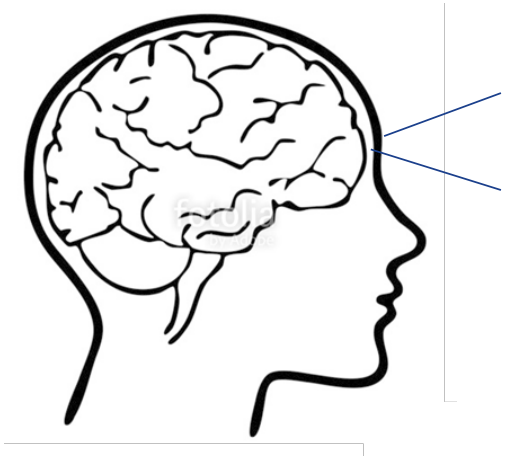
Synergies of ADAS & Lighting

ZKW, R. Klädtke

DVN LIDAR Conference 19-20 November 2018

Manual Driving Architecture

2 visual sensors
(eyes)
+
brain

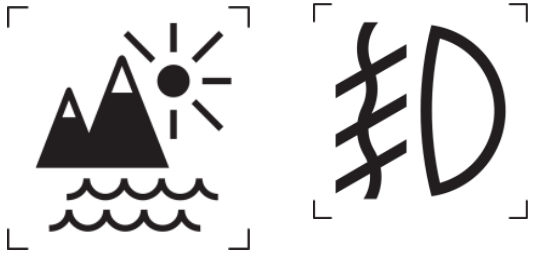


+

Lighting

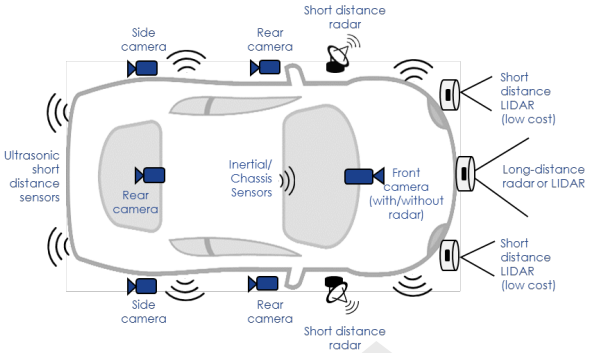
=

ALL WEATHER Capability



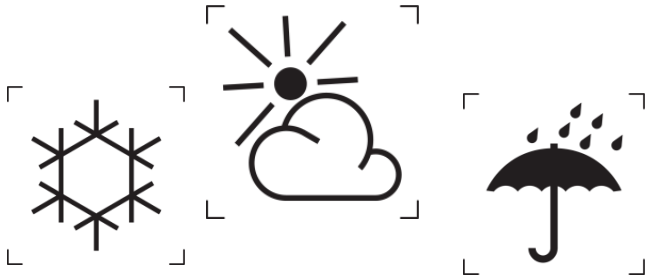
ADAS Driving Architecture

Visual Sensors
Radar
LIDAR
IR, MS, ..
+
Artificial Intelligence (AI)

