Self driving and AI – prospects and challenges

Nov 2018

AIMOTIVE

ABOUT LEVELS OF SELF-DRIVING

- Different level of self-driving depending on level of automatization
- L0 – L2 ADAS system
- L3 is conceptually wrong
- L4 – L5 partial and full automation

OPEN QUESTIONS AND CHALLENGES

- What extent AI is necessary ?
- Will it require general intelligence or only domain AI ?
- How to solve relevant amount of testing ?
- Homologation issues ?

ABOUT LEVELS OF SELF-DRIVING

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

AIMOTIVE'S OFFER – INGREDIENTS OF SELF-DRIVING

aiDrive

Self-driving Software Platform

Artificial Intelligence-based software suite for Level 4 and 5 autonomous driving

aiSim

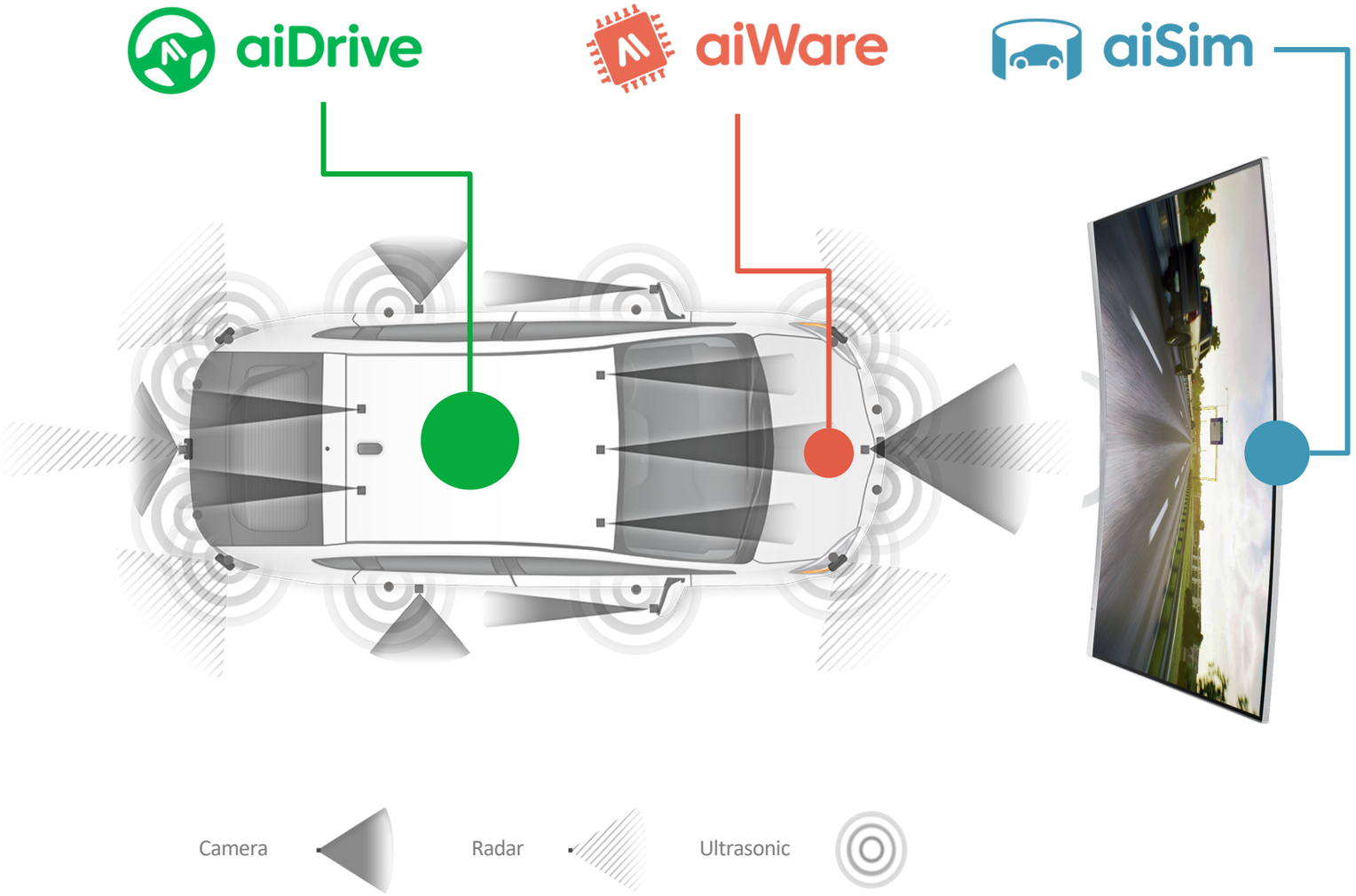
Virtual Simulation Environment

Photorealistic and dynamic virtual environment for AI training and system testing

