DVN - LiDAR Deep Dive 1 Workshop
April 08th/09th 2024
STUTTGART
Event Summary

About 50 LiDAR attendees (live & on-line) joined at the Porsche Tower Hotel for the DVN-LiDAR Deep Dive 1 workshop, organized in 4 sessions and 1 start-up pitch:

1. Leading applications for Lidar: L2+ Navigation On Autopilot then L3 Highway pilot?
2. Is the regulation ready for the deployment of AVs ready: contribution of UNECE
3. Maturity of the scanning technologies : Mechanical Scanning, Solid State
4. Which sensors to achieve a robust data fusion: Imaging Radar, Lidar, IR cameras
5. Start-up Pitch: Ommatidia (FMCW lidar)

Companies registered

Live		On-Line	
Porsche	Brightview-Technology	Renault	Ansys
Hesai	Renesas	Chinese OEM	Chasm
Continental	KSLD	Robosense	Dexerials EU
Valeo	Docter Optics	Tanway	Docter Optics
Innoviz	Scramblux	Vanjee	Warwick University
Microvision	AGC Wideye	Vertilite	
Cepton	DEKRA	Steerlight	
Scantinel	Fka GmbH	Koito	
Ommatidia	UNECE/GRVA		

OEM invited: PORSCHE

Speakers

We had 11 speakers incl. 4 Chinese companies, and 1 International Organization (UNECE/GRVA), in charge of Regulations for Automated Vehicles and Connectivity

Moderators

Chairman: Eric Amiot, Head of DVN-Lidar

Eric Amiot   Leo Metzmaekers   Ralf Schaefer   Alain Servel

Introduction - DVN 2024 events and compliance rules

NEW
- Deep Dive Workshop I   EU - Stuttgart   (Apr. 09)
- 6th EAC Lidar Tech Expo   CN - Suzhou   (Jun. 21-22 / co-hosted by DVN)
- Deep Dive Workshop III   US - Detroit   (Sep. 12)
- 7th DVN Lidar Conference   EU - Wiesbaden   (Nov. 18-19)

Summary

1.   Leading applications for Lidar: L2+ Navigation On Autopilot then L3 Highway pilot?

ROBOSENSE: NOA Systems in China
Market of SEVs (Smart Electrical Vehicles): 0,9Mvehs expected in 2024 (67% of NEVs), growing fast at +35%/y. Mainly used in urban areas (90% of the time). Premium EV brands - Xpeng, Nio, LiAuto, Huawei, Haomo (GWM) – are using 1 or 2 lidars: Highway NOA (Navigation On Autopilot) incl. Automated ramp entering & exiting, Traffic light & sign Recognition, Automated valet parking, Automatic Parking Assist, Automated Lane change & overtaking.

The pivotal role of Lidar in City NOA solutions: Rapid go-to-market

01 Multi-modality perception — Better detection & geometric performances

02 General obstacle detection — Irregular objects

03 Regardless of lighting conditions — Backlighting/Glare/Darkness

04 Occupancy Network — Easier for the 3D representing model

05 Online Mapping — HD Map → Lightweight HD Map

06 Long-tail problems — relatively infrequent but challenging

Smart Sensor, Safer World   www.robosense.ai   robosense

HESAI: NOA Market development
NOA makes Lidar attractive on the Chinese Market and pushing the growth: Hesai expects to deliver 1 Mu Lidar sensors this year. It gives Chinese OEMs a lead in Lidar applications (2 or 3 years ahead).

Lidar combined with front cameras improves significantly the sensing performance at night.

Lidar market estimated to 4,5 B$ in 2028

CONTINENTAL: Far Distance Object Detection for L2+ to L4 fusion systems.
Challenges and Requirements: Detecting small objects is a challenge because objects are small, rare, and difficult to classify. A minimum resolution of 0.05° is required, it is possible to reduce the number of dots on the targets using sensor fusion. The approach is to use cameras (0,008° resolution), lidars (0,05° resolution), and radars (up to 0,1° resolution) to merge detections, estimate object dimensions, and reduce misclassification.
Results show data fusion can improve the accuracy of the object height compared to the raw lidar data and reduce wrong classification events.

2. Is the regulation framework ready for the deployment of AVs

UNECE/GRVA: moving toward Worldwide Standards

Framework document on AVs
A global initiative

The number of countries applying UNECE regulations depends on the different mandates signed.

