VOLVO

STATUS ABOUT VOLVO LIDAR INTEGRATION

SESSION 1 - AUTOMOTIVE LIDAR APPLICATIONS (PART 1)

DVN AUTOMOTIVE LIDAR CONFERENCE & EXPO
15-16 NOV. 2021 FRANKFURT

"APPLICATIONS, SYSTEMS, TECHNOLOGY ENABLERS, MARKET & ECOSYSTEM"
THE DORINT HOTEL MAIN-TAUNUS CENTER, FRANKFURT-SULZBACH

- 4TH DVN CONFERENCE & EXHIBITION ON AUTOMOTIVE LIDAR -
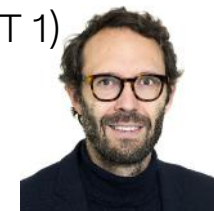
Paul-Henri MATHA, Exterior lighting, Technical Leader, Volvo Cars   DVN, 15th of November 2021

VOLVO

Volvo official communication about sensor integration Development with Luminar for SPA2 cars

LUMINAR

Extract of the press release

May 6th , 2020

"… Volvo Cars, a global leader in automotive safety, is setting new safety and technology standards by partnering with tech firm Luminar to provide their industry-leading LiDAR and perception technology for Volvo's next generation cars.

The partnership will deliver Volvo's first fully self-driving technology for highways and paves the way for future active safety developments.

Volvo Cars' next generation SPA 2 modular vehicle architecture will be available as hardware-ready for autonomous drive from production start in 2022, with the Luminar LiDAR seamlessly integrated into the roof…"
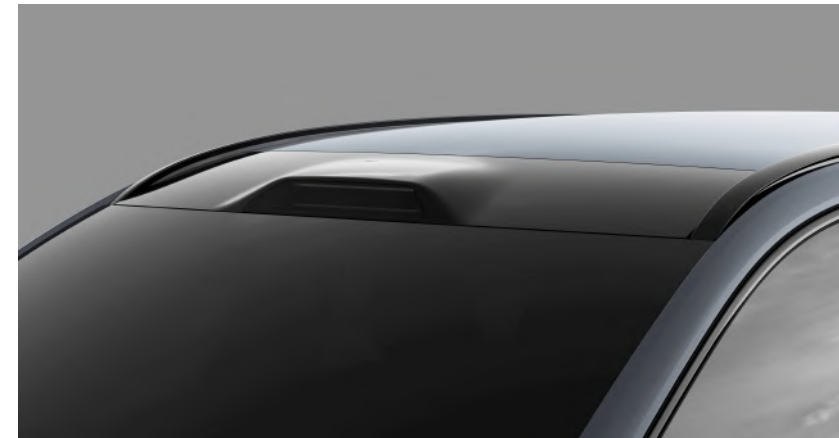
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24th of June 2021

[Next generation pure electric Volvo comes with LiDAR technology and AI-driven super computer as standard to help save lives - Volvo Cars Global Media Newsroom](#)

Next generation pure electric Volvo comes with LiDAR technology and AI-driven super computer as standard to help save lives

...

The fully electric successor to Volvo Cars' XC90, to be revealed in 2022, will come with state-of-the-art sensors, including LiDAR technology developed by Luminar and an autonomous driving computer powered by the NVIDIA DRIVE Orin™ system-on-a-chip, as standard.

...

By combining this state-of-the-art hardware with Volvo, Zenseact and Luminar software for the next generation of its well-established collision avoidance technology, Volvo Cars aims to reduce fatalities and accidents as a whole with this new safety package.

...