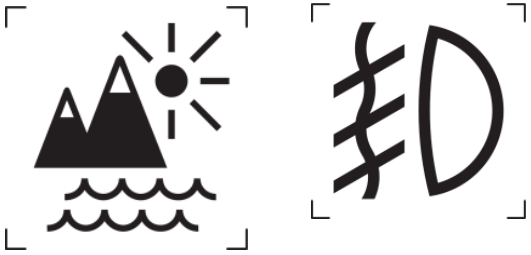


ADAS Level 4/5
∑ **28-50 Sensors**

Digital Lighting



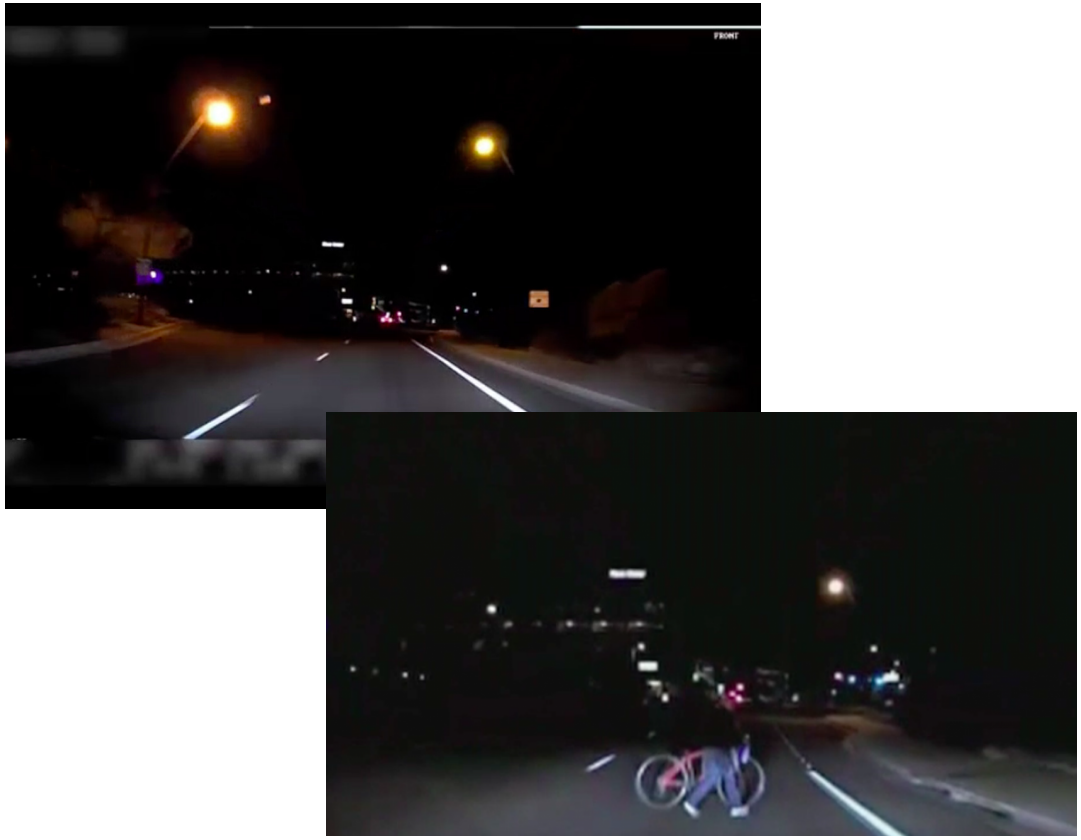
ALL WEATHER Capability

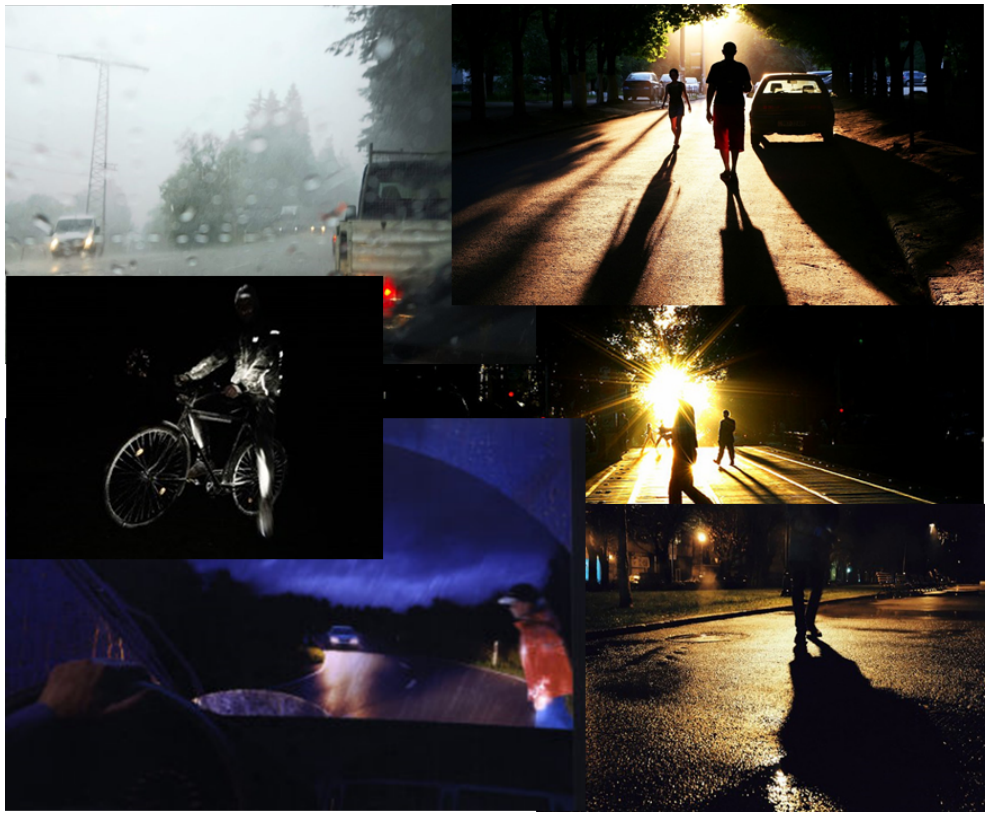


Digital Light & ADAS

Object Classification

Sensors & Algorithms of Artificial Intelligence face challenges





Digital Light & ADAS

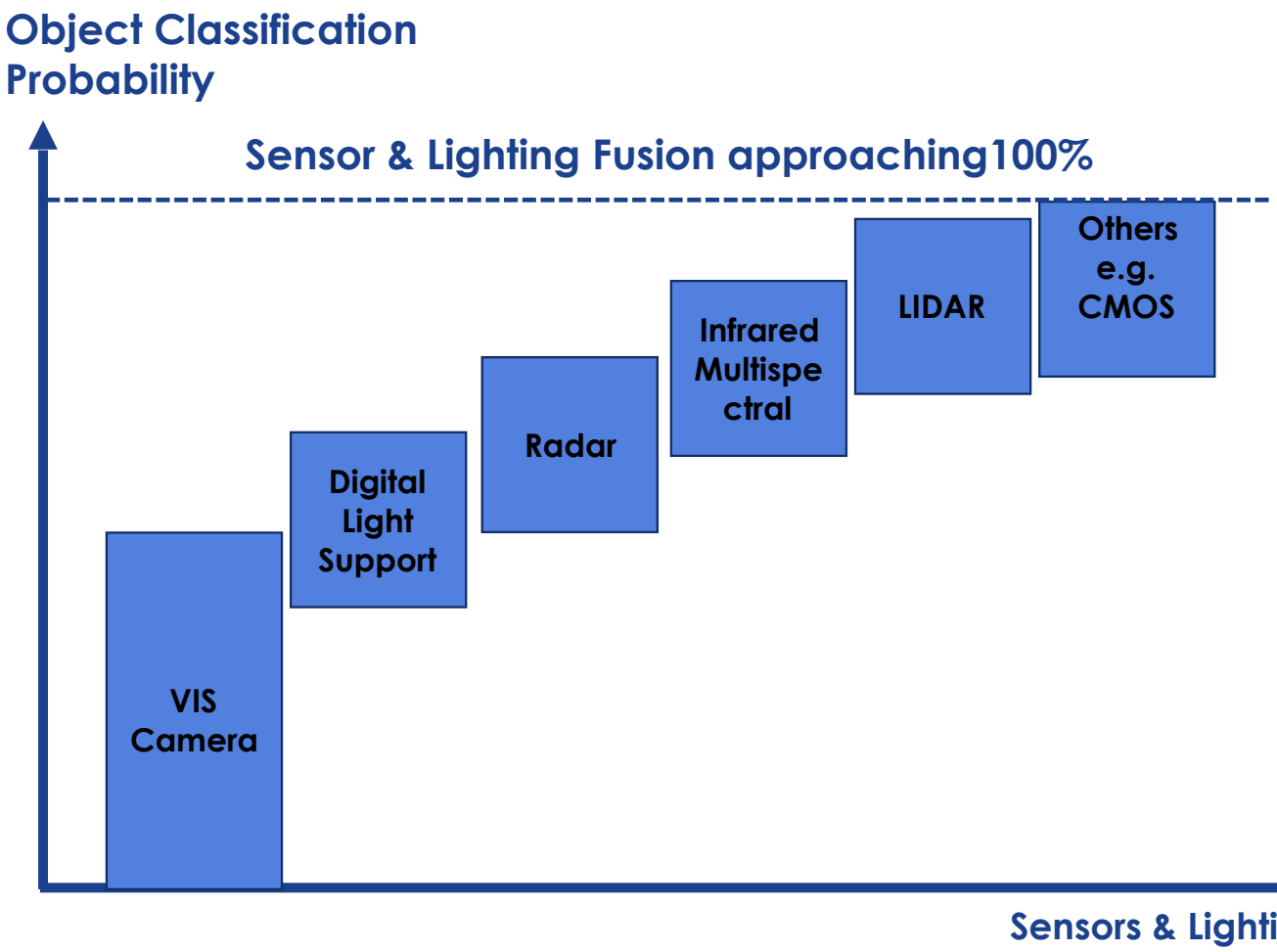
Digital Light

Targeted Illumination or seamless ADB with up to 1,3 Mio Pixel

Strong support for Object Classification

Source: BMW

All Weather Object Classification



Example:
Sensor & Lighting Fusion:

- LIDAR or RADAR detect moving object
- No high probability object classification possible
- Digital Light targeted illumination
- Higher probability for object classification via VIS Camera & Lighting

