DVN - LiDAR Deep Dive 3 Workshop

September 09, 2024 / Detroit Hotel Sheraton Novi

Special Report

LiDAR attendees joined (live& on-line) at the Hotel Novi for the LiDAR Deep Dive workshop.

DVN Introduction

Chairman: Eric Amiot – DVN-Lidar general editor

DVN Events and Membership, Rules of discussion - compliance rules,
Deep Dive Agenda & format (max 30p live, break-out groups interactive sessions)
Attendees Introduction (27 attendees from GM, Aeva, Cepton/Koito, Hesai, Innoviz, Robosense, Luminar, Valeo, Voyant, ams Osram, AGC Wideye, fka GmBH, NTT, Hitachi High Tech, Saint Gobain, Steerlight)

Presentations and Breaking Groups report

Session 1

- Business Conditions (Luminar): Investment shift is now to “when are you going to make money with Lidar”. China has been interesting development. OEMs specs are not stable, RFQs keep changing, pushing out, SOP changes etc.
- Lidar L2+ benefits & use-cases (Robosense): Lidar can enhance detection in strong direct light, low illumination, unknow objects, complex scenes. A 25% better collision avoidance performance with Lidar equipped systems has been shown in studies. Lidar allows a reduced reliance on HD maps – can perform localization real-time. But Detection depends on perception software as much as laser performance.
- L3 Edge cases (Valeo): thermal works well for night animal/pedestrians, HD radar works for front vehicle cut out, Lidar best for object separability and environment mapping. Lidar works better than camera for tunnel, work zones. For lost cargo, HD radar and lidar work better, objects close to guard rail, pedestrian lying on road. Lidar for overhanding loads. Thermal camera has lower resolution due to large pixels – work well in glare situations and can penetrate fog.

- L3 applications (Valeo): OEMs want to detect objects (free space detection) but also "actors" to anticipate certain behaviors (i.e. a person close to his car, changing a wheel, who can move suddenly). L3 requires ASIL-D level perception, which needs redundant sensors operating in different modes (Camera, Radar, Lidar). HD radar market is ramping up with 2 different versions (200 channels and 2000 channels)

Break-out 1:

- Markets: Is there spec differentiation between China and ROW ? Integration needs to be hidden in US/EU. In China it has become a status symbol to have the LiDAR bump on the roof. Non-China market is pushing the spec envelope more. China approach is to deliver one or two use cases for the LiDAR, scale volume, reduce cost, versus ROW approach to try to have much more comprehensive ODD with targets that keep changing. AEB for lost cargo is one key scenario for LiDAR.
- NHTSA ruling for Pedestrian detection in the dark: includes both true positive & false positive specs which is very demanding in term of performance. OEMs and suppliers do not have yet a clear vision of which technology is required. IR cameras or lidar might be selected by some OEMs, but the expectation is the combination of a camera with a radar (HD radar with a sub-100$ price point) will be sufficient to minimize the cost.
- How to define LiDAR Range in a standard manner: Hard to do, since each OEM has different requirements and ways to measure, even to standardize range for lane detection is hard, since NTHSA alone defines 300 types of markings, and to then test under all weather conditions and temps would be practically impossible. Range specs from OEMs are a moving target.

Session 2

- SW defined Lidar (Cepton): new LR Lidar has 300m range and a configurable ROI (with power tradeoffs), with a small packaging. Perception can be done in the Lidar unit. Thermal design is key consideration, Height as well but is limited by optics, noise is also important when integrated behind windshield (even on the roof - vibrations).
- FMCW (Voyant): Long range low cost sensors with PIC and on-chip beam steering, detecting a black cinder block at night at range is the design goal !
  FMCW eliminates blooming and is required to perceive real scenes. FMCW shows every object true to form. Voyant uses established datacom processes for its components – low cost – target <$500 for Lidar unit. 1Mpps is less than Scala 3 but FMCW can measure velocity – and would allow perception stacks to do better detection (points can not only be correlated based on space and time but also on velocity). Furthermore, the Scan pattern is under software control and can be optimized. Scanning Concept: Focal plane array for beam steer – switch needs to be an order of magnitude less lossy that datacom switch, plus a moving mirror used for horizontal steer. Focused on industrial market for now (128 lines, 80m range), could do automotive production by '27/'28.

