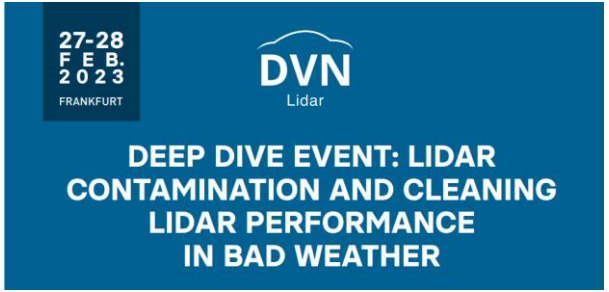
VOLVO

LIDAR CONTAMINATION



Paul-Henri MATHA, Exterior lighting, Technical Leader, Volvo Cars

DVN, 28h of February 2023


— VOLVO FOR LIFE —

sensors on the roof integration - Stakes

1 Foreign Contamination

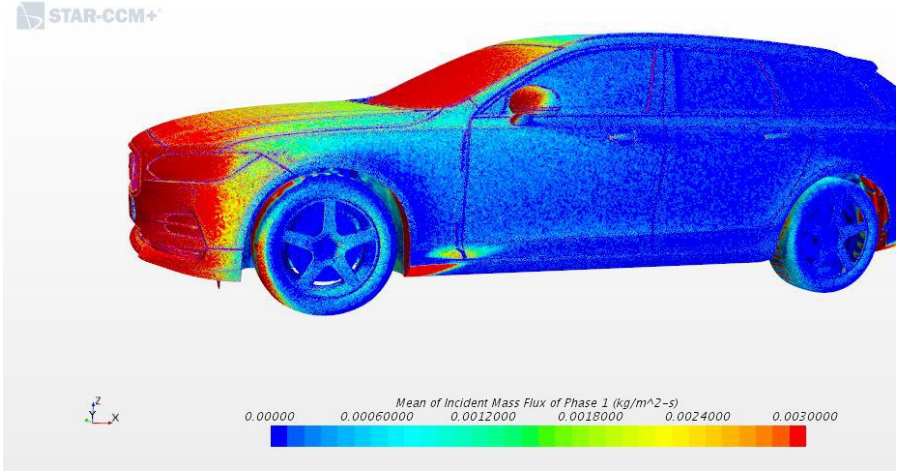
2 Self contamination

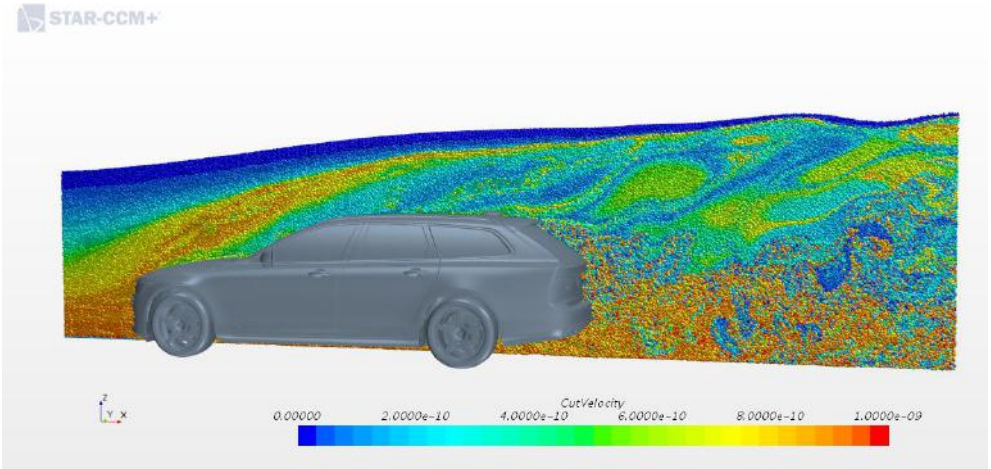
3 Aerodynamics

4 Temperature & required cooling system