These back-up systems alongside LiDAR, compute and software will enable the Highway Pilot functionality, developed in-house together with Volvo Cars' autonomous driving software development company Zenseact. An autonomous driving feature for use on motorways, the optional Highway Pilot will be activated for customers when verified safe and legally allowed for individual geographic locations and conditions.
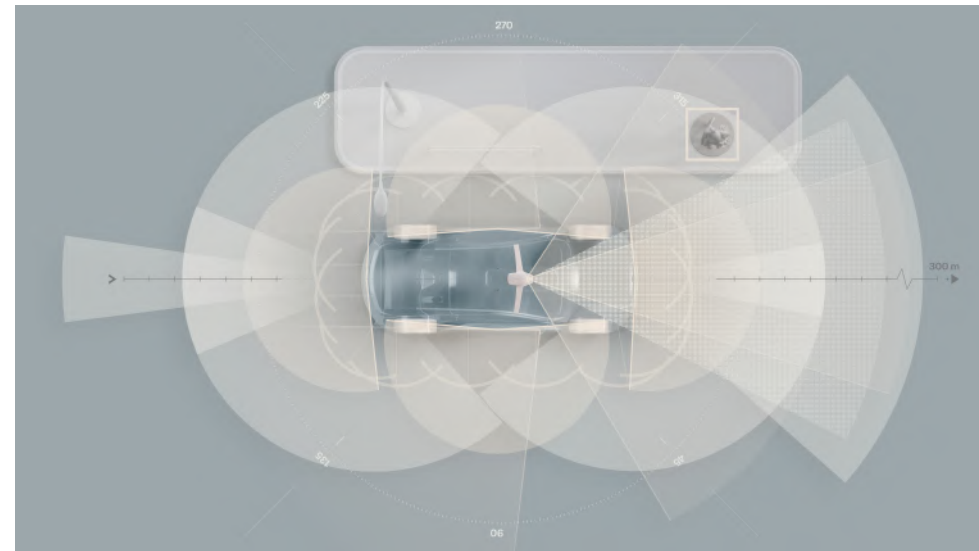
V O L V O

30th of June 2021

[The Volvo Concept Recharge is a manifesto for Volvo Cars' pure electric future - Volvo Cars Global Media Newsroom](#)

…

Finally, the Concept Recharge also reflects Volvo Cars' safety ambitions in coming years. A LiDAR sensor, built by technology company Luminar and a critical part of Volvo Cars' plan for forthcoming safe autonomous drive technology, is placed in an optimal position on the roof to collect data on the environment around the car.

…

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The traditional grille has been replaced with a shield-like structure, supported by a new interpretation of Volvo Cars' Thor's Hammer headlight design. These include the latest HD technology-enabled pure graphic which open at night to reveal the main lamp units.

...

Conclusion – DVN workshop 17th of November 2020

Sensor by itself is important but not enough,

From OEM perspective, sensor integration is a key issue :

- Transmission through outerlens
- Location
- Contamination
- Cleaning
- Scratch resistance
- Thermal load

Toolbox for simulation + Testing

Stakes

(1) Power consumption

(2) Performance in Heavy conditions

(3) AD Signaling Lamp

(1) Power consumption

[Self-Driving Cars' Massive Power Consumption Is Becoming a Problem | WIRED](#)

Self-Driving Cars Use Crazy Amounts of Power, and It's Becoming a Problem

All those computers and sensors can hurt fuel economy and range, practical problems for commercial systems.

...

Even that's not good enough for full self-driving vehicles. Nvidia believes that a fully self-sufficient, no-steering-wheel-or-pedals kind of driverless car will need to run on a platform it's calling Pegasus. With two Xavier chips and two more GPUs, this platform can crunch 320 trillion operations per second and keep power consumption to an acceptable **500 watts.**

...

≡ WIRED   Self-Driving Cars Use Crazy Amounts of Power, and It's Becoming a Problem

Shelley, a self-driving Audi TT developed by Stanford University, uses the brains in the trunk to speed around a racetrack autonomously. NIKKI KAHN/THE WASHINGTON POST/GETTY IMAGES

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(1) Power consumption

Lidar and Power Consumption for EVs | Velodyne Lidar

VOLVO

(1) Power consumption - What are the stakes ?

Power consumption	Internal combustion engine	Electrical vehicle
1 Watt	0,02 gCO2 / km (*)	2,2 Wh/100km (**)

(*) Calculation based on formula 3, COMMISSION IMPLEMENTING DECISION (EU) 2019/111, for Petrol engine
EUR-Lex - 32019R0111 - EN - EUR-Lex (europa.eu)

$$C_{CO_2} = \left(\sum_{i=1}^{m} \Delta P_i \cdot UF_i \right) \cdot \frac{V_{Pe}}{\eta_A} \cdot \frac{CF}{v}$$

(**) WLTP cycle : 30 minutes driving - 23 km
 1 watt power consumption ⇔2,2 Wh / 100km

