

***DIGITAL***  
***Institute for***  
***Digital Technologies***



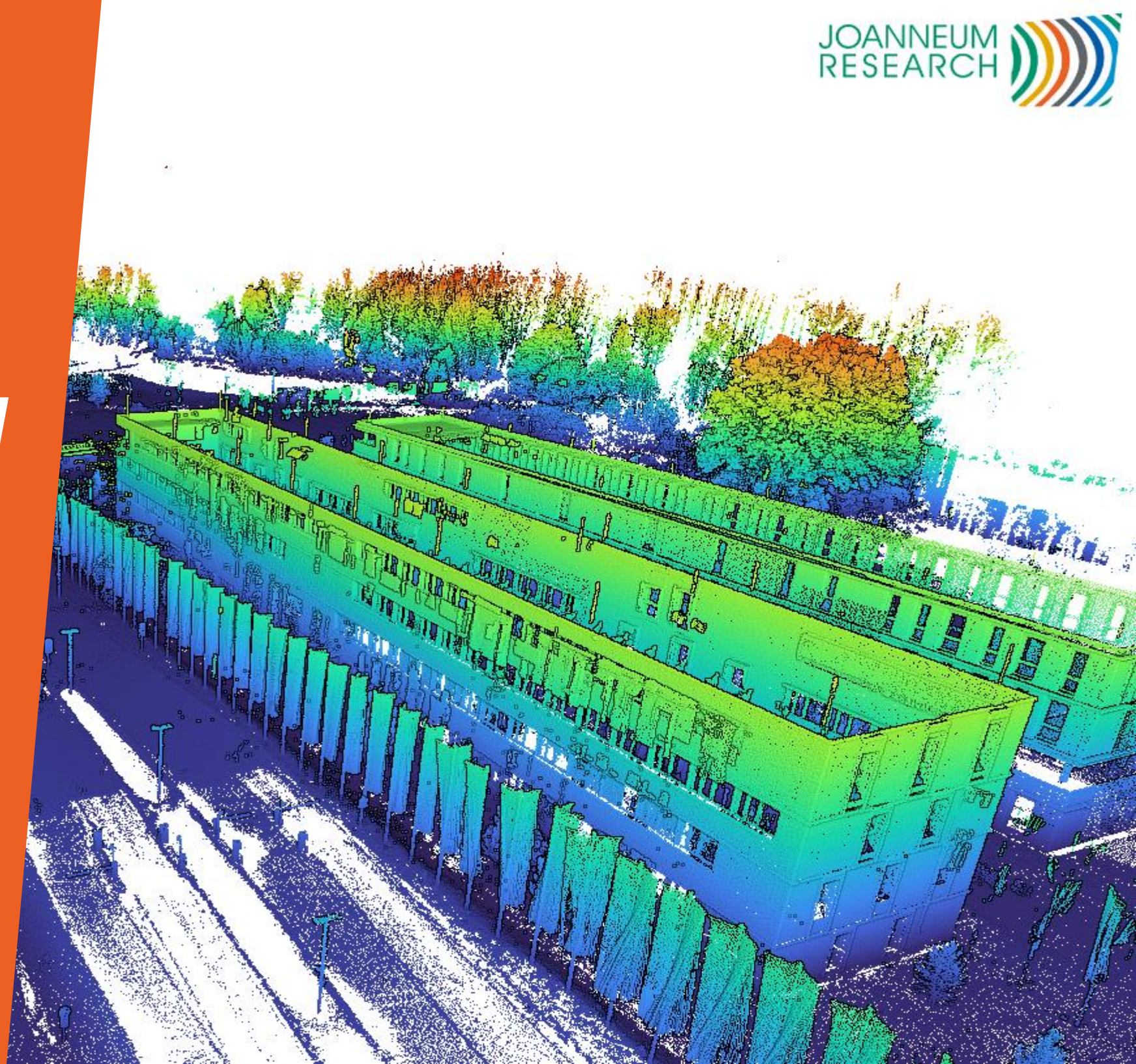


# *JOANNEUM RESEARCH Digital Twin Lab*

*Lakeside Science & Technology Park*

*Patrick Luley*

*Head of Digital Twin Lab*



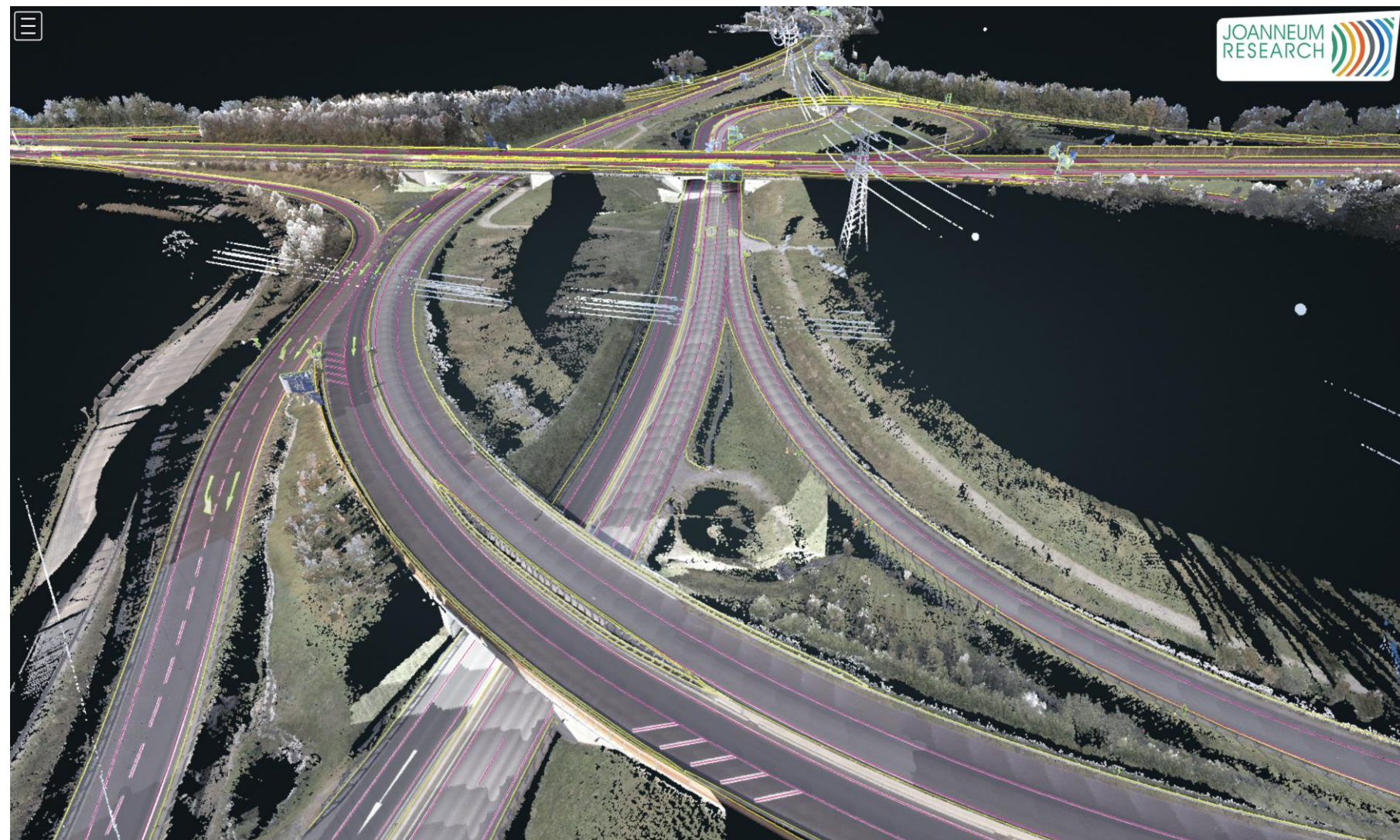


## ***Digital Twin Lab - Key Facts***

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- **Bezeichnung:** Digital Twin Lab
- **Standort:** Klagenfurt am Wörthersee / Lakeside B13b
- **Forschungsthema:** F&E / Digitalisierung / „Räumlicher Digitaler Zwilling“
- **Zeitplan:** Aufbauphase von 2023 bis 2027
- **Personen:** 10+ Mitarbeiter\*innen in fünf Jahren
- **Fläche:** 130 m<sup>2</sup> Büro / 100 m<sup>2</sup> Labor
- **F&E-Infrastruktur:** 1,6 Mio. Euro an Messtechnik und IT

