automotive engineering

Virtual validation of AD with physical multi sensor simulation in closed loop environments

IPG Apply & Innovate – TECH WEEKS 2020, 09/2020, Christian Heiduschke

Project HEAT

- Consortium: Hochbahn, IAV, Siemens and 4 other partners supported by German federal ministry
- Project duration from 2018-2021

- Safety and technology
- Customer acceptance
- Business models

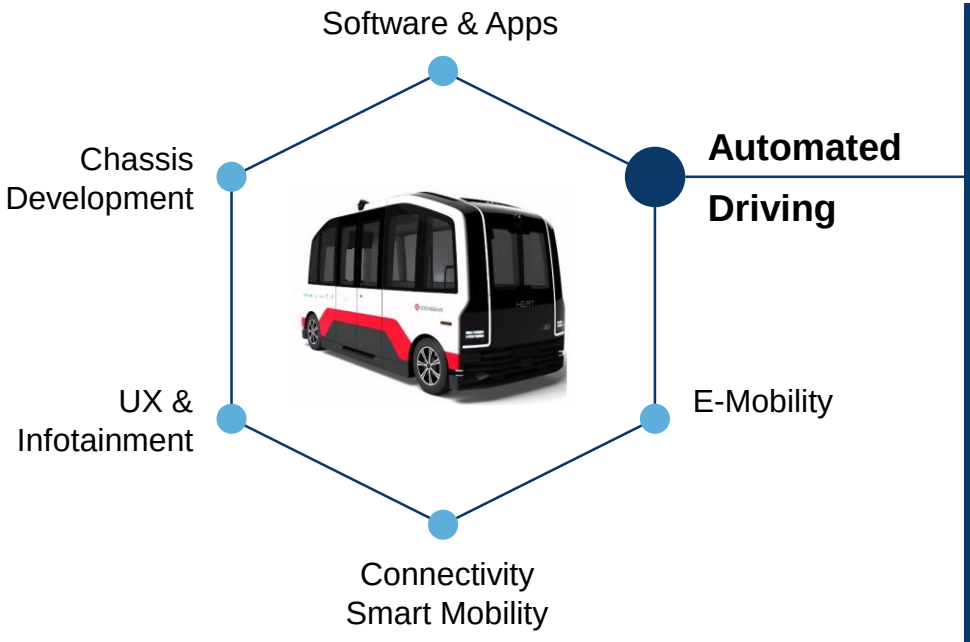
- On board: AD components
- Infrastructure: Sensors and digital communication
- Control center: permanent supervising

- Operation @ ITS world congress 2021
- 2km route on public roads with fixed stops in Hamburg Hafencity

