Hochschule für Technik und Wirtschaft Dresden
University of Applied Sciences

Laboratory of Automotive Mechatronics

2. FAMNIT/HTWD-Hackathon
AI in Automotive

FAMNIT (Koper): 15-18.09.2025
HTWD (Dresden): 22-26.09.2025

Prof. Dr. Branko Kavšek
University of Primorska

Prof. Dr. rer. nat. Toralf Trautmann
University of Applied Sciences Dresden

HTWD Hochschule für Technik und Wirtschaft Dresden University of Applied Sciences

Laboratory of Automotive Mechatronics

Mechlab

Schedule

- University and Mechlab-Laboratory
- AI in Automotive
- Task description and project partners
- Discussion and task selection
- Programming…

17.09: 2.30pm → Prefinal-Presentation
18.09: 3.30pm → Final-Presentation

HTWD Hochschule für Technik und Wirtschaft Dresden University of Applied Sciences

Laboratory of Automotive Mechatronics

University and Mechlab-Laboratory

The HTWD

163
Professors

40+
Degree programmes

4800
Students

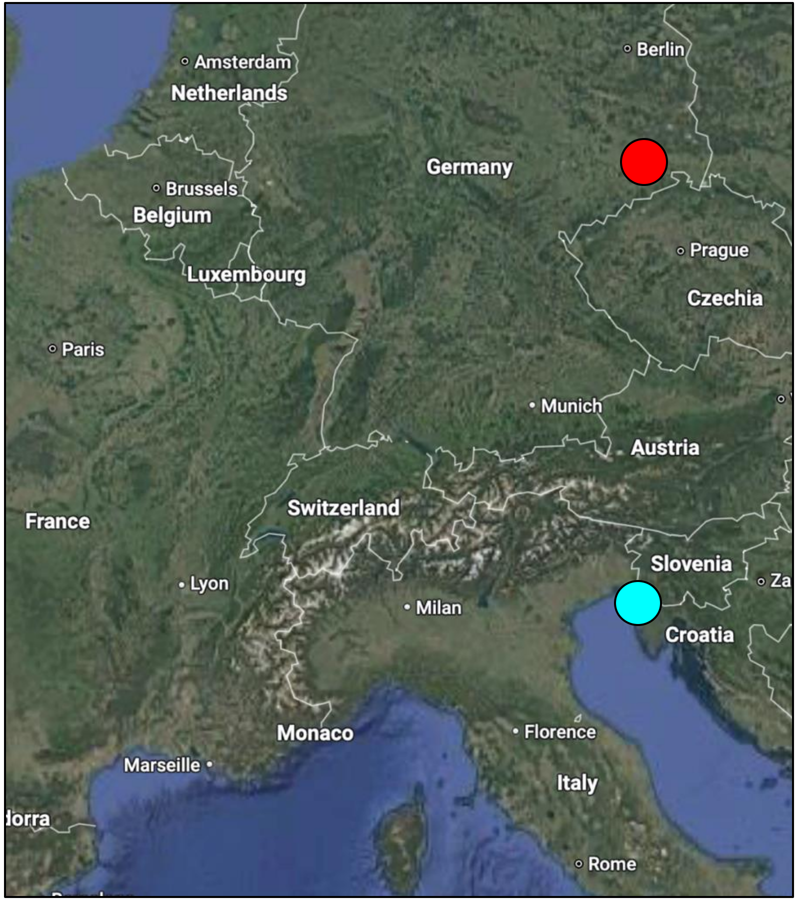
2
Campuses: Dresden-City und Pillnitz

10
Percent international students

18
Mio. Euro third-party funding income in 2022

Founded

150+
International university partners



Mechlab – Head and stuff

Prof. Dr. rer. nat. Toralf Trautmann (Physicist)

1967:	born in Zella-Mehlis (Free State of Thuringia),
1995 - 2000:	PhD research at Freiberg University of Technology, Thesis: „Radioluminescence of Feldspar“
2001 - 2005:	Development Engineer Robert-Bosch-GmbH, Schwieberdingen
since 2005:	Professor of Automotive Mechatronics (HTWD)

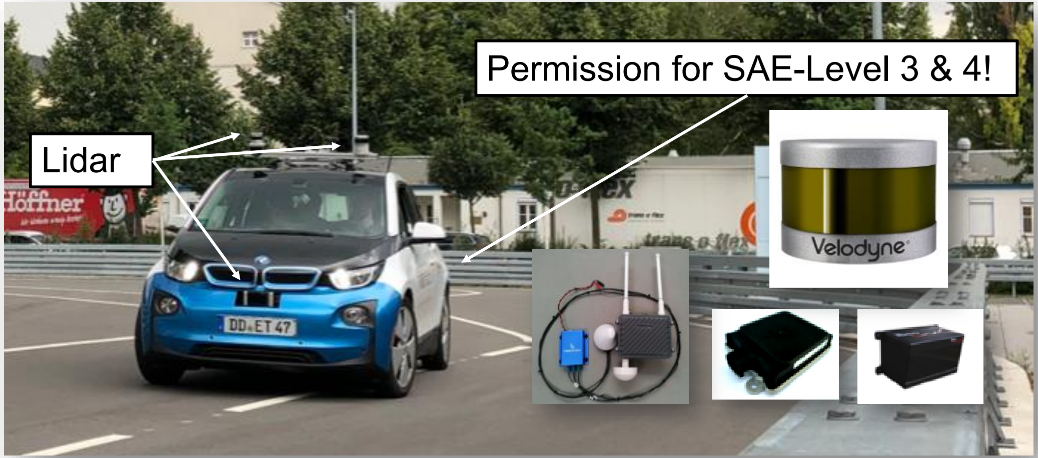
Research/Education:

- Development and test of advanced driver assistance systems,
- Surrounding sensors (**Lidar**, Radar, Camera) and data fusion,
- **Type approval process for autonomous vehicles**,
- Software development and prototyping using Matlab/Simulink.

Stuff:

- 1 lecture assistant and 3 full time research assistants
- 3 student workers (automotive engineering)
- 1 guest student (Vietnamese-German University VGU)

Equipment and partners



Partners:
- tracetronic GmbH
- FSD Fahrzeugsystemdaten GmbH
- GTÜ GmbH
- Fraunhofer Research Institute
- Accident Research Institute
- Mercedes-Benz AG
- Dewesoft d.o.o. (Slovenia)

Universitys:
- TU Dresden
- University of Primorska (Slovenia)
- Univ. of the Balearic Islands (Spain)

- Different test cars (Skoda Enyaq, MB EQE, VW ID.7)
- Autonomous Shuttle (EasyMile EZ10)
- Matlab with all toolboxes
- Lidars: Velodyne, Ouster, Livox, LS-Lidar (1550nm), OPSYS
- Radar: Continental SRR & LRR
- Spot® - The Agile Mobile Robot (Boston Dynamics)

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Laboratory of Automotive Mechatronics

AI in Automotive

- Requirements for autonomous vehicles (Germany)
- Prototype of test procedure
- Use and evaluation of AI

General Description of the ADS

A description must be provided that includes a simple explanation of the ADS's operating characteristics and ADS functions.

...

Description of the ADS's Functions

A description must be provided that explains **all functions**, including the control strategies that ensure **robust and safe operation** of the ADS, as well as the methods for executing dynamic driving tasks within the ODD and the **limits** to which the automated driving system is designed, along with a description of how this is ensured.

...

A list of **all input and measurement variables**, specifying their defined scope, must be provided, along with a description of **how each variable affects** the ADS's behaviour.

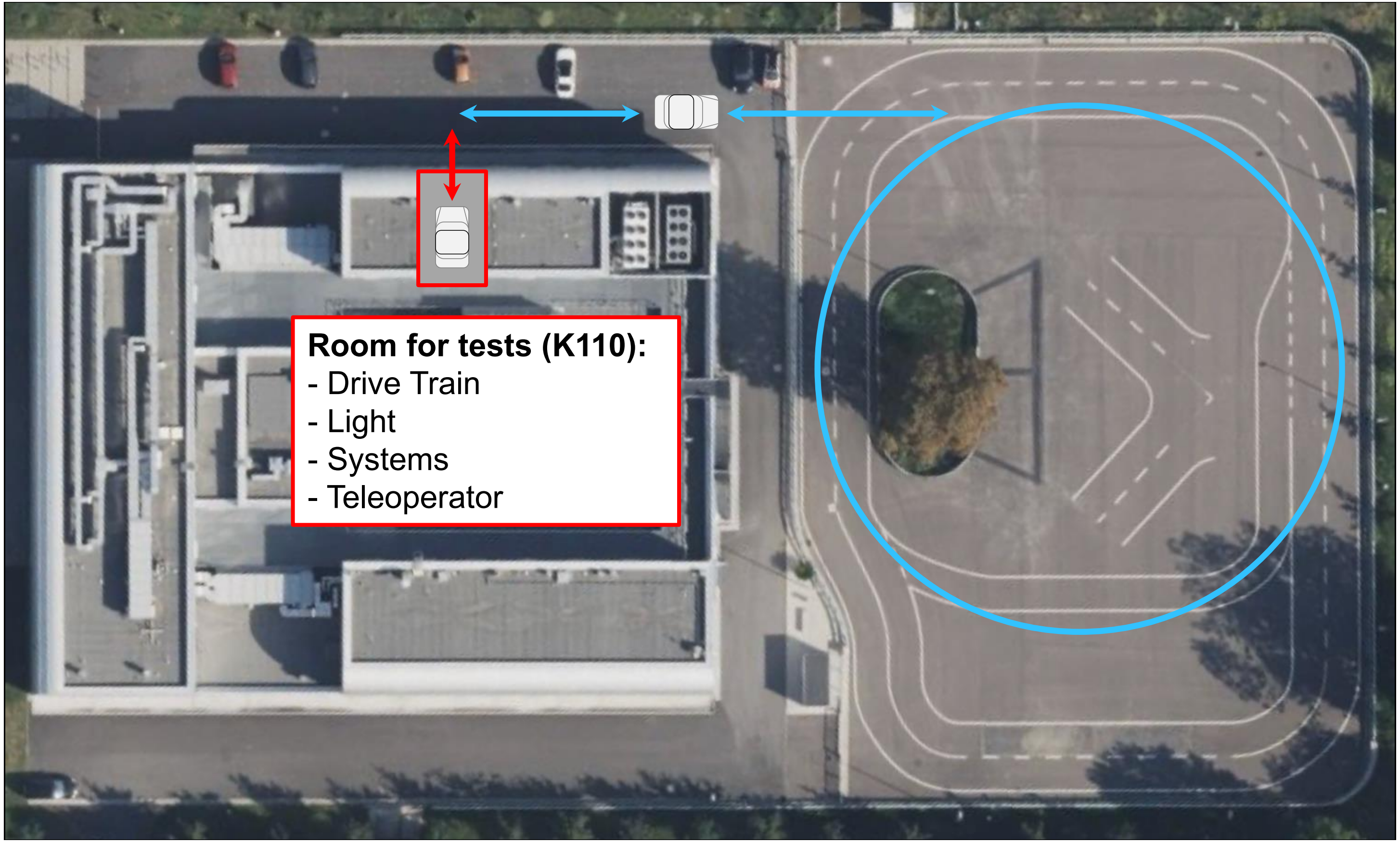
...

Obligations for owners of vehicles with autonomous driving functions:
Extended daily pre-operation checks before commencing operation

1. **Test drive to activate the systems!**
2. Subsequent inspection of:
   1. Braking system,
   2. Steering system,
   3. Lighting system,
   4. Tires/wheels,
   5. Chassis,
   6. Safety-relevant electronically controlled vehicle systems as well as sensors for recording external and internal parameters and
   7. Mechanical vehicle systems for active and passive safety.

The vehicle must undergo a **general inspection** every 6 months.

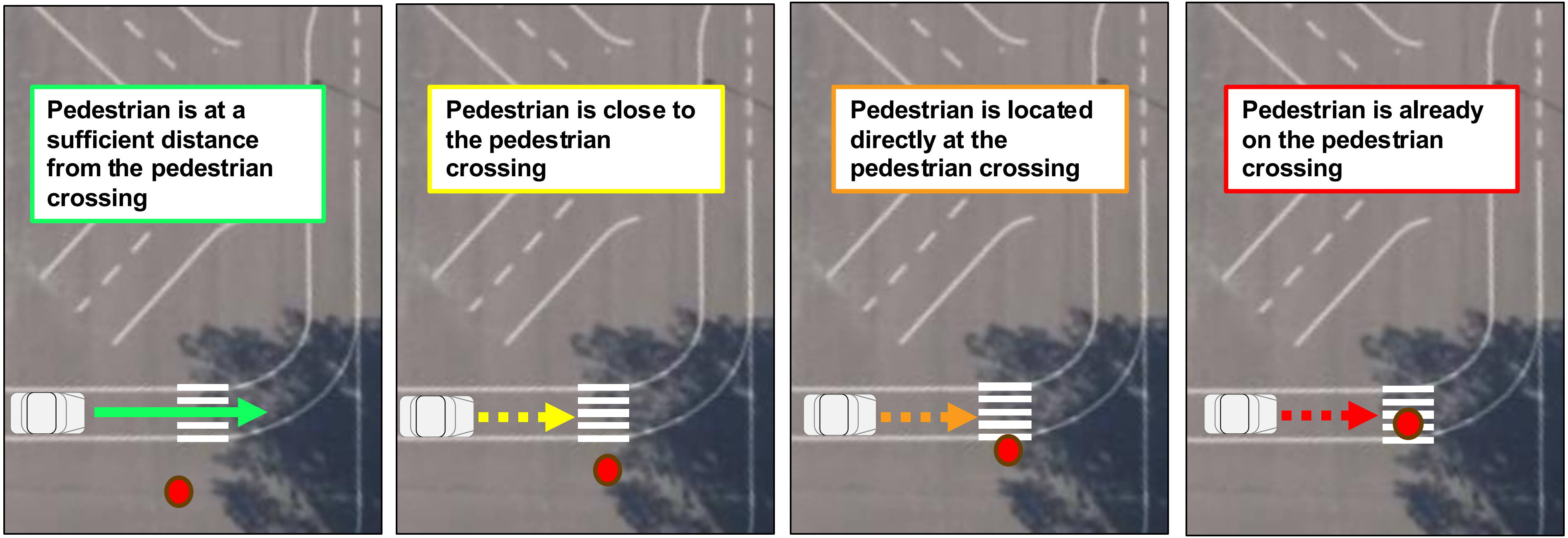
HTWD test area - Overview



Test drive for activation :
- Sensors
- Brake
- Damper
- AEB

Automated emergency braking (AEB) – Test cases

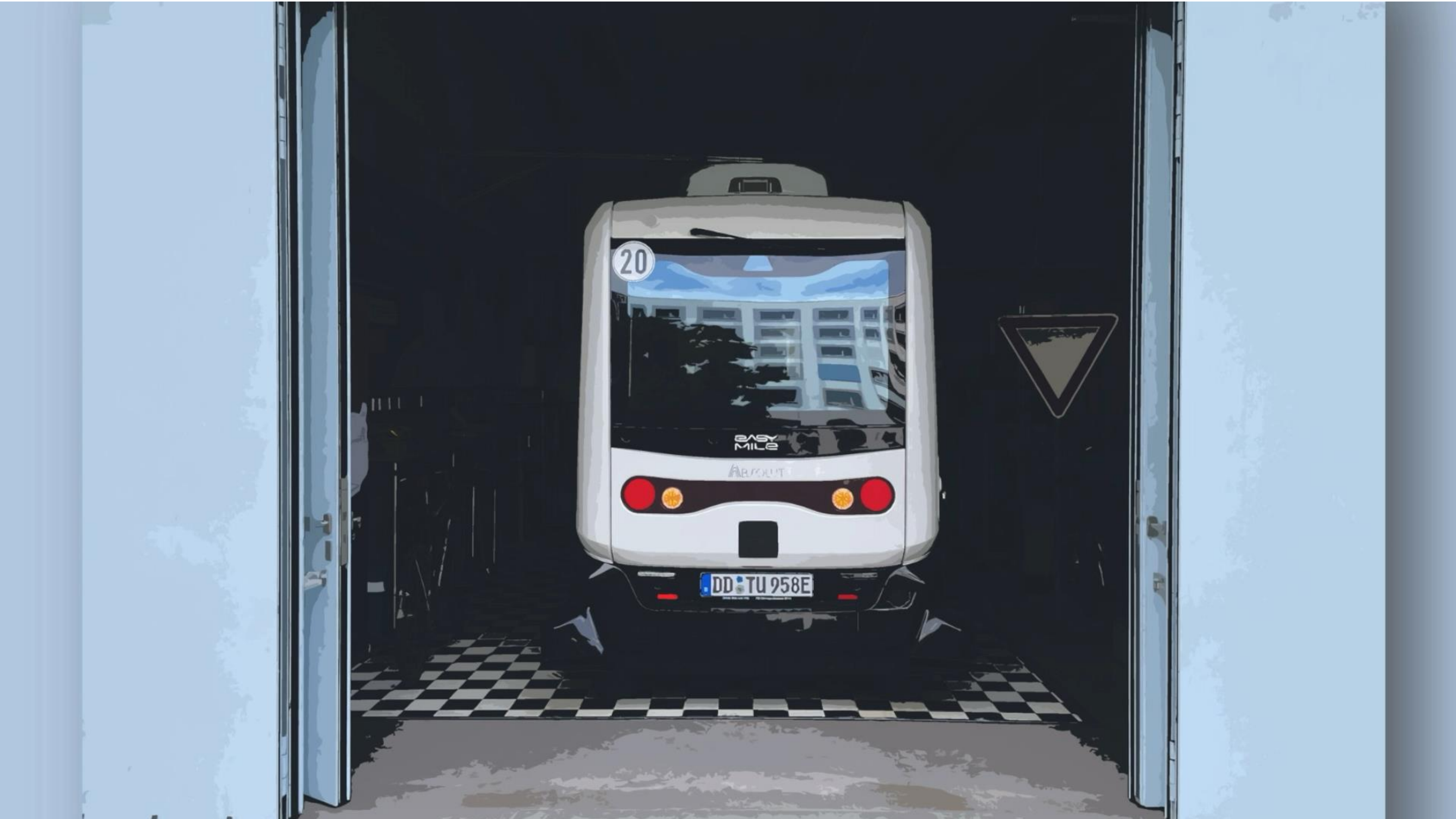
Passing | Warning | Partial braking | emergency braking



- 4 situations with different reactions
- Determination of precise test parameters is necessary
  - Distances, speed of Car and Pedestrian
- If time is limited, only test the most important situations

1. Problem:

→ NO test with real people!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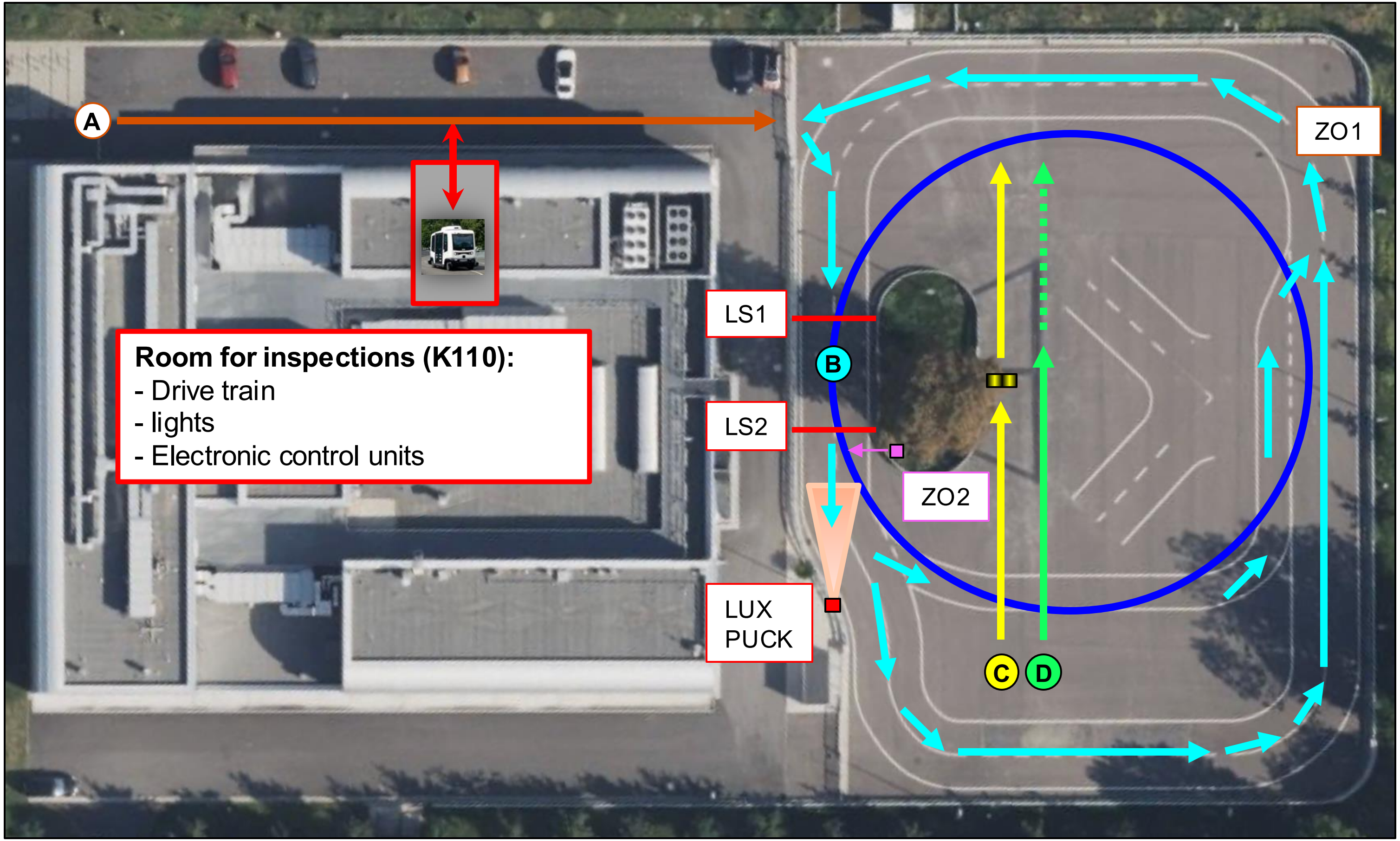
HTWD test area - proposed test procedures



Test cases

Nr.	Measured quantity	Remarks	External sensors	Start
1	Target detection (ZO1)	e.g. traffic signs detected by Lidar and Camera		A
2	Time to GNSS-Fix			K110
3	Deviation starting position		Lidar (Puck, Livox)	B
4	Passage speed	Use circular drive	Lidar (Lux, Puck), light barrier	B
5	Emergency brake (ZO2)	**At least 3 situations:** passing, braking, swerving	Lidar (Lux, Puck), light barrier	B
6	Threshold crossing		PTI-Adapter	C
7	Reference braking		PTI-Adapter	D
8	Stationary circular drive		PTI-Adapter	B
9	Server latency	Testing data transfer to a server		

Need for reliable traffic sign recognition:

- Intelligent Speed Assistance (ISA) is mandatory for new vehicles in EU
  - for type approval, recognition of 90% of speed signs is sufficient
  - the diversity of variants in the EU presents a particular challenge
  - automatic use as new set speed in Adaptive Cruise Control (ACC)

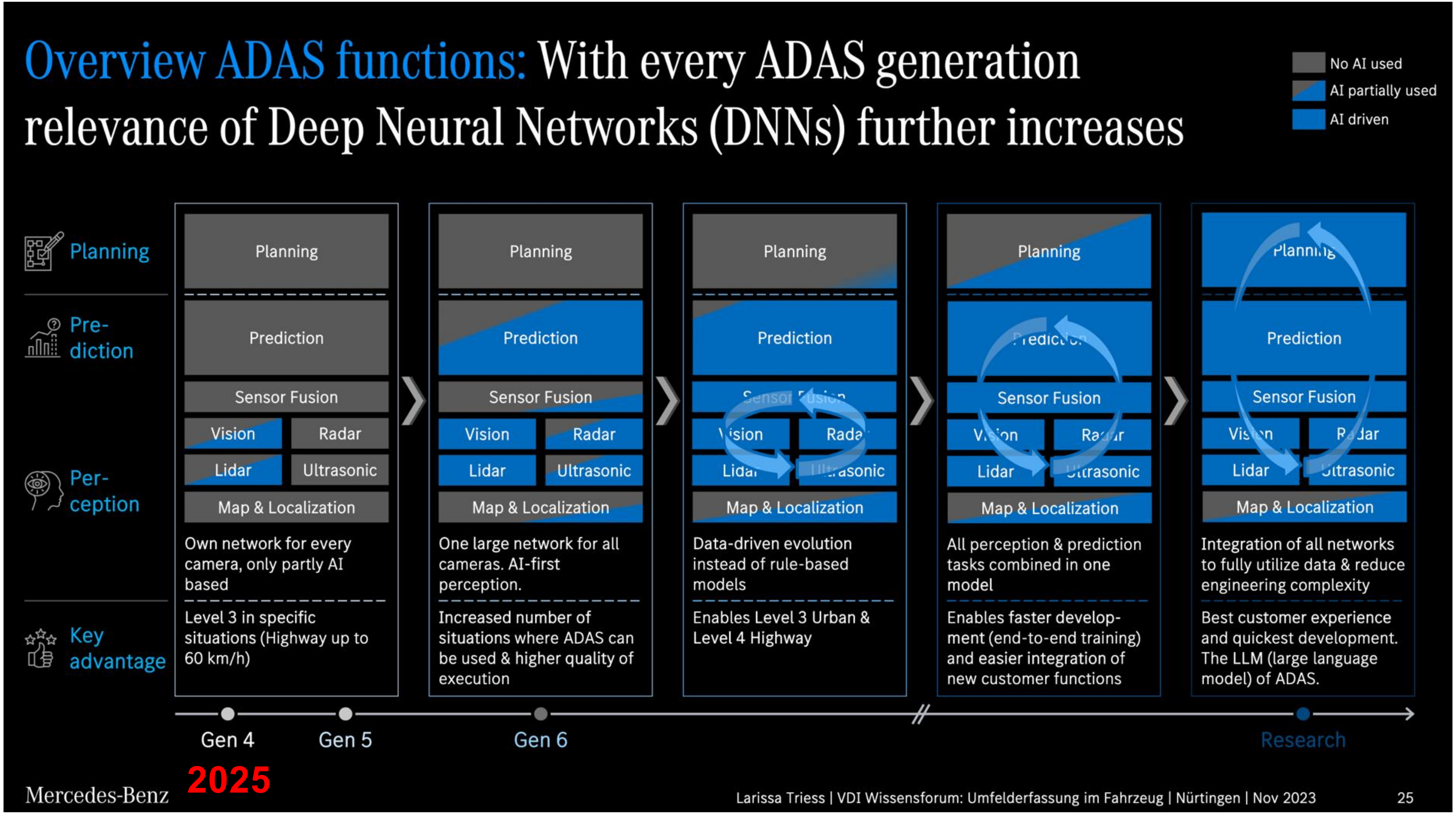
- Various manufacturers offer additional functions:
  - Tesla: Stop- and Traffic Light Assistance (Full Braking)
  - Mercedes: Pedestrians at zebra crossings can be recognised (Warning)

Limitations (e.g. Hyundai):

Intelligent Speed Limit Assist may not operate properly, or it may operate unexpectedly under the following circumstances:

- The road sign is contaminated or indistinguishable
- The road sign is difficult to see due to bad weather, such as rain, snow, fog, etc.
- The road sign is not clear or damaged
- The road sign is partially obscured by surrounding objects or shadow
- The road signs do not conform to the standard
- The text or picture on the road sign is different from the standard
- The road sign is installed between the main line and the exit road or between diverging roads
- There is no conditional road signs on the road sign located on the exit road
- A sign is attached to another vehicle
- The distance between the vehicle and the road signs is too far
- The vehicle encounters illuminant road signs
- Intelligent Speed Limit Assist incorrectly recognises numbers or pictures in the street signs or other signs as the speed limit
- A road sign near the road you are driving is detected
- The other traffic sign or signboards are alongside the road sign
- Multiple signs are installed close together
- The minimum speed limit sign is misrecognised
- The minimum speed limit sign is on the road
- The light level changes suddenly, for example when entering or exiting a tunnel or passing under a bridge
- Headlamps are not used, or the brightness of the headlamps are weak at night or in the tunnel
- Road signs are difficult to recognise due to the reflection of sunlight, streetlights, or oncoming vehicles
- The navigation information or GPS information contain errors.
- The driver does not follow the guide of the navigation.
- The driver is driving on a new road that is not in the navigation system yet.
- The field of view of the front view camera is obstructed by sun glare
- Driving on a road that is sharply curved or continuously curved
- Driving through speed bumps, or driving up and down or left to right on steep inclines
- The vehicle is vibrating heavily
- Driving on a newly opened road
- The navigation software is being updated whilst driving
- The navigation is restarted whilst driving

Use of AI in Automotive (e.g. Mercedes-Benz Research)



Education:

- Use of different Algorithms/Networks as an introduction for student
  - Self training of ACF-Detector for yield signs
  - Use of Yolo v4 (Matlab) and Yolo v12 (Linux/ROS) in practical exercises
  - The main objective is the **critical evaluation** of the results

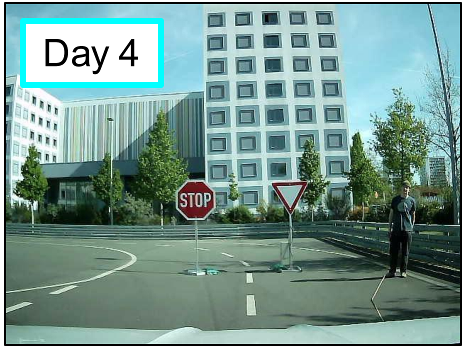
Research:

- Extension of the tracetronic software ecu.test for automatic evaluation of AI
- Use of an additional sensor (e.g. Lidar) to automatically generate an independent reference
  - can also be used for automated labelling of big data

Example – Education (1)

Stop-Sign Detection with Yolo v4:

- 5 different distances at 4 different test days (different colors)
- each recording 10 images at each distance
- Evaluation of recognition value (%) and sign height (pixels)



Example – Education (2)

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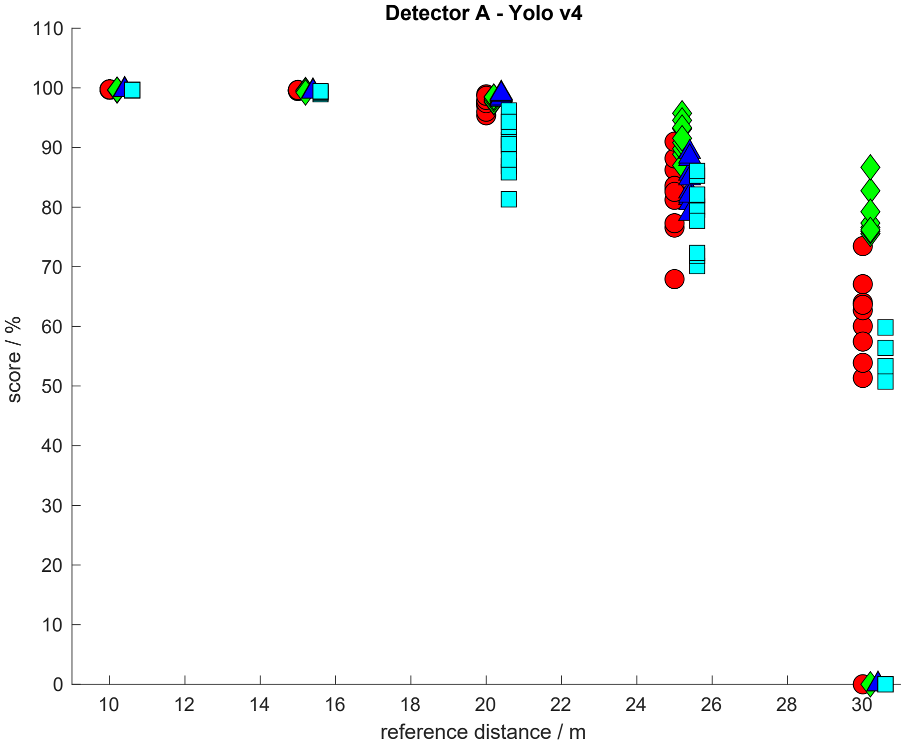
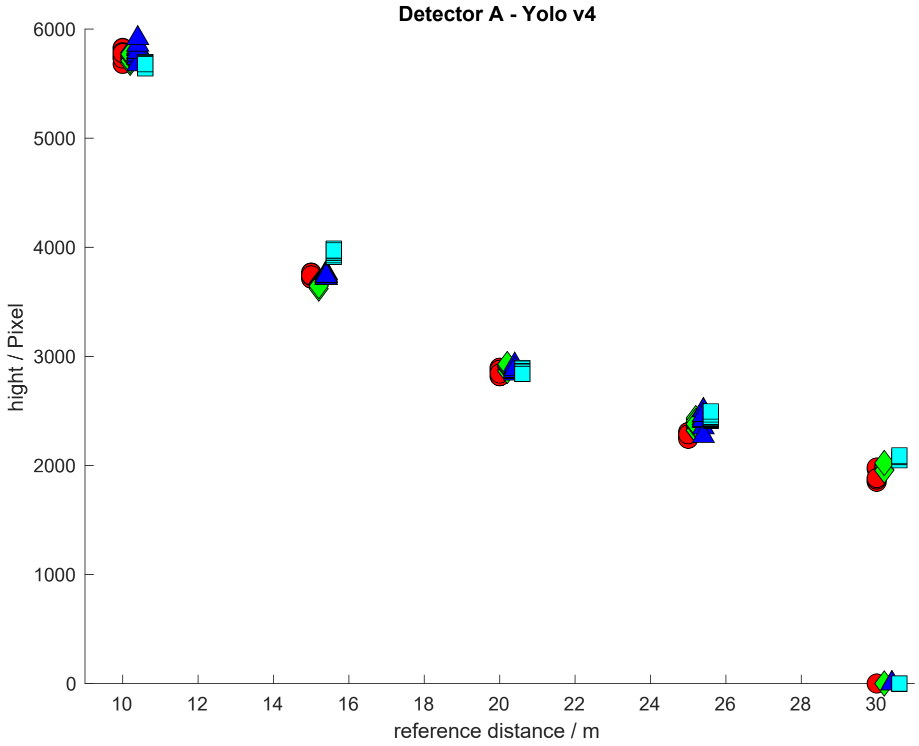




Matlab ACF-Detector:

→ 8 Groups with identical 40 images for training

→ Differences lie only **in the labelling** of the images!



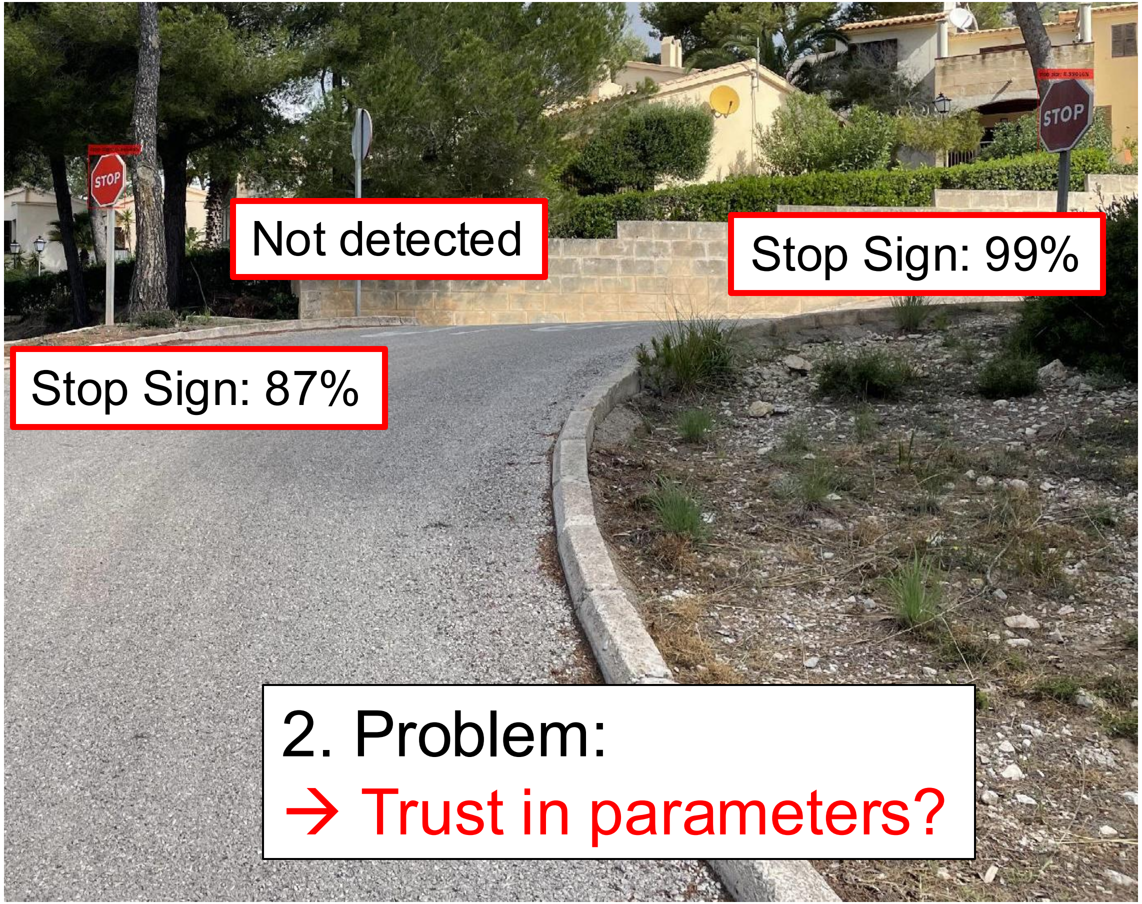


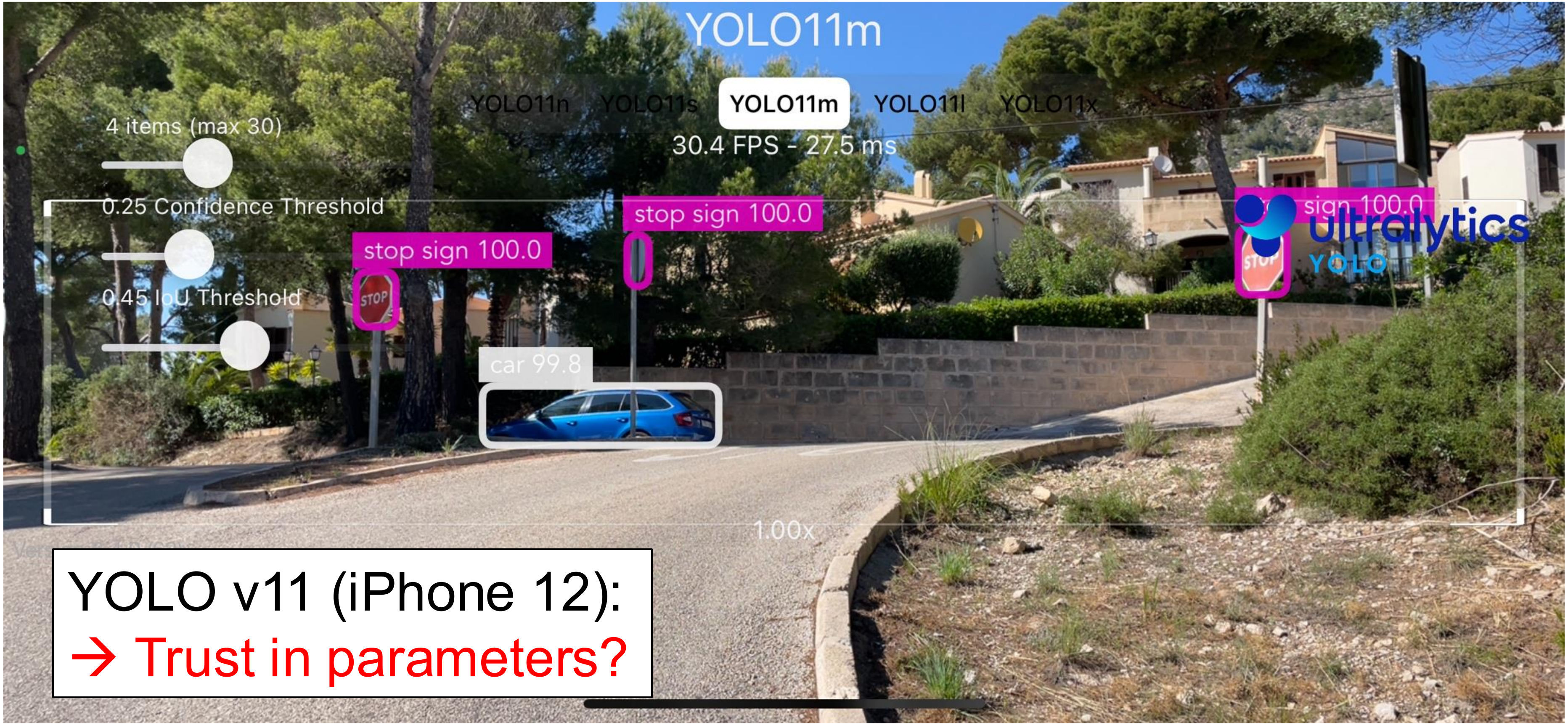



Example – Mallorca (1)

Example – Mallorca (2)

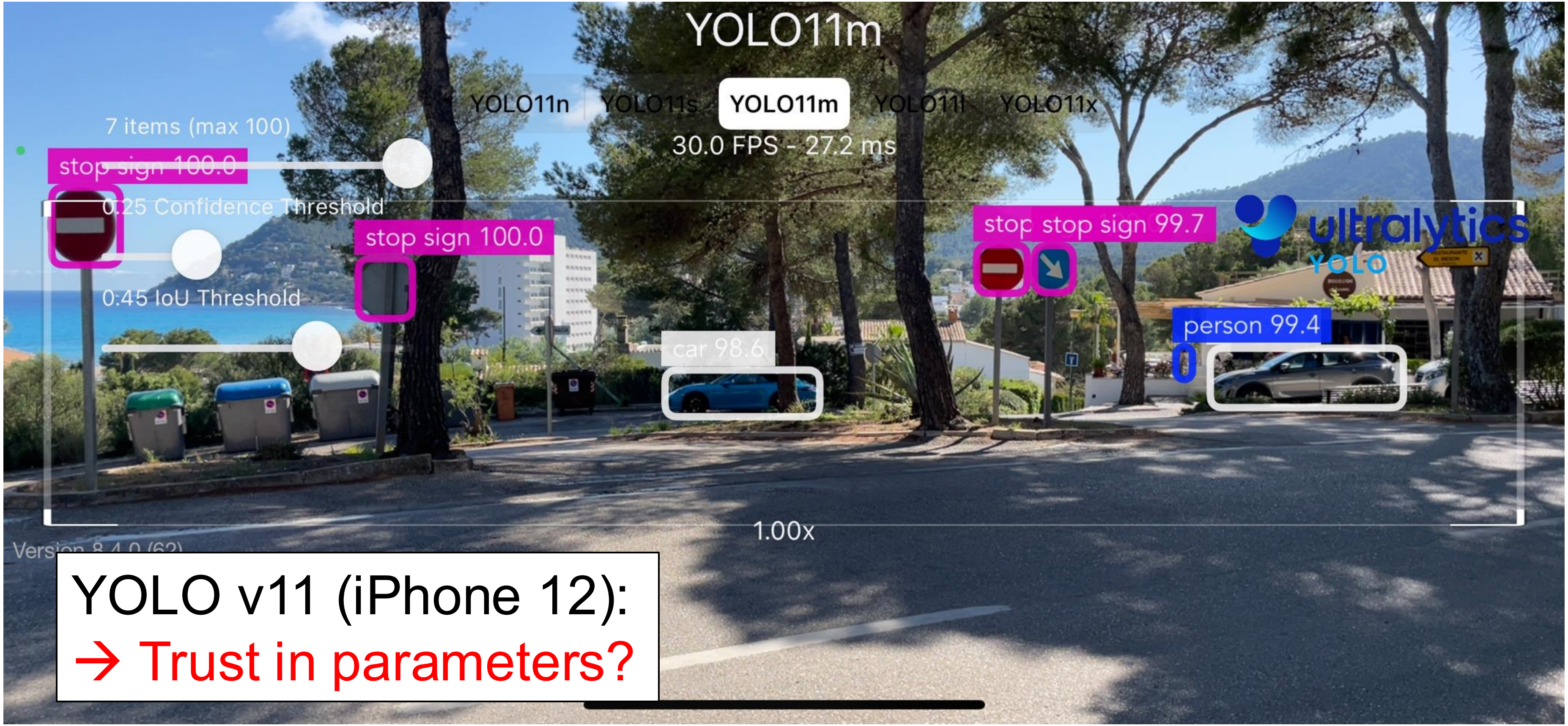
Example – Mallorca (3)





YOLO v11 (iPhone 12):
→ Trust in parameters?

Example – Mallorca (5)



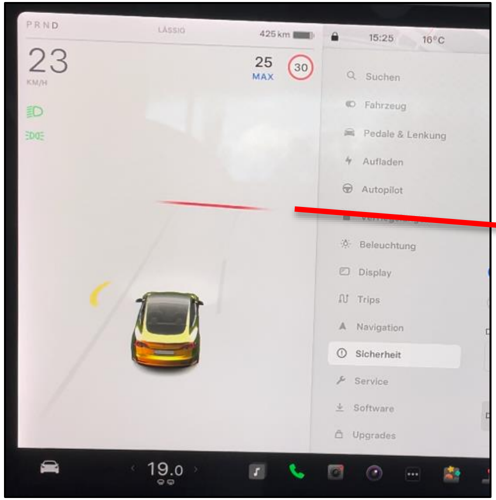
YOLO v11 (iPhone 12):
→ Trust in parameters?

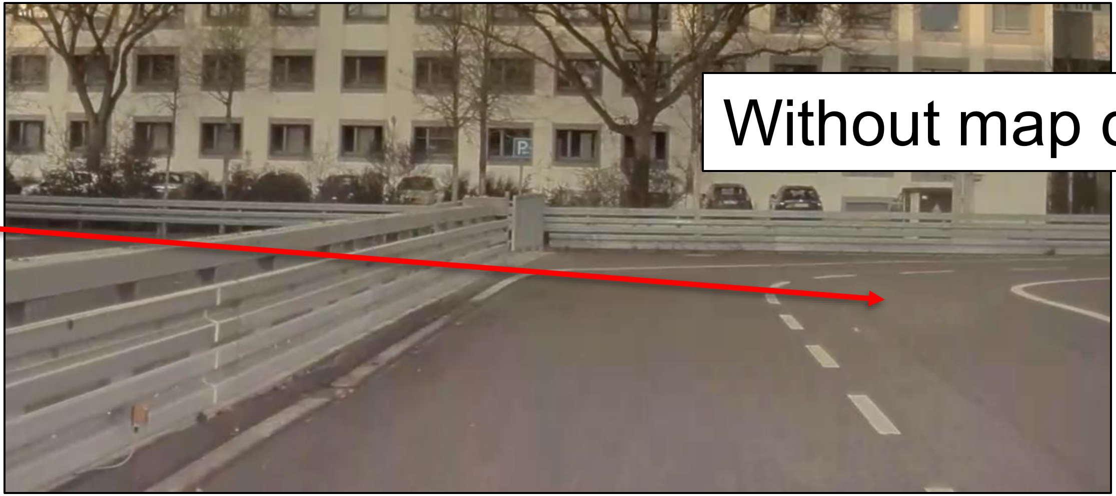
Tesla Model 3 (1)

End of T-junction

If Model 3 detects a T-junction based on the map data, Model 3 slows down and comes to a complete stop at the red stop line displayed on the touchscreen. When you want to proceed, you must take over steering and acceleration.

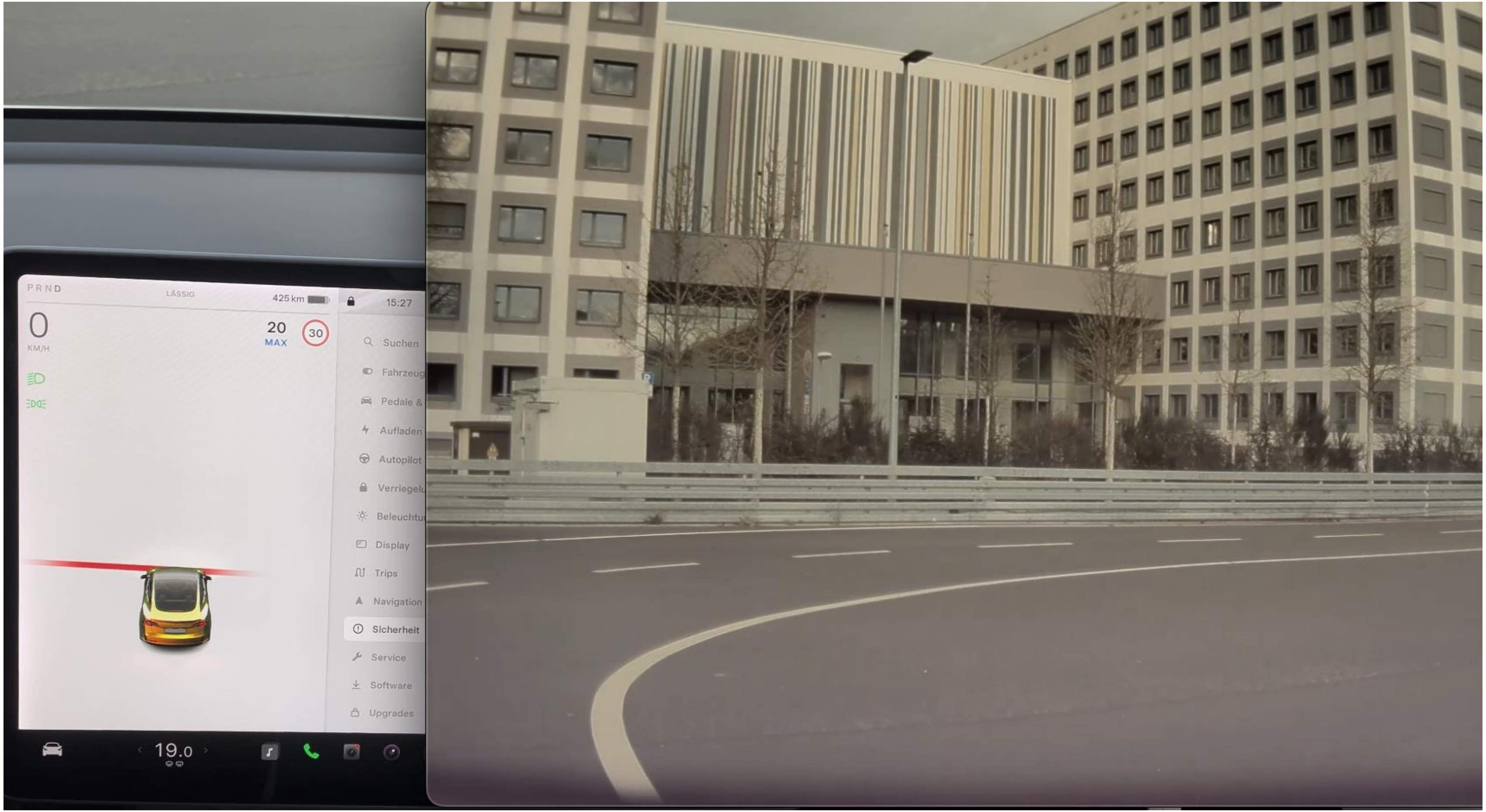
> **WARNING**
> Model 3 may not stop at a T-junction that does not have a stop sign or stop line, or if the T-junction is not included in the map data. Drive attentively and be prepared to stop (when necessary and/or appropriate).

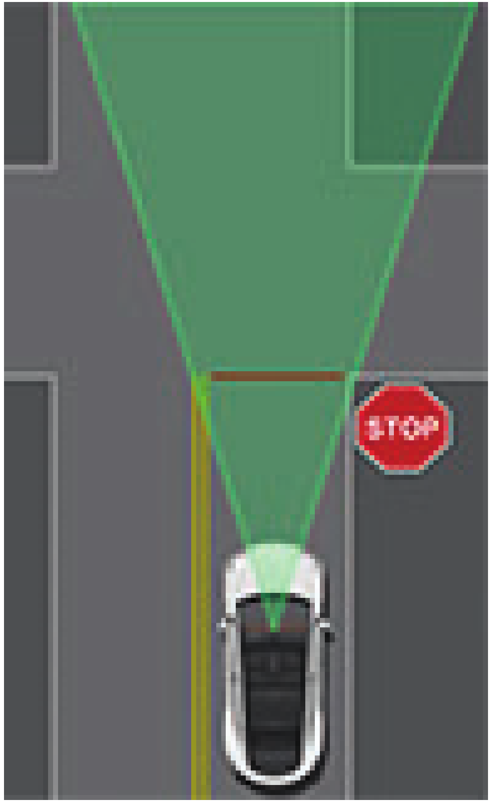




Without map data !

Tesla Model 3 (2)





Traffic Light and Stop Sign Assist is a **BETA feature** and works best on roads **frequented by Tesla vehicles**. The traffic light and stop sign assistant tries to stop at all traffic lights and may also stop at green lights.

NOTE: If you confirm that you want to proceed through an intersection with a stop sign by depressing the traction lever or momentarily pressing the accelerator pedal before Model 3 has stopped, your confirmation will be ignored.

Model 3 is not designed to drive past a stop sign without stopping first.

Tesla Model 3 (4)

Full video: youtube → MechlabDE channel

Some feedback is sent to Tesla. The driver has no influence on the data!

3. Problem:
→ Trust in feedback?

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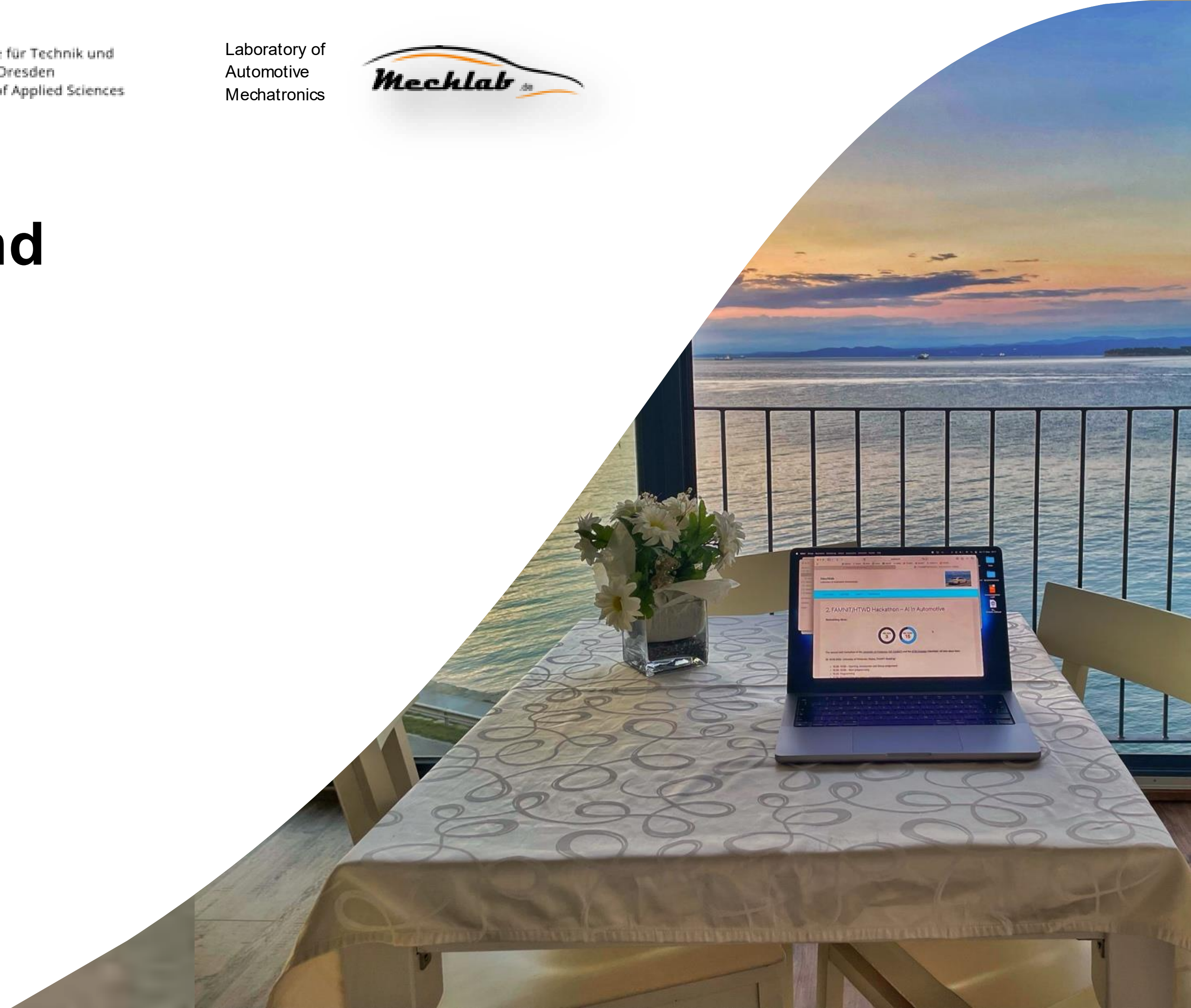
Project partners and task descriptions



FSD Fahrzeugsystemdaten GmbH:

The FSD GmbH, headquartered in Dresden, is the legally appointed central body under the German Road Traffic Act (StVG) for vehicle system data and inspection specifications. Established in 2006, the company develops, validates, and provides technical data, test specifications, and tools required for the periodic technical inspection of vehicles (HU and SP) in Germany. Main products:

Central vehicle database: A structured, validated collection of technical system data from manufacturers covering more than 100 million vehicles.

Test specifications: Standardized inspection procedures that tell testing organizations (TÜV, DEKRA, GTÜ, KÜS, etc.) how to check safety- and emissions-related systems.

Inspection tools & IT systems: For example, the **PTI-Adapter**, which allows inspectors to access and test electronic systems via the vehicle interface (OBD, CAN bus, etc.).

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PTI-Adapter:

An FSD PTI adapter is a **mandatory** vehicle inspection device used in Germany and some other countries for periodic technical inspections (PTI). It is a communication and measuring tool that connects to a vehicle's electronic interface to read dynamic driving parameters, supporting the measurement of vehicle performance and enabling electronic vehicle data to be integrated into the inspection process. Developed by FSD GmbH, the PTI adapter provides access to vehicle data for inspection and can also function as a **decelerometer** for vehicles that cannot be tested on a roller brake.

Dynamic cof automated and connected driving systems:

New inspection methods and tools for monitoring of automated, connected assistance and driving functions are currently being developed and prepared for near-term implementation in the inspection bodies. In addition to static methods, scenario-based test methods offer the possibility of testing the response of the vehicle during a specific scenario by suitably depicting the traffic environment (virtually/physically).

https://charta2030.de/en/areas-of-focus/

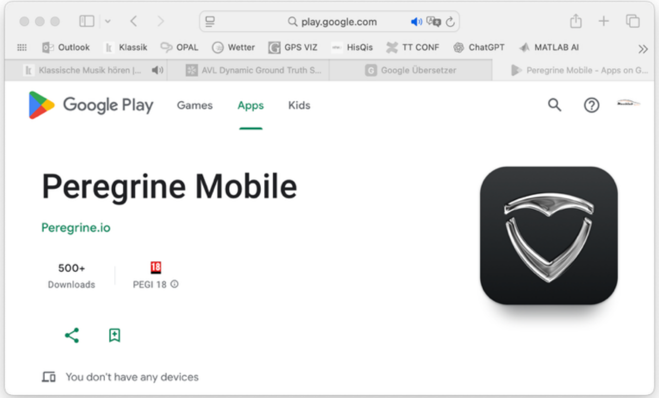
tracetronic GmbH:

Founded in 2004 as a spin-off from TU Dresden, tracetronic GmbH is a specialist company headquartered in Dresden, Germany, that designs and delivers automated software testing and integration solutions for the automotive industry and related fields.

- They develop software tools such as ecu.test, TRACE-CHECK, and TEST-GUIDE, which support all phases of testing embedded vehicle control unit software: specification, execution, evaluation, and reporting.
- Their solutions work in both virtual and physical test environments, enabling highly automated workflows.
- They also help with trace analysis, handling large volumes of data from tests (from different sources/sensors etc.), integrating test tools, and streamlining continuous integration/continuous testing (CI/CT) processes.

Project task 1 – Data evaluation for scenario-based inspection

Measurements were performed using an AVL system to precisely identify surrounding objects (vehicles, lanes). These form the basis for future scene-based testing procedures. In parallel, data was also collected using the Peregrine Mobile app, which also provides self-motion data and video information.



Tasks:

1. Data Preprocessing
2. Visualization
3. Filtering

A filter for cornering is to be implemented using three examples on the data sets. Cornering should be based on:

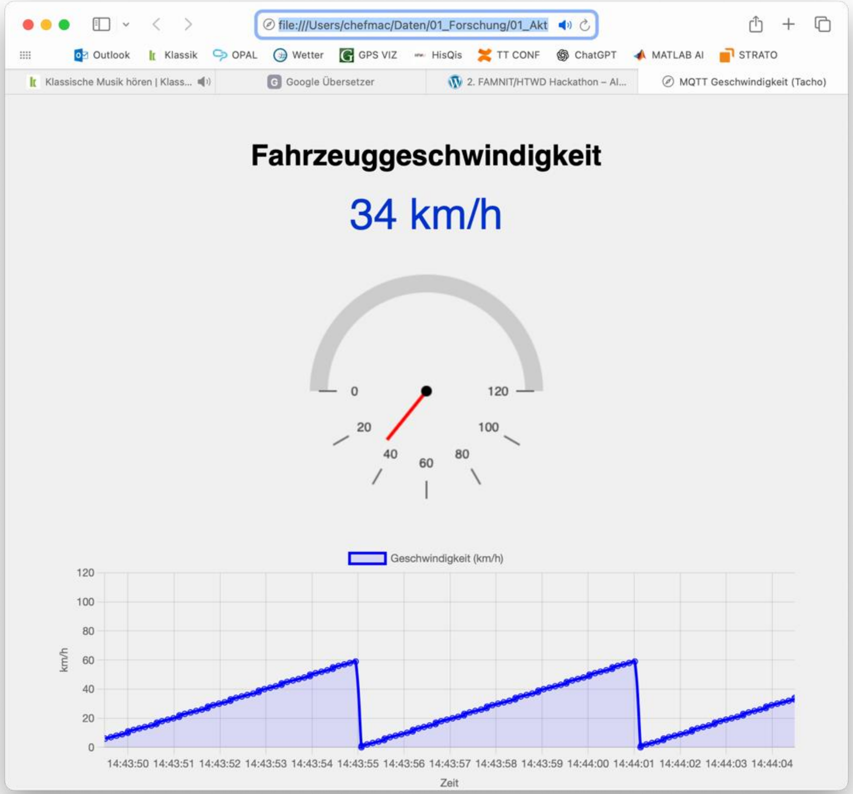
- The vehicle dynamics data (yaw rate, lateral acceleration)
- The lane information from the AVL data
- The lane information from the Peregrine data

Additional filters, such as speed or visibility, can be added.

https://www.avl.com/en/testing-solutions/automated-and-connected-mobility-testing/avl-dynamic-ground-truth-system

Project task 2 – Live display of shuttle operating data

An autonomous shuttle has recently been deployed at the HTWD. This will be used to develop test procedures that can/must be used for safe daily operation. Currently, there is no live display of the position and important operating data. This is necessary so that an assistant can monitor the journey and intervene if necessary. Furthermore, it may be necessary to repeat certain tests. Therefore, a live display based on an open-source map (e.g., Open Street Map) is to be developed that offers interactive options for intervention. The concept is intended to be expandable so that multiple shuttles can be monitored simultaneously. The data exchange of all sources can be done, for example, via **MQTT server**.



(poorly) Self-programmed simple example (using ChatGPT)

Live presentation on 02.10 for State Secretary Prof. Dr. Heike Graßmann!

A lidar sensor from Livox (MID-360) will be used in the future for the precise measurement of static objects (PTI Light test, Accident analysis). The special measuring principle allows the entire surface within the detection area to be recorded.

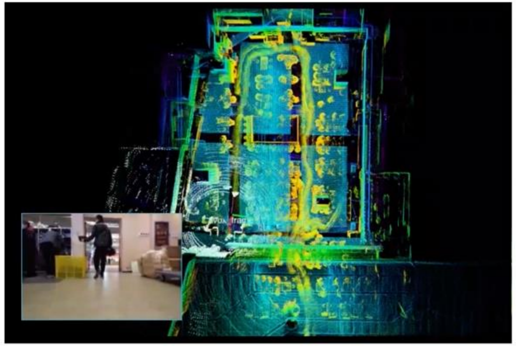
The following tasks are planned:

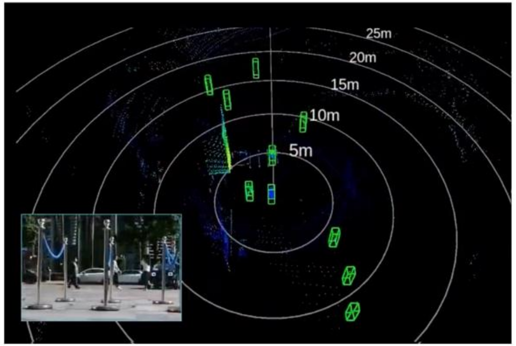
- Dedicated program for recording in ROS2
- Extraction of object points for specified target objects
- Output of the data in a flexible format
- Porting to a Raspberry PI (in Dresden)

Enhanced indoor perception for greater efficiency

Compared with 2D single-line LiDAR sensors, the Mid-360 delivers advanced 3D perception that enables mobile robots to collect sufficient environmental data for mapping and positioning. This eliminates the need to modify the spatial environment and greatly improves efficiency. In addition, the angular resolution of the Mid-360 improves significantly over time. This greatly enhances small object detection to ensure safe operation.

Angular resolution changes over time ›





Compatibility with outdoor scenarios brings more possibilities

The Mid-360 is not affected by ambient light either indoors or outdoors. It's rich point cloud data assists mobile robots in navigation, obstacle avoidance and even detection classification – fully unlocking the potential of AI.

https://www.livoxtech.com/mid-360

Project task 4 - Person detection and gesture recognition

In an automated vehicle for passenger transport, it is important to know the number and reactions of the occupants. Camera-based methods with AI support are particularly well-suited for this. The aim here is to develop a feasible and expandable concept to obtain as much usable information as possible from the video image.

Koper: Development with a prototype structure.

Dresden: Installation and testing in the shuttle.

Optional: Porting the program to NVIDIA Jetson for real-time improvement.

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See you in DRESDEN 2025/2026

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