(1) sensors on the roof – Foreign contamination

Importance of the location & simulation



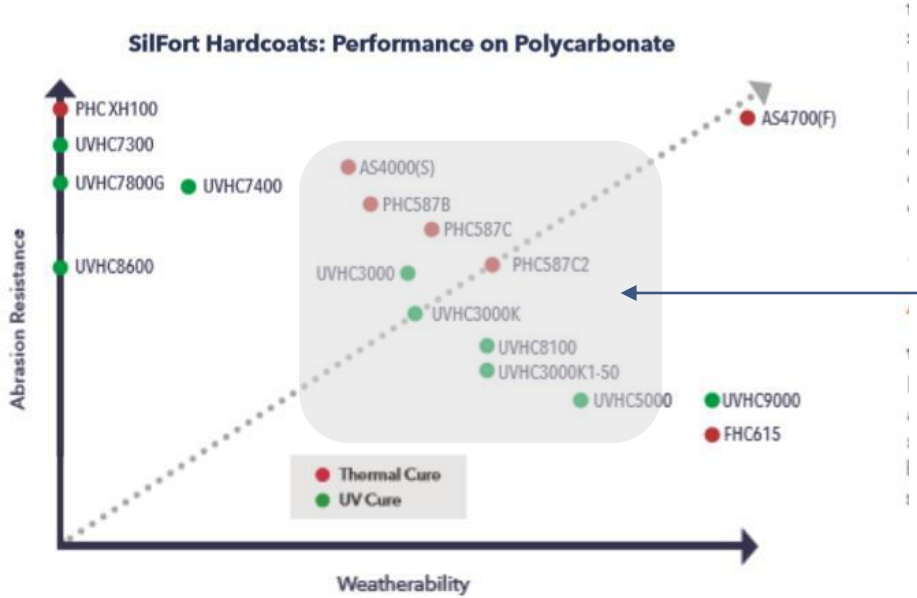


Importance of a good cleaning system

Importance of a good scratch resistance

(1) sensors on the roof – Foreign contamination

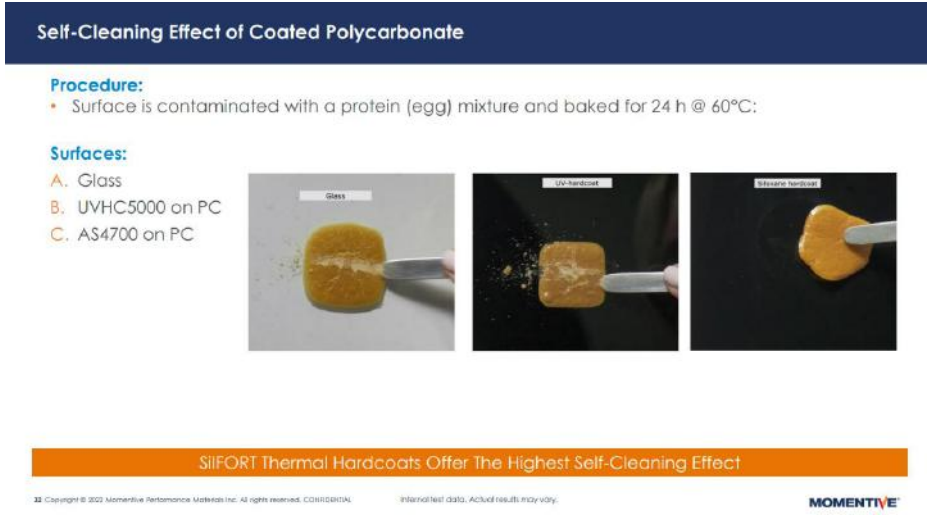
Example of PC-lens coating scratch resistance – extract from momentive-silfort-brochure%20(002).pdf



