ESRIUM

SAFE AND EFFICIENT ROADS

Road wear map creation for traffic management and maintenance planning

JOANNEUM
RESEARCH
DIGITAL

fh
OBERÖSTERREICH
UNIVERSITY
OF APPLIED SCIENCES
UPPER AUSTRIA

LOGISTIKUM
CHALLENGE ACCEPTED

ASFiNAG

virtual vehicle

NLS
FINNISH GEOSPATIAL
RESEARCH INSTITUTE
FGI

NNG

enide

[evolit]
we make IT yours

OUR VISION

The overall objective of ESRIUM is to foster safer and more efficient roads towards a smarter, safer, greener transport system through an EGNSS-based digital map.
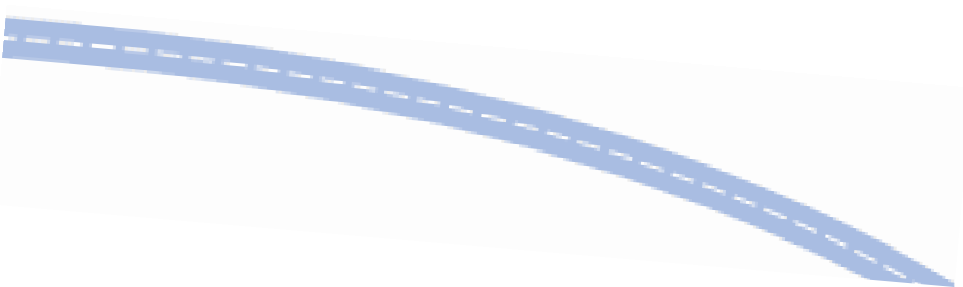
Smarter

Exploiting detailed driving recommendations received from the road operator in every automated and connected car.

Safer

Allowing the vehicle to drive on an undamaged road surface.
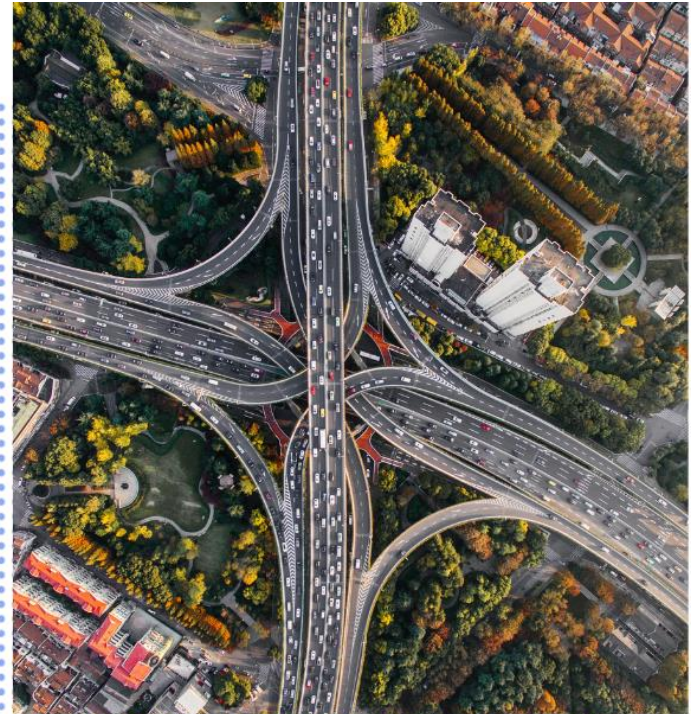
Greener