ALKS (L3) & DCAS (L2) regulations are based on the 1958 mandate which is not including USA & China.

The latest mandate signed in 1998 include US & China, which will allow the development of Worldwide Standards (ADS).

The regulation must be technology neutral, nevertheless regulators need a good understanding of what the technology can do. The scope of the AV regulation is restricted to cars with the intelligence embedded in the car.

The AV regulation is based on the declaration of intention by the manufacturer, a technical evaluation by a competent authority, and the issuance of a certificate of approval. The manufacturer is involved in designing, developing, updating, and retiring ADSs, as well as providing the necessary information to users and authorities.

UNECE is also working on AI, starting by the review of the technology neutral approach.
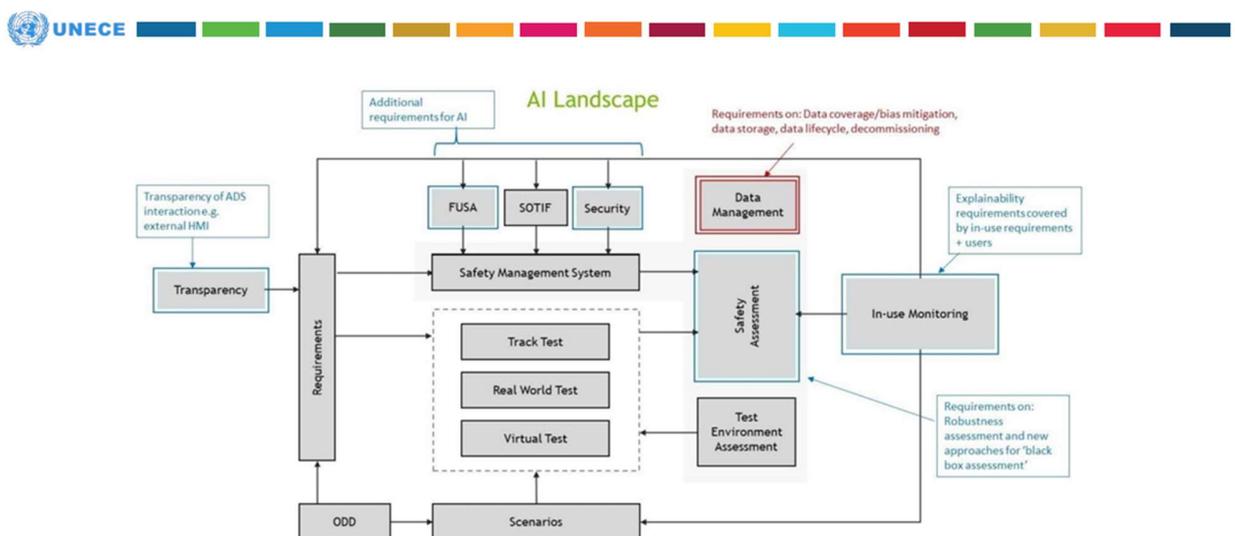
3. Maturity of the scanning technologies : Mechanical Scanning, Solid State

MICROVISION: review of scanning technologies
- Mechanical scanning: The common approach uses a motor-driven rotating mirror to extend the horizontal field of view but has drawbacks like wearing and complexity. Another method uses a galvanometric mirror and an angled mirror to cover the vertical field of view.
- MEMS: They are based on the oscillation of a mirror in the elastic regime of the material, which prevents wear. It shows the different types of MEMS, depending on their scan angle, size, resonant frequency, and activation mode. It also shows some examples of lidar designs using MEMS.
- The Lens Shift Approach: Another option is moving the lenses relative to the transmitter and receiver, which allows for different directions in the field of view. It is a biaxial system that uses a mechanical lock to synchronize the relative motion of the lenses.
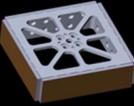
SCANTINEL: Silicon Photonics Applications
Scantinel is developing a lidar technology based on silicon photonics, integrating all the optical components on a single chip and uses a solid-state scanning principle (switching beam patterns), which reduces the costs, size and complexity of the system. FMCW is expected to improve range & detections in bad weather (fog, fumes).
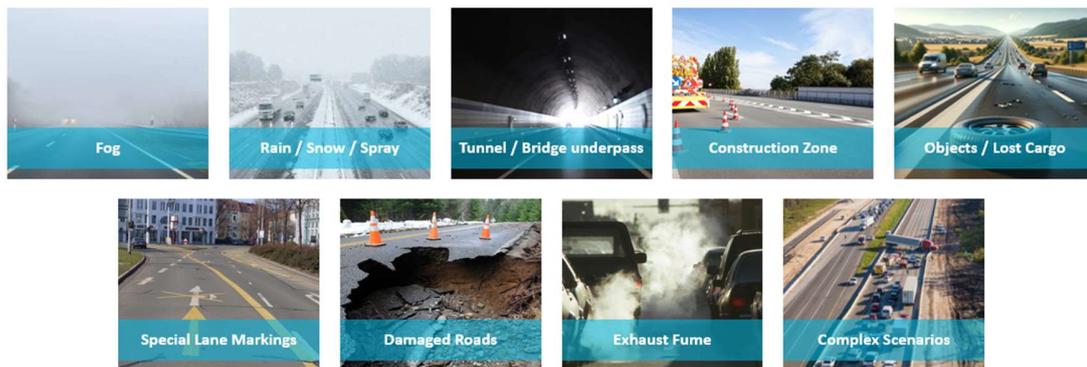
CEPTON: Micro Motion Technology (MMT) and new design concept Magnosteer
Cepton's CMM technology allows a frictionless and wear-free beam deflection

