

Open Autodrive Forum

Ultra HD Mapping and the EU Project ESRIUM

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Motivation

- Exploit the potential of high precision digital infrastructure twins for
 - Testing and Validation of Driving Functions
 - Optimization of Infrastructure Usage
 - Optimization of Infrastructure Maintenance
- Provide the Technology for
 - Data Capture
 - Data Processing
 - Data Interfaces and Distribution

Agenda

- UHD-Mapping
 - Data capture
 - Workflow
 - Applications
- ESRIUM
 - Motivation and concept
 - Use-cases
 - First results

UHDmaps™



JOANNEUM RESEARCH provides a benchmark for test & validation of automated driving functions

JOANNEUM RESEARCH - DIGITAL

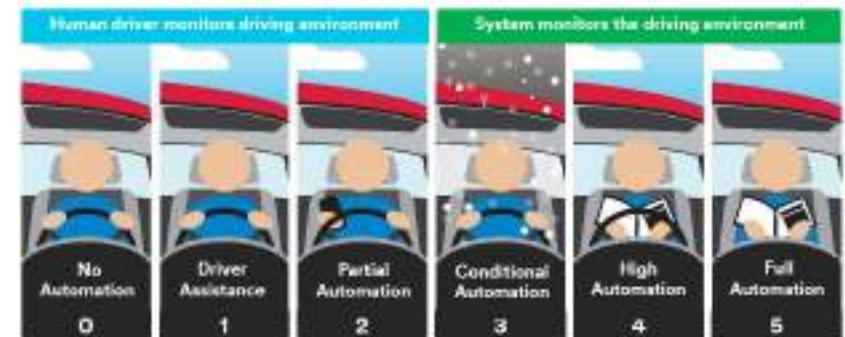
- Research organization for applied science
 - Headquarters in Austria, Graz
 - 2nd largest in Austria (~450 staff)
- ICT department: DIGITAL (~140 staff)
- Research lab for automated driving
 - Test and validation of automated driving functions
 - Reference maps (UHDmaps) and sensor platforms
 - Evaluation and simulation of ADAS/AD functions
- Scientific partner and shareholder of ALP.Lab
 - Test region for ADAS in Austria



Why do we need test and validation?

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- ASIL¹ A, ISO 26262
 - Only one safety critical failure in 10⁶ hours of operation
 - 50 km/h → 50 Million km without failure
- SAE Level 2 → SAE Level 3
 - Vehicle takes responsibility – Liability!
 - Safeguarding of driving functions needed
- 17,7 Billion km
 - Statistically reliable assessment of safety
 - Source: Rand Cooperation
- Cannot be achieved with real-test only



Society of Automotive Engineers (SAE) levels of automation

¹ Automotive Safety Integrity Level

What is currently tested? Basic ADAS!

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Test Lane-Changing



Test Lane-Keeping



Test Blind-Spot-Detection



UHDmaps™ for testing automated driving

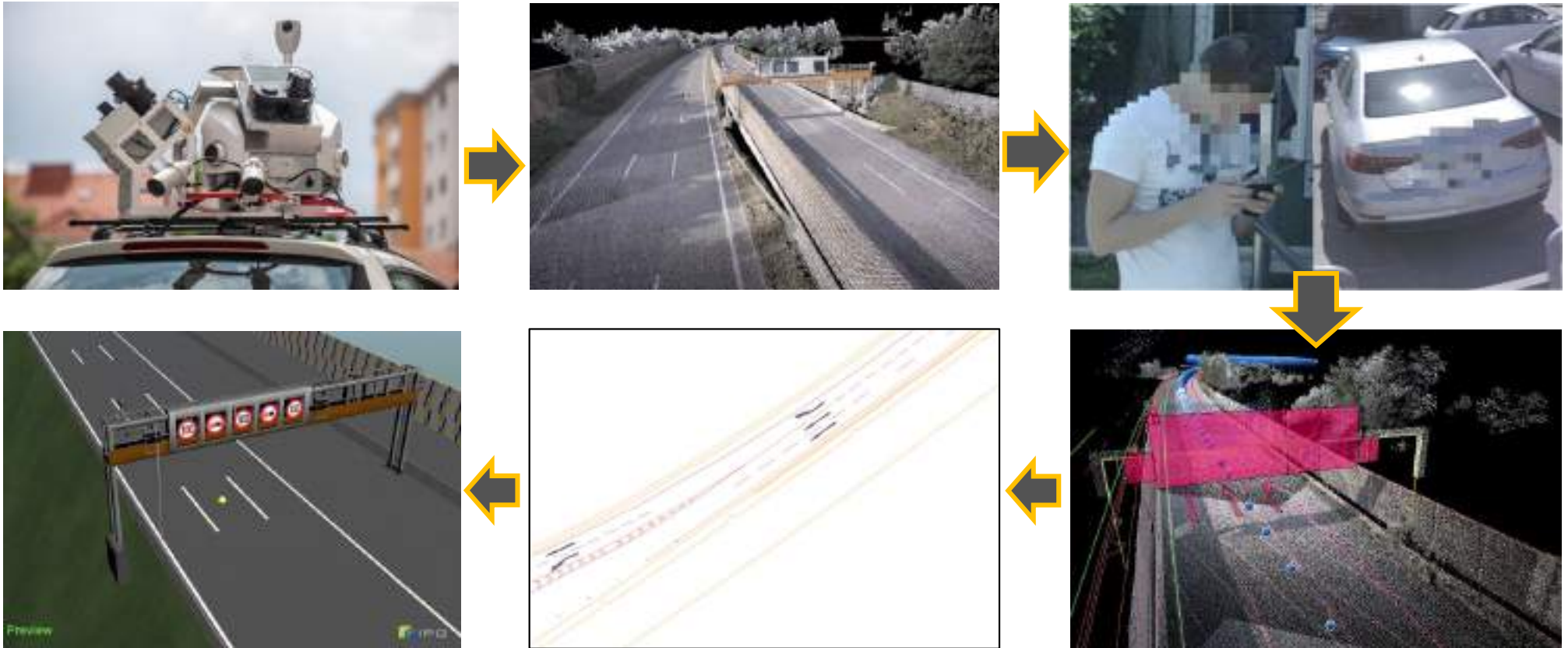
- **Simulation** based on UHDmaps
 - Realistic maps, 3D models and road surfaces
 - Detailed models with materials data for sensor simulation
- **On-Road testing** based on UHDmaps
 - Evaluation of automated driving performance (KPIs)
 - Evaluation of perception performance (data fusion)
 - Evaluation of driving scenarios (edge-cases)