(1) Power consumption - Lighting

Function	DRL		Passing Beam		Driving Beam		front Position light		Front Turn indicator		Rear Turn indicator		side turn indicator		licence plate light		reverse		stop		Rear fog		Rear Position light		average consumption	WLTP consumption
	WATT / lamp	% usage	WATT / lamp	% usage	WATT / lamp	% usage	WATT / lamp	% usage	WATT / lamp	% usage	WATT / lamp	% usage	WATT / lamp	% usage	WATT / lamp	% usage	WATT / lamp	% usage	WATT / lamp	% usage	WATT / lamp	% usage	WATT / lamp	% usage	per car Watt	Per car Watt
halogen	26	64%	68,5	33%	75	3%	6	36%	26	15%	26	15%	5	15%	10	36%	26	1%	26	15%	26	1%	6	36%	108	52
led basic performance	5	64%	15	33%	15	3%	2	36%	5	15%	5	15%	1	15%	1	36%	5	1%	5	15%	5	1%	3	36%	24	10
led high performance	30	64%	60	33%	90	3%	5	36%	30	15%	30	15%	3	15%	2	36%	10	1%	30	15%	10	1%	20	36%	116	60

Lighting Bulb : 100W

Lighting LED : 25W

Lidar : 20-50W

Total AD : 500 W ?

(2) Performance under heavy conditions

Testing under different weather conditions

(2) Heavy fog

Heavy fog conditions captured by Luminar lidar and camera at the same time stamp. In these conditions, with no window clearing for either sensor, lidar detection of the lead car is 79m at which time camera data shows nothing discernible.
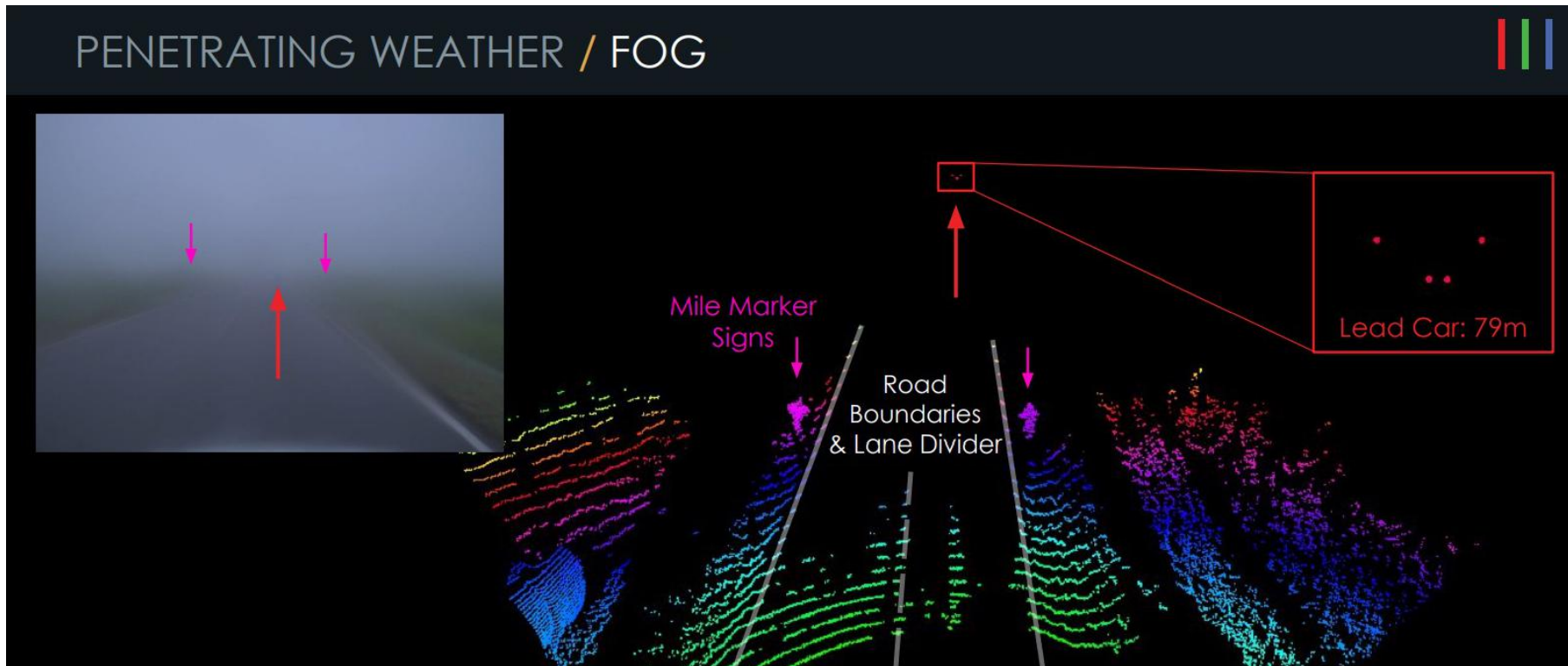
(2) Heavy rain

