Use of Automotive Digital Twin for extended PMS

Kris De Meester

XenomatiX

Agenda:

➢ **Road Survey market today**

➢ **Automotive development opportunity**

➢ **Automotive LiDAR for road surveys**

➢ **Example - LiDAR road survey**

➢ **Example - road survey visualization**

➢ **XenomatiX info**

➢ **Take-aways**

How is this done today

Manual inspection

x Labor-intensive

x Operator dependent

x Very partial data

Balanced wheel (APL)

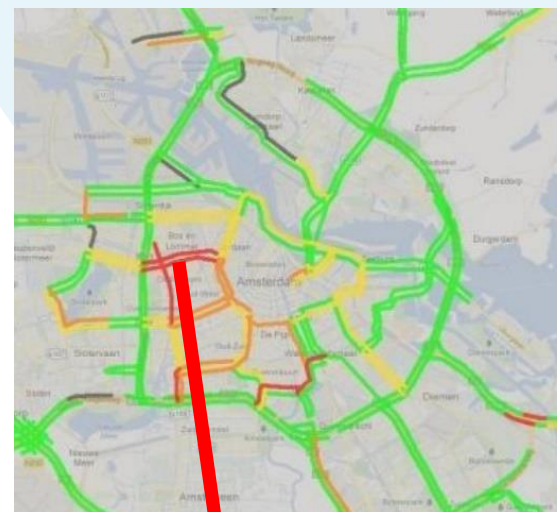x Waviness only

x Requires fixed speed

x Only wheel track

Multi-functional vehicles

x Very accurate & complete

x Expensive

x Road characteristics but no digital twin
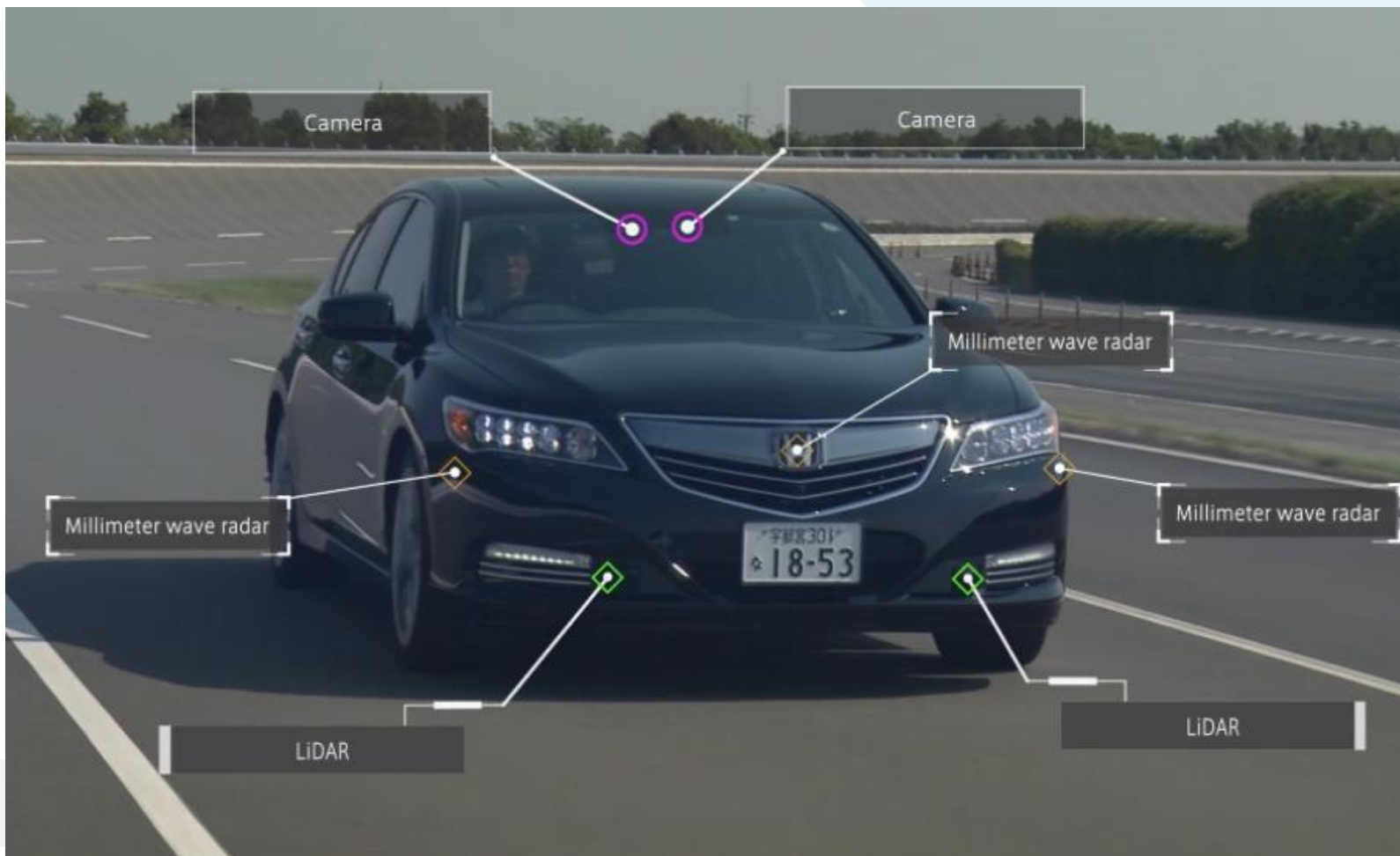
Visual Inspection for PMS