→ Simulation
- UHDmaps - Digital twin of reality
 - **10 times** higher accuracy than commercial HD-maps
 - **Guaranteed** accuracy, level of detail and completeness
 - **Continuous update** for test regions and proving grounds



UHDmaps™ – Production workflow

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Data capturing by „Mobile Mapping“

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Public roads, Austrian highway A9

Private proving ground, ZalaZone



Digital twin of reality: „Static ground truth“

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Automated UHDmaps™ production

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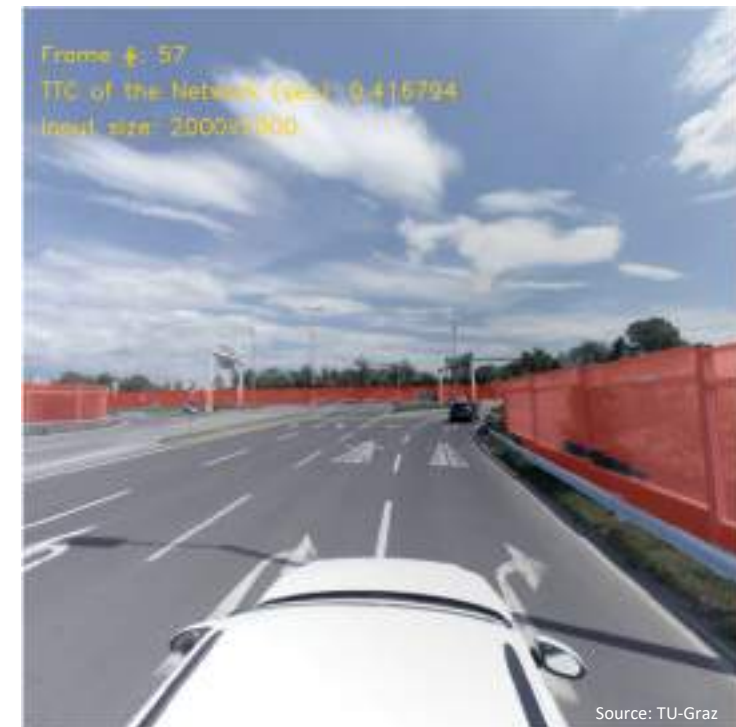
- Object detection and classification (cooperation TU-Graz)
 - Road markings
 - Road traffic signs
 - Noise barriers, jersey barriers and guardrails
- Automatic semantic interpretation
 - Road topology (lanes, exits, junctions, traffic rules)
 - Traffic sign parameters (constraints, assignments)
 - Lane parameters (boundaries, speed limits, ...)
 - Road geometry (slope, camber, elevation profile)
- Human monitored quality control workflow



Automated detection of map features

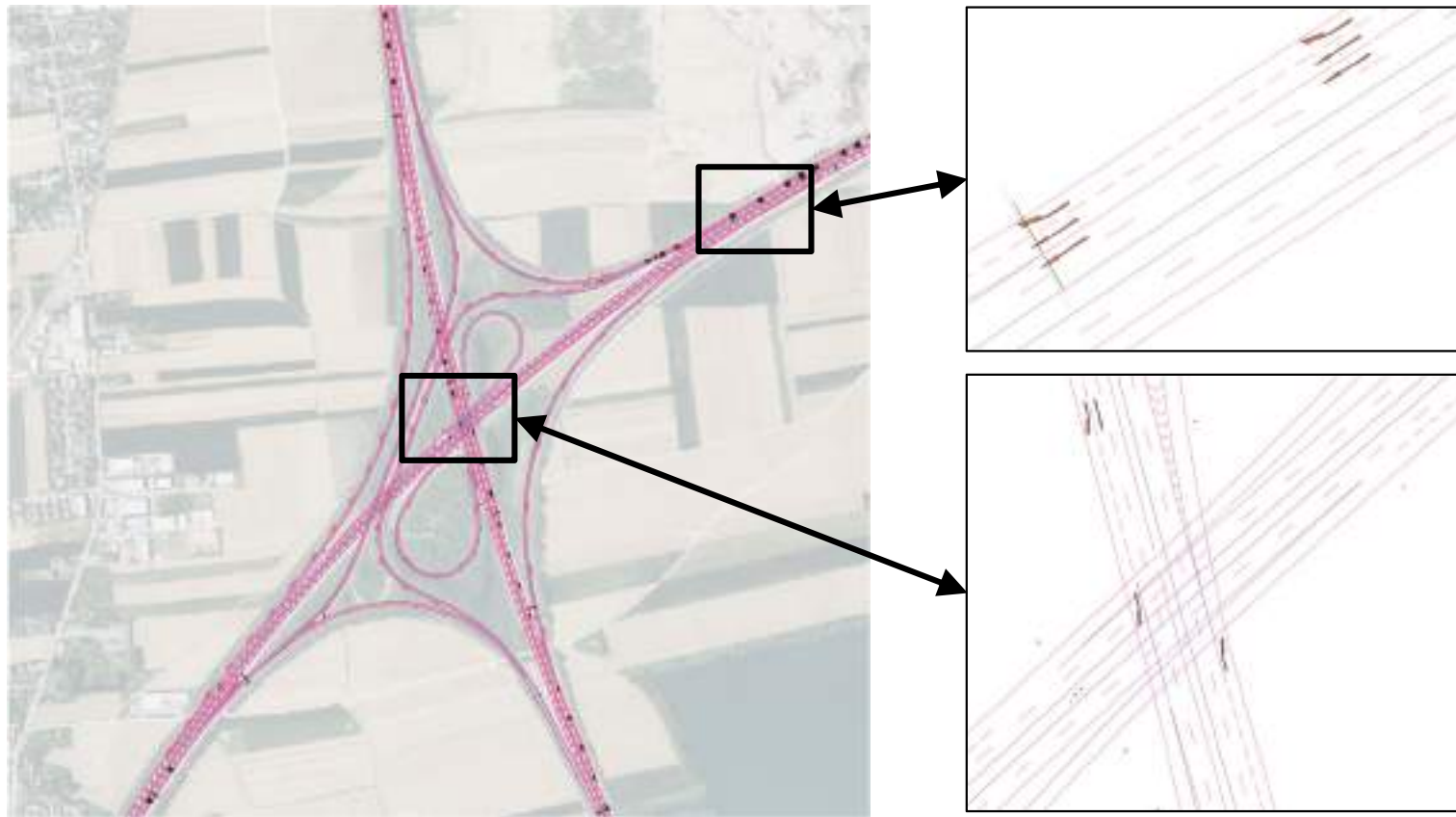
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Cooperation JOANNEUM RESEARCH and TU-Graz