aiWare

AI-Optimized Hardware Platform

NN accelerator IP for low-power, high-performance AI-optimized computing



Sensors

Cameras

1. Very high resolution
2. Infinite distance
3. Cheap
4. Generates huge amount of data
5. Infrared cameras
6. Can have problems in bad weather

Radars

1. Low resolution
2. Quite cheap
3. Speed measurement
4. Quite whether proof

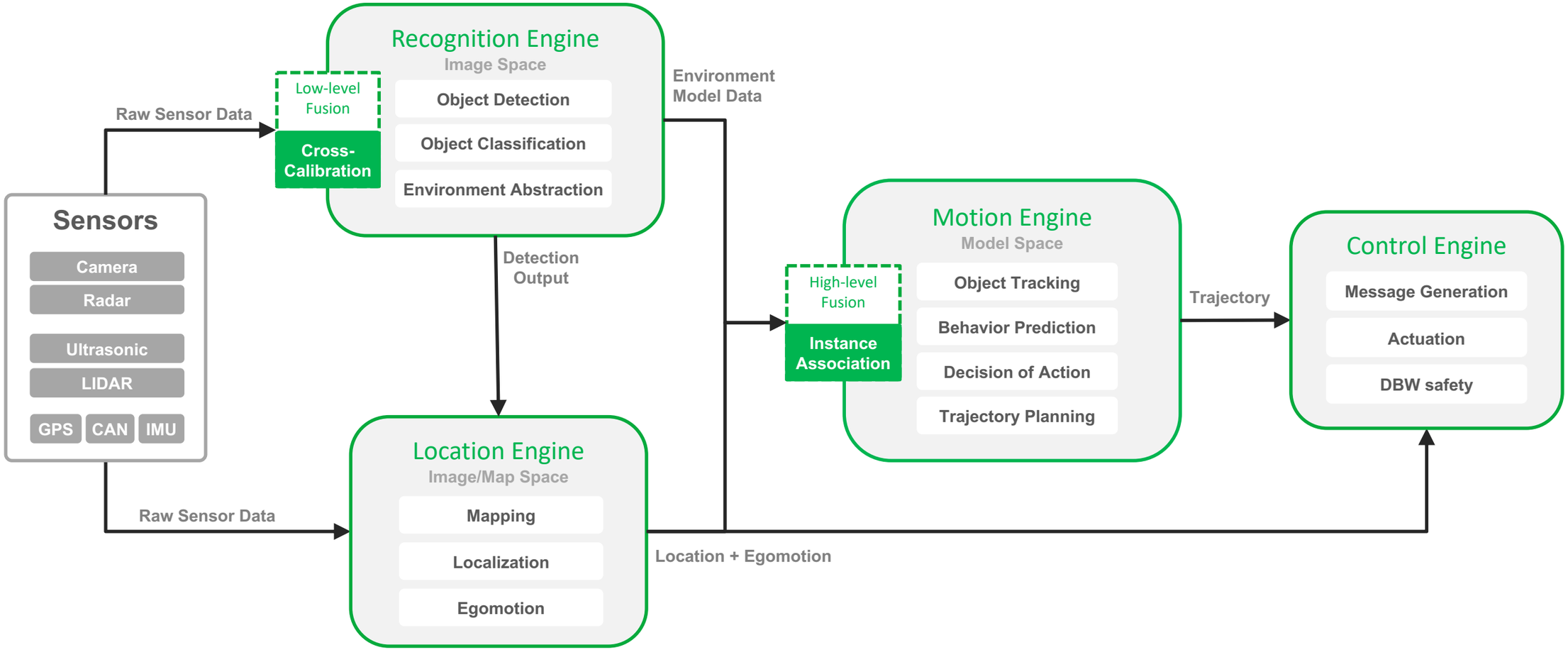
LIDARs – Light Detection and Ranging

1. Medium resolution
2. Active sensor, emits laser light
3. Very expensive
4. Capable os measuring distance
5. Limited ranges
6. Can have problems in bad weather, snow, rain