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Autonomous vehicles

The (near) future: DIGITAL TWIN

All roads will be digitized periodically and completely to:

- x Make/maintain inventory of road infrastructure (roads, traffic signs, markings, ...)
- x Provide all stakeholders with easy access to centralized data
- x Enable offline and automated road quality control
- x Save money thanks to predictive maintenance

Why measuring roads? Automotive & Road Sector

Safety	Maintenance planning	Comfort	Self-driving cars
- ADAS functions such as lane keeping relay on clear road markings - Worldwide yearly cost of bad roads is estimated to be: ??? (accidents, damaged vehicles, back injury, …) - Human, visual, on-site road inspection is slow and dangerous	- Objective numbers reveal where and when to best spend road maintenance budget - Road digitization documents evolution of road condition for road exploitation under consignment - Acceptance of road (re)construction	- Delicate transport (e.g. non-urgent ambulance service) needs road quality for route selection - SatNav feature: From A to B in most comfortable way - Government aiming to increase of standard of living	- Self-driving vehicles need road profile info for safe & comfortable navigation: ▪ Pothole avoidance ▪ Speed reduction at bumps ▪ Curbstone detection ▪ Platform localization for shuttles & buses

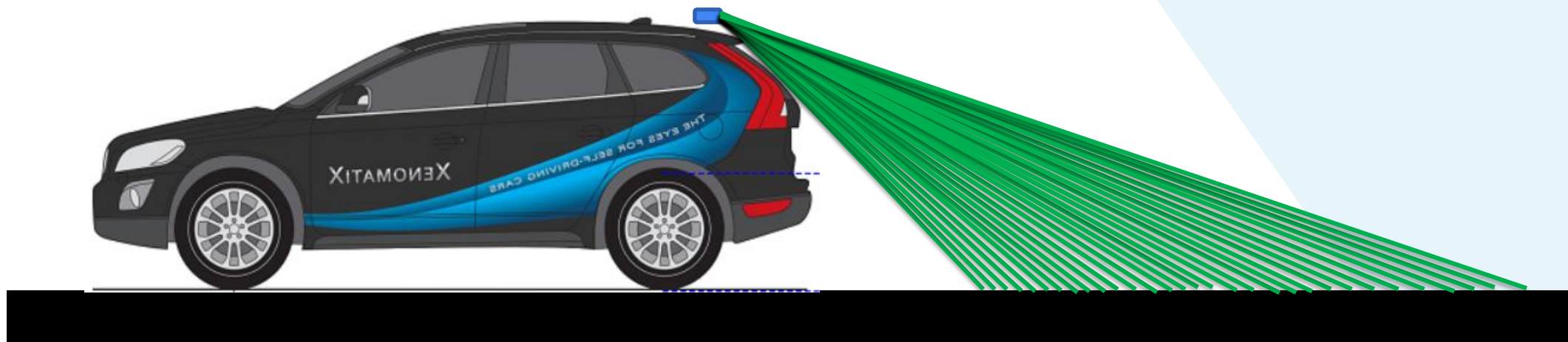# Agenda:

Measurement Principle

Road digitization for Active Suspension

How the Road LiDAR works

- x Solid-state, multi-beam Lidar, developed for automotive applications
- x High-accuracy short range Lidar for lane-wide measurements
- x Independent from ambient light conditions
- x Also used as road preview system for active suspension control
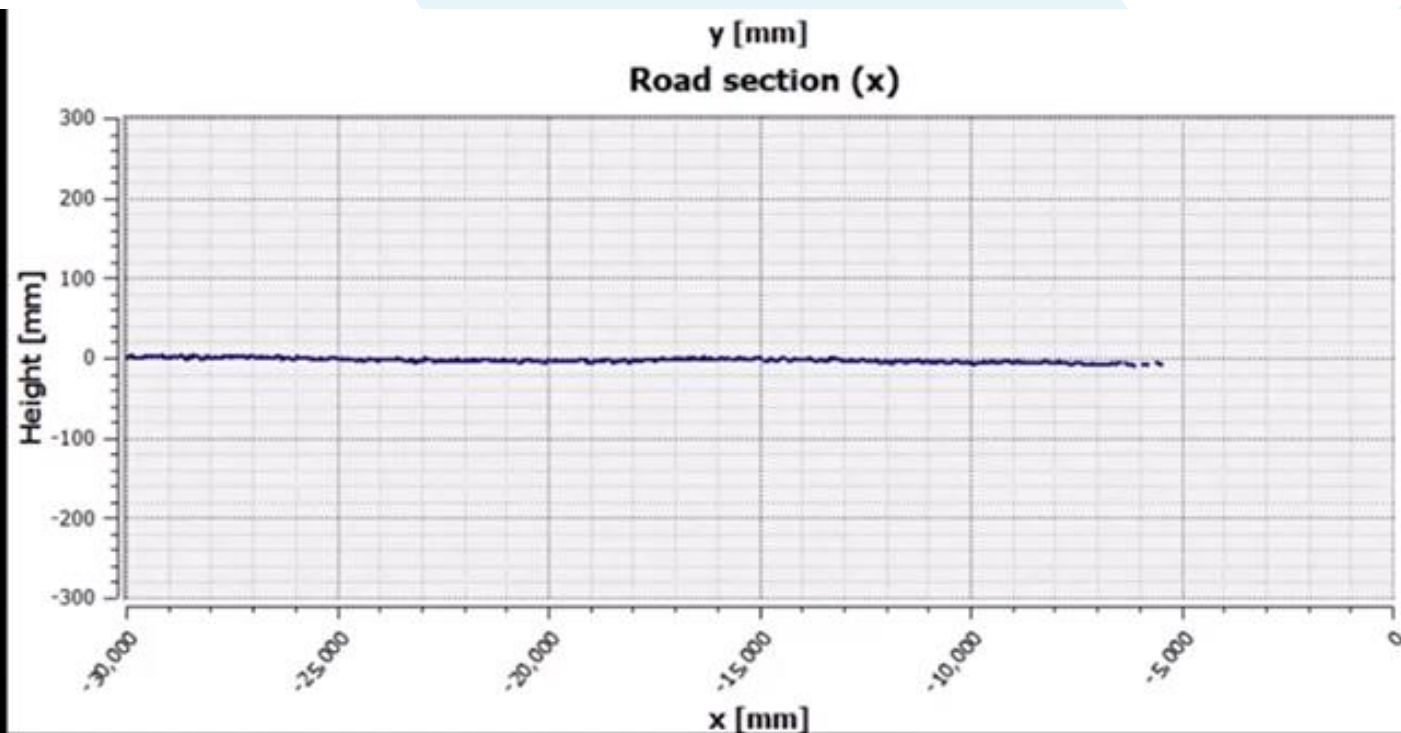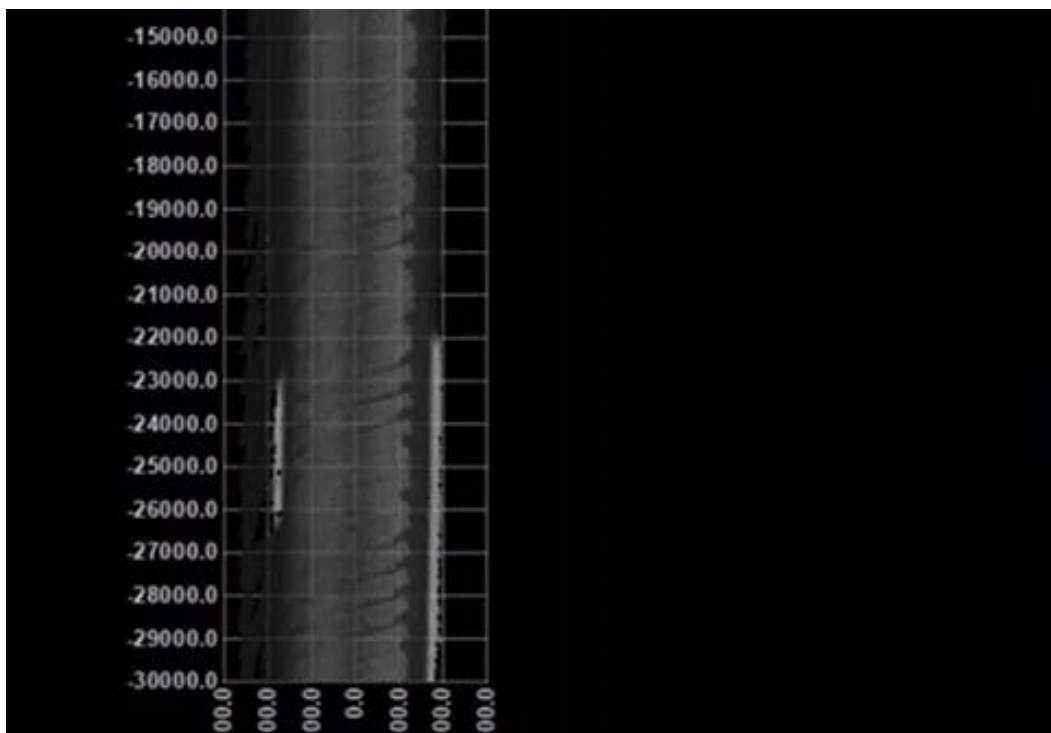
Road damage