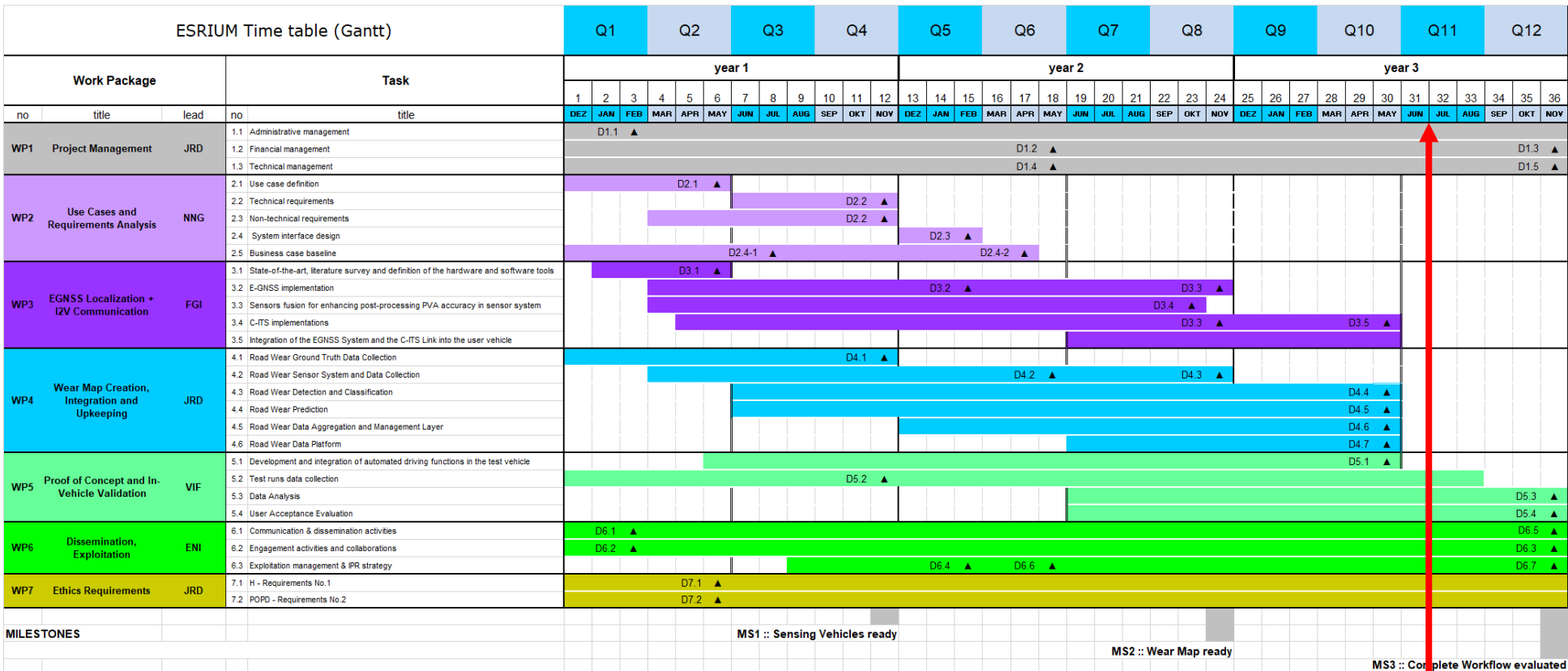A longer paving lifetime makes road operations greener and more resource-efficient.

OUR MISSION

Our key innovation is an EGNSS-based data platform. Our innovative digital road wear map will generate routing recommendations in-lane and cross-lane based on

✓ Road damage locations
✓ Road damage type
✓ Recent repair interventions
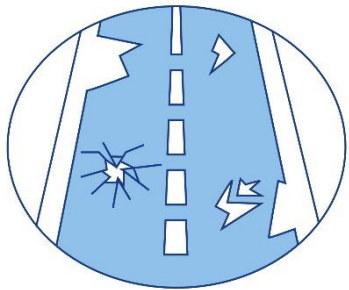✓ Prediction on the temporal evolution of road damages depending on environmental and traffic conditions
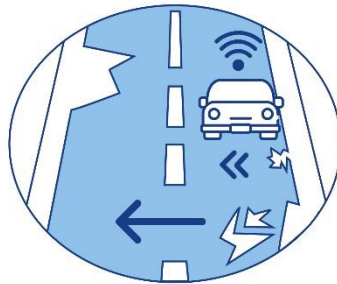
Timeplan