ZKW Strategic focus

SYSTEM
Ground Control Center

System Partner & LG

- Operation Control Center
- Communication Network LTE & 5G

SYSTEM

System Partner & LG

- ADAS – Advanced Driver Assistance System
- AD – Autonomous Driving System (Driving & Parking)

ZKW

- Light / Sensor System

Full-LED-Laser-HSW

SUBSYSTEM

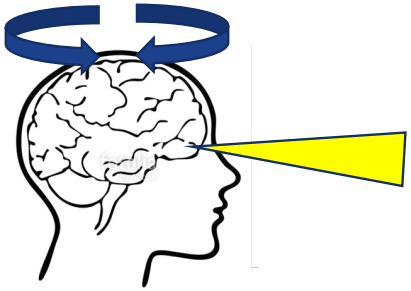
ZKW & LG

- Innovative Digital Light / Sensor subsystem
- Exterior Lighting incl. Sensor (Camera, IR/ MS, LiDAR, Radar,..) – V2X
- Electronics, ECU, Event Recorder Rear Lights incl. Sensor

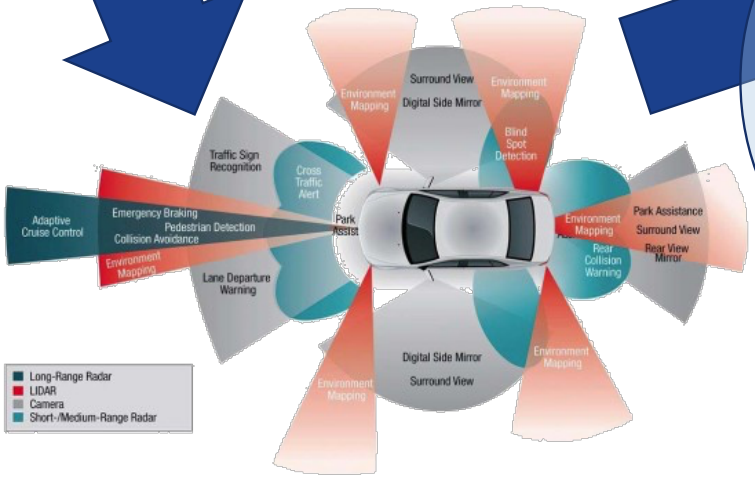
External Partners & LG

- Sensors & Artificial Intelligence & sensor fusion algorithms
- Ethernet Bus, Communication (V2X, 5G), Cyber Security, Embedded System, AD Simulation & Validation, ...