- Lidar Growth – The key factors (DVN):
  - Pure vision systems for L2+ - some vendors are trying to improve- for example adding IR, gated cameras with illuminator.
  - Radar for L2+ – imaging radar or networked radars. With Digital Aperture Radar (DAR), you can get up to 0.15^0 x 0.9^o resolution
  - Low cost lidar for L2+ have 0.15x0.15° resolution– so on par with future DAR. Lidar gives you improved AEB and Navigation on Autopilot, expected to approach sub $200 as volume increase
  - High resolution Lidar for L3/L4 is 0.05x0.05° or less – which is still a big difference. Lidar integration is still a challenge. should go from sub $1K to sub $500.
  - CN market – short duration hands-off allowed, but clearly an L2 system. >6% false positive rates, and 80-100Km between disconnects. SOPs could be faster for systems with lidar (less testing) – but that might be changing.
  - US Market: Tesla L2+ system with hands off. MIT study showed no safety benefit in 2021. False braking surged when they removed radar in 2022. NHTSA crash study showed that most drivers had hands on the wheel but didn't take action.
  - EU Market, L2+ systems use front radar – L3 will add 360^o radar and front Lidar. Mobileye claimed sensor "true" redundancy allows for reduction in collected data.
  - Robotaxis Market: Waymo now has 100K customer drives per week. Validations required millions of miles on public roads and billions on simulation. Claim 85% crash reduction rate.
  - IIHS study on maturity of L2 systems (March 24) showed only Lexus system was acceptable. GM, Nissan were next on the list and others were poor.
  - Social acceptance – important issue for L3 and Robotaxis
  - Safety will be the key to wider adoption, even for L2+ – Tesla track record so far is not great.
- Lidar Standardization activities (fka GmbH):
  - EU: fka leveraged its sensor test experience to lidar testing, to build the DIN SAE 91471 spec as a base framework for testing. Can evaluate lidars at point cloud level with simple equipments based on 12 KPIs. UTAC in France is looking at adverse weather functional testing with scenarios similar to NCAP
  - US: Tests on-going such as NHTSA/VVTI interference study, SPIE/SAE/DOT is working on standardization – but still working on the scope of this
  - CN: has already a standard
  - New fka Project: Testing for adverse conditions, reference (ideal conditions) and then weather, interference. currently testing 8 sensors – consortium members include Torc, Honda, Volvo, Chasm, Valeo, Microvision, Luminar, Santinel + 2 more non-public.
  - How are different standards aligned ? FKA is indirectly aligned with ISO and is also part of US standard activities (SAE). For SAE it is mostly American OEMs.

Break-out 2:

- Are OEM requirements well understood and fixed ?
    - Sensor requirements are driven by feature requirements and each OEM is different. FOV and resolution requirements are very different for example. Software programmability can relieve some of this.
    - OEMs have different priorities and design goals
- How can lidar vendors increase design wins ?
    - Lower the costs !
- What are some of the packaging constraints and how do you design around it ?
    - OEMs want to centralize compute – but redundancy of perception stack in sensor may be good ?
    - GM wants smaller units. Entertaining to move compute off the sensor that helps thermal. Height is what matters.
    - Depth can be challenging in some locations – like behind the grille.
- What are the impacts of noise to the consumer (from the Lidar unit)
    - FKA is not looking at noise. GM does have a spec for that.
    - Attached to the header is also an issue for noise
- Which technology is best suited to support the new NHSTA ruling ?
    - Camera/Radar is likely cheaper
    - If you have lidar for L3 anyway – can you use it for AEB – but it is not so simple since you have to have that function, there on lower spec trims.
    - Can a just camera system work at ASIL-D level ? You might need a second sensor anyway.
    - Lidar suppliers in the room are not seeing requests yet for lidar for this specific function.
- How do we map use cases to test conditions at point cloud level better ?
    - A minimum is a set of standard targets
- Is there something that lidar vendors are looking for cleaning ?
    - Hydophobic coatings have limited durability, no good answer today
    - ISO is developing external cleaning standard – to determine efficiency of cleaning cycle.