3D view reveals:

x Longitudinal and traversal **cracks**

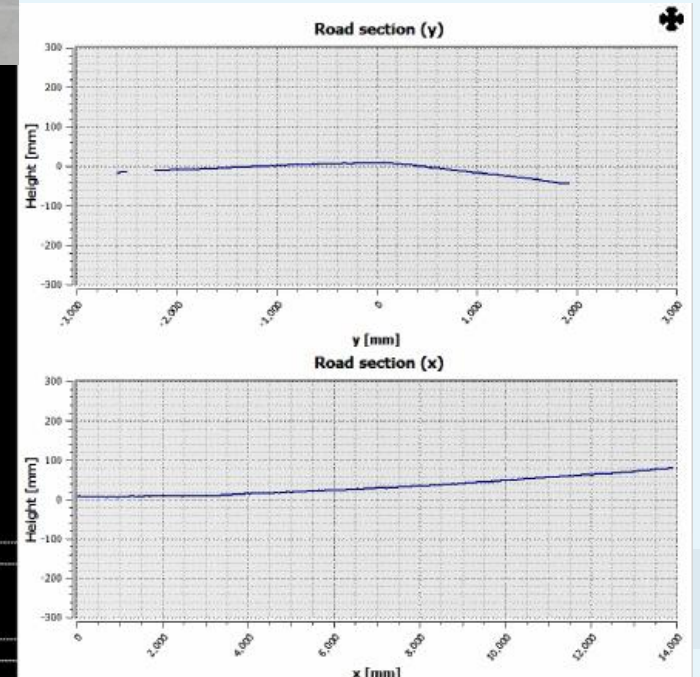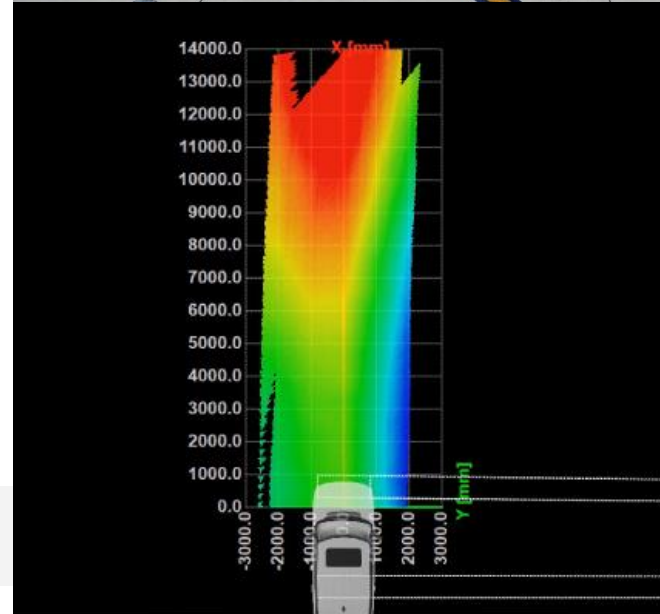**x** **Potholes** and **repaired asphalt**

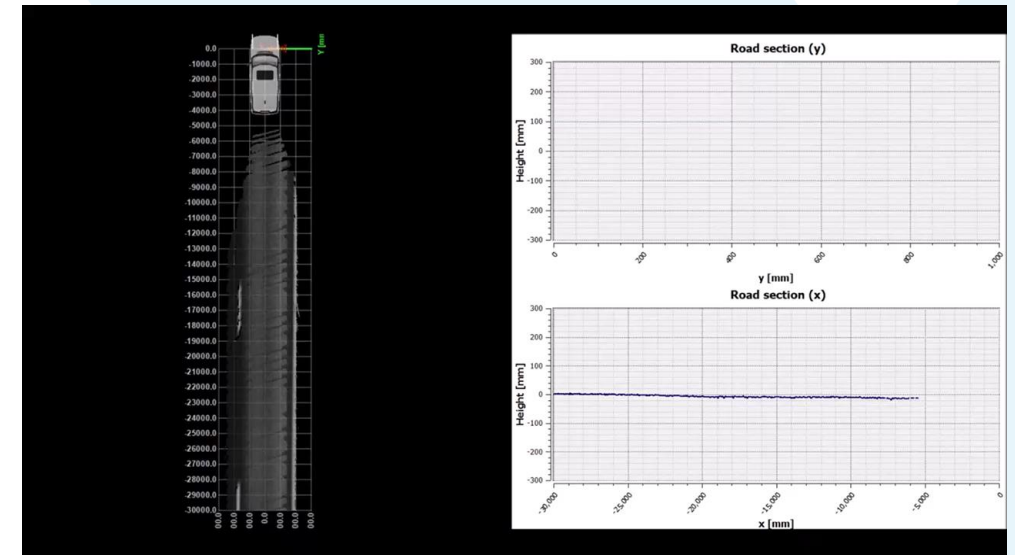**x** **Gutter** next to curbstone

Asphalt waviness inspection

Accuracy for airfield runways

Automated Paving Equipment - milling, paving, compacting

XenoTrack sensor

Value proposition of 6D road scanning

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➢ Take-aways

Top View | 3D View | Car Dynamics | Spot Image | External camera | Meta data | System Information