ADAS – Sensors – FOUR strategic corners

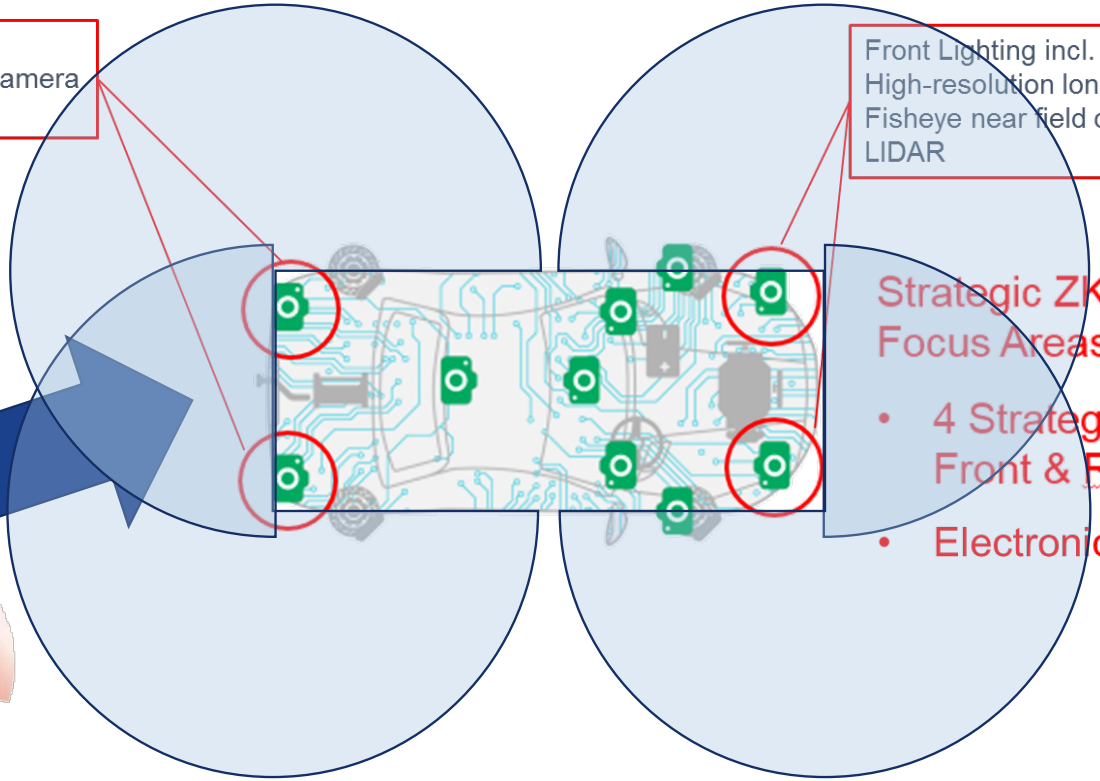


4 x 270°
Full redundancy field of view



Rear Lighting incl.
Fisheye near field camera
LIDAR

Front Lighting incl.
High-resolution long range camera
Fisheye near field camera
LIDAR



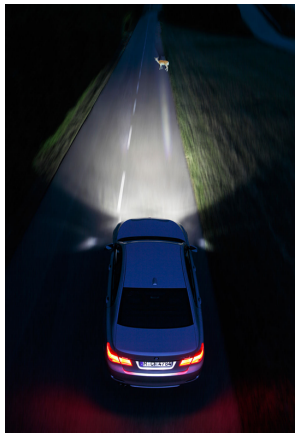
Strategic ZKW Focus Areas:

- 4 Strategic corners: Front & Rear Lighting
- Electronics / ECU

4 Strategic Corners - Advantages/Synergies

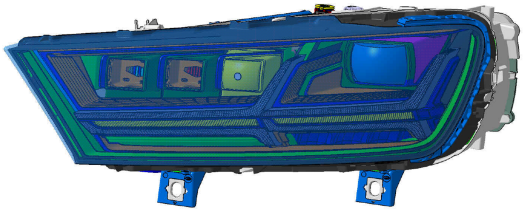
Advantages/Synergies:

- Reuse of the levelling system
  - Basic adjustment
  - Dynamic compensation feasible
- Interfaces (supply 9-16V, data)
  - CAN, CAN-FD, Ethernet,…
- Light support for camera systems
- Protection against UV-light / weathering
- Protection against road stone, notch test
- FOV > 120° feasible – 270°
- Existing Defogging, deicing solutions
- Re use of cleaning system
- Redundancy of sensor systems