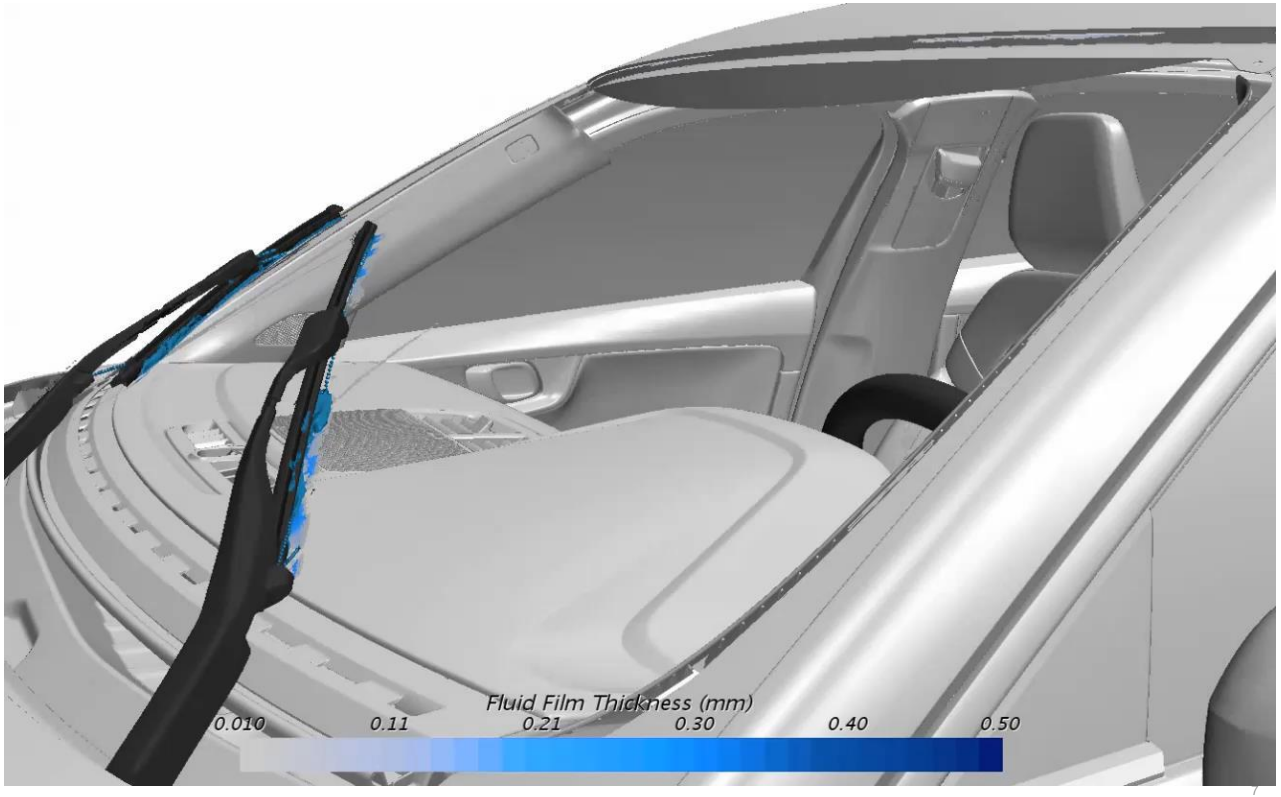
Standard Coating for Headlamp PC lens

(1) sensors on the roof – Foreign contamination

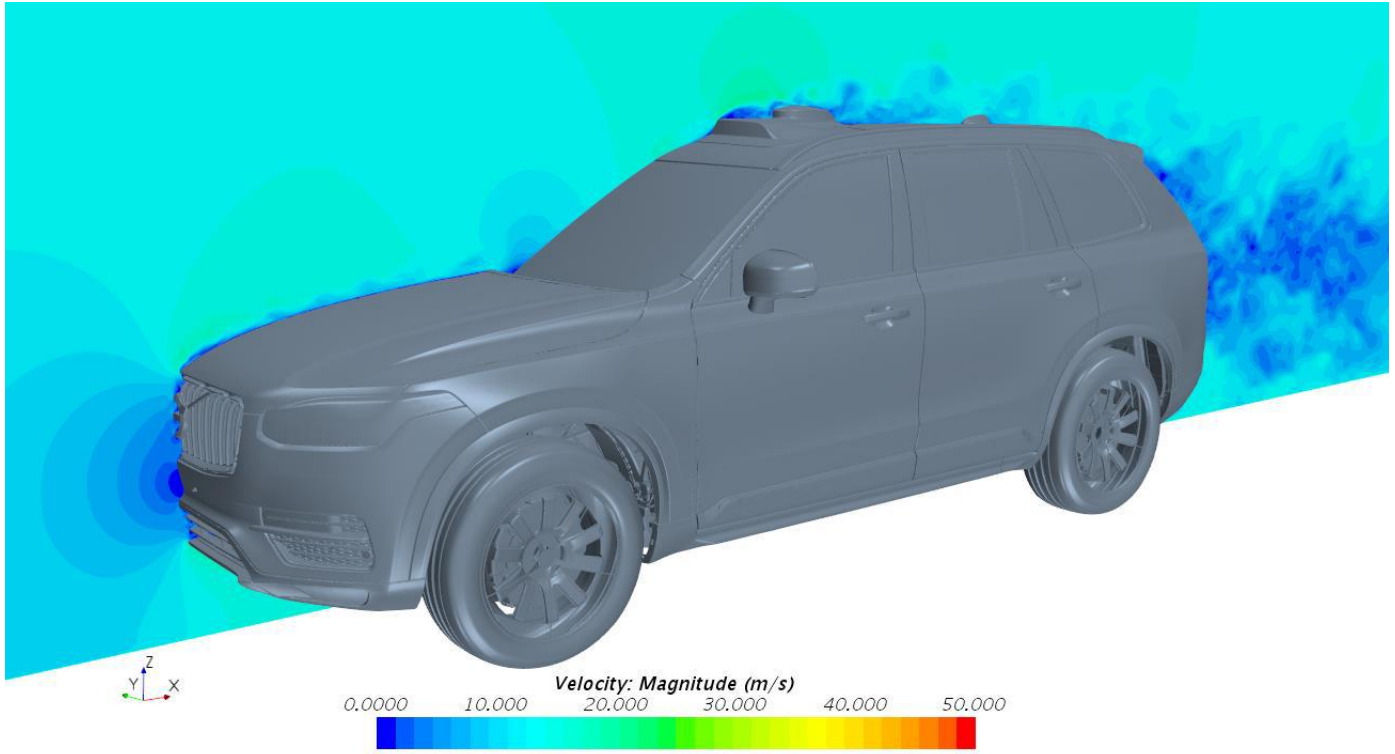
Cleanability of the surface



(2) sensors on the roof – Self contamination



(3) sensors on the roof – Aerodynamics impact



(4) Thermal impact and self heating