ESRIUM — SAFE AND EFFICIENT ROADS

ESRIUM Time table (Gantt)

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
year 1				year 2				year 3			

Work Package no	title	lead	Task no	title
WP1	Project Management	JRD	1.1	Administrative management
			1.2	Financial management
			1.3	Technical management
WP2	Use Cases and Requirements Analysis	NNG	2.1	Use case definition
			2.2	Technical requirements
			2.3	Non-technical requirements
			2.4	System interface design
			2.5	Business case baseline
WP3	EGNSS Localization + I2V Communication	FGI	3.1	State-of-the-art, literature survey and definition of the hardware and software tools
			3.2	E-GNSS implementation
			3.3	Sensors fusion for enhancing post-processing PVA accuracy in sensor system
			3.4	C-ITS implementations
			3.5	Integration of the EGNSS System and the C-ITS Link into the user vehicle
WP4	Wear Map Creation, Integration and Upkeeping	JRD	4.1	Road Wear Ground Truth Data Collection
			4.2	Road Wear Sensor System and Data Collection
			4.3	Road Wear Detection and Classification
			4.4	Road Wear Prediction
			4.5	Road Wear Data Aggregation and Management Layer
			4.6	Road Wear Data Platform
WP5	Proof of Concept and In-Vehicle Validation	VIF	5.1	Development and integration of automated driving functions in the test vehicle
			5.2	Test runs data collection
			5.3	Data Analysis
			5.4	User Acceptance Evaluation
WP6	Dissemination, Exploitation	ENI	6.1	Communication & dissemination activities
			6.2	Engagement activities and collaborations
			6.3	Exploitation management & IPR strategy
WP7	Ethics Requirements	JRD	7.1	H - Requirements No.1
			7.2	POPD - Requirements No.2

Deliverables: D1.1, D1.2, D1.3, D1.4, D1.5, D2.1, D2.2, D2.3, D2.4-1, D2.4-2, D3.1, D3.2, D3.3, D3.4, D3.5, D4.1, D4.2, D4.3, D4.4, D4.5, D4.6, D4.7, D5.1, D5.2, D5.3, D5.4, D6.1, D6.2, D6.3, D6.4, D6.5, D6.6, D6.7, D7.1, D7.2

MILESTONES

MS1 :: Sensing Vehicles ready

MS2 :: Wear Map ready

MS3 :: Complete Workflow evaluated

ESRIUM

SAFE AND EFFICIENT ROADS

ESRIUM BUSINESS USE CASES

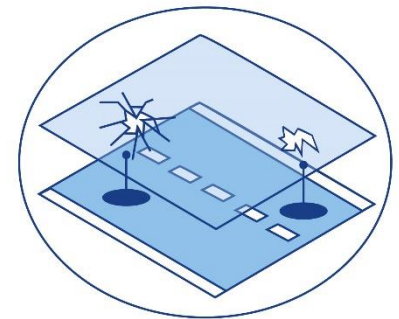**Business Use Case 1:** AI-based Road damage Prediction System