Light sensor support

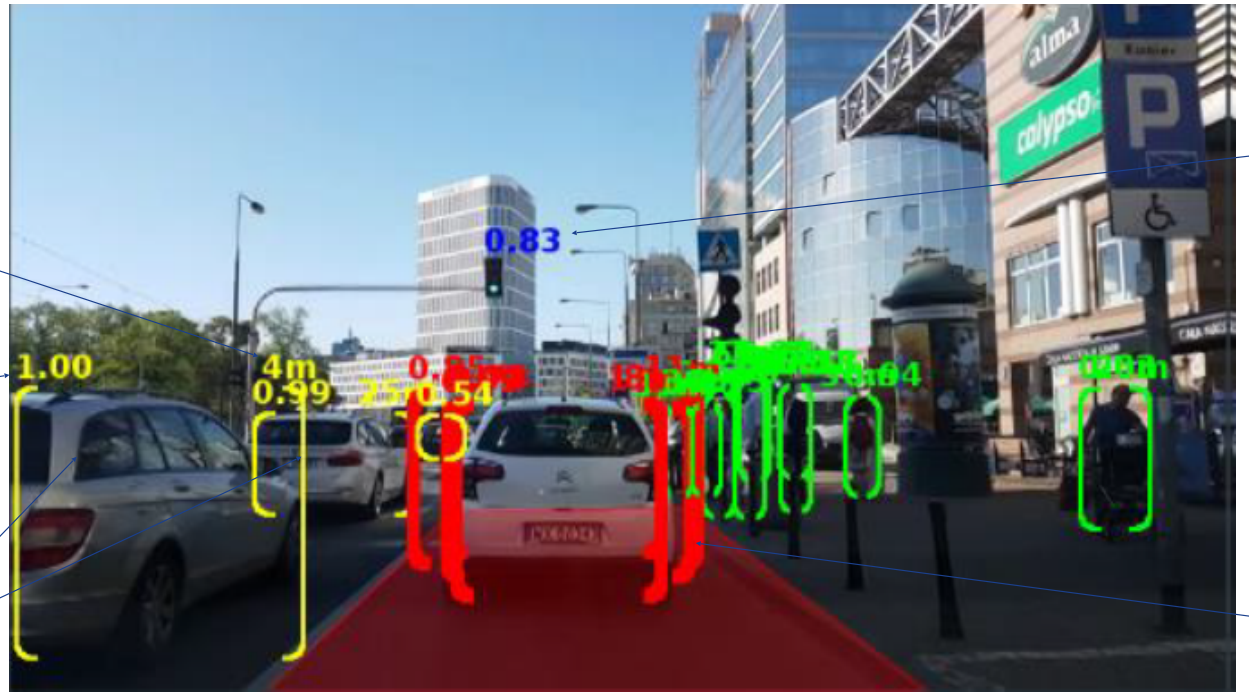
Design advantage -> no roof mounting



Existing housing

Reuse of the headlamp Cleaning system

Lighting/Sensor Integration with Artificial Intelligence



Distance

Confidence (between 0 and 1)

Detected Objects

Confidence value for green traffic light

Objects on route (red)

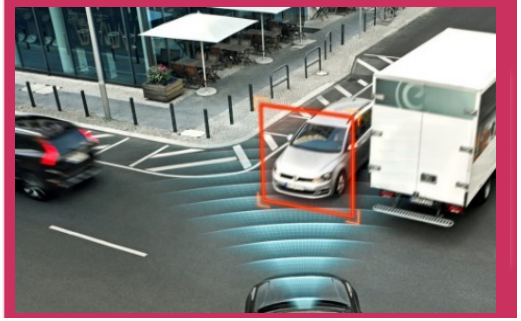
Source: AVISYSTEMS

Current direction

LG Autonomous Driving Lab - Research

ADAS Sensors
- Radar/ LiDAR / Camera

Autonomous Driving
- Highway Autopilot / Automatic Parking



Connectivity
- V2X /In-vehicle Network / Security

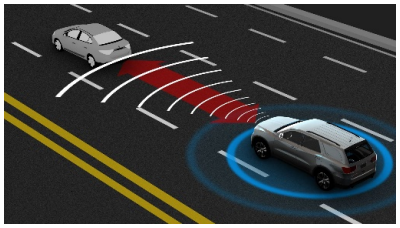
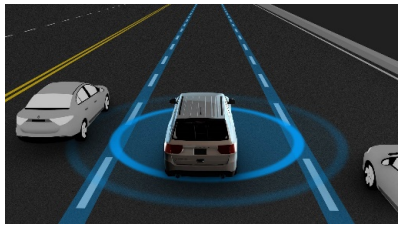
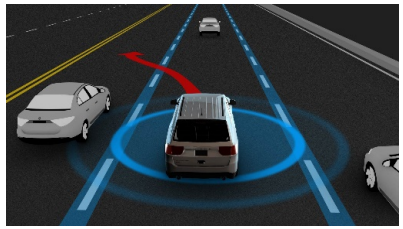
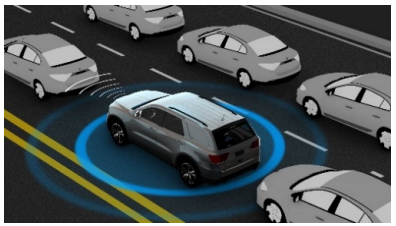
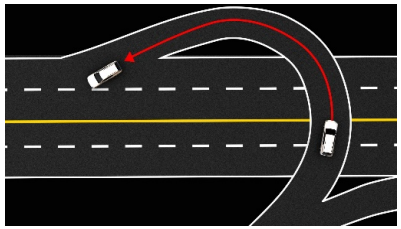
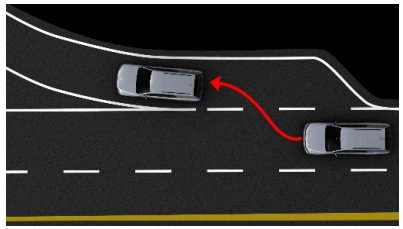
Technology

- Safety Platform
- Perception / Decision / Control Algorithms
- Sensor Fusion Algorithm
- DSRC/5G Communication
- In-vehicle Network
- Cyber Security

Product

- Radar / LiDAR / Camera Sensors
- V2X
- Sensor Fusion ECU
- Highway Autopilot
- Automatic Parking