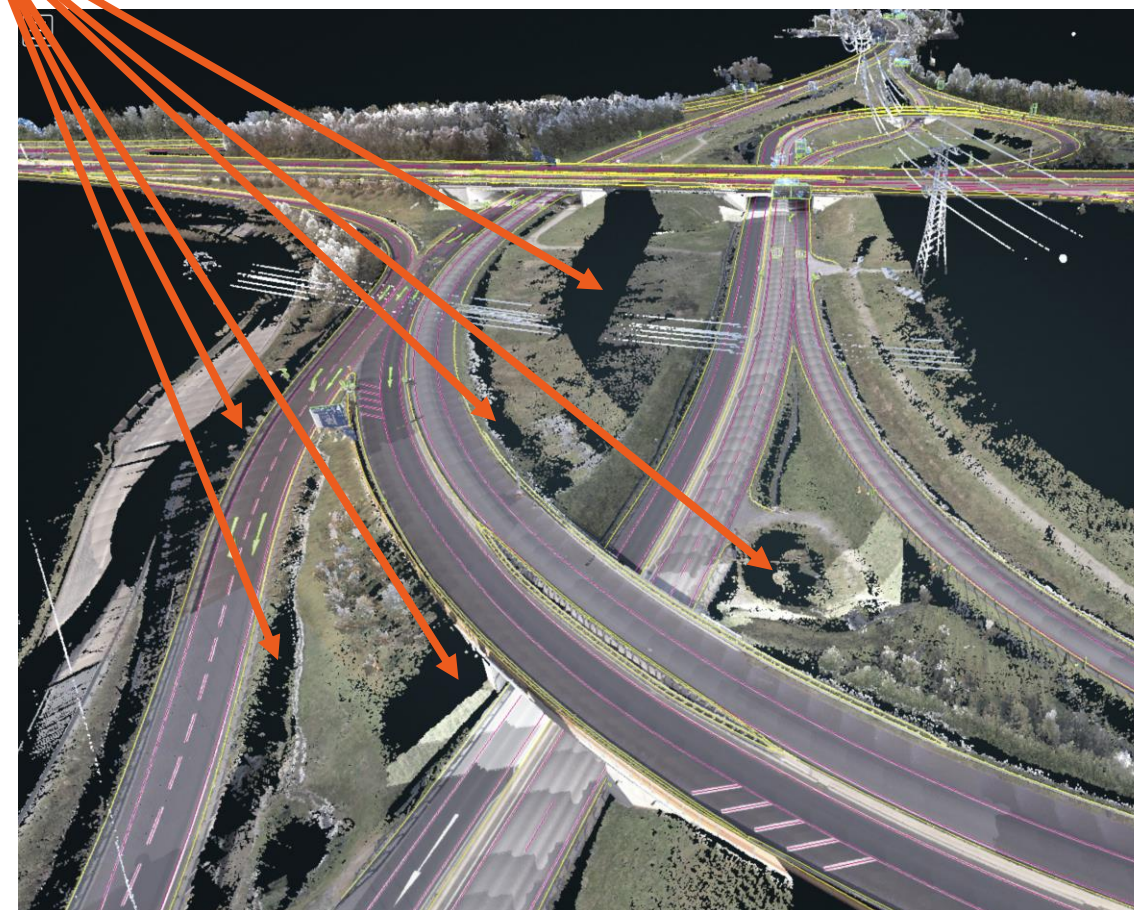
# *Spatial Digital Twins - State of the art*





## *Digital Twin Lab - Problem to be solved*

- Current digital twins have huge **blind spots** (black areas) due to...
  - Usage of a single sensor systems
  - Scanning from a single perspective
  - Signal occlusions by objects along the road
  
- ➔ Object recognition fails
- ➔ 3D reconstruction fails
- ➔ Sensor simulation fails