UHDmaps™ - Road geometry and topology

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UHDmaps™ - Export for simulation

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- Export of simulation formats
 - IPG Road 5 (IPG CarMaker)
 - ASAM OpenDrive (VIRES VirtualTestDrive)
 - ASAM OpenCRG, OpenFlight
- Automatic geometric processing
 - Generation of reference lines
 - Logic assignments of road objects
 - Curve fitting of line objects
 - Calculation of road coordinates
- Export format verification



UHDmaps™ – Simulation (IPG CarMaker)

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UHDmaps™ - Public road testing (ALP.Lab)

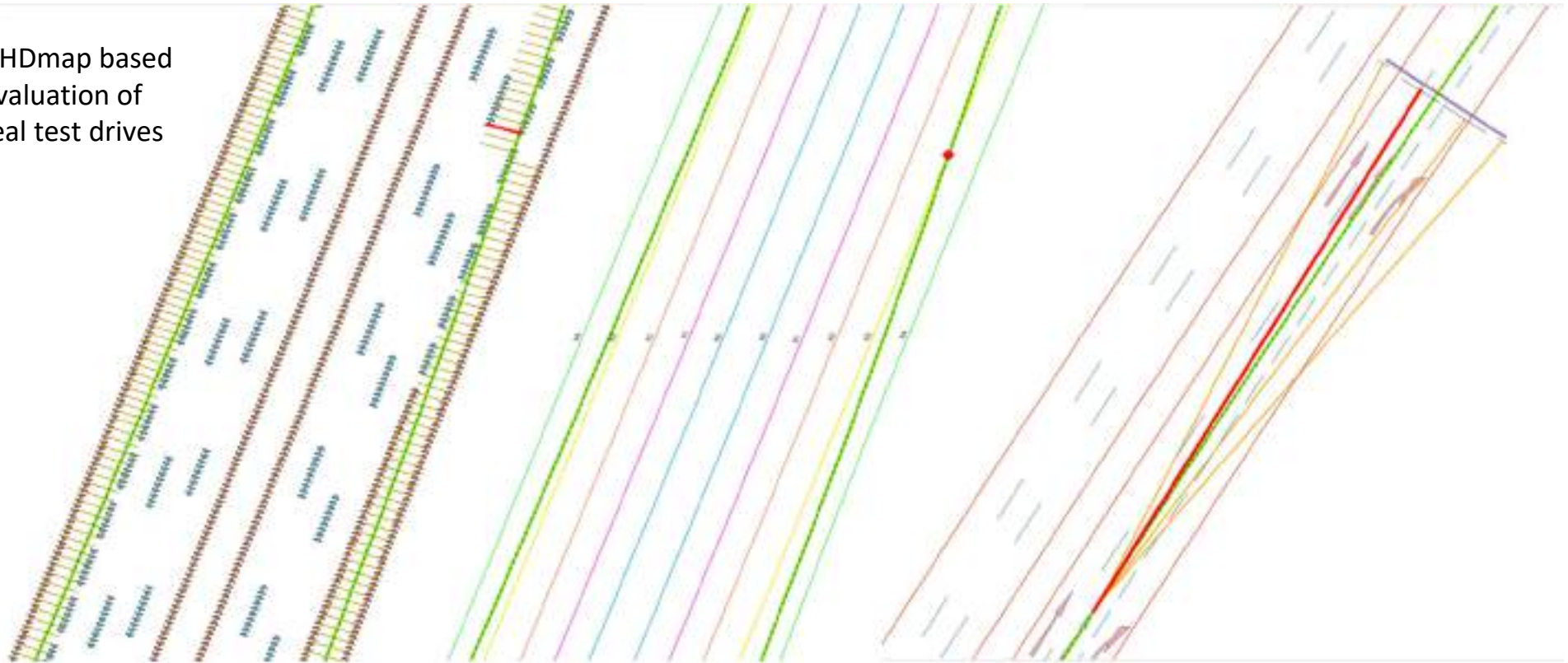
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Lane Keeping