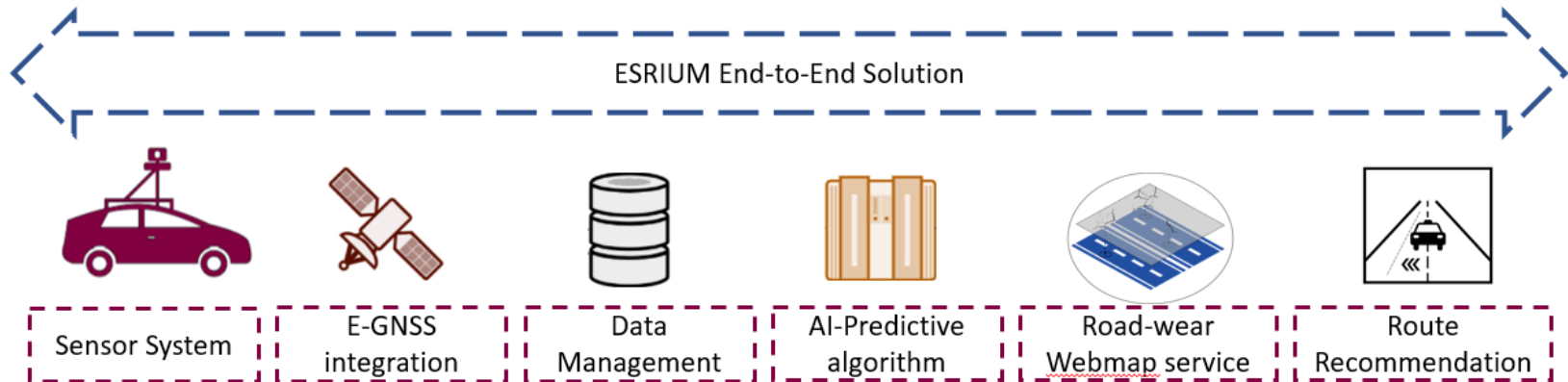**Business Use Case 2:** Routing Recommendations based on the road wear map, provided via C-ITS messages

Business Use Case 3: C-ITS Message 'GNSS-correction data' provision

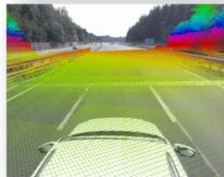**Business Use Case 4:** Wear-map content provision

Products and Services

ESRIUM End-to-End Solution

| Sensor System | E-GNSS integration | Data Management | AI-Predictive algorithm | Road-wear Webmap service | Route Recommendation |

Technical Challange

Cost Efficient Data Acquisition

(a)

Lane Data Capture

(b)

Detection of Damages and Changes

DAMAGE

material3

material1   material2

METAL
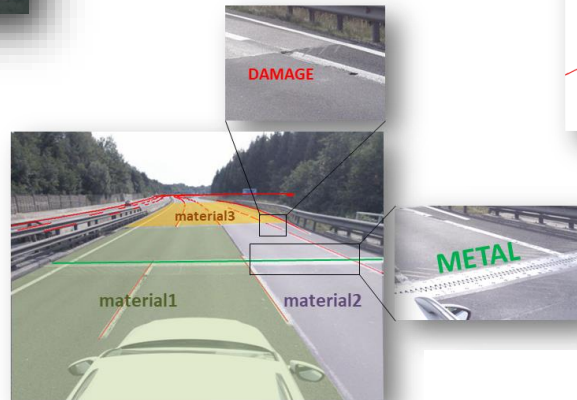
(c)

Communication of Driving Recommendations
for Automated Vehicles
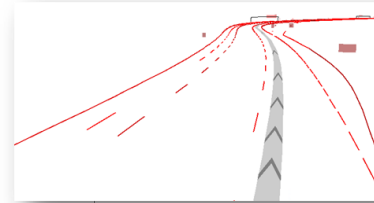
(d)

Reduced Road Wear

Optimized Maintenance

(e)

Low-Cost Sensor Platform

- 2x Basler acA4112-30uc USB3 Vision Kamera ace L

- Very compact and light-weight MEMS - based EGNSS/IMU System
(Novatel PwrPak7D-E2 including Novatel OEM7 multiband EGNSS receiver and Epson G370 IMU)