***DIGITAL TWIN LAB***  
***Multi Platform Mapping***





# 3D Mapping and data fusion

3D Mapping: On-road, off-road, indoor and aerial laser scanning



VIAMetris Backpack



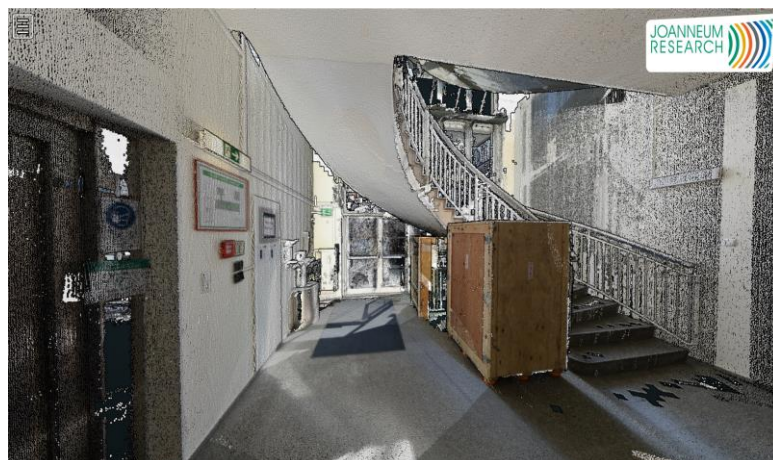
Riegl VZ400i



Riegl VMX-2HA



Riegl RiCopter VUX-SYS





# Aerial, On-Road and Off-Road Mapping



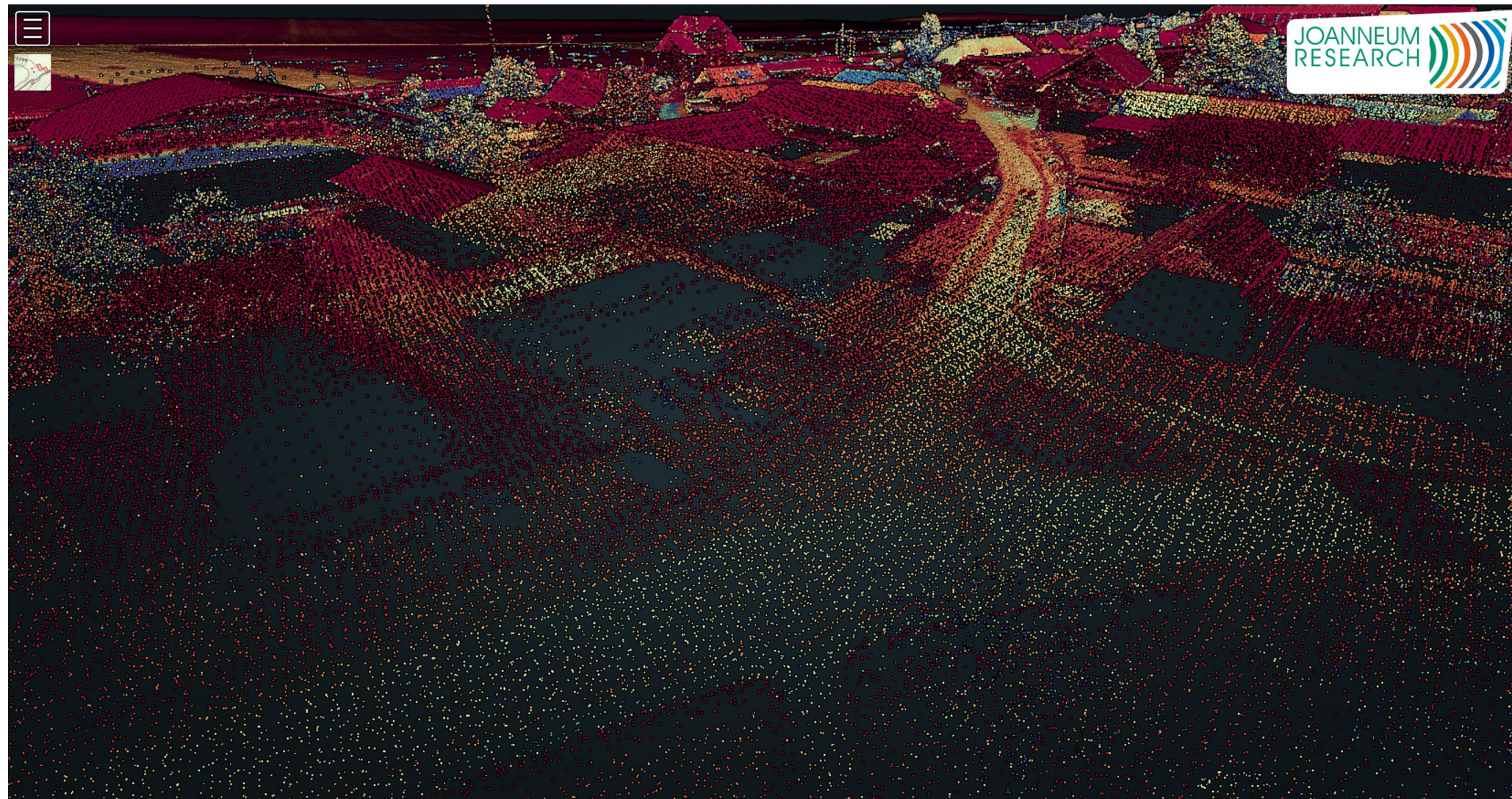
Riegl RiCopter VUX-SYS



Riegl VMX-2HA



Riegl VZ400i





# Aerial, On-Road and Off-Road Mapping



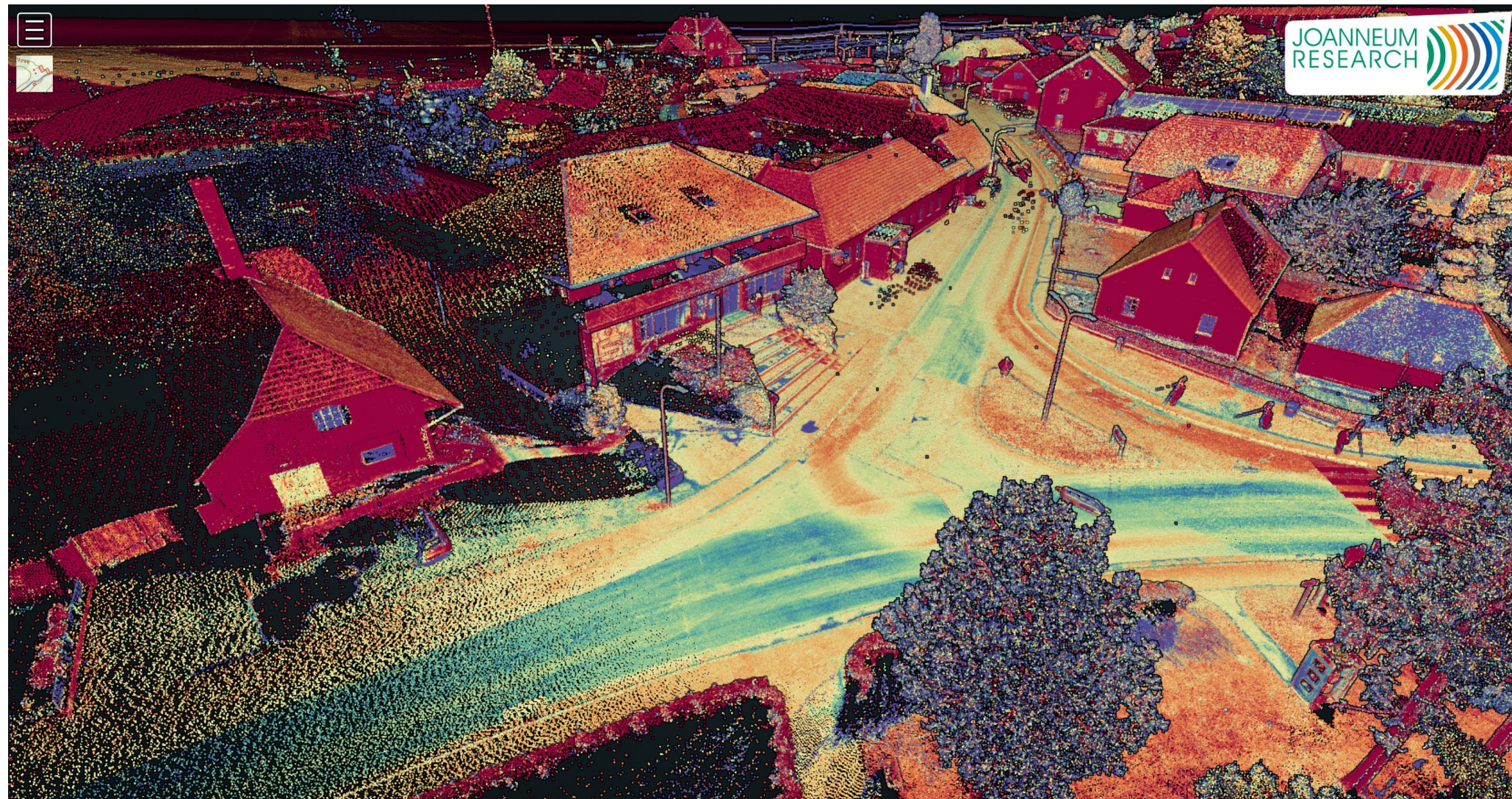
Riegl RiCopter VUX-SYS



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# Aerial, On-Road and Off-Road Mapping



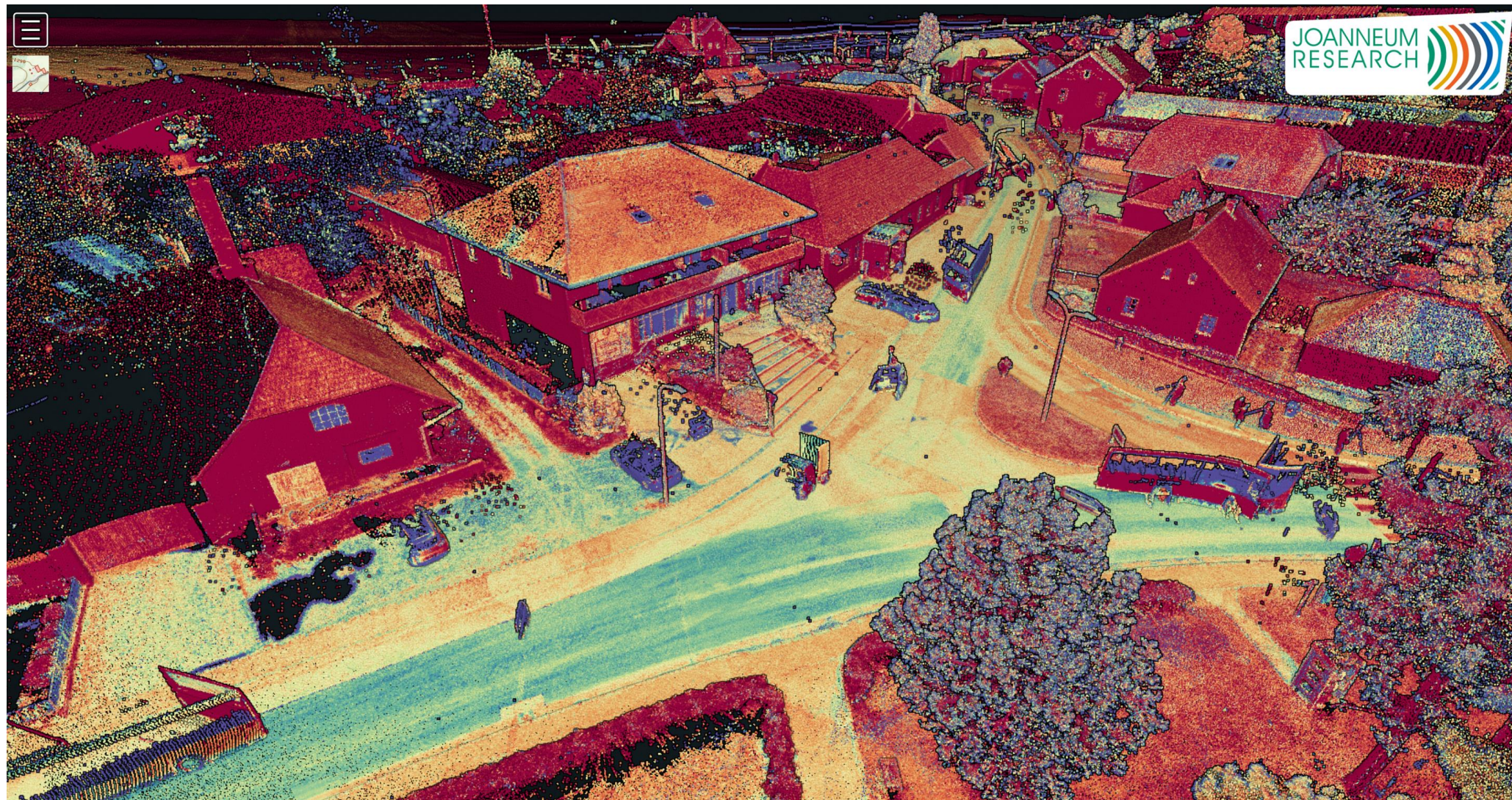
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Riegl VMX-2HA