Home

Back

Stop

Playback Tools

<   >   ↺

Frame | 1005 ▲▼ | /2501 | »

Automatic Start/Stop

Press Start to start the recording.

Magic tools

Folder Name | C002

Record

Rolling Carpet Snapshot

STL | BIN

Gui state

Save state

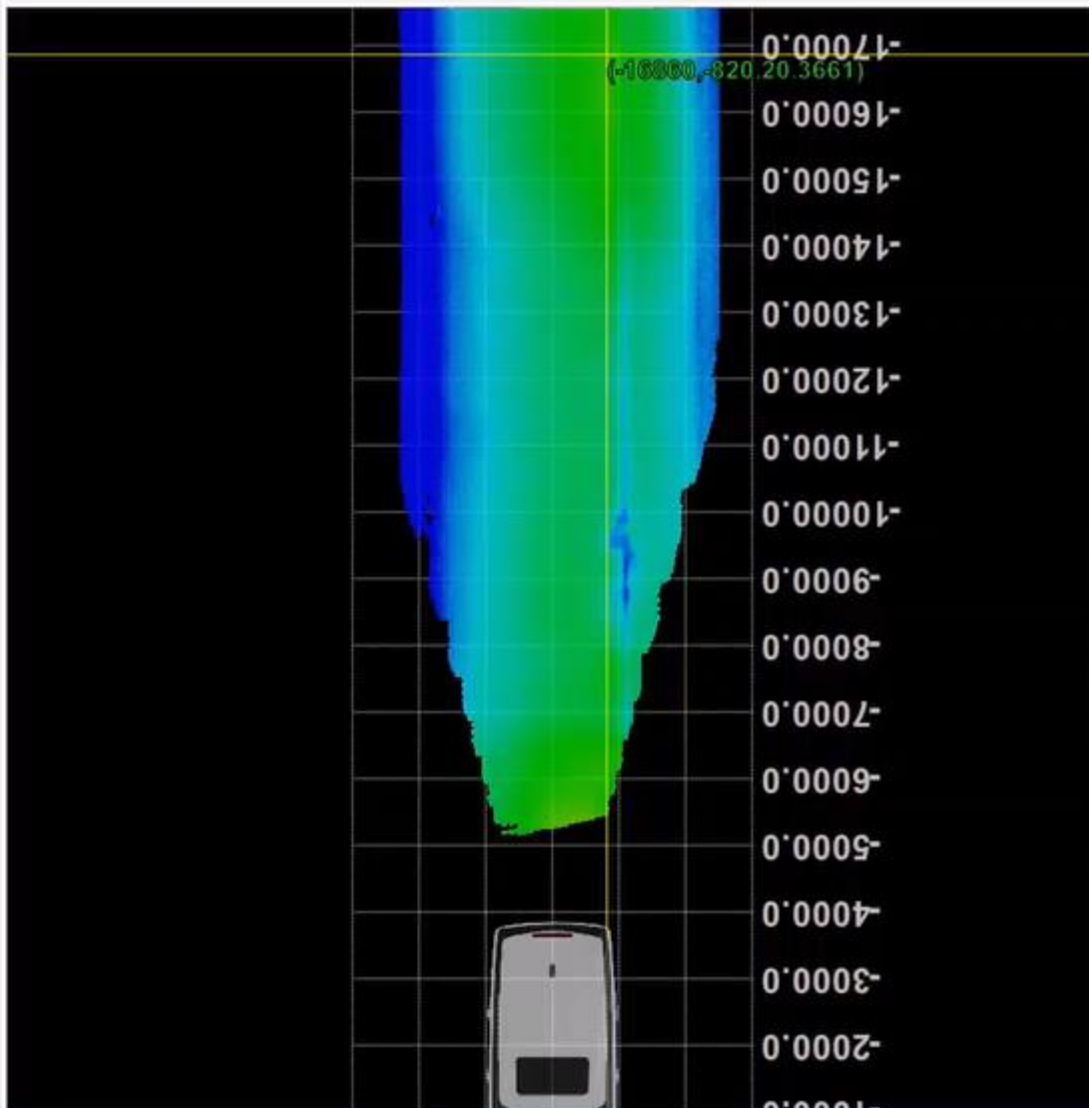☐ Show leveling

Dashboard

27.6 km/h

0.00 deg

System status

✓))) XENOTRACK

✓ 🖧 CAN

✓ 🛰 INS

Map display | Rolling Carpet Height ▼ | Height [mm] : | -20,00mm ▲▼ | 50,00mm ▲▼ | Reset