Ultrasonic sensors

1. Practically no resolution
2. Very short range
3. Cheap
4. Only a single distance
5. 8 m range
6. Works quite reliably

TYPICAL HIGH LEVEL ARCHITECTURE OF A SELF DRIVING SOFTWARE



AI BASED ENVIRONMENTAL RECONSTRUCTION, RECOGNITION

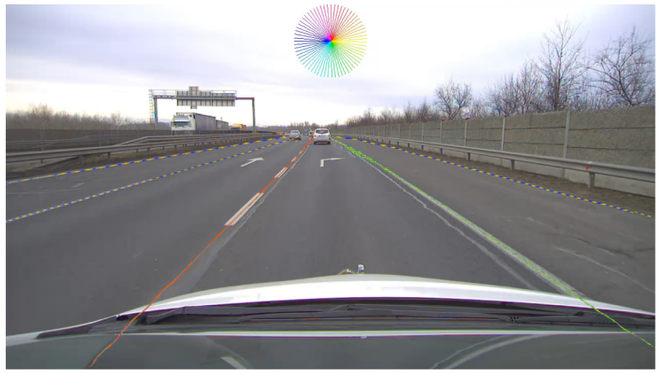
AI based solution for environmental reconstruction object detection and classification

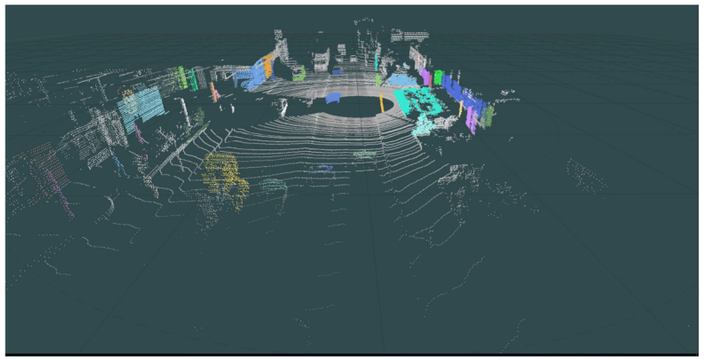
AI FOR OBJECT DETECTION AND CLASSIFICATION

1. AI is a must
2. Recognition solution must be data driven
3. Matter of fact that AI performs much better for sensor data processing than anything else
4. Sensor fusion is needed

OPEN QUESTIONS AND CHALLENGES

1. How to ensure training data diversity
2. How to verify AI based recognition solution
3. How to measure AI based object detection confidence
4. Computing issues
5. Is narrow AI sufficient ?