Riegl VZ400i



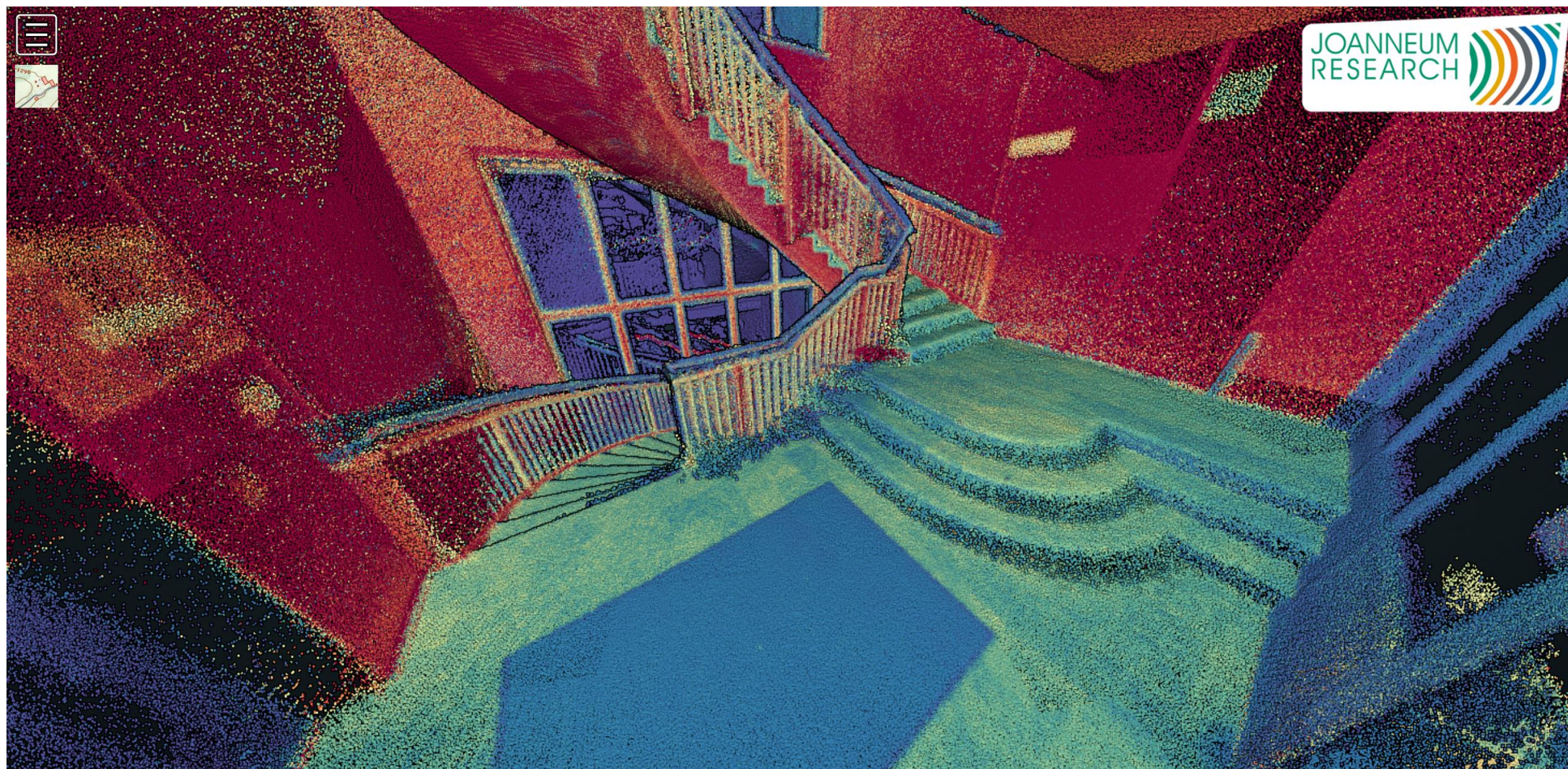


# Indoor Corridor Mapping

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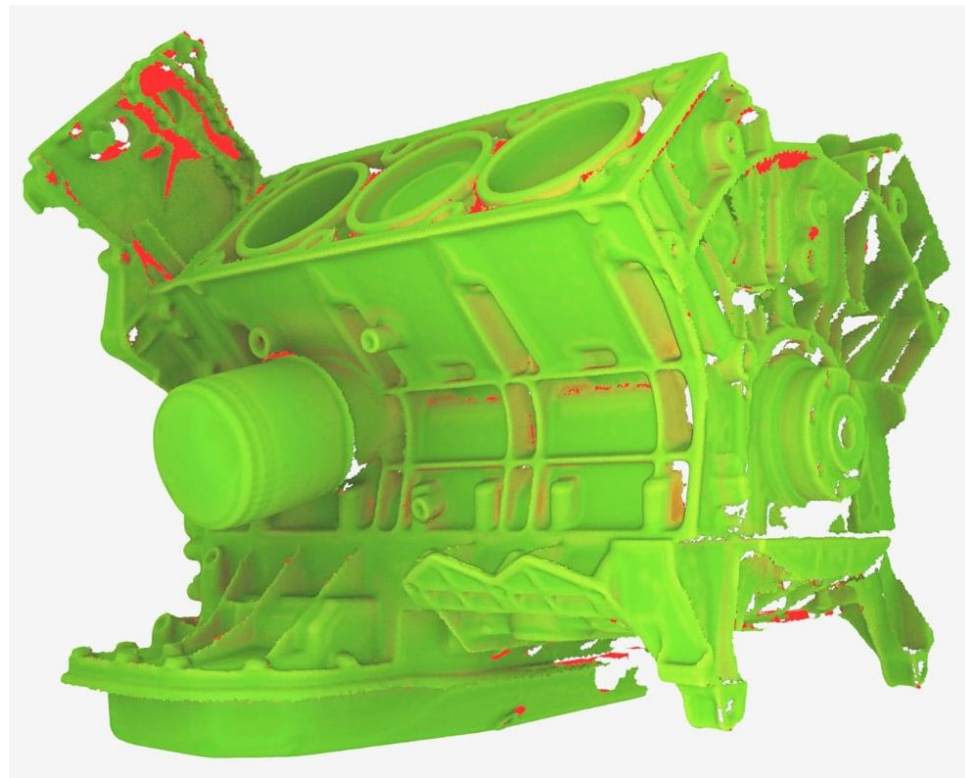


