

Lidar Integration Solutions Optical, Cleaning and Thermal Considerations



Motivation for Sensor Integration



Project Dragonfly





Position of head/rear lamps are the 4 strategic corners for sensor integration (61 ADAS/AD functions require among others an intelligent illumination to support sensors for object and scene classification

- Motivation Multispectral approaches give you robustness
- Function Concept

Synergy

Facts for

Sensors at

4 Strategic

Corners

- Integration of sensors into lamps, grills and emblems Camera, LiDAR, Radar Architecture dependent:
 - Sensor | Light | Data fusion
- Integration of AI
- Leveling system: dynamic compensation, self adjustment
- Interfaces: power | data bus (CAN/Ethernet,..)
- Protection: against UV-light | weathering | road stone defogging & deicing solutions
- Cleaning system
- FOV > 120° for each lamp
- Redundancy of sensor systems





OPTICAL

CLEANING





OPTICAL

CLEANING







- Scratches/Condensation/Icing influence
- > Exit/Entry Angle measurements







- > Influences of the cover glass for LiDAR integration found
 - Scratches/Condensation/Icing influence
 - > Exit/Entry Angle measurements
- > Influences of coatings for different LiDAR technologies evaluated
 - Effect of the Hard coat, Anti-fog-coating, Anti-reflective coatings
 - > Graining effects, Condensation, Back reflections







Reflections





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> Environment effects tested

- Road tests
- Climate wind tunnel testing in 2018 and 2019
 - > technology dependent influence of cover glass and environment observed









Backlight











OPTICAL

CLEANING





OPTICAL

CLEANING



Cleaning



- > Wipers
- > High pressure water nozzle (static vs. telescopic)
- > Coating for omniphobic properties
- > Air blowing
- > Heating Systems







OPTICAL

CLEANING





OPTICAL

CLEANING





- Internal heat production
- > Motor heat
- > Solar impact



→ Inside temperature in the headlamp: -40 to 105 °C Temperature ratings for LiDARs are typically below 105 °C

 \rightarrow temperature management is crucial

- > Fan cooling
- > Active cooling systems



Depth of LiDAR Integration

Depth of integration	Full integration	Partial integration	Attached mounting
	Shared cover Shared housing	Shared cover Separated housings	Separated covers Separated housings
Heat management			
Deicing, Defogging, Cleaning			
Design aspect			
Exchangeability			
Technology dependency			



Thank you!