☐ Show road sections | ☑ Display webcam | ☑ Rotated view

(-16860,-820,20.3661)

-17000.0
-16000.0
-15000.0
-14000.0
-13000.0
-12000.0
-11000.0
-10000.0
-9000.0
-8000.0
-7000.0
-6000.0
-5000.0
-4000.0
-3000.0
-2000.0
-1000.0

XenoWare by **XenomatiX**

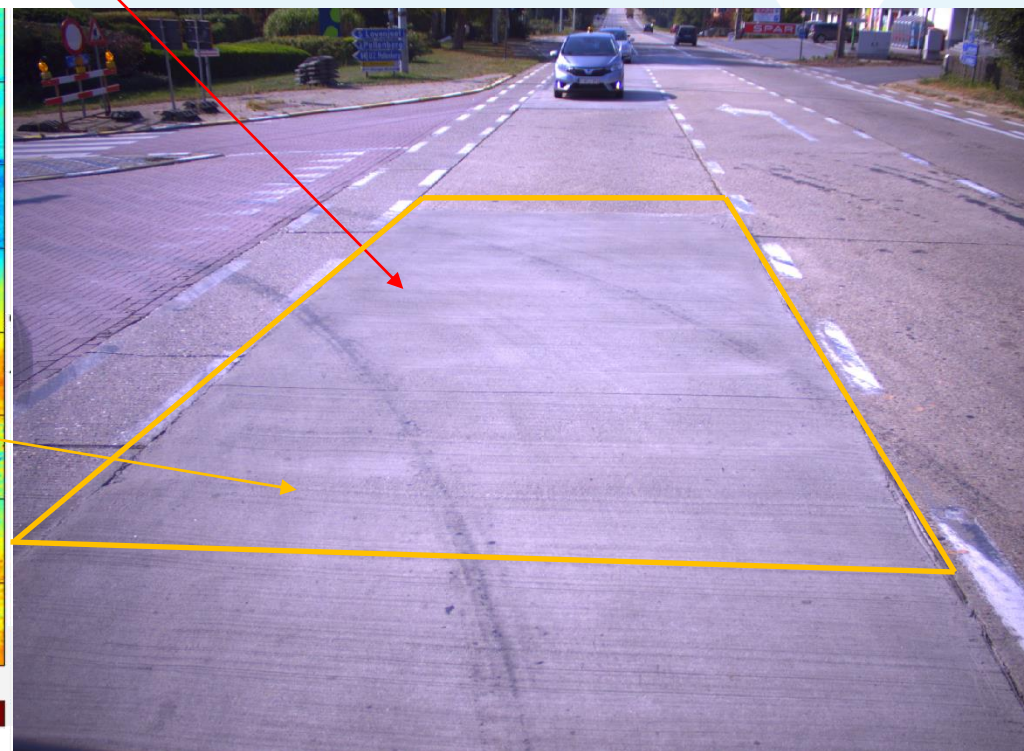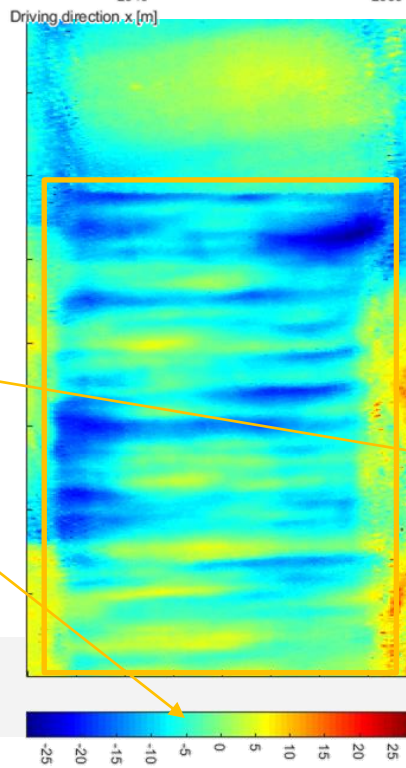# IRI details