The new Magnosteer concept, which uses some headlight components, is reducing weight, size, noise, and power consumption. It provides a much better solution than a rotating polygon.

Design Comparison Example at the same photon throughput & FOV		
Design Parameter		
Mirror size	75 mm	75 mm
Rotational Diameter	79 mm	110 mm (1.4x)
Moving Mass	23g	104g (4.5x)
Power	0.10W	> 0.20W (2x)
Moving Mass	23g	104g (4.5x)

4. Which sensors to achieve a robust data fusion: Imaging Radar, Lidar, IR cameras

TANWAY
- Tanway is integrating a lidar and a camera in one HW, using a common optical axis to ensure spatial and temporal alignment and synchronization between the lidar and the camera. It also uses the same control unit for both sensors. In this way, it produces three-dimensional data with color and distance information. Early data fusion improves accuracy, speed and confidence of perception and reduces computational costs
- Tanway has developed an image fusion product that integrates 64-channel lidar with a high-definition camera. It offers a detection range of 200 meters, a horizontal field of view of 120 degrees, and an angular resolution of 0.16 degrees. It is already used in the SV7 model from Xpeng, a Chinese automaker.

VALEO AD Research Team
- Valeo sensing portfolio includes Lidars, Imaging Radars, IR cameras
- Lidar and Imaging radars are both mandatory to offer robust and redundant L3,4 features. This is the only solution to support an extended ODD. Data fusion will weigh the contribution of each sensor based on the environmental conditions because each sensor has limitations.
- Lidar is best to provide a high-quality reference for cross calibration & synchronization of all sensors.
- IR camera is best to detect human beings and animals at short/mid-range, and can extend the ODD in poor visibility conditions, when Lidar has limitations.

VANJEE
- Lidar is used for driving assistance features mainly, but only a few OEMs are using Lidar for active safety
- Lidar has advantages over the camera, such as the ability to measure the distance and orientation of objects, detect faint objects, operate in low-light conditions, and provide essential spatial information.
- Data Fusion camera, Lidar & V2X: Safety for low visibility intersection can be improved with V2X. the algorithm developed by VanJee, uses a deep neural network to reduce computational overhead, detect and classify objects from lidar data, and merge camera and CV2X information to improve accuracy.

LiDAR refers Light Detection and Ranging. LiDAR is crucial for safe navigation due to it perform solid detection and provides precise distance measurement data toward each object.

In contrast, human eyes and camera vision can only see objects by feeling far or close but **do not** have distance data. VanJee uses LiDAR to create fundamental perception modeling (3D Model to create __coordinate system__ XY axis) to scan all object information surround the vehicle including object classification, object position and each object distance to the vehicle.

VanJee team creates **Digital Twin** by fuse camera data and LiDAR point cloud data. The main purpose of camera is to classify insignificant size difference of objects (bicycle vs. motorcycle, kid vs. traffic cone).