VIAMetris Backpack





# *High-Resolution Detail Mapping*



Artec Leo

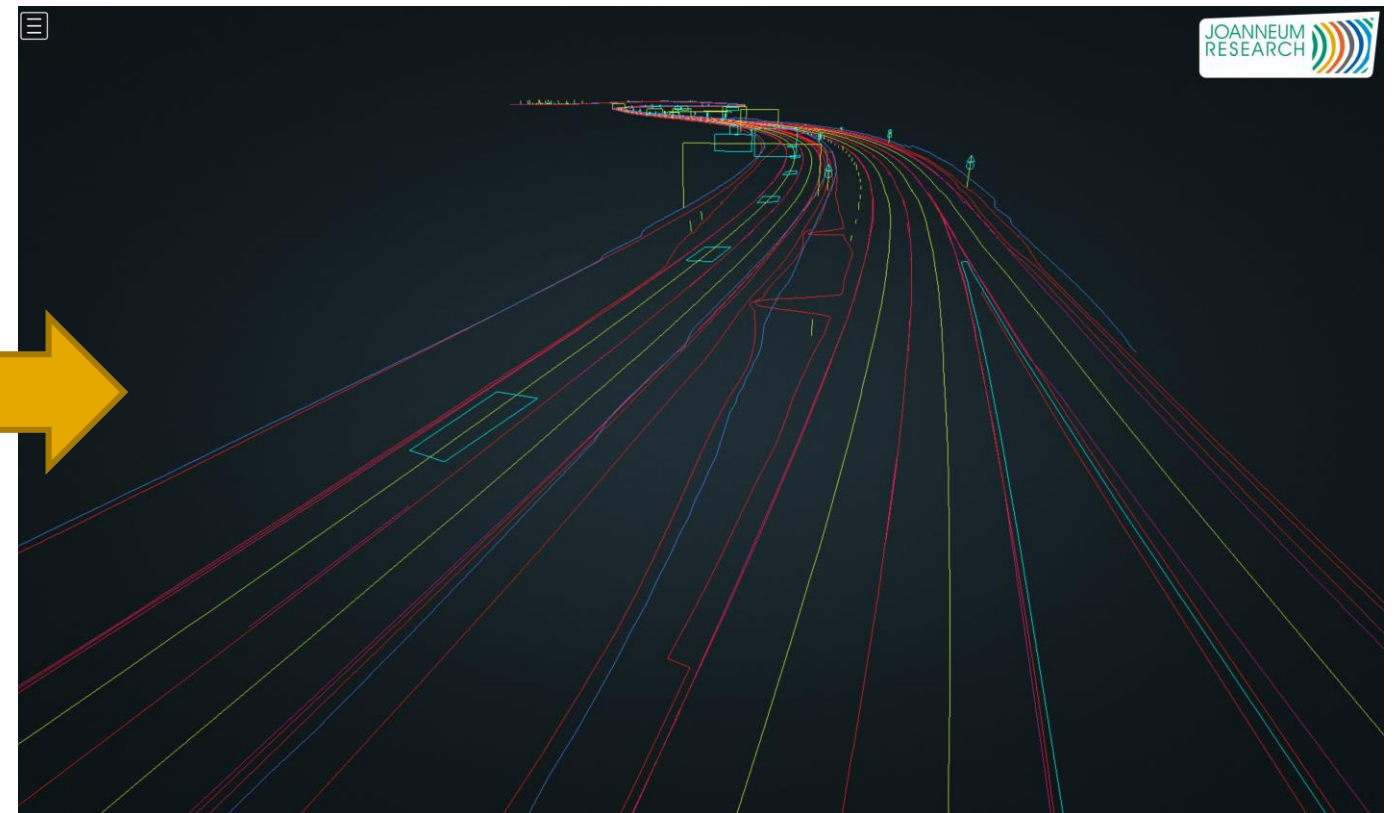


***DIGITAL TWIN LAB***  
***Data Processing***



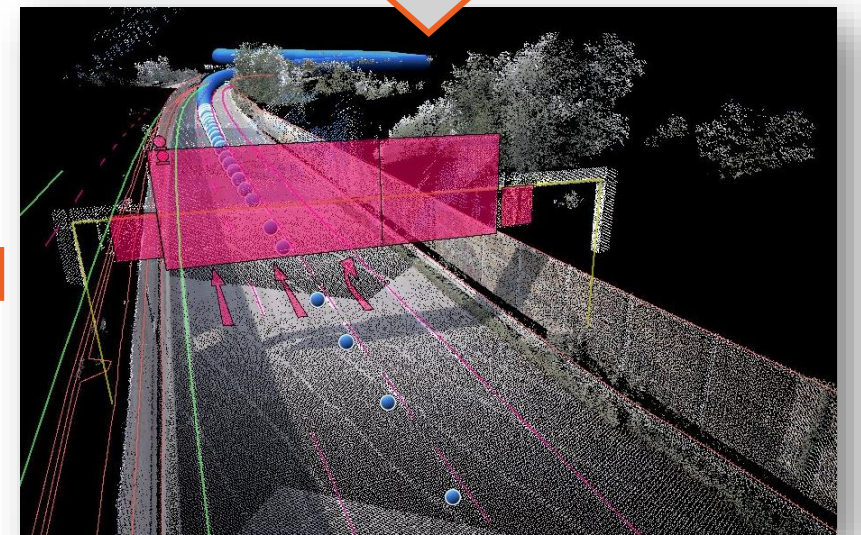
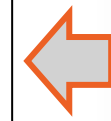
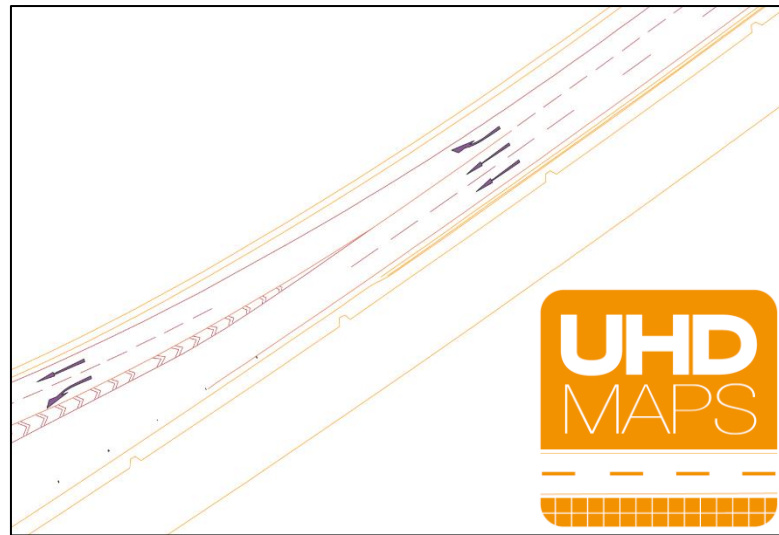
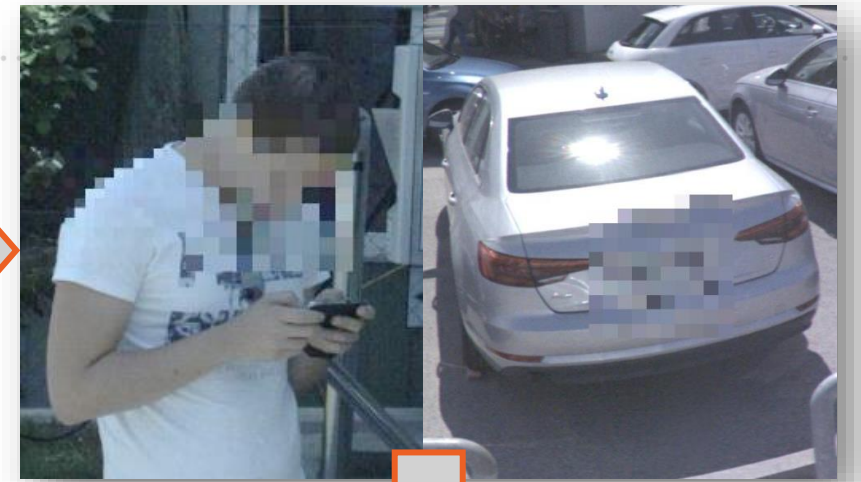