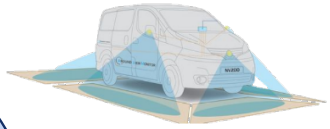
LG Highway Auto Pilot & Valet Parking

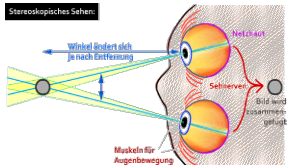
		
FSRA[1)]	AEB	Lane Centering
		
Automatic Lane Change	Traffic Jam Pilot	Ramp
		
Exit & Merge	Valet Parking	Licensed Vehicle

1) Full Speed Range ACC

ZKW covering AD & Sensor Integration

ZKW Sensor – Building Blocks





13

Sensor data fusion

Artificial intelligence

LiDAR integration

AD-Democar

360° Camera integration

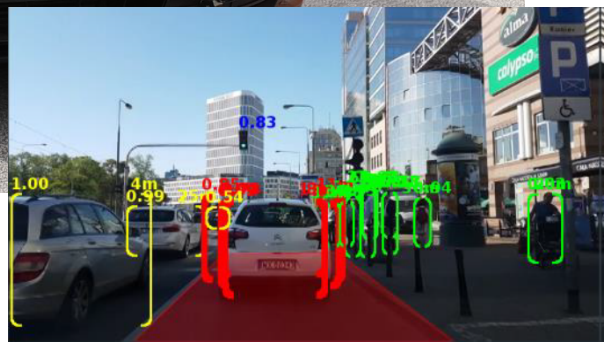
Sensor Cleaning

3D (Stereo) Camera

Light / Sensor Fusion

Light support for sensors

ZKW Test Vehicle for Data Generation



- **Goals for test vehicle:**
  - Test data generation for Deep-Learning experiments
  - Angle and FOV analyses
  - Quality analyses with existing Deep-Learning Neuronal Networks
  - Preparation for further test-drives and to gather experience with head-light position
  - Testing of further sensor setups

ZKW Tests – Climate Wind Tunnel RTA Vienna

- Performing of different test scenarios with **LiDAR** and **Camera** Setups
- Goal is to compare LiDAR-Technologies regarding performance under good/bad weather conditions
- Using of the Vienna Climatic Wind Tunnel – length 100m / Wind velocitymax. 300km/h / Temperature -45°C to +60°C

AD-Demo Car headlight

Sensor integration: AD – Development car

Camera integration in headlight

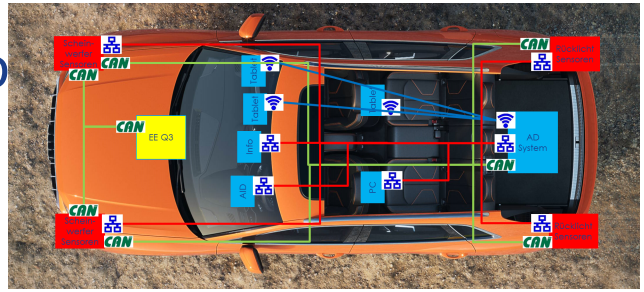
- Together with ADAS Level 3+ series sensors

Light for camera support

- Improvement of object detection/classificatio

Lidar Integration in headlight

- Sensor fusion – higher detection/classificatio
- Lower Bus-load
- Higher redundancy



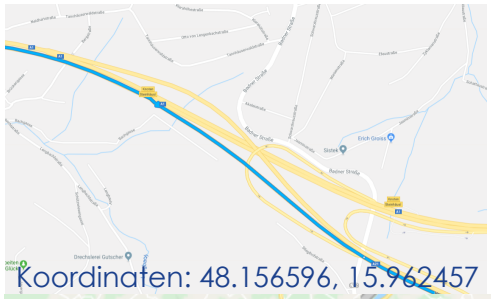
- Camera
- Radar
- LiDAR
- USS
- IR/MS Camera
- Audi series
- **ZKW Integration**
- Further sensors for redundancy

Sensor/Camera integration in rearlamp

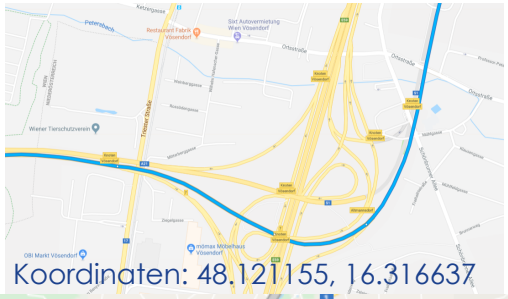
- 360° sensor view

Test-road

Highway Chauffeur / Traffic jam assistant



Koordinaten: 48.156596, 15.962457



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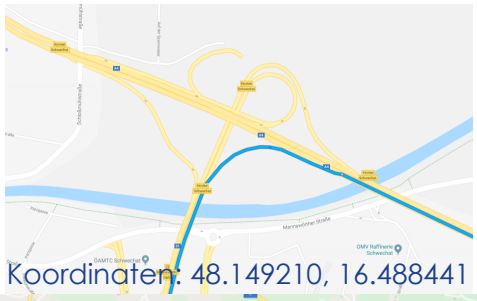

