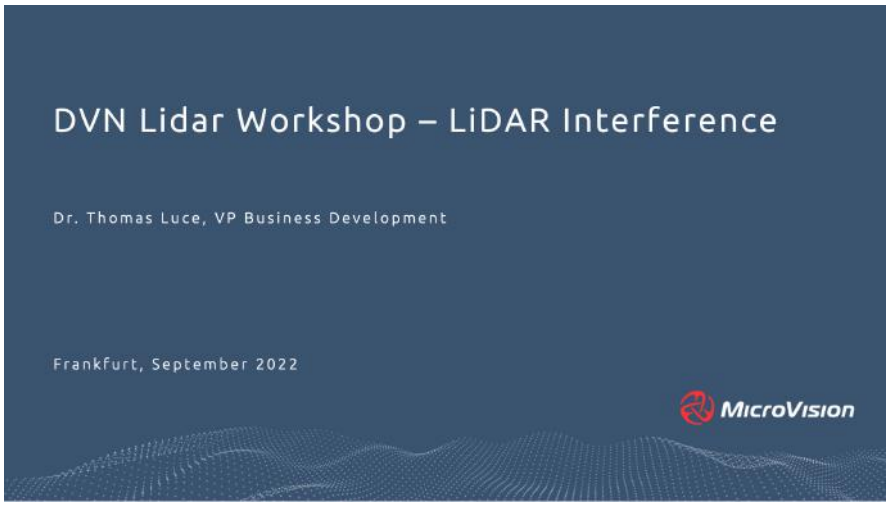
FORD priority is to narrow down Lidar requirements & relevant use cases

Ford presented its system set-up used in its latest automated driving configuration – ARGO.AI Gen4 - and the expected benefits of the Lidar technology. Ford sees key performance contributions from the Lidar to achieve a robust localization and small objects detection (0,3g braking target at 130kph). There is also a clear need of redundancy with different technologies to achieve SOTIF requirements: a pure vision system cannot do the job.

Question of Ford to the Lidar community:

How to achieve realistic performances and define relevant use cases for the Lidar technology?

MICROVISION: Lidar interference



Microvision presented generic use cases to assess interference mitigation technics between several cars equipped with Lidars. Some of these technics have been discussed, as well as comparisons between lidar technologies. Microvision mentioned there are today very few studies on the shelf related to this topic and sees a need to build a generic framework to assess interference risks.

Question of Microvision to the Lidar community:

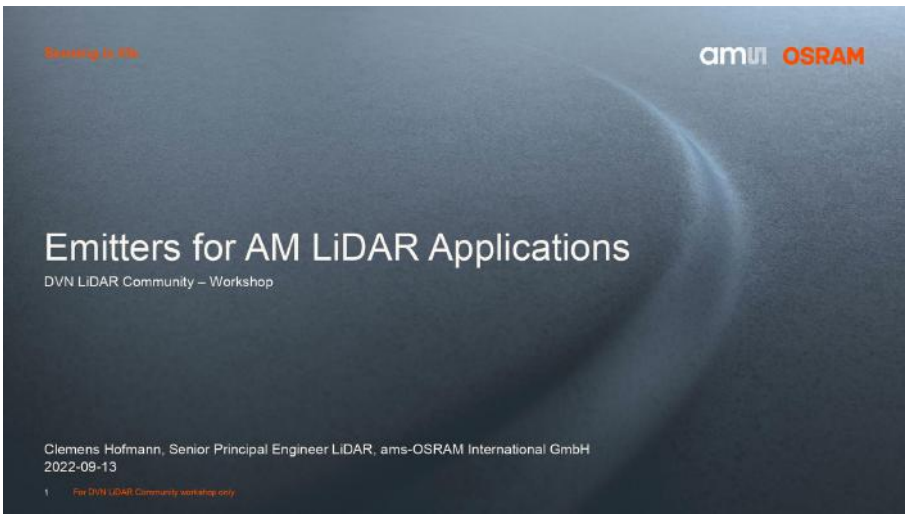
Is interference a real problem? Do we need regulatory prescriptions? which mitigation technics could work?

DVN comments:

The presentation didn't include the risk of interference with Traffic Surveillance Systems (i.e. Police Laser guns…) which is forbidden by Traffic Laws in many countries. A joined framework to define worst cases and evaluate mitigation technics, has been performed in the past for automotive radars through European organizations & funded projects (suppliers could even test their own systems against systems from competition). The same approach could be used for the Lidar.

Afternoon: presentations from OSRAM (C.Hofmann) & Fraunhofer-IMS (J.Rukowski)

OSRAM: 906 nm still mainstream, unclear specs for short range Lidars



OSRAM presented the technologies of emitters and their market perspectives (i.e., Yole-2022). It seems 906 nm will stay mainstream for the next 5-10 years. The two emerging technologies, 1550nm and FMCW, will take some market shares but are not expected to significantly change the market. For emitters, SPAD fits well with the future requirements. There is a big question mark for the short range lidar specifications (40-50m range with a large FoV and 0,4° angular resolution is technically not possible today).

Question of OSRAM to the Lidar community:

Which use cases for urban pilot & valet parking? which parameters should we improve for emitters?

DVN comments:

based on current technologies, short range radars can support the 40-50m detection range to the side of the car with a large FoV, and Lidar can offer a higher resolution with a more limited range (20m+).

Fraunhofer: Detectors

The SPAD technology seems promising with a quick response time & 2D matrix capability. This also can fit well with Flash Lidar and be combined with a VCSEL emitter and fits with OPA (Optical Phase Arrays) solutions and agile scanning. The detection modules might be integrated in photonic chips, typically for FMCW Lidars.

Question of Fraunhofer to the Lidar community:

Do we need a complete solution or multiple ones optimized for specific applications? which parameters should we improve for the 2025 generation

DVN comments:

The receivers need to improve their resolution for short range surround view lidars, especially for urban assist which combines a high resolution (0,4°) and a large FoV.

Working Group sessions – Main results (extract)

Realistic requirements: lidar spec must be at least as good as human vision. Specs are to be also derived from the key contributions expected for the Lidar, from the limitations of the other technologies (i.e. much better distance resolution than radars), from the limitations of the Lidar itself (i.e. detection of black objects with very low emissions). The current standardization work from DIN-SAE & ISO Working Groups should help as well.

Interference – Yes, it is a real problem, and this needs clarification. The interference risks with TSS must be included: there is a need for Lidar standard data sheet, for TSS equipment to optimize their design. The recommendation is to find an institute which can do a global study and initiate a generic framework to assess interference risks with a "standard" test catalogue. This topic can be part of the future DIN-SAE & ISO specs, after the study has been done. There is also a need to permanently monitor the interference risks with new technologies.

Emitters –For Urban Pilot, the typical offer on the market is limited to 20m, more range can be achieved with compromise on the specifications. Lidar might be combined with short range radar which can do 40-50m range.

Receptors – improvements required mainly on Dead time for SPADs, Photon Detection Efficiency, Cross Talk pixel to pixel, Megapixel like solutions. Germanium might be used to increase speed.

Feedbacks from participants & Conclusion

Workshop Concept "few topics, going deeper": highly appreciated with presentations and deep dives to build a common view between the participants and agree about open issues (and sometimes to list first solutions to solve them – i.e. for interference)

Learning opportunity about technologies: interesting presentations, live participants have especially appreciated the opportunity to initiate technical discussions, inside the working groups and during the networking periods (dinner, lunch).

Applications & Markets: great opportunity to understand the difference between EU/US market needs and China market needs (LS Lidar)

Improvements: some connexion issues during the first working group session, have impacted the contribution of on-line participants