Heavy rain conditions captured by Luminar lidar and camera at the same time stamp. In these conditions, lidar detection of the road surface is possible to nearly 40m depending on the degree of puddling on the road surface. An upcoming cross-traffic intersection is detected at more than 190m by detecting and tracking vehicles highlighted in yellow and blue boxes within zoom panel
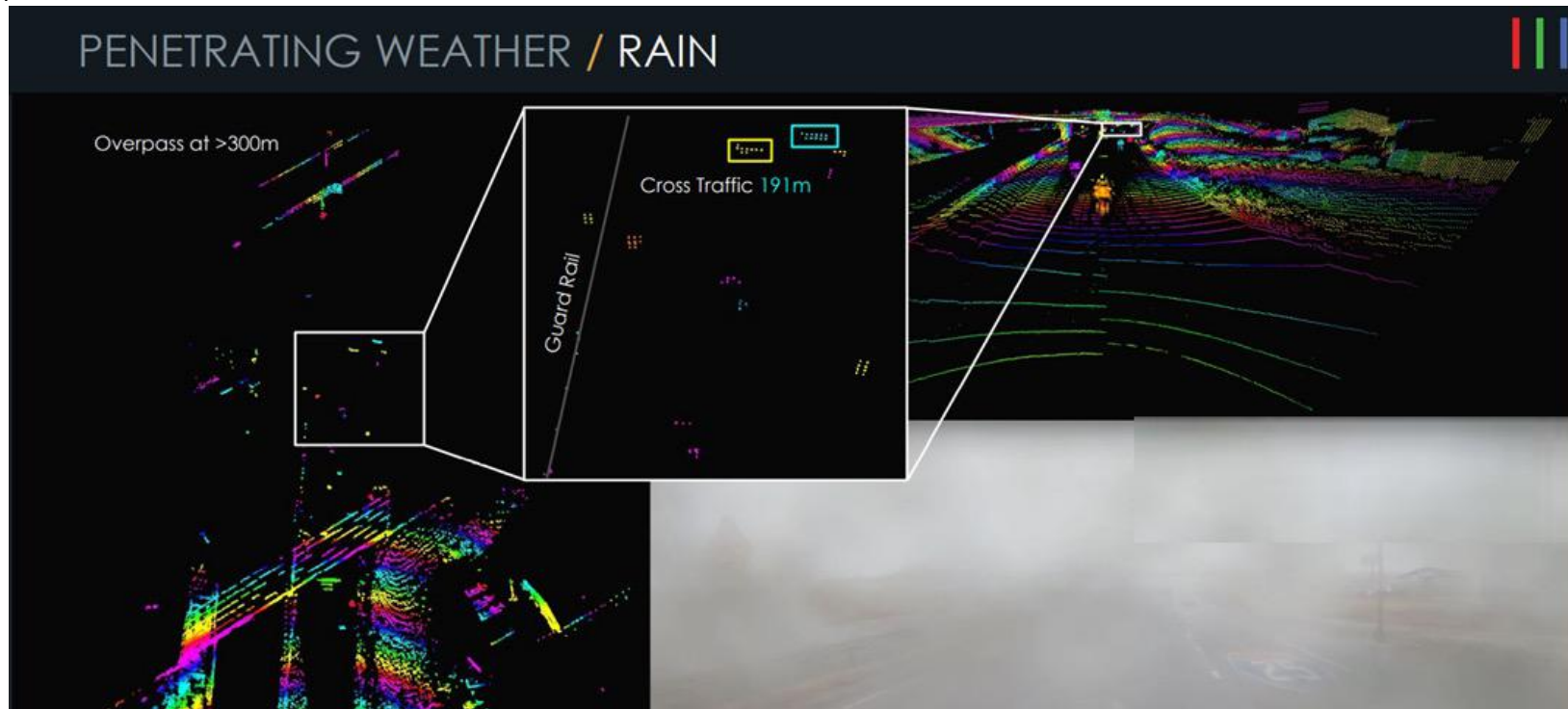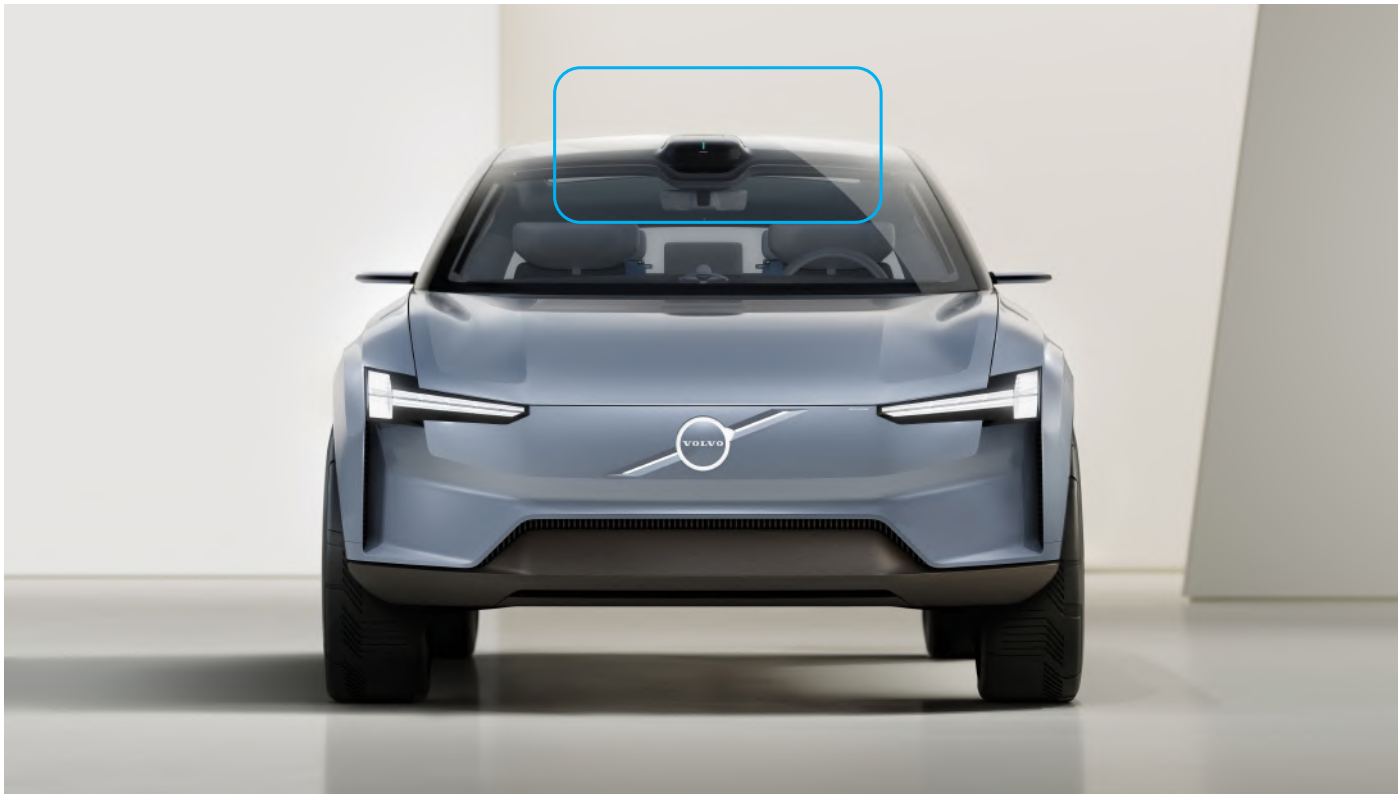
(2) Snow