- Septentrio mosaic-x5 EGNSS receiver module

- EGNSS/IMU System for reference localization
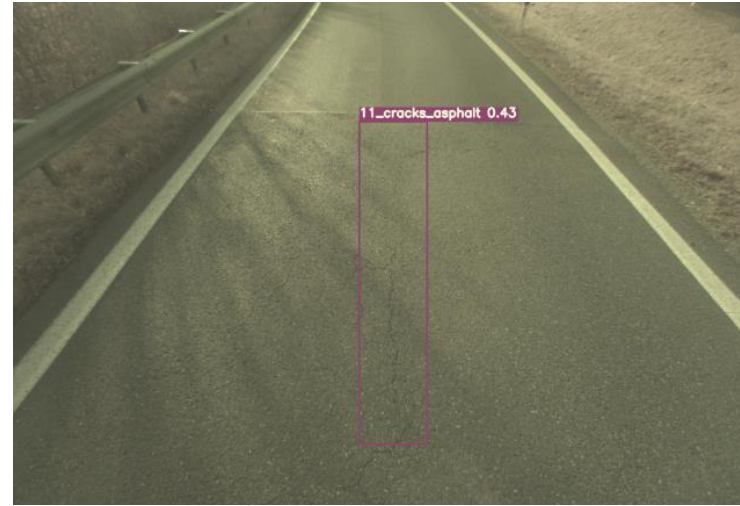(iMAR iNAT FSLG01 with FOG-based Gyroscopes and Novatel OEM7 receiver)

# Road Wear Sensor System
Camera based defect recognition
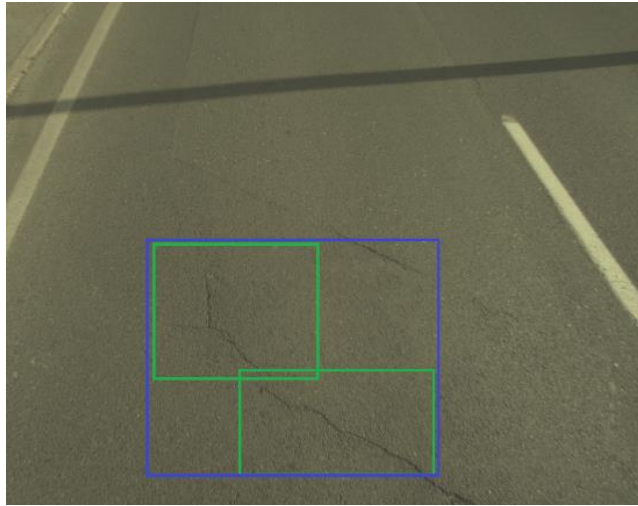
(a)

(b)

Images from the ESRIUM road wear sensor. (a) Explains why it is hard to label damages like cracks consistently. Both, the blue box and two green boxes, would be reasonable labels for the crack at the bottom. The difference for the application/use is not important, but influences the cost and evaluation numbers like IOU and box centre costs. (b) Shows a detection result on new, unseen data.