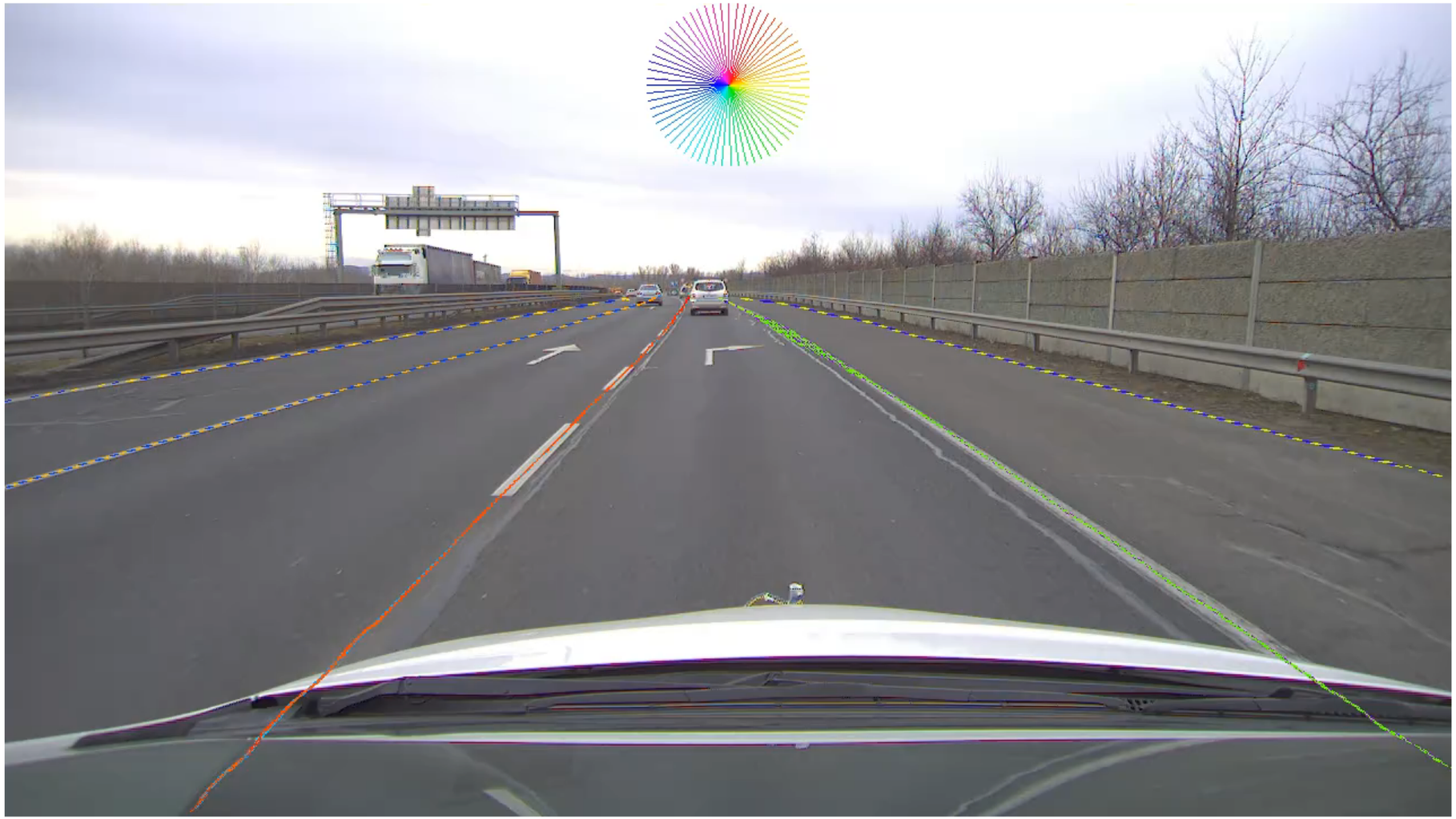




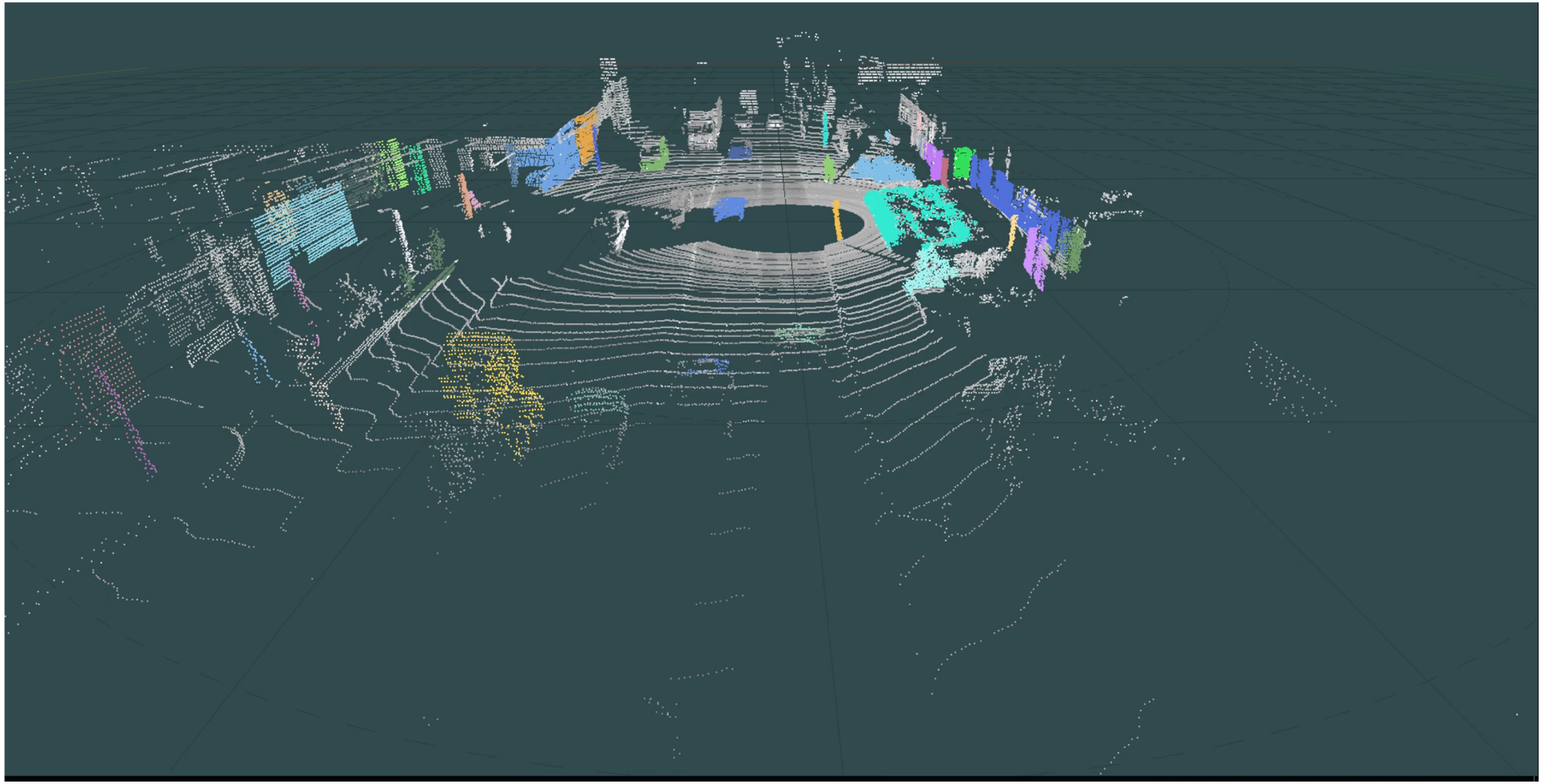
PWRCEPTION IN A CITY ENVIRONMNET

PWRCEPTION IN A HIGHWAY ENVIRONMNET

LANE DETECTION IN HIGHWAY ENVIRONMENT



AS LIDARS ARE SEEING THE WORLD



DECISION MAKING AND PATH PLANNING

Solving the complex problem of decision making in autonomous driving through AI-based motion planning.

DECISION MAKING PATH PLANNING

1. Predict behavior of surrounding objects
2. Make a decision
3. Plan the actions (trajectory, signals, etc) necessary for the decision