# *Creation of Ultra-High-Definiton Maps (UHDmaps®)*





# UHDmaps® - Automated Production Workflow





## *Data capturing by „Mobile Mapping“*



Public roads, Austrian highway A9,  
Supported by ASFINAG

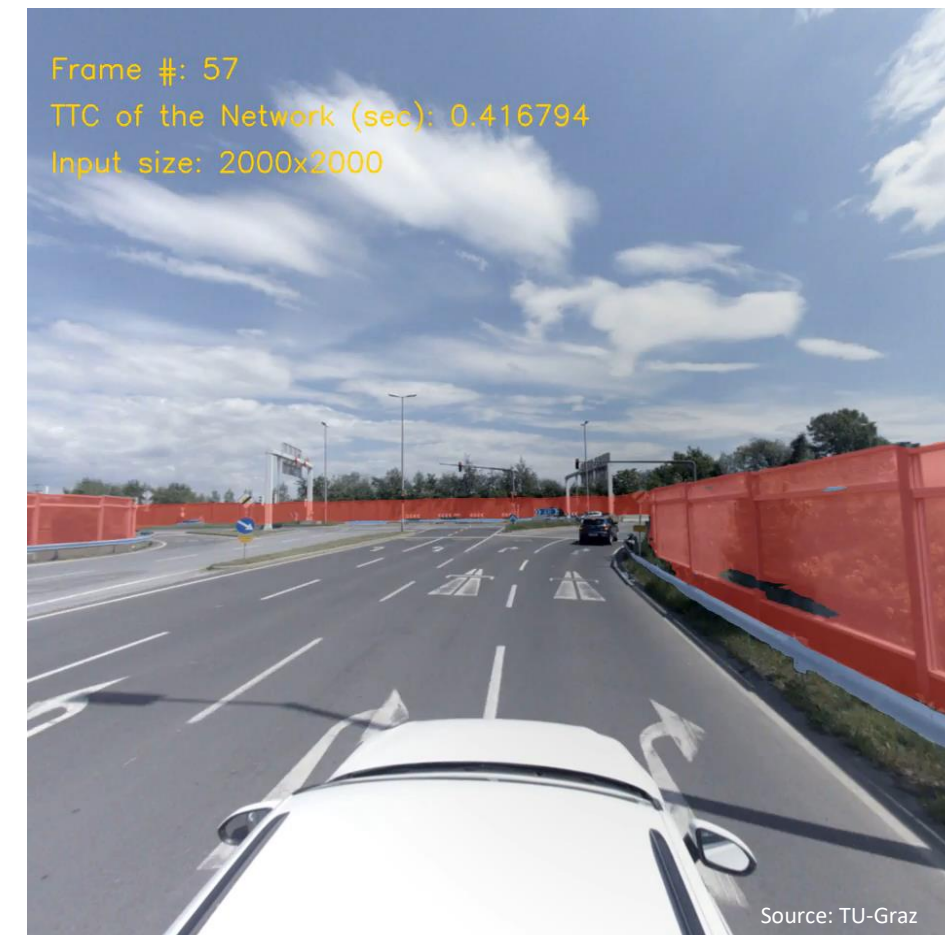
Private proving ground, ZalaZone





# UHDmaps<sup>®</sup> - Automated Creation

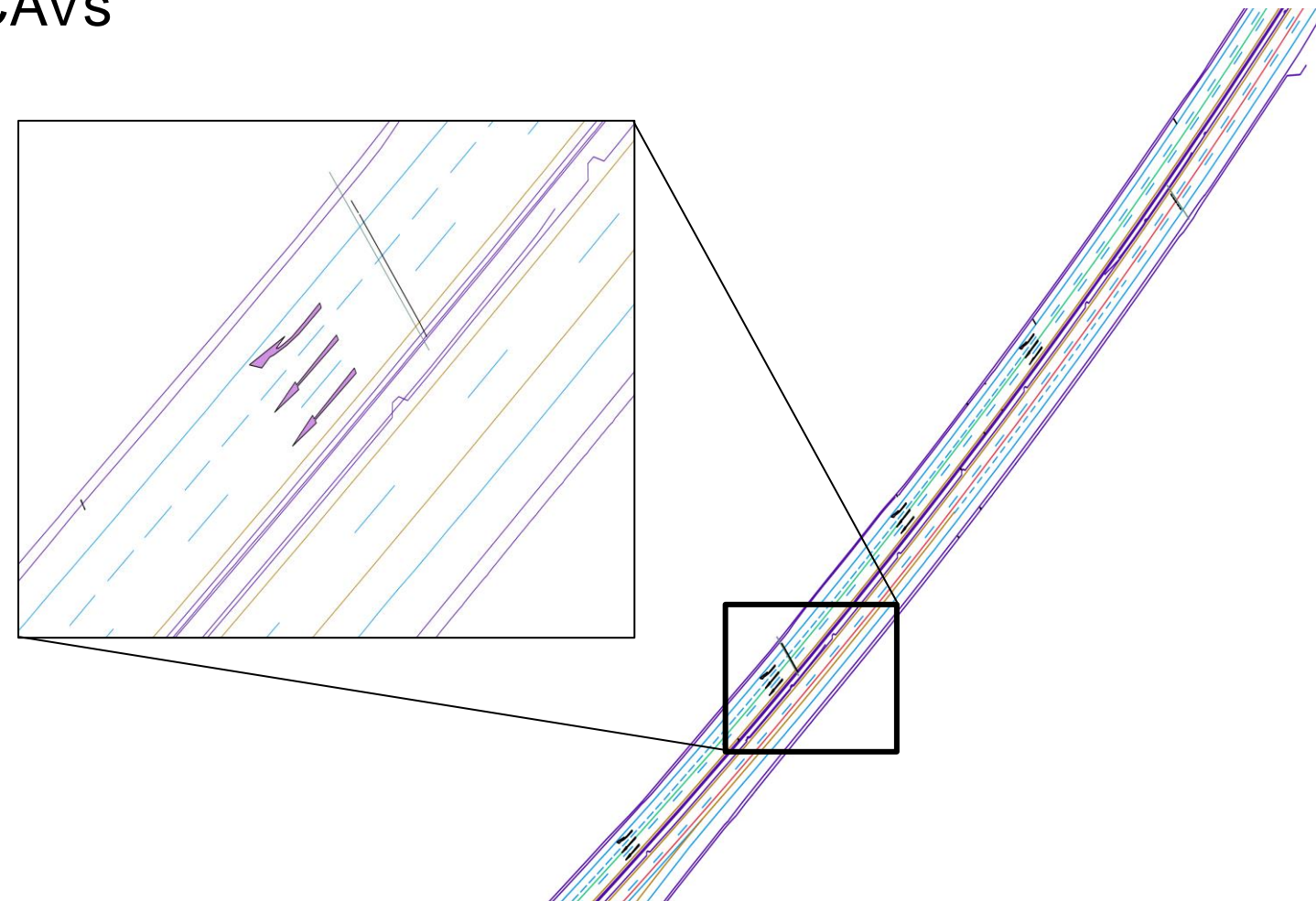
Cooperation JOANNEUM RESEARCH and TU-Graz





## ***UHDmaps® - As a service***

- **Static Ground Truth Data for testing CAVs**
  - Minimum +/- 5cm absolute accuracy
  - 100% complete and correct
  
- **Basic map features**
  - Road geometry and topology
  - Road markings and traffic signs
  - Over head constructions
  - Noise barriers, jersey barriers and guardrails
  - Curbs, Manholes, Street lamps, etc.