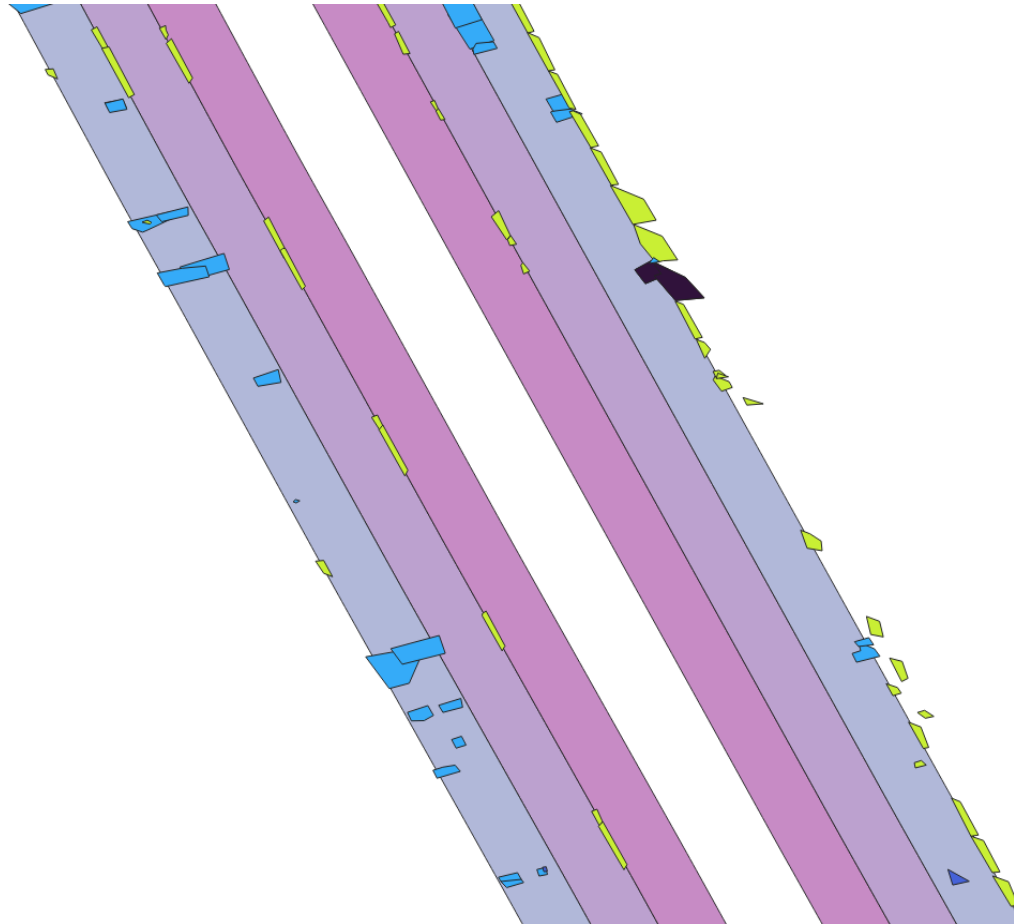# Road Wear Sensor System
Camera based defect recognition
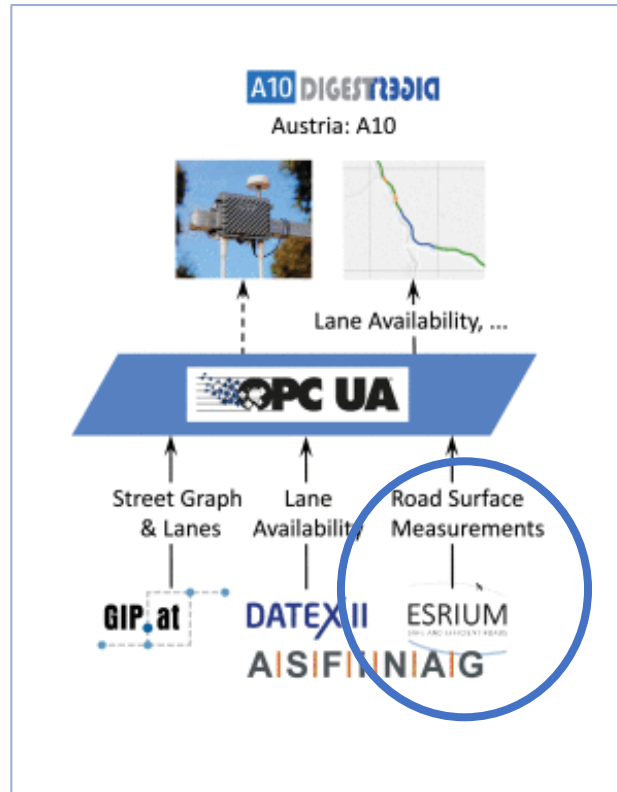
Road Wear Feature User Interface
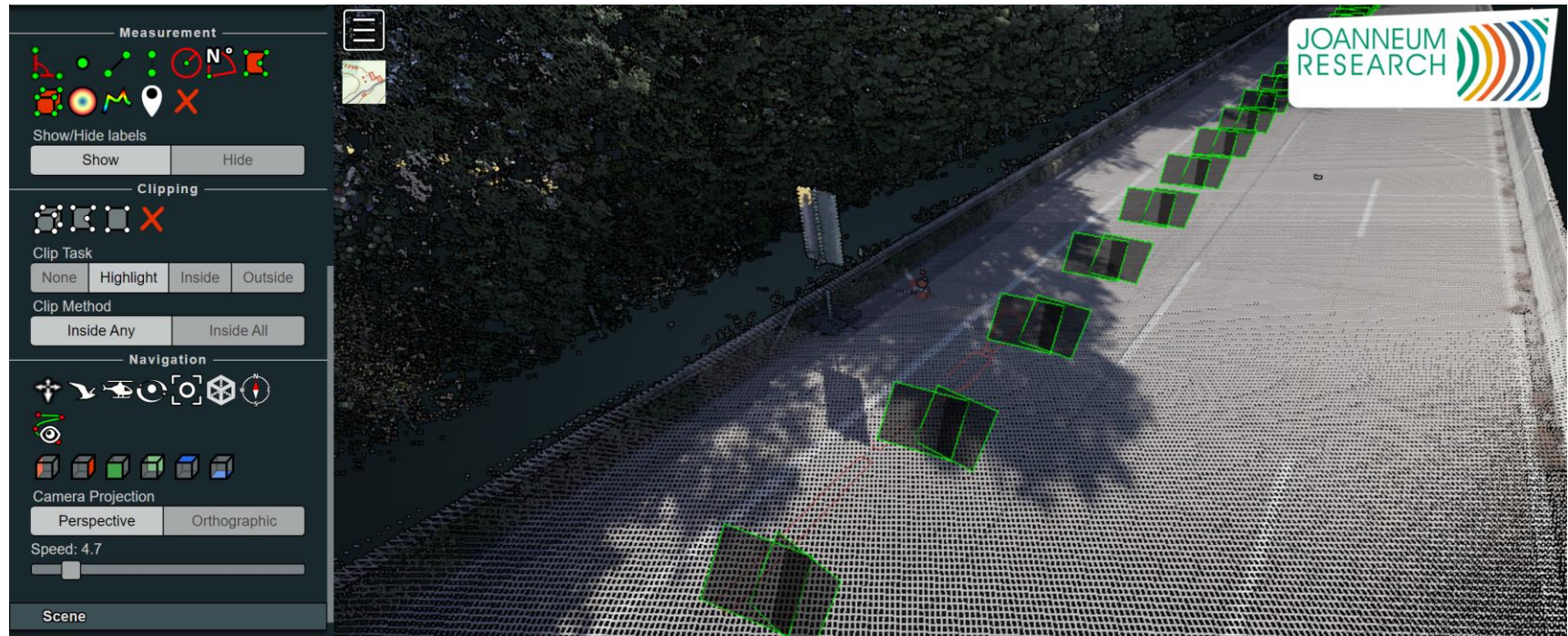
Data Platform
Sample from Web Feature Service

lanes & road wear features

CCAM Decision Support Platform

E. Thonhofer *et al.*, "**Infrastructure-Based Digital Twins for Cooperative, Connected, Automated Driving and Smart Road Services**," in *IEEE Open Journal of Intelligent Transportation Systems*, vol. 4, pp. 311-324, 2023, doi: 10.1109/OJITS.2023.3266800

NEXT STEPS

User Acceptance Evaluation

Truck Drivers

Real-world C-ITS testing of "lane changing" and "within-lane changing" recommendations

Road Operators

Usability of implementing ESRIUM results (e.g. road wear map) into operating systems

Contact

Matthias Rüther, PhD

JOANNEUM RESEARCH Forschungsgesellschaft mbH
DIGITAL – Institute for Digital Technologies
Steyrergasse 17, 8010 Graz, Austria
phone: +43 316 876-5001
mobile: +43 664 602 876-5001
email: matthias.ruether@joanneum.at

@Esrium_H2020

Esrium group
Esrium page: @ESRIUM

www.esrium.eu