Closure

Presentations and Meeting Minutes will be shared to Attendees and Gold Members (when approved by speakers)

Agenda

12th September (Lidar Deep Dive 3 Event)

8:30	Registration
9:00	Opening and introduction of participants

Session 1: Lidar Applications & Technology

9:20	**Luminar:** Aaron Jefferson - Unexpected Gifts, Impact of AV Lidar Research on Automotive Safety
9.40	**Robosense**: Scott Skelton - The critical role lidar plays in Level 2+ and beyond sensing systems
10:05	**Coffee Break**
10:35	**Valeo**: Waqas Malik - High-Definition Sensors Redundancy for Autonomous Vehicle
11:00	Two breakout groups, each discussing two questions from the speakers
12:35	**Lunch Break**

Session 2: Lidar Trends and Market Development

13:30	**Voyant**: Peter Stern - FMCW Lidar using photonic integrated circuits
13:50	**Cepton**: Luis Goncalves – Optimizing Lidar Design for Today's Automotive Trends
14:10	**DVN**: Eric Amiot - Market Growth factors in China and US/EU (L2+/L3/L4)
14:30	**Coffee Break**
15:00	**fka GmbH:** Amogh Sapkal - Lidar Standardization Activities Worldwide
15:30	Two breakout groups, each discussing 2 questions from the speakers.
16:30	Breakout group reporting and discussion
17:00	**Closing Remarks**

Speakers

Aaron Jefersson
Luminar

Waqas Malik
Valeo

Scott Skelton
Robosense

Peter Stern
Voyant

Luis Goncalves
Cepton

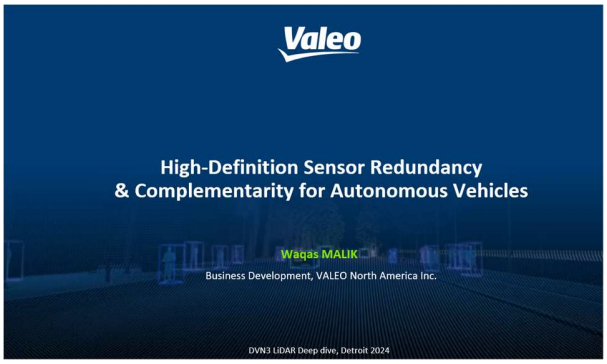
Amogh Sapkal
fka GmbH

Eric Amiot
DVN-Lidar

Presentations Overview

LUMINAR

ROBOSENSE



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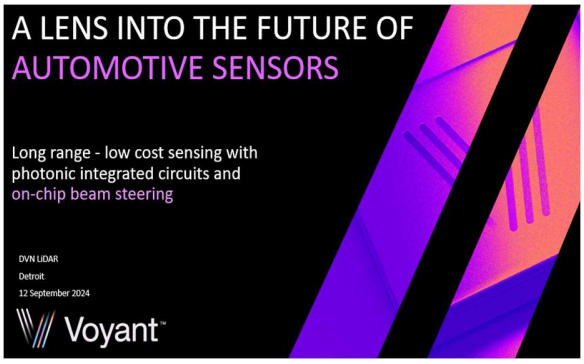

VOYANT

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DVN

Fka GmbH

Attendees

Company		Name	Job
GM	Michelle	Brinker	Lidar Expert GM
Robosense (speaker)	Scott	Skelton	Dir. Engineering
Robosense	Sathya	Santhanam	
Luminar (speaker)	Aaron	Jefferson	VP of Product
Cepton (speaker)	Luis	Goncalves	Business Dev. Director
Voyant (speaker)	Peter	Stern	CEO
Valeo (speaker)	Waqas	Walik	Business dev Manager
fka (speaker)	Amogh	Sakpal	Lidar Test Method Lead
Aeva	John	Schloss	
Hesai	Aleksander	danielewski	Project Manager
Hesai	Robert	gibson	Dir. of Auto. Business
Koito-NAL	Kiyotaka	Mochizuki	
Koito-NAL	Joe	Messmer	
Koito-NAL *	Takanori	Namba	
Steerlight *	François	SIMOENS	CEO
AGC Wideye	Eric	Zaborniak	
AGC Wideye *	Yonggjiang	Li	
Innoviz	Mrinal	Sood	
ams OSRAM	Kevin	Markell	
ams OSRAM	Clemens	Hofmann	Business Dv. Dir.
NTT Innovative Devices Corp	Tomoyuki	Yamada	Director - Project Leader
Hitachi High-Tech	Bryan Peter	Kruuk	Director - Infrastructure Dpt
Saint Gobain Sekurit	Leticia	Kamiya	
DVN (Speaker)	Eric	Amiot	DVN-Lidar General Editor
DVN	Martin	Booth	DVN-Lidar Senior Advisor US
DVN *	Alain	Servel	DVN-Lidar Senior Advisor EU
DVN *	Ann	Ai	DVN-Lidar Senior Advisor JP
DVN	Eichii	Ono	DVN-Lidar Senior Advisor CN