x Renewed road segment

x Distance = 2240 - 2283 m

x Poor quality due to grooves

x Conclusion: bad repair

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Different layers of results
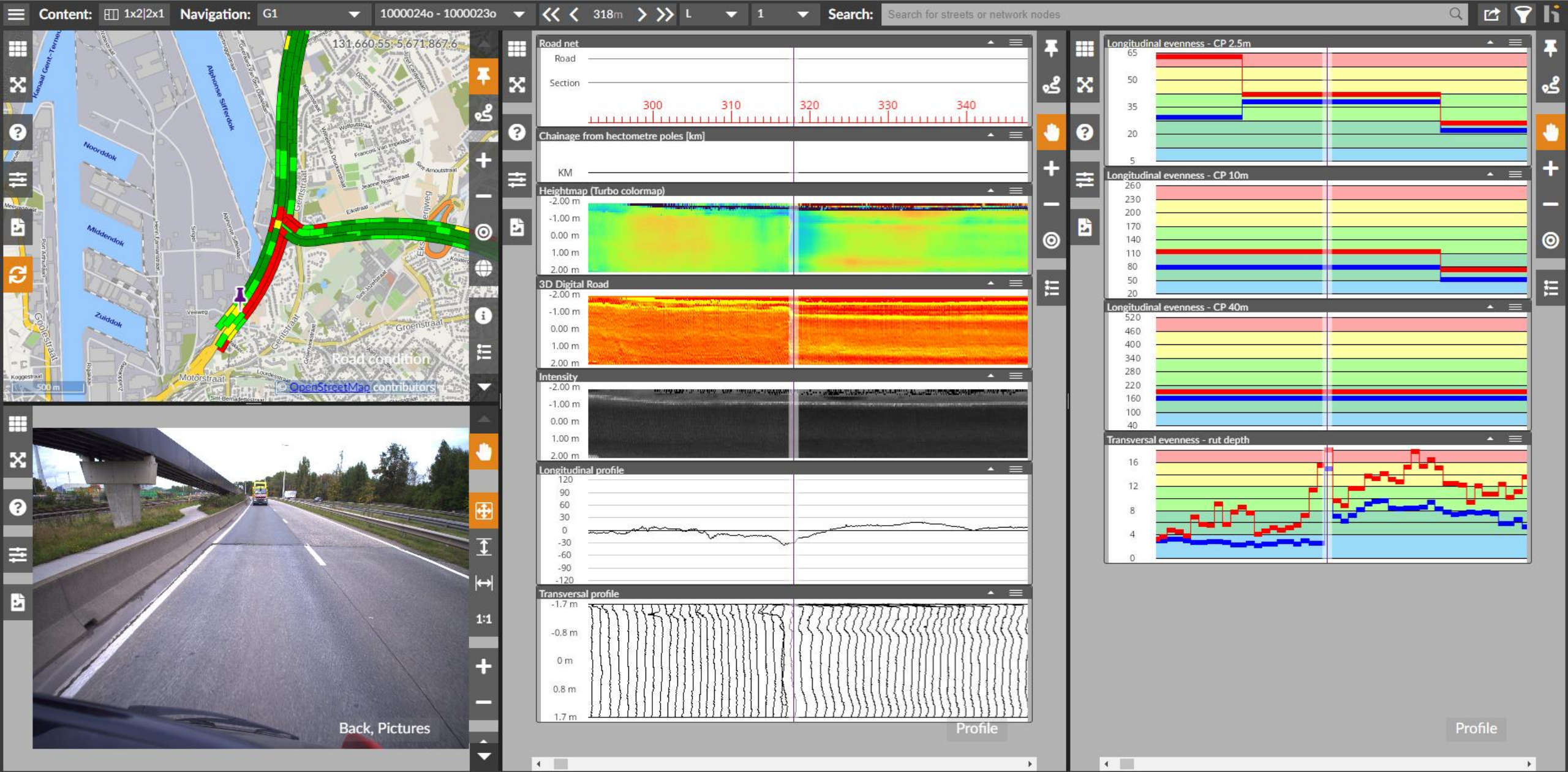
Trend analysis
- Crack analysis
- Road degradation quantification
- Maintenance advices