OPEN QUESTIONS AND CHALLENGES

1. How to verify AI used for decision making ?
2. On the fly verification of actions, decisions
3. Reproduction of situatiosn
4. Corner cases
5. Human – machine interactions

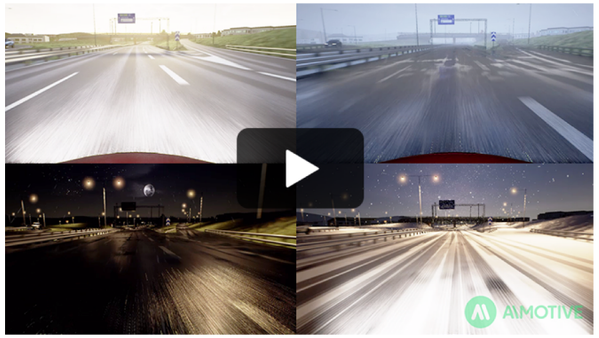
TRACKING AND DECISION MAKING

DECISION MAKING

SIMULATION ENVIRONMENT FOR DEVELOPMENT AND TESTING

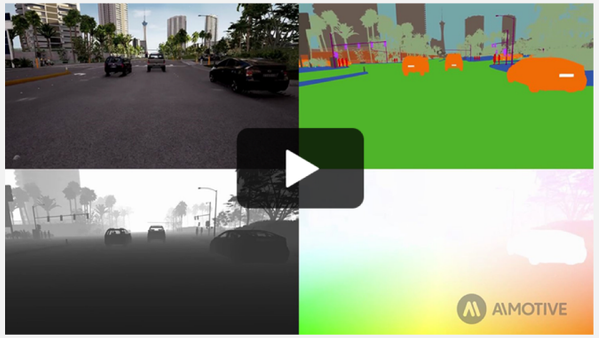
OVERVIEW

- Simulation is the only viable way of testing
- High fidelity reconstruction of environmental, sensor data and vehicle physics