Lane Change

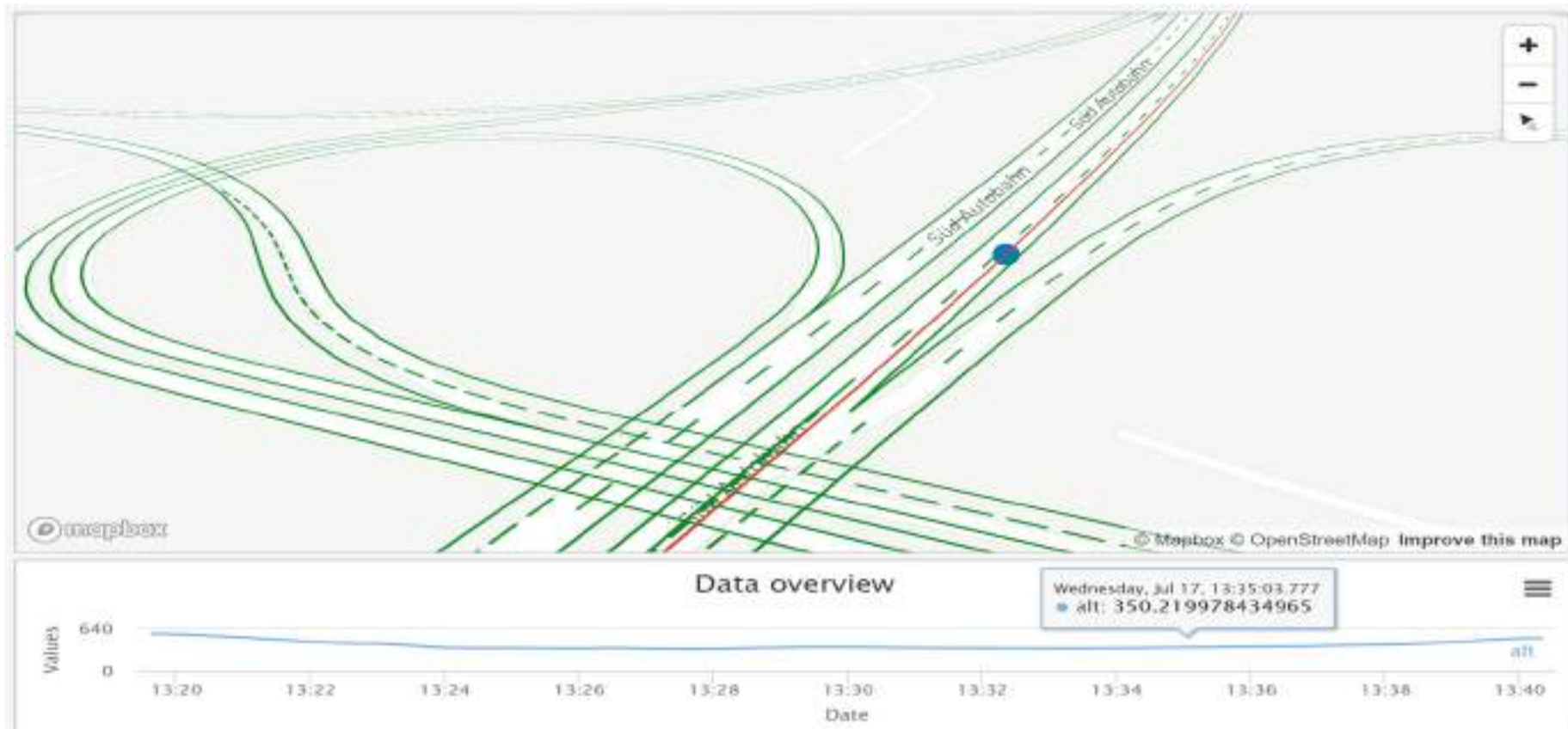
Traffic Sign Detection

UHDmap based
evaluation of
real test drives



UHDmaps™ based assessment of AD

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ESRIUM

SAFE AND EFFICIENT ROADS

JOANNEUM
RESEARCH
DIGITAL

virtual  vehicle

 ASFINAG

 UNIVERSITY
OF APPLIED SCIENCES
UPPER AUSTRIA

 LOGISTIKUM
CHALLENGE ACCEPTED



 NLS
FINNISH GEOSPATIAL
RESEARCH INSTITUTE
FGI

 evolit
we make IT yours





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Objectives of ESRIUM



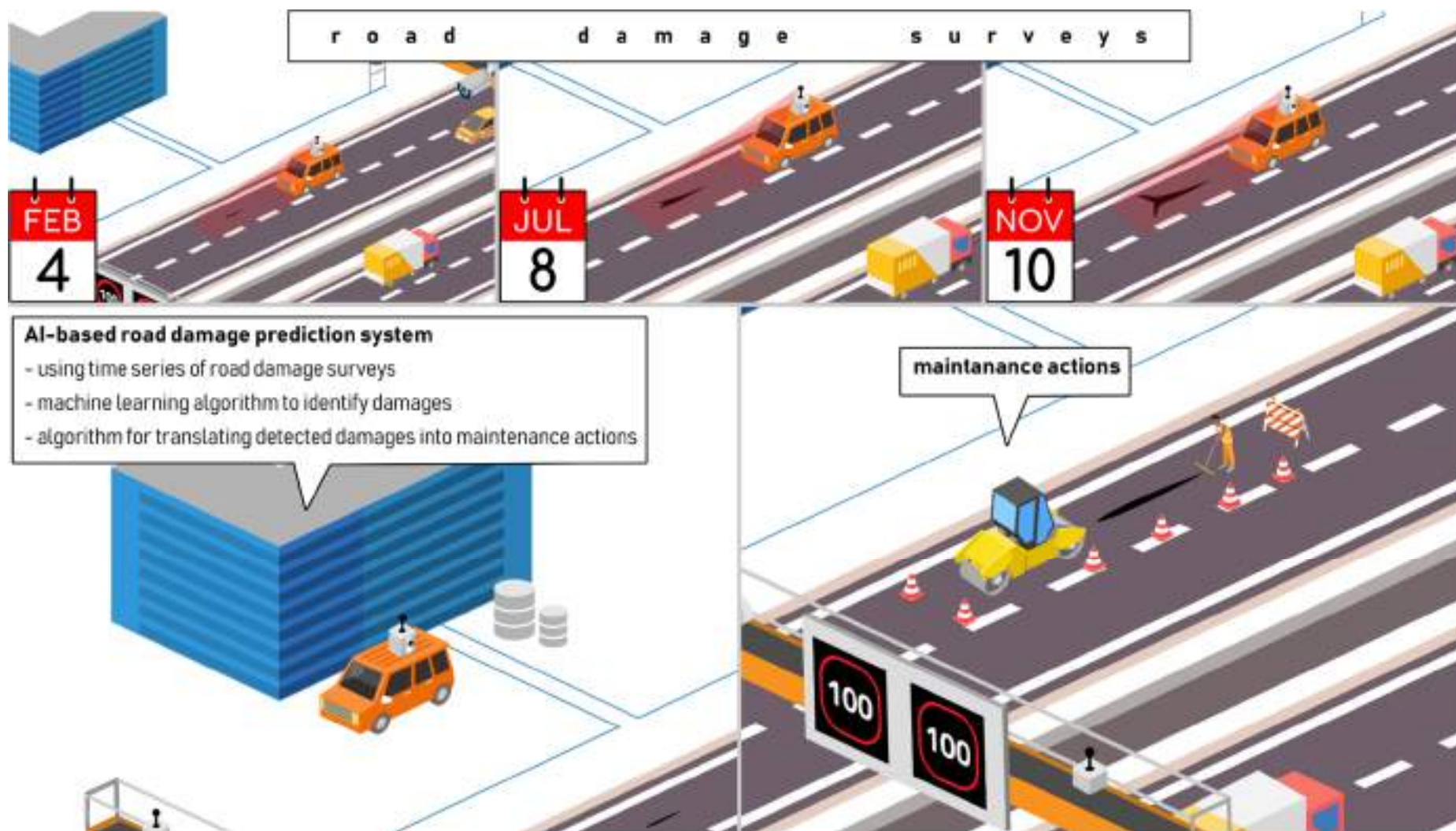
ESRIUM is a Horizon 2020 project increasing the safety and resource efficiency of transport on European roads. Its key innovation is a digital map of road surface damage and road wear.