Snow conditions captured by Luminar lidar and camera at the same time stamp. In these conditions, lidar detection of falling snow extends to 20m. These detections are very low reflectance, and leave no "holes" in the point cloud and so understanding the scene is simple
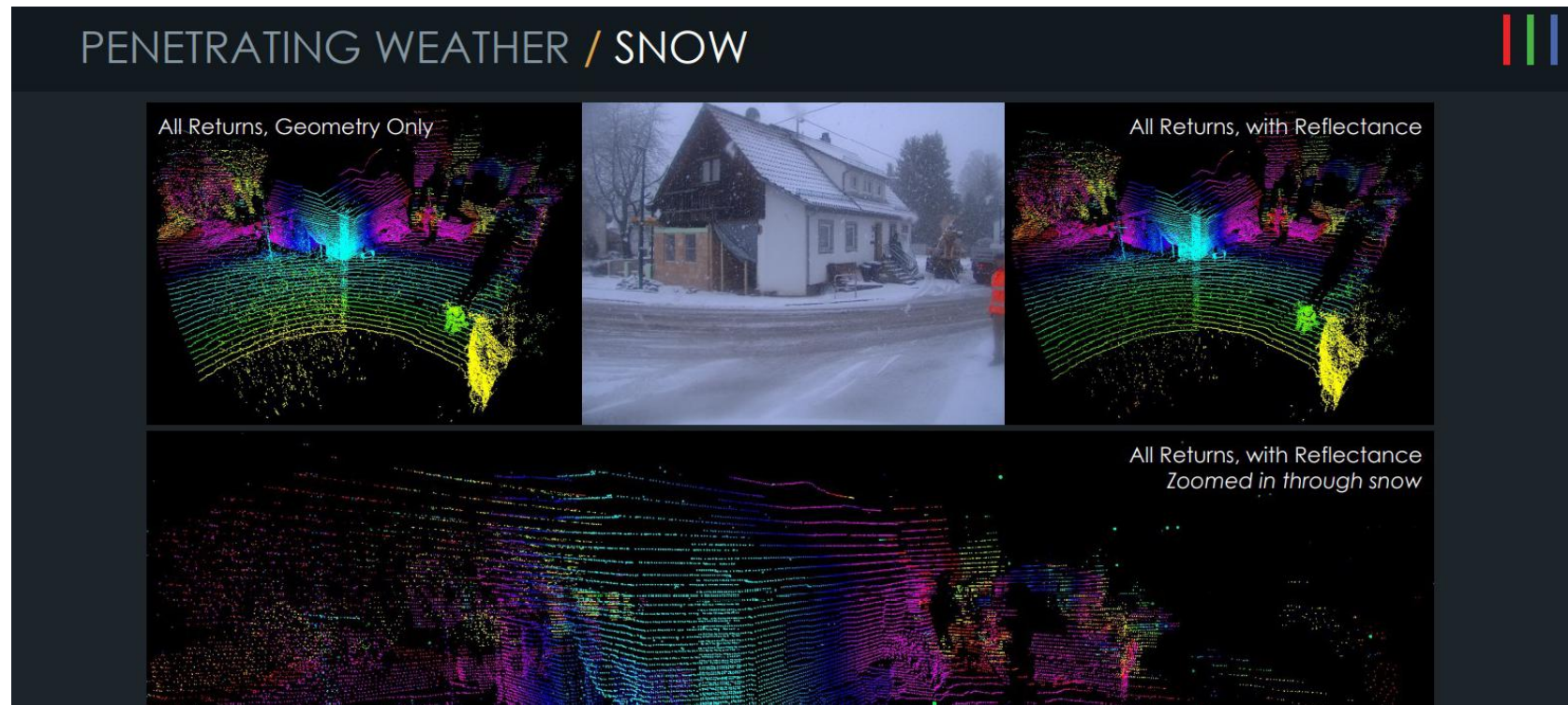
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(3) AD Signaling lamp

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Already possible in some markets like Japan

V O L V O

(3) AD Signalling - Status

UNECE :

Discussion still continues about autonomous vehicles and their need for specific light signalling requirements. GRE is in close contact now with GRVA about this topic. A synthesis was done by the chairman of the AVSR task force (GRE 85-34).

GRE TF AVSR (unece.org)

CHINA :

Three draft proposals for RID (Road illuminating devices); LSD (light signaling devices), and RRD (retro reflective devices) have been published, and authorities are inviting lighting community to provide feedback by 16 of November 2021. These new texts are based on a copy-paste of UN R148, R149 and R150, with some additional requirements. The main differences are:

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Introduction of AV signaling lamp, mandatory for L 3 vehicles

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The expected implementation date for the new-type lamps is July 2024, and for the new type vehicles is July 2025

汽车标准制修订管理系统 (catarc.org.cn)