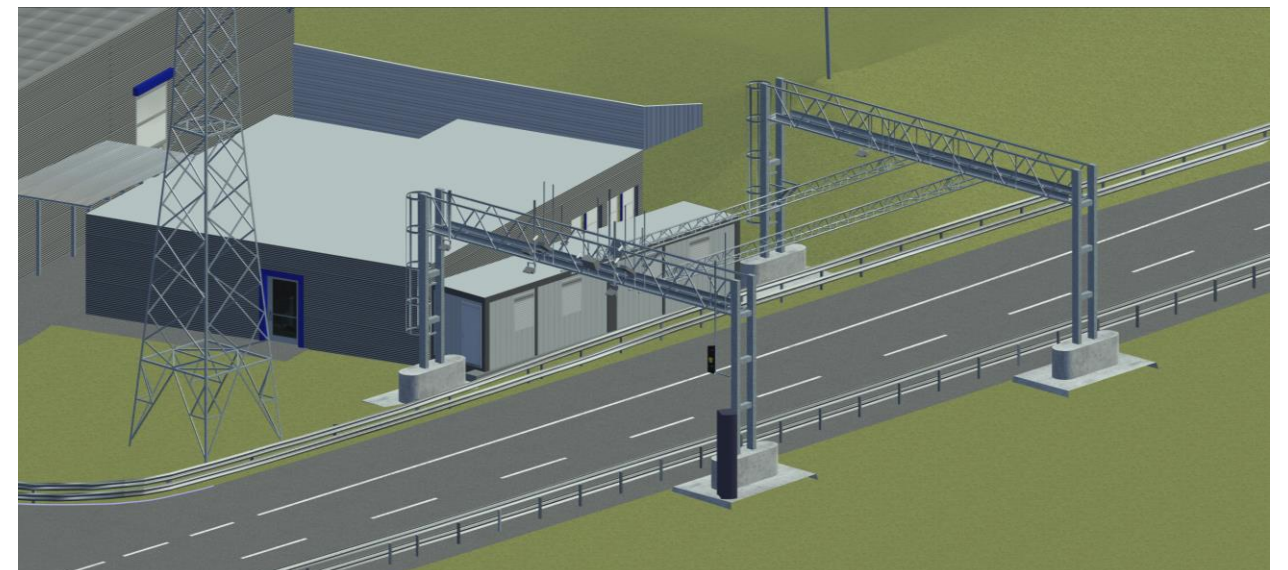
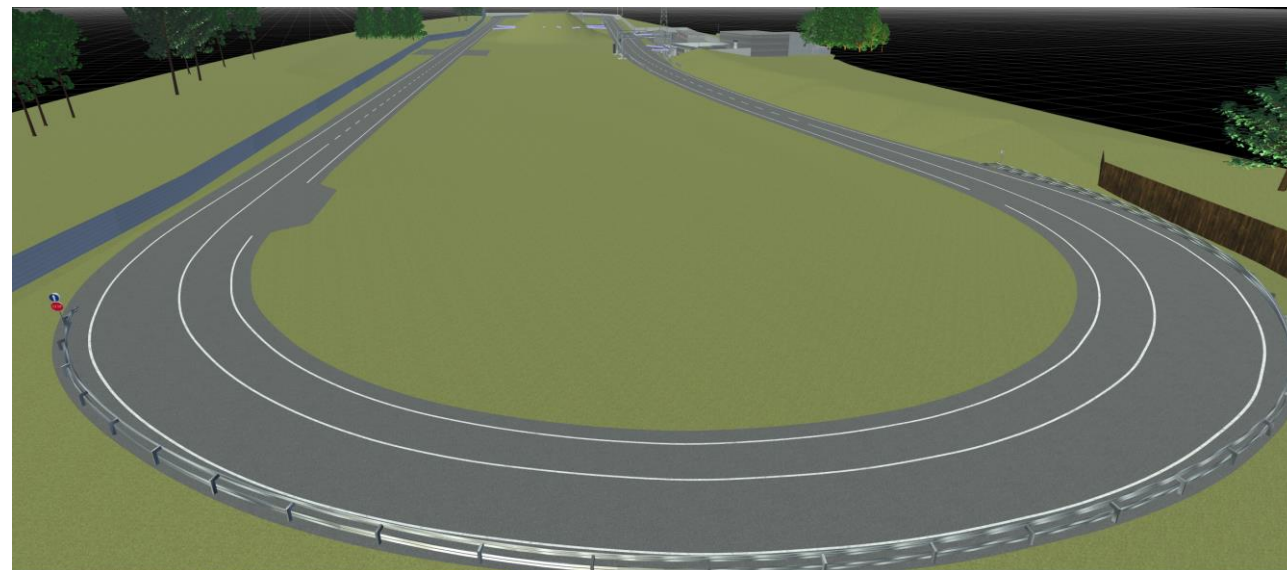
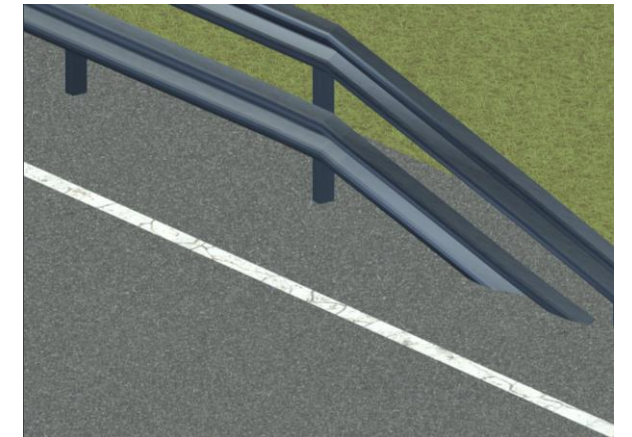
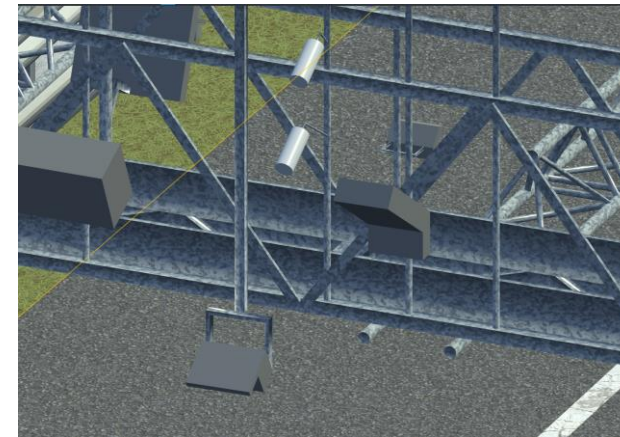
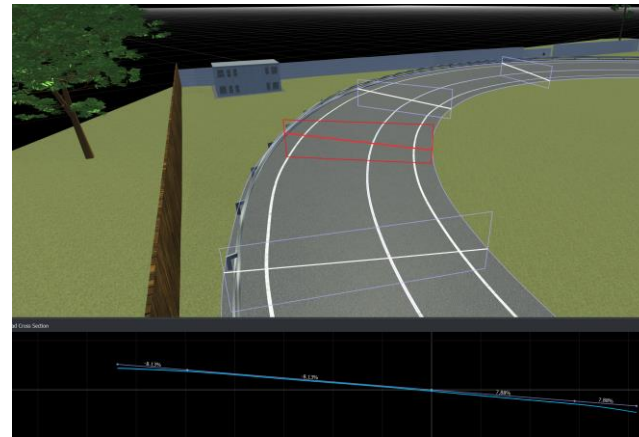
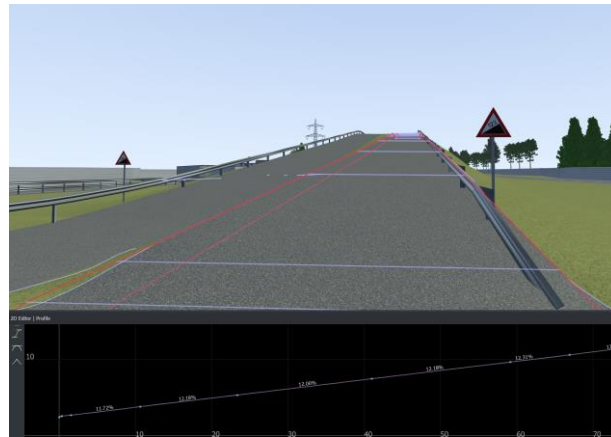