The digital road wear map will contain unique information for the road operators to enhance the road maintenance planning and to provide routing recommendations (in-lane and cross-lane) to automated vehicles and conventional vehicles to avoid road damages.

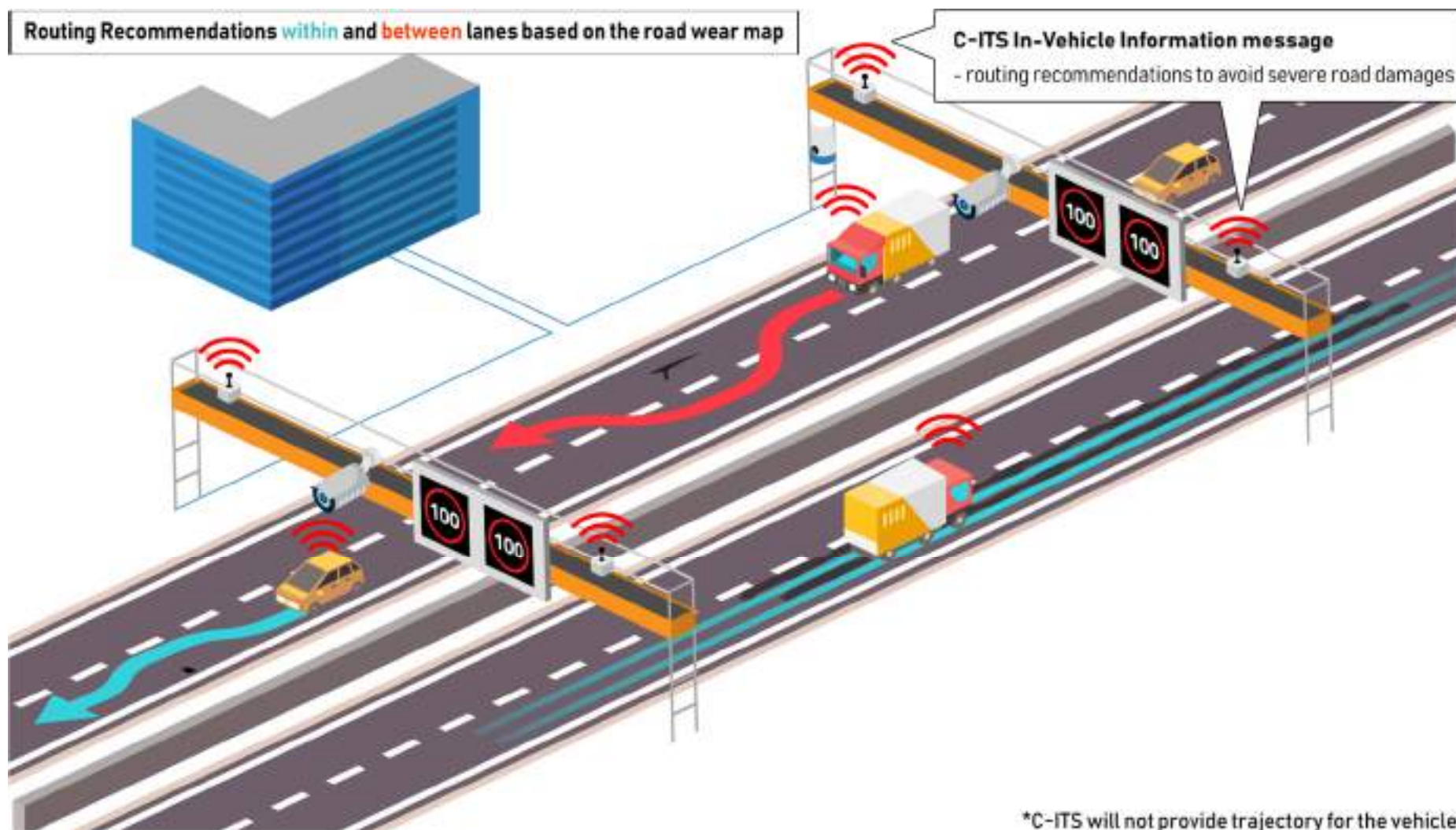
Through ESRIUM, transportation becomes...

- **Smarter:** Exploiting detailed driving recommendations received from the road operator in every automated and connected car.
- **Safer:** Allowing the vehicle to drive on undamaged road surface.
- **Greener:** A longer paving lifetime makes road operations greener and more resource-efficient.