Road characteristics
- IRI
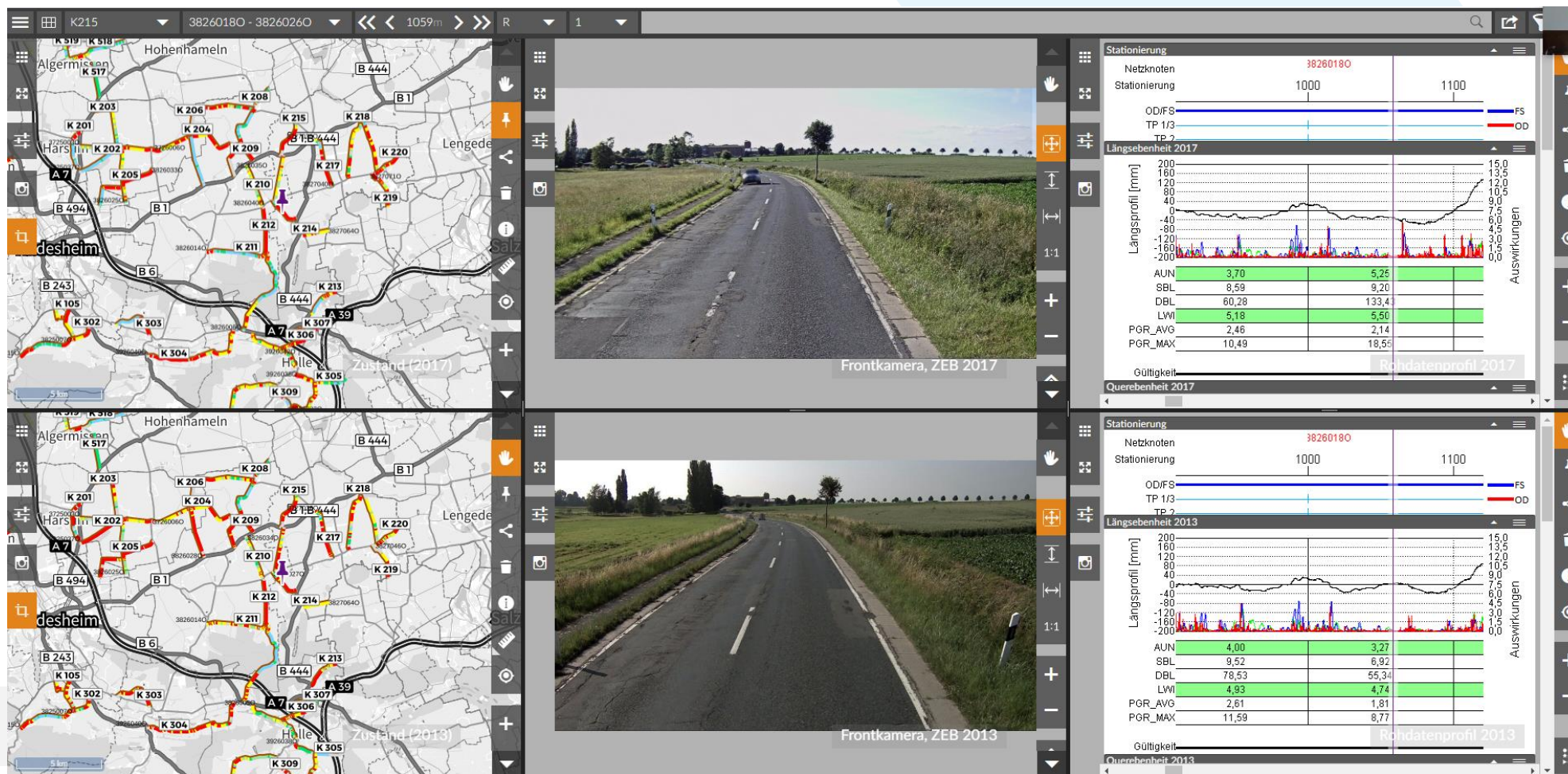- Longitudinal waviness
- Transversal waviness / Rutting

Realtime raw data
- 2D camera images every x meter
- **3D Digital Twin**
- Reflectivity map
- GPS & IMU value, synchronized with Lidar data

Link to Cloud Data GIS

XenomatiX
True solid state lidar

Online Analysis – Comparison - Follow-up

Agenda:

What XenomatiX stands for

× XenomatiX provides superior 3D sensing for automotive applications.

× XenomatiX' novel LiDAR solutions enable reliable detection of road users, obstacles and road conditions for **safer**
× **and more comfortable driving**.

XenomatiX customers

Automotive OEMs: TMG (Toyota Motorsport GmbH), Ford, Toyota Research Institute, Bentley, Toyota, Subaru, Daimler, Tesla, VW, GM, Hyundai, Honda, FCA (Fiat Chrysler Automobiles), Mazda

TIER I Automotive: AGC, AL Automotive Lighting, Marelli, Denso, Aptiv, Tenneco, Panasonic, SL Corporation, Cosworth, Kautex A Textron Company, Hitachi, AVL, ZF, ClearMotion, ZK, Autoliv, Magna, Delphi, ThyssenKrupp

Industrial: Siemens, JAT, Università Koblenz · Landa, Trimble, TOYO Corporation, Pepperl+Fuchs, Sick Sensor Intelligence.

Road Market: Besix, Belgian Road Research Centre – Together for sustainable roads, Vlaanderen is wegen en verkeer, Brussel Mobiliteit – Gewestelijke Overheidsdienst Brussel, Colas, SSI, Nexco 中日本, Stadsbader, XAIS Asset Management

Global representation

- Headquarters:
- XenomatiX Belgium

- Local offices:
- XenomatiX Deutschland
- XenomatiX US
- XenomatiX China

- Distribution channels for XenomatiX products:
- Japan through **TOYO CORPORATION**
- US through **TOYOTech**
- South-Korea through **JAT**
- China through **Shanghai ZK Auto Electronics**

Awards

From 2016 to 2022...

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Take-aways

1. PMS requires regular pavement surveys

2. Automotive developments will increase survey frequency and will change our activities

3. It's not a threat but an opportunity

4. These technologies are available today for road surveying

Contact XenomatiX

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Follow us on Social Media @XenomatiX

True solid state lidar