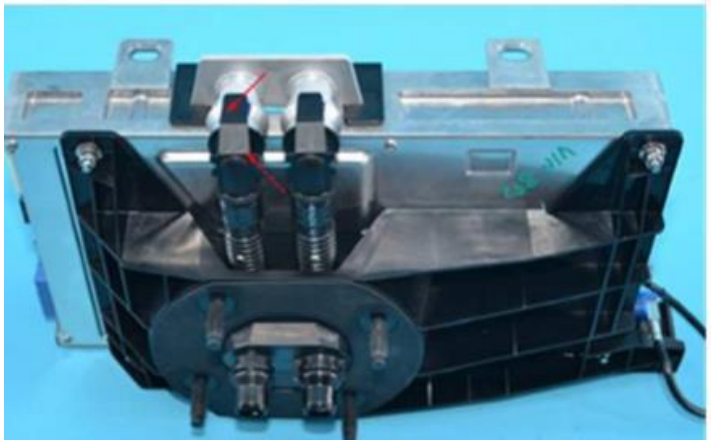
Maximum Ambient temperature

Self heating

Derating in worse condition with / without functionality

Definition of a cooling system

Thermal simulation



Benchmark of cooling system for ECU

Conclusion

Sensor by itself is important but not enough,

From OEM perspective, sensor integration is a key issue :