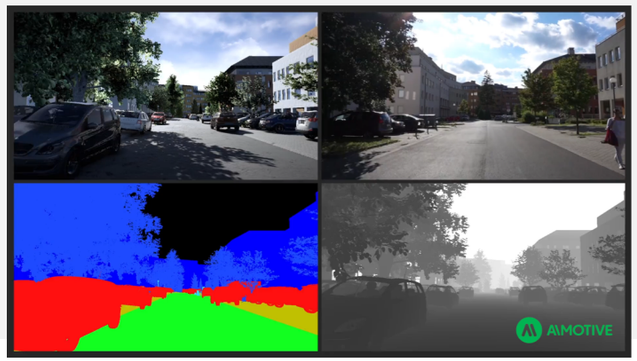


The SIMULATION CAN BE USED FOR

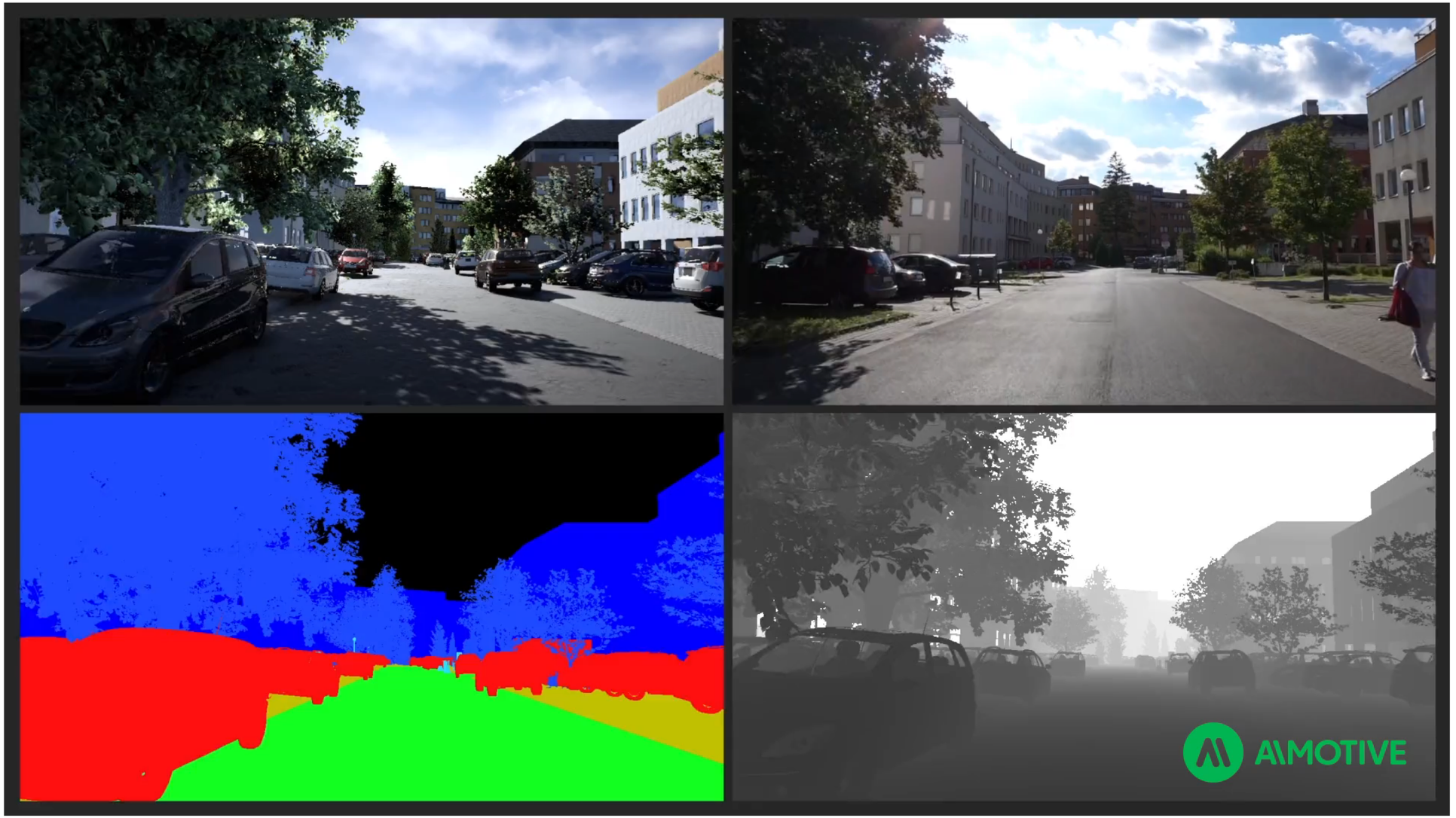
- Training data generation
- Situational testing
- Recognition testing
- Simulated sensor behavior
- Vehicle dynamics
- Corner cases
- Dynamically changing environmental conditions like rain, snow, direct sun, etc.