## *Creation of 3D Models*



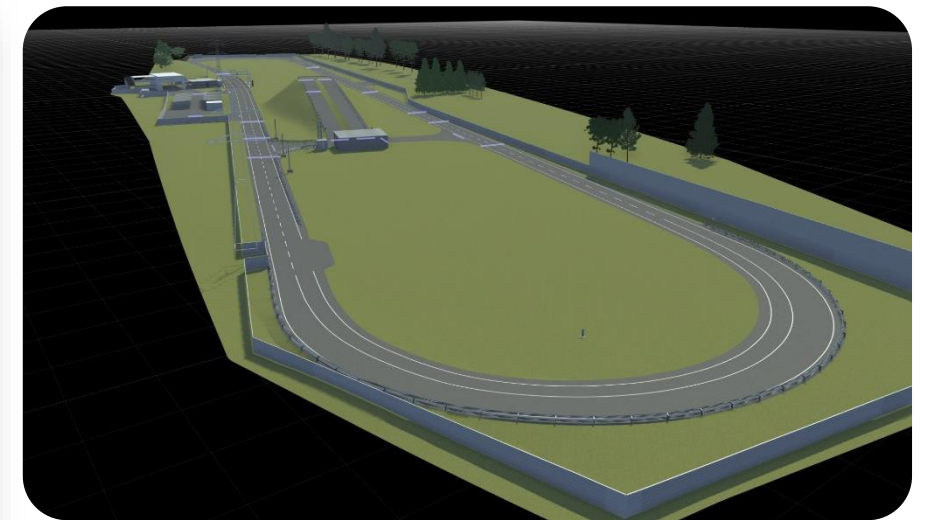
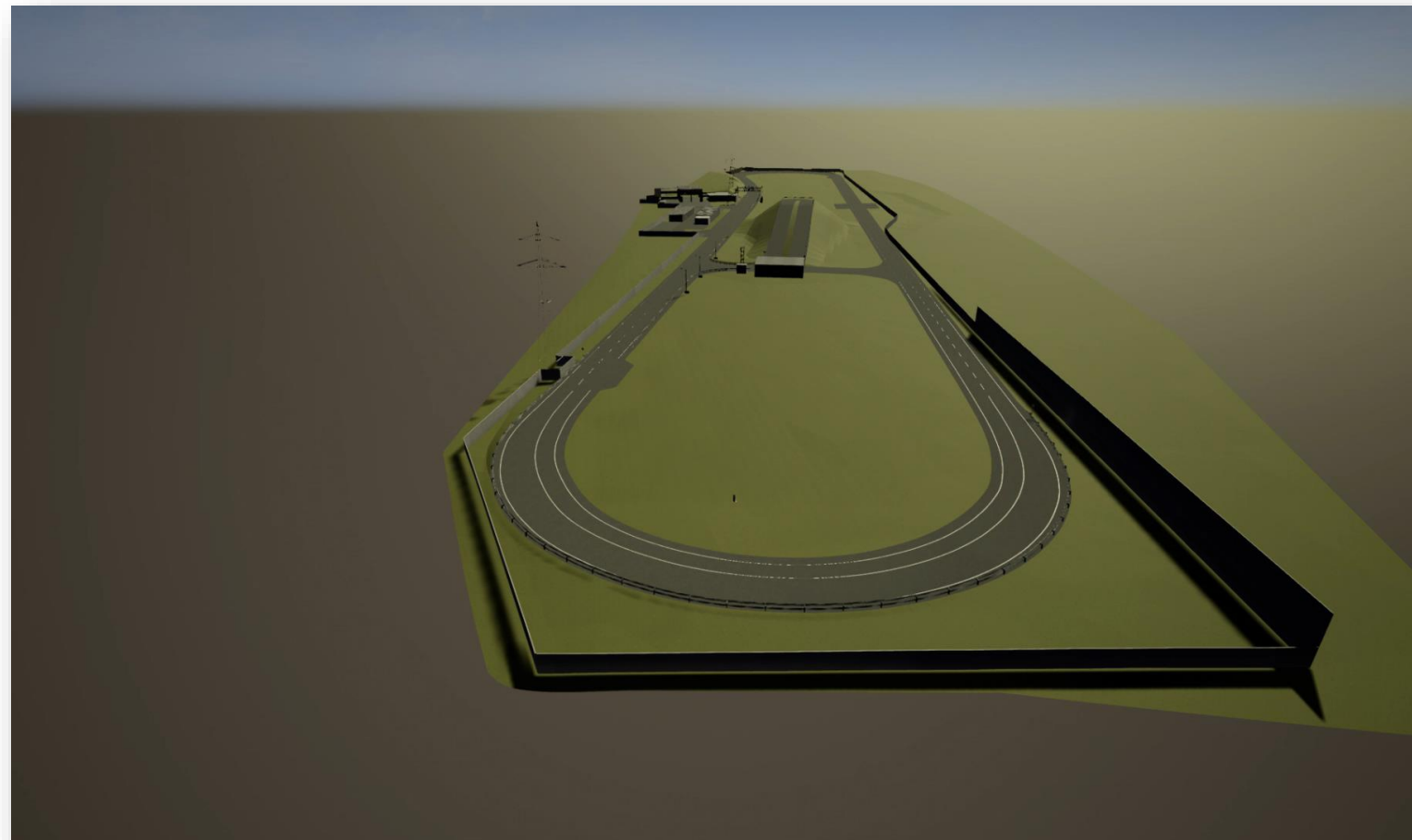


# High Detail 3D Reconstruction





# Simulation-capable 3D reconstructions



AVL Proving Ground, Gratkorn





# Available data formats

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- Supported Simulation Formats
  - ASAM OpenDrive
  - ASAM OpenCRG
  - IPG Road 5
  - GeoJSON
  - LaneLet2
  - Wavefrong OBJ
  - Unreal Engine FBX
  - Navigation Data Standard NDS

**OpenDrive™**



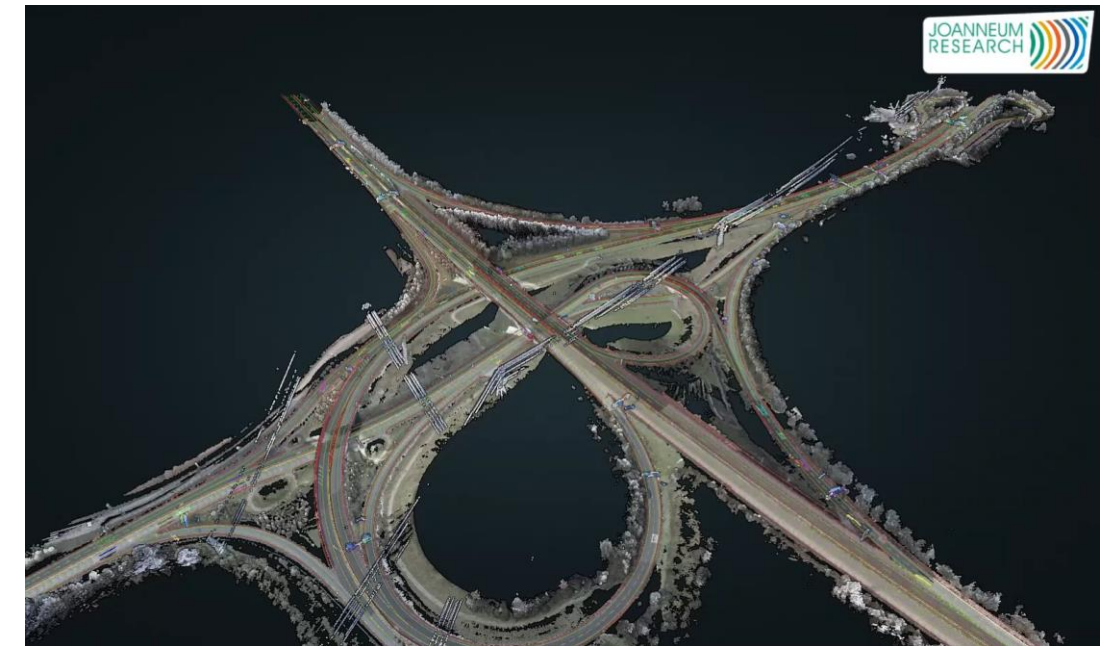