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

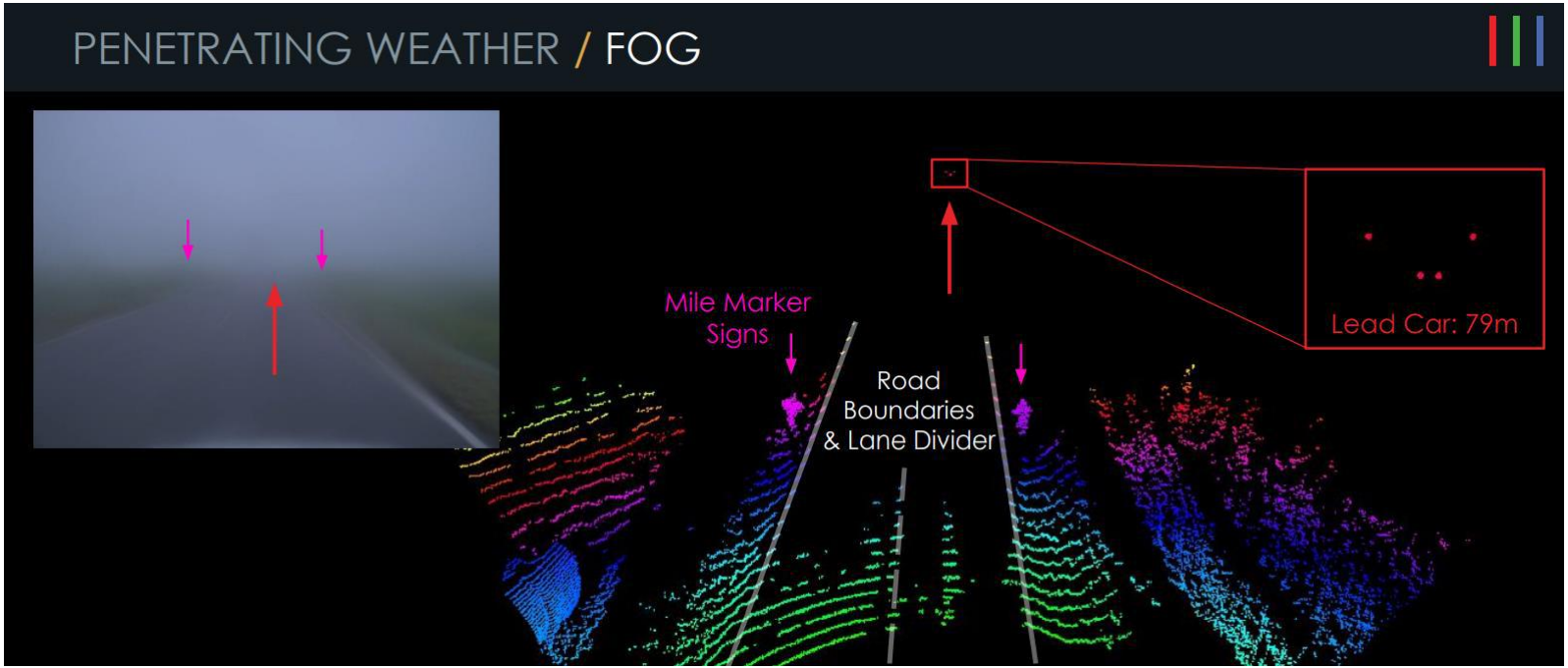
Toolbox for simulation + Testing

Performance under heavy conditions

Testing under different weather conditions

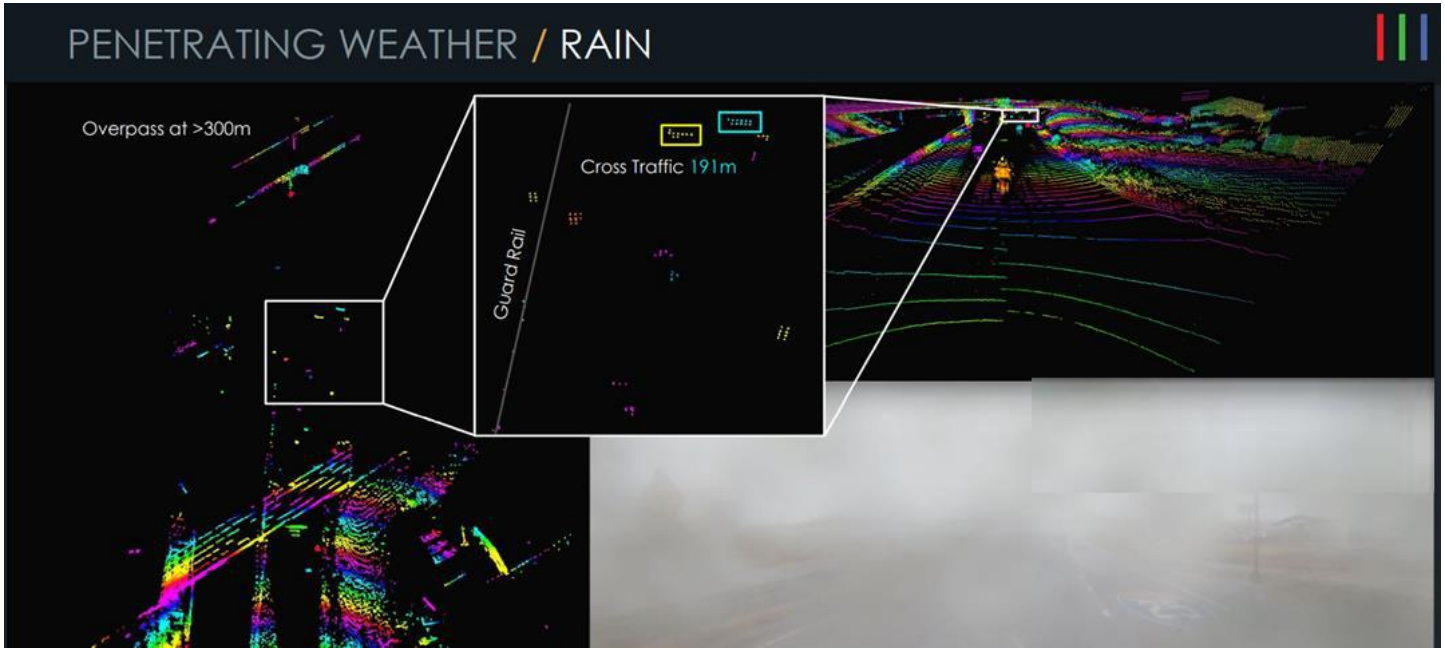
(1) Heavy fog

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



(3) 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

(4) Test in lab

To reproduce exterior heavy conditions

Location: Rail Tech Arsenal, Vienna, Austria