Hamburg Electric Autonomous Transportation

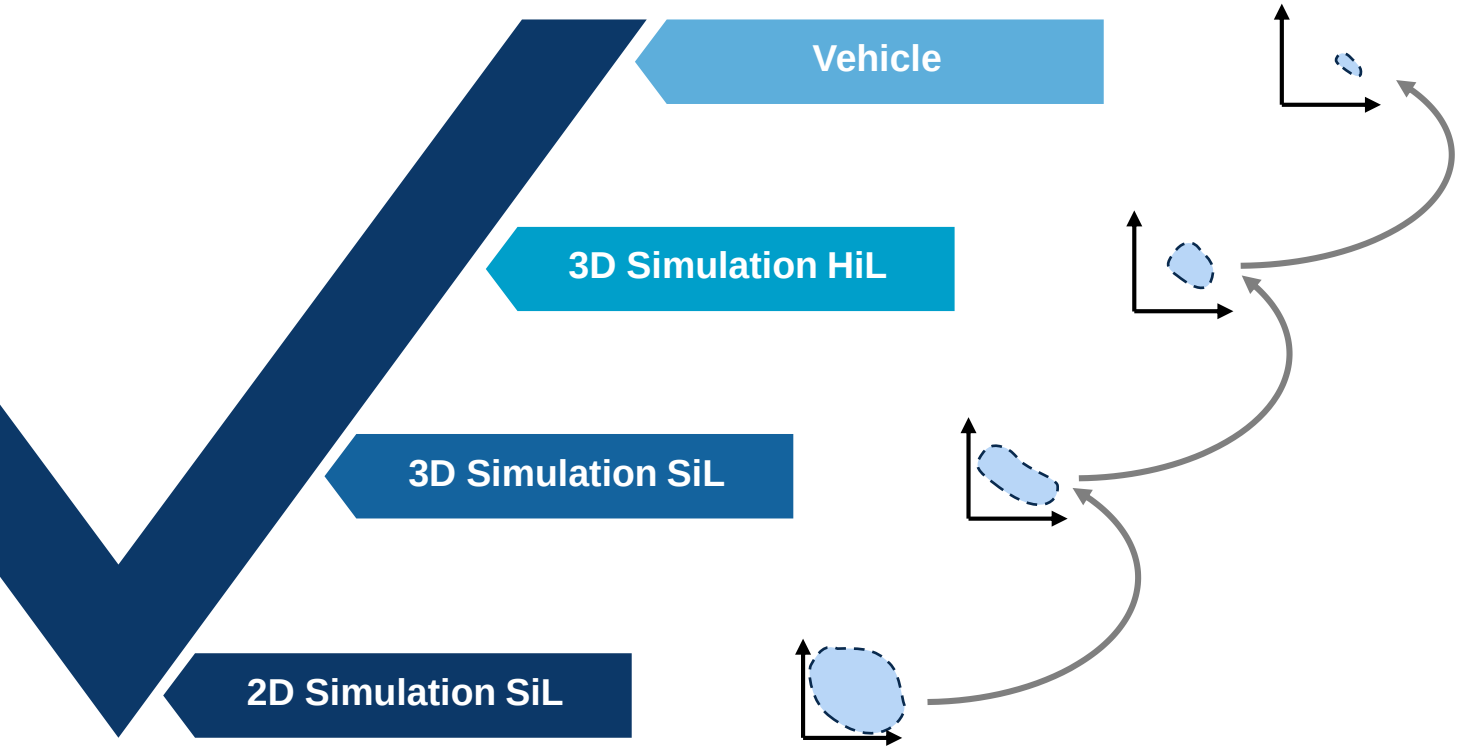
Project HEAT

automotive engineering iav



- Perception
- Planning (strategic, tactical, operational)
- Active Safety Layer
- Cooperative Driving
- Acting (longitudinal & lateral control)
- Concept and Function Development
- Validation
- Data Analysis
- Safety-related Development
- Homologation & Type Approval

HEAT validation strategy and test level



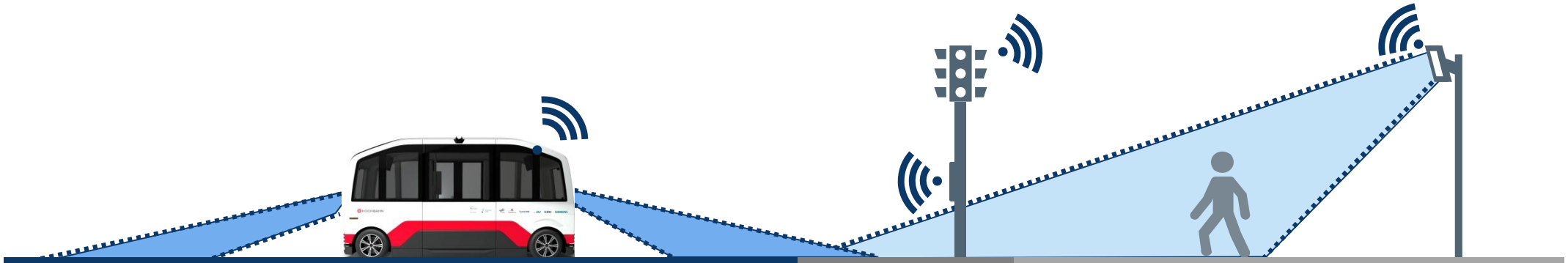
Double test approach:

- Scenario based
- Endurance run

Minimized effort for scenario based test at higher test levels:

- Parameter space analysis with DoE method (IAV CoMPASS algorithm)
- Maximized test scope at high scalable test environments

HEAT sensor setup



4x 150° Areaview camera

1x 48° Frontcamera

5x Long range radar

1x 360° 40-channel LiDAR

8x 360° 16-channel LiDAR

Communication:

- Traffic lights
- Control center
- …

LiDAR and radar sensors positioned along the track

HEAT simulation environment

Sensor models

Requirements:

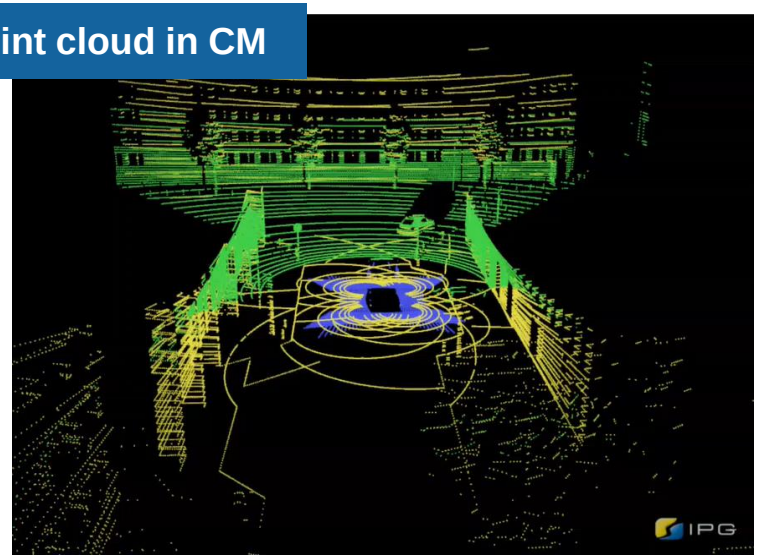
- Physical sensor modelling for Radar, Camera and LiDAR
- Compute raw data parallel and in real time

Approach:

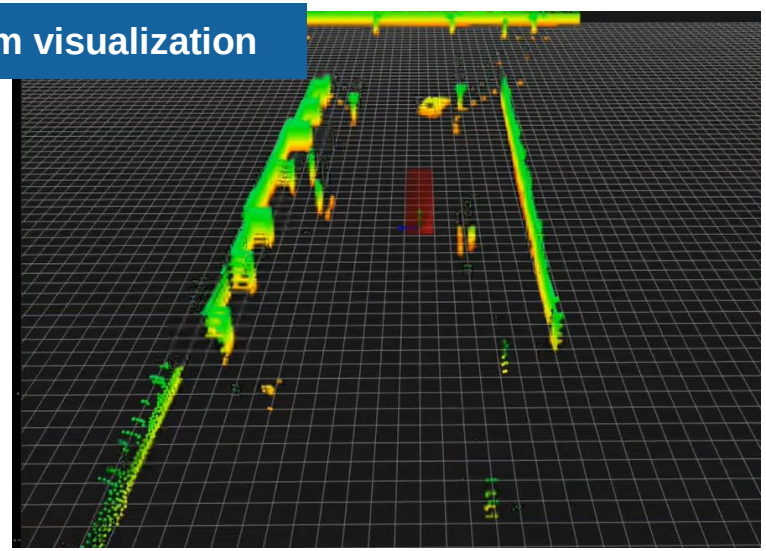
Modeling of several complex sensors in one environment

- 1x LiDAR RSI with 40 channels (discontinuous)
- 8x LiDAR RSI with 16 channels
- 5x Radar RSI
- 4x Camera RSI
- 1x Camera HiFi Sensor