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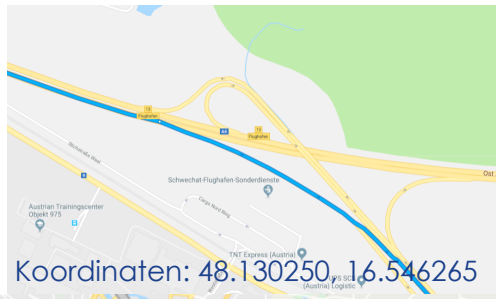

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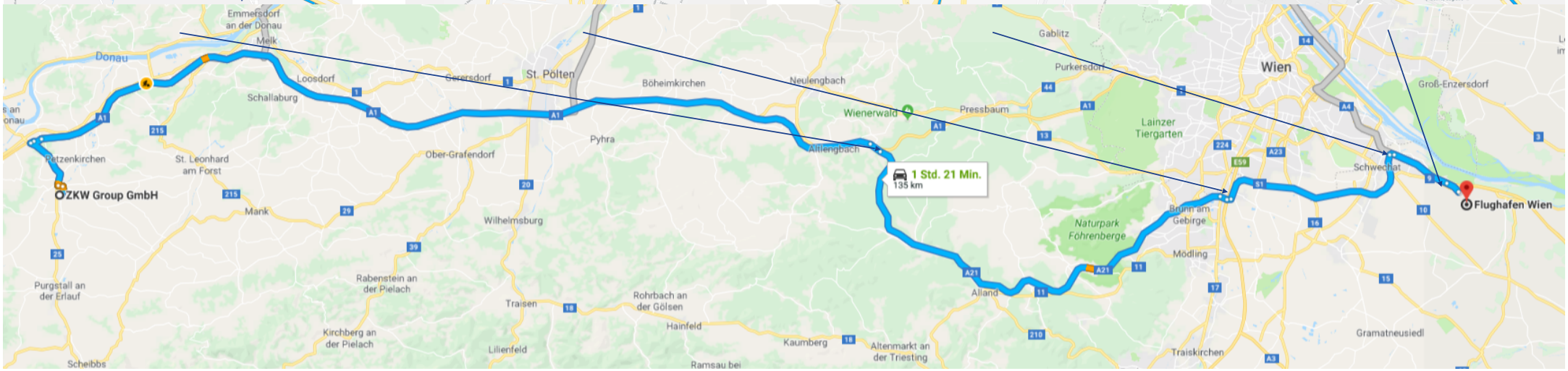


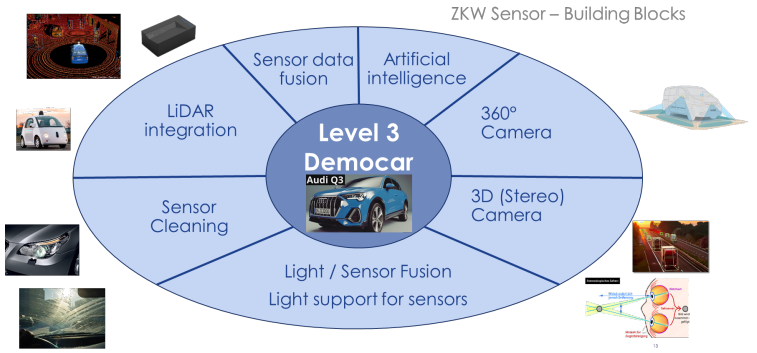
Function development in Demo car

- Displays and demo-mode to demonstrate **added value** of sensor integration in headlight, in existing ADAS level 3+ use cases
  - E.g. “highway pilot” and “crossroad assistant”
  - Development of new AD/ADAS functions in terms of night/bad weather/country road use cases

Synergies of ADAS & Lighting - Conclusion

Digital Lighting is an integral element of Autonomous Driving:

- **4 Strategic Corners = digital light / sensor integration covering 360 degrees**
- **Digital Light = strong support for Object Classification >> Improved Safety**
- **Sensor/Digital Light Fusion >> leading to 100% Object recognition**



<u>Main Conclusion "Hector Fratty"</u>: lighting needs ADAS to lead the intelligent lighting, and ADAS needs lighting to aid visibility of sensors and integrate cameras and lidars inside the headlamp.

ZKW

BRIGHT MINDS,
BRIGHT LIGHTS.

THANK YOU