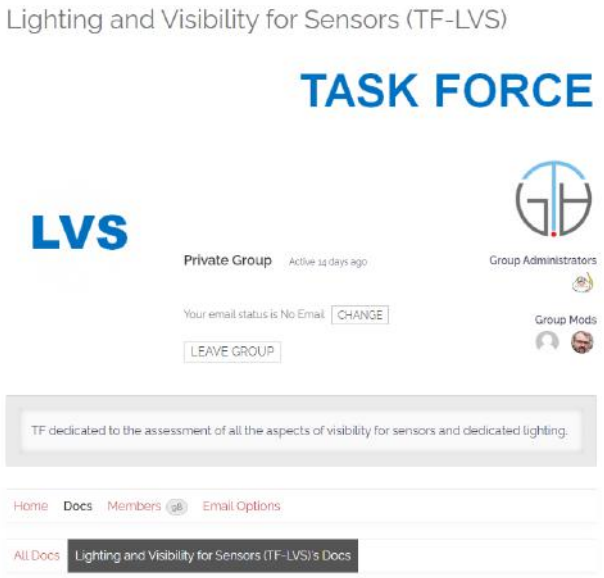
- 100m tunnel
- Rain: 15 l/h, 50 l/h, 80 l/h
- Wind speeds: 10 km/h, 30 km/h, 60 km/h
- Fog intensities: 5%, 10%, 25%, 100%
- Droplet Size Distribution (DSD) for fog was given

(5) Test procedures

Need to develop standard rule :

- SAE norm in USA ?
- European best practice ? Join GTB working group ?

Docs – Lighting and Visibility for Sensors (TF-LVS) – GTB (gtb-lighting.org)

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