LiDAR can reduce the complexity of algorithms for ADAS and autonomous driving compared to cameras, as LiDAR provides depth information which can be crucial for understanding 3D environment. LiDAR is much more reliable on dark light compare with camera

5. Start-up Pitch: Ommatidia (CMM very accurate lidar)

- Lidar Technology: new lidar architecture based on continuous frequency modulation (CMM) and inspiration from the compound eyes of insects.
- History: The startup's technology comes from the space sector, where it has worked with the European Space Agency to develop very high-precision metrology instruments. It is now marketing its Q1 product, a lidar that can resolve distances of 0.1 millimetres for metrology purpose. Its current clients are mainly in the aerospace, industry, and civil engineering fields.
- Next step: The startup is currently working on the miniaturization of its lidar, integrating the laser and circuit into a single package (see below). It plans to deliver units to Tier1(s). It also aims to enter the mobility market and provide the cutting-edge technology for autonomous vehicles.

Our Ant™ Series

- **Fully Packaged FMCW Transceiver**
  - **4D, inmune to interference, accurate.**
- **Ommatidia sells Ant™ + IP Core**
- **1024 x2 Channels in Line**
- **Up to 120 degree Horizontal FOV**
- **Compatible with long-range operation**
- **Digital Output**
- **Includes Laser, ASIC, PIC & Micro-optics**
- **Development Kit + Support services**

Take out from the Workshop sessions

Lidar Growth - L2+ vs L3

Today NOA (L2+, eyes on) is the leading application to support Lidar sales in China. The next key feature should be Highway Pilot up to 130 kph (L3,eyes off).

Highway Pilot is not expected to launch before 2027 in Europe since 130kph is still a challenge to detect small objects (one of the critical use cases). The regulation to launch L3 in China is expected by end of 2024 at the earliest, Highway Pilot might be easier in China which has a lower max speed on Highways.

New applications of Lidar: SLAM, Mapping update, Valet Parking (front Lidar at least), Surveillance around the car (i.e. BSD Lidar), Traffic Control, ….

AD Regulation – Worldwide Standard

UNECE Worldwide regulations are now possible with the 1998 Agreement signed by USA and China.
There is already a common initiative on AVs signed by EU, Japan, China, USA.

Scanning Technologies – Emerging technologies

-Today the scanning mirror technology has the lead
-MEMs is emerging, but still faces the challenge of reliability, resonant mirrors is the best solution in that respect
-the MMT & Magnosteer solution of Cepton is an alternative to traditional MEMs or polygon mirrors
-FMCW is the next step and should offer reliable pure solid-state solutions (i.e. switching beams). It needs to be validated in term of performance with challenges such as field of view coverage, cost of DSP and data, and reliability under extreme temperature and humidity conditions.

AV sensors & Data Fusion – Which sensor is needed

AV Sensors contribution:
Each sensor has limitations, and the OEM has to consider the sensing redundancy for L3,4 applications, and the trade-off between ODD and system cost.
- Lidar improves the Camera perf. in bad weather, the radar perf. (resolution & classification) and offers a high accuracy mapping
- Lidar is used as a redundant sensor for L2+,L3,4 applications - with a significant benefit regarding the ODD
- Lidar contributes to cover the edge cases and increase the safety perf. (zero accident is expected for AV modes)

Data Fusion: Lidar resolution and mapping capabilities allow an accurate synchronization/calibration of all the sensors which helps to get an accurate & robust data fusion.

Imaging radars: are not expected to replace radar in the short term, also in China, if the Lidar continues to reduce its cost. The best imaging radars can support most of the features of Lidars but with a lower performance, and they are not so cheap.

More sensor integration:
Tanway solution integrating a lidar and camera in one box is a low-cost solution when Lidar is used 100% (premium brands), but its adoption might depend on size (vehicle integration) and scalability issues between L2 and L2+,L3 (Generalists), and the limited number of suppliers available.