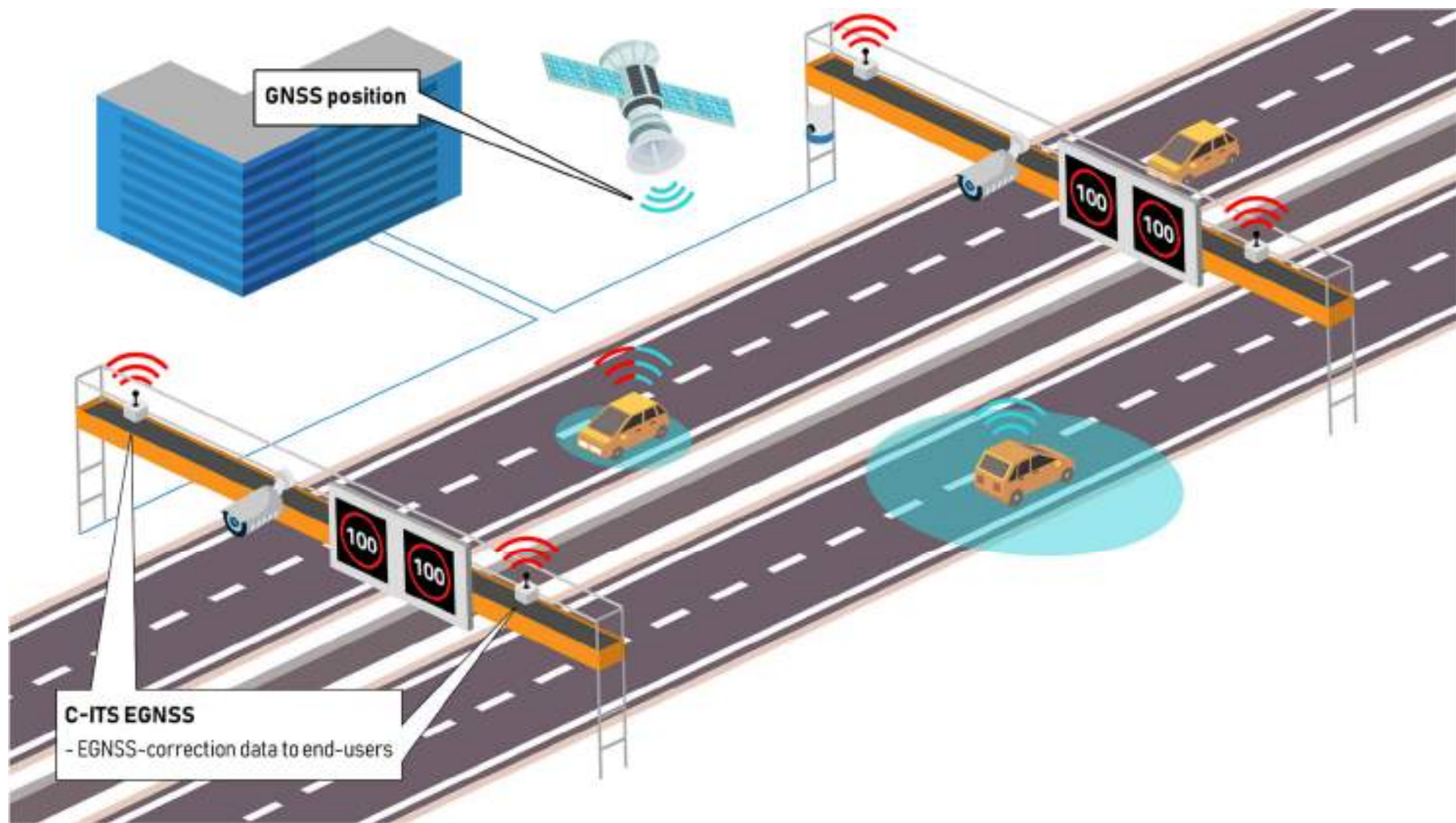
EUC-001: AI-based road damage prediction to support enhanced road maintenance planning



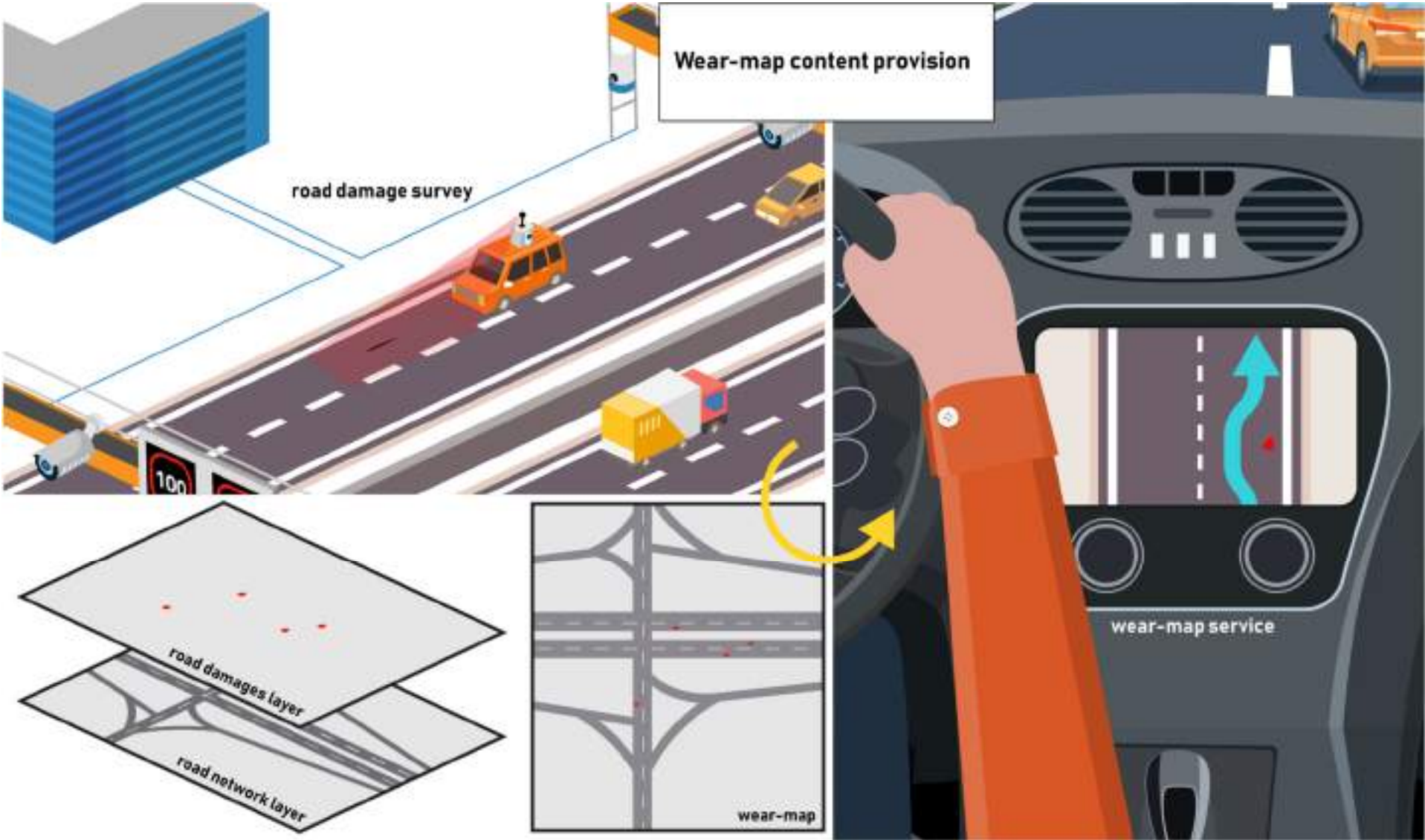
EUC-002: Routing recommendations within and between lanes based on the road wear map, provided via C-ITS messages