LiDAR point cloud in CM



AD system visualization



HEAT simulation environment

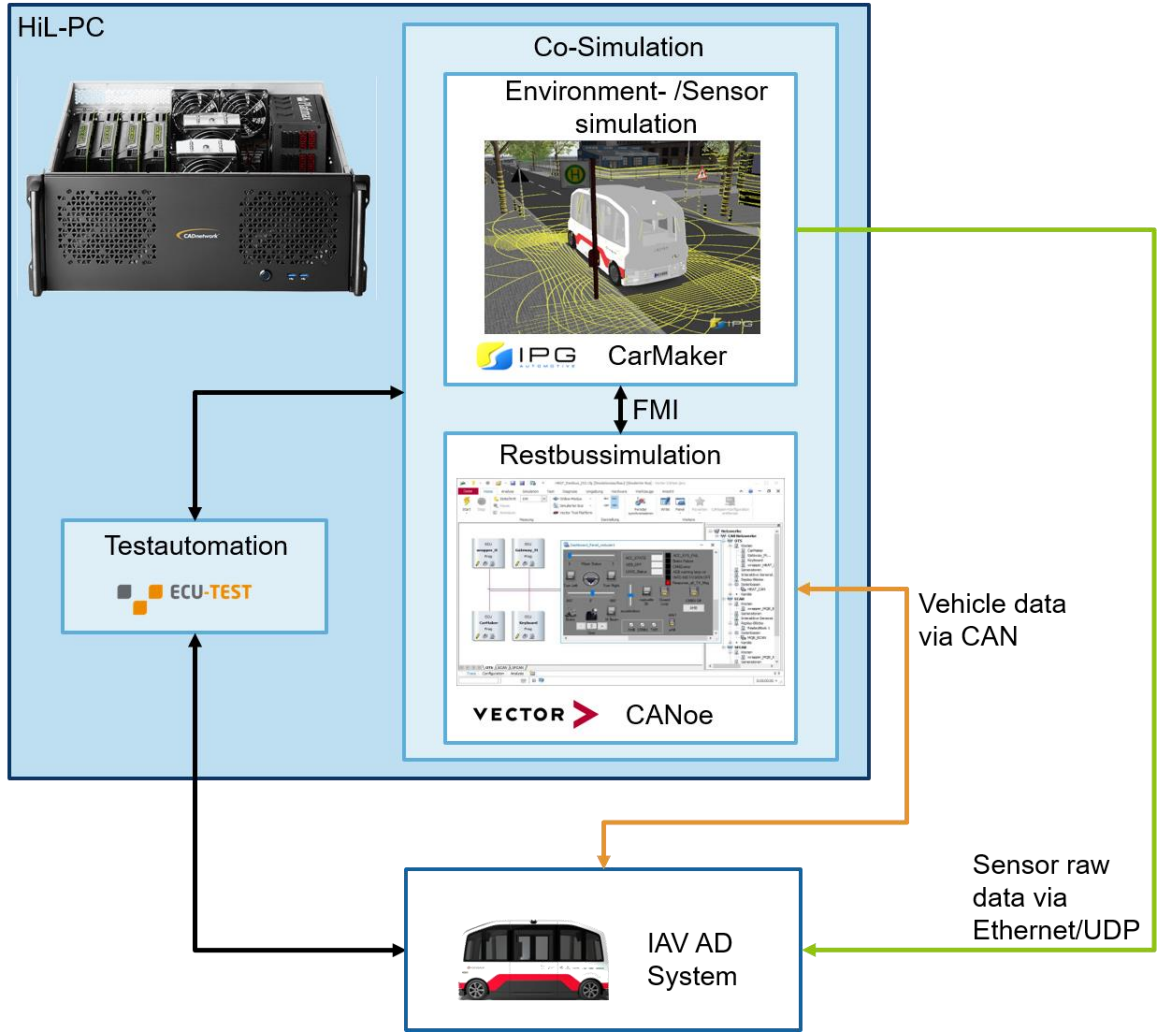
HiL setup

Requirements:

- Sufficient CPU/GPU performance for parallel computation
- Real-time system for closed loop test
- Affordable setup – base for scaled test resources

Approach:

- Windows based system with high performance CPU
- Parallelization of sensor simulation by use of 4 high performance GPU
- Co-Simulation with Canoe and closed loop setup



HEAT simulation environment

Digital road network

Requirements:

- High adaptable road network for scenario based validation/verification activities
- High precise Hamburg road network for endurance runs

Approach:

Flexible - Road network as complex as required

- Generic CarMaker road networks
- High precision CarMaker Hamburg road network from HD maps

Highly adaptable generic road

Highly complex HD road network

IAV AD @ HEAT

Virtual validation on HEAT track 2020 in CarMaker:

Validation activities @ Hafencity:

HEAT achieved milestones and prospects

Simulation environment for validation of HEAT AD function

- Physical simulation of all sensor data in parallel

Highly adaptable test environment

- Generic connection enables fast adaption to other projects

Affordable HW/SW setup

- Cost-efficient validation of large test scopes

Q3/2020

Extend sensor simulation

- Models for V2X and LiDAR/radar infrastructure sensors

Automated HD maps

- Generation of road networks by HERE HD maps

Microscopic traffic simulation

- Complex microscopic simulation of all traffic participants

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