PROGRAM

08 April • Evening

19:00   COCKTAIL & WELCOME DINNER

09 April • Full Day

08:30   Opening of the Deep Dive

08:40-09:40   **SESSION 1 • APPLICATIONS 1**
               LIDAR FOR L2+ & L3 APPLICATIONS

               Robosense - Chris Dawei Luo
               "Navigating Urban Landscapes:
               Exploring LiDAR's Role in NOA"

               Hesai - Tilman Gasche
               'From Vision to Reality:
               Integrating LiDAR into SAE-Level
               2 & 3 ADAS Programs"

               Continental – Wolfgang Schultz
               "Far Distance Object Detection for L2+
               to L4 fusion systems"

               Q&A

09:40-10:05   **SESSION 2 • APPLICATIONS 2**
               AD REGULATION STATUS L2+ & L3

               GRVA – Francois Guichard
               "Update on recent regulatory
               activities at UNECE related to
               Automated and Connected
               Vehicles"

               Q&A

10:05-10:50   Start-up Pitch & Coffee Break

               Ommatidia – Eduardo Margallo
               "Massively Parallel Coherent LiDAR for
               high resolution solid-state imaging"

10:50-12:00   WORKING GROUPS & SHARING

12:00-13:15   LUNCH BREAK

13:15-14:15   **SESSION 3 • TECHNOLOGY 1**
               SCANNING TECHNOLOGIES & SOLID STATE

               Microvision - Hanno Holzhüter *"Scanning*
               Technology Overview and position of
               MEMS"

               Scantinel - Oliver Ramoli
               "Realizing the needs for Autonomous
               Driving with a Single Chip FMCW LiDAR
               Technology"

               Cepton - Henri Haefner
               "Efficient, Compact, Reliable
               Innovation Overdrive: Surpassing Industry
               Standards in Scanning."

               Q&A

14:15-15:15   **SESSION 4 • TECHNOLOGY 2**
               AV SENSORS & FUSION: Lidar, Radar, IR

               Tanway - Guanjie Xu
               "Sensor Evolution: Hardware level Early-
               Fusion drives Perception Performance to
               Next Era?"

               Valeo - A. Aaddaj El Oudrhiri
               "High-definition sensors redundancy for
               AV' extended ODD"

               VANJEE – Zhao ZHAI
               "How will VanJee LiDAR+C-V2X solution
               create vehicle with utmost safety?"

               Q&A

15:15-15:35   COFFEE BREAK

15:35-16:35   WORKING GROUPS & SHARING

16:35-16:40   **CLOSURE**

16:25-18:00   **OPTION : Visit Porsche Museum**

ATTENDEES

SPEAKERS	COMPANY	
online	Robosense	Chris Luo
Live	Hesai	Tilman Gasche
Live	Continental	Wolfgang Schultz
Live	Microvision	Hanno Holzhueter
Live	Scantinel	Oliver Ramoli
Live	Cepton	Henri Haefner
Live	Ommatidia	Eduardo Margalo
Live	UNECE	Francois Guichard
online	Tanway	Guanjie Xu
Live	Valeo Research AD	Ahmed Aaddaj-el-oudrhiri
online	VANJEE	Zhai Zhao

ATTENDEES		
Live	Porsche	Jan Simon
Live	Microvision	Thomas Luce
Live	AGC Wideye	Raed Elmakhour
Live	Valeo Lidar	Michael Aeckerle
Live	Valeo Lidar - 2d rep	Uensal Kabuk
Live	ams Osram	Clemens Hofmann
Live	Hesai - 2d rep	Mensah Kevin
Live	Dekra	Samer Galal
Live	Dekra 2d rep	Thomas Stolp
Live	KSLD	Josip kovacevic
Live	Scramblux	Simon Viets
Live	Innoviz	Benny Shaya
Live	Renesas (system architect)	Juergen Kernhof
Live	Renesas (product manager lidar)	Leonard Germic
Live	fka	Amogh Sakpal

ATTENDEES		
online	Renesas (Manager aplication eng)	Adrian Stenzel
online	Renault	Javier Ibanez-Guzman
online	Ansys	Fabien Bastide
online	Steerlight	Francois Simoens
online	Chasm	Dskiba Chasmtek
online	Chasm	Ijiang Chasmtek
online	Vertilite	Lizhao Vertilite
online	Dexerials Europe B.V. & Japan	Kohei Okado
online	Koito	Mkomatsu Koito
online	Chinese OEM	Youchun Sun
online	Tanway 2d rep	Wangshushu
online	Tanway CTO	Zhengruitong
online	Vanjee 2d rep	Wanliyun Vanjee
online	University of Warwick	Valentina Donzella
online	Docter Optic	Oliver Streitz

DVN		
Live	DVN	Eric Amiot
Live	DVN	Alain Servel
Live	DVN	Leo Metzemaekers
Live	DVN	Ralfschaefer T
online	DVN-CN	Ann Ai
online	DVN-JP	Eichii Ono

Photos