EUC-003: C-ITS message 'GNSS-correction data' provision

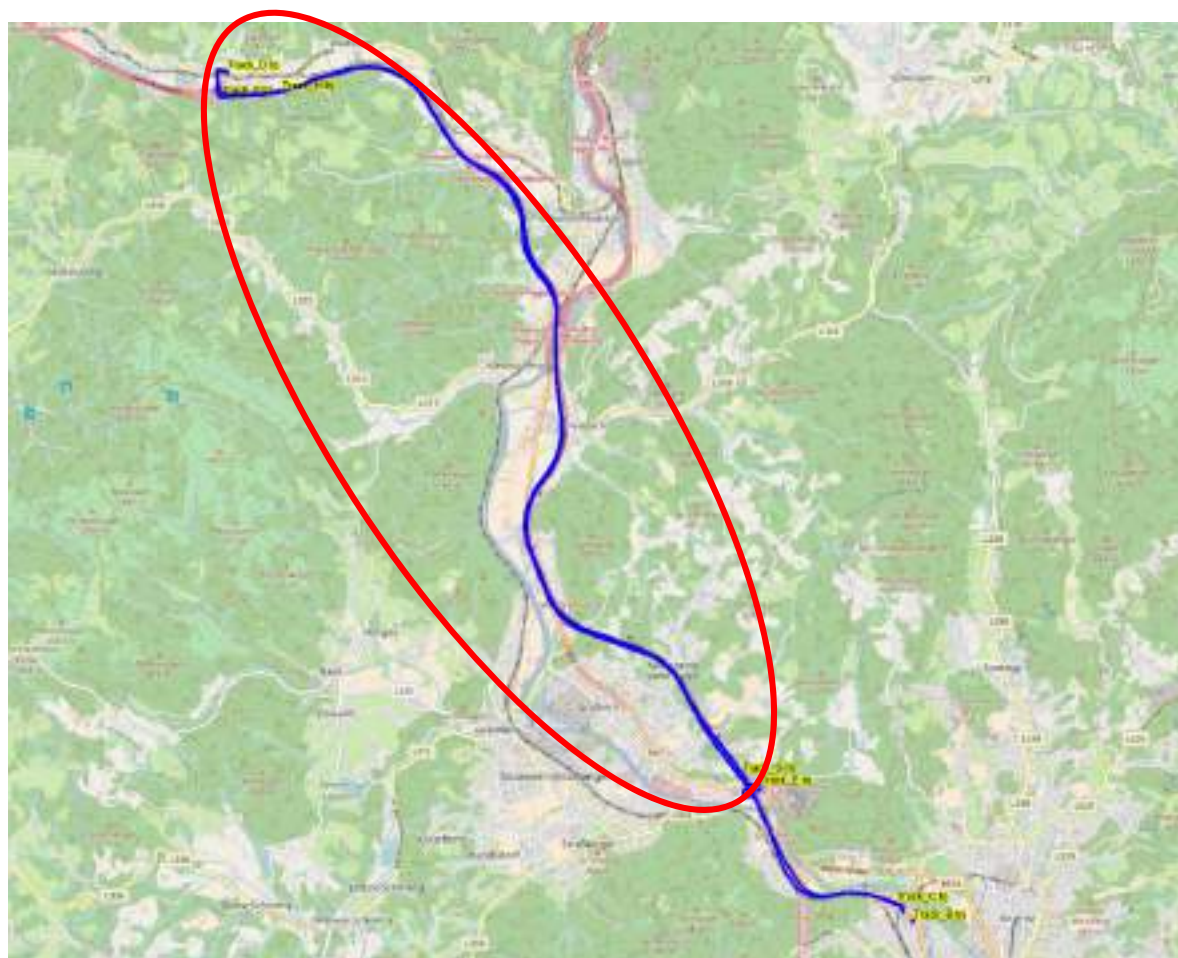


EUC-004: Wear-map content provision



Initial test run

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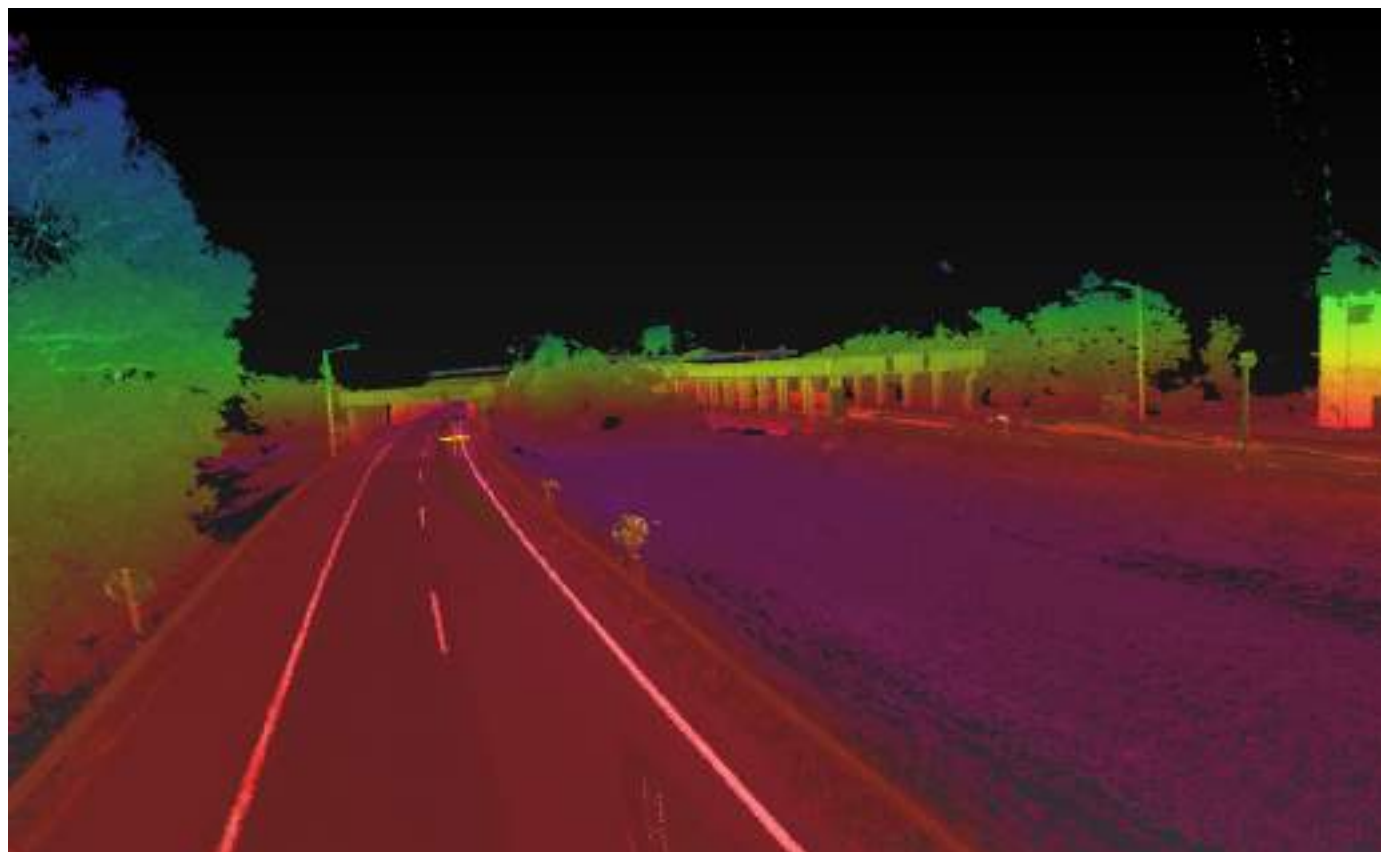
Camera data

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LIDAR data

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Sample of a crack

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- Track C / Frame Nr. 1839 / Lane #1



Sample image of a crack

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- Track G / Frame Nr. 406 / Lane #3



Sample image of repaired cracks

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- Track D / Frame Nr. 778 / Lane #1