Sample outputs: Image, segmentation, optical flow, depth, lane markings



TESTING AND DEVELOPMENT IN SIMULATION



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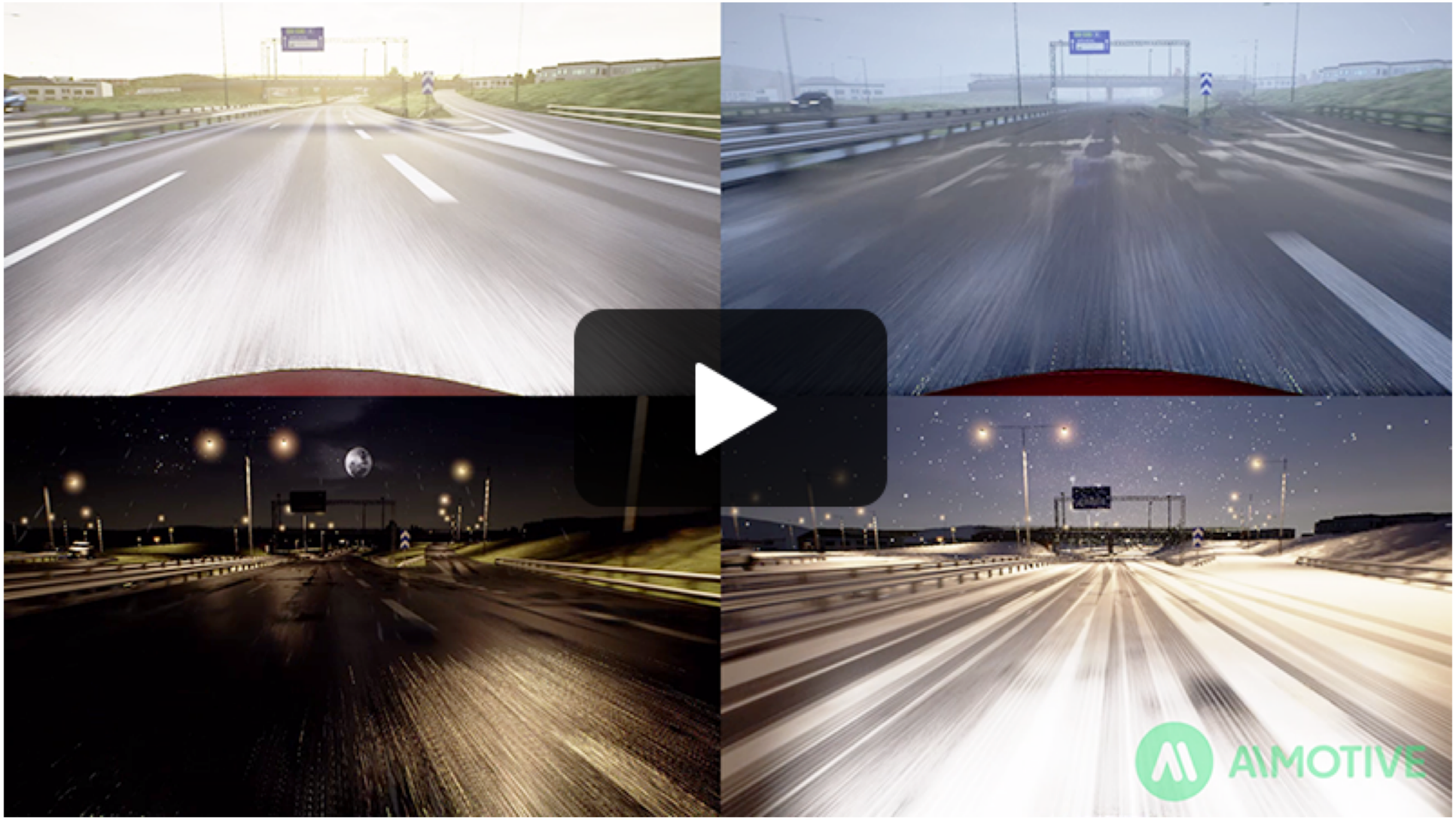

AND HOW IT WORKS IN THE CAR...