Sample image of broken repaired cracks

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- Track G / Frame Nr. / Lane #3



Sample image of a detachment

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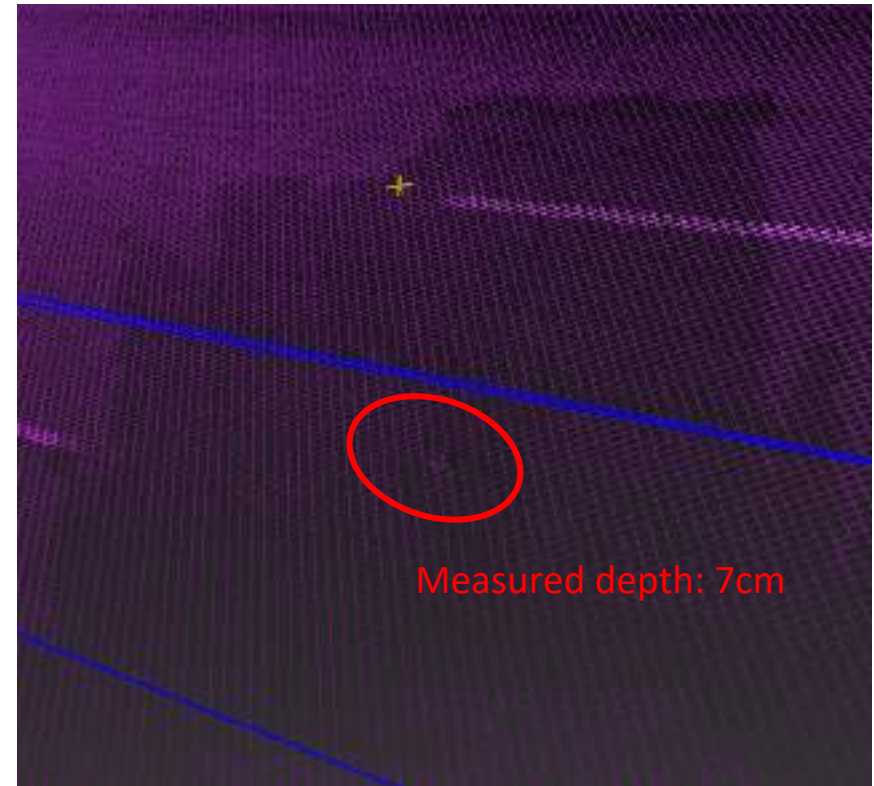
- Track C / Frame Nr. 2270 / Lane #1




Sample image of a pothole

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- Track G / Frame Nr. 1761 / Lane #2



A black satellite icon with two solar panels and a signal antenna, positioned on a blue dotted curved line that arcs across the top of the slide.

14/09/2021

Thank you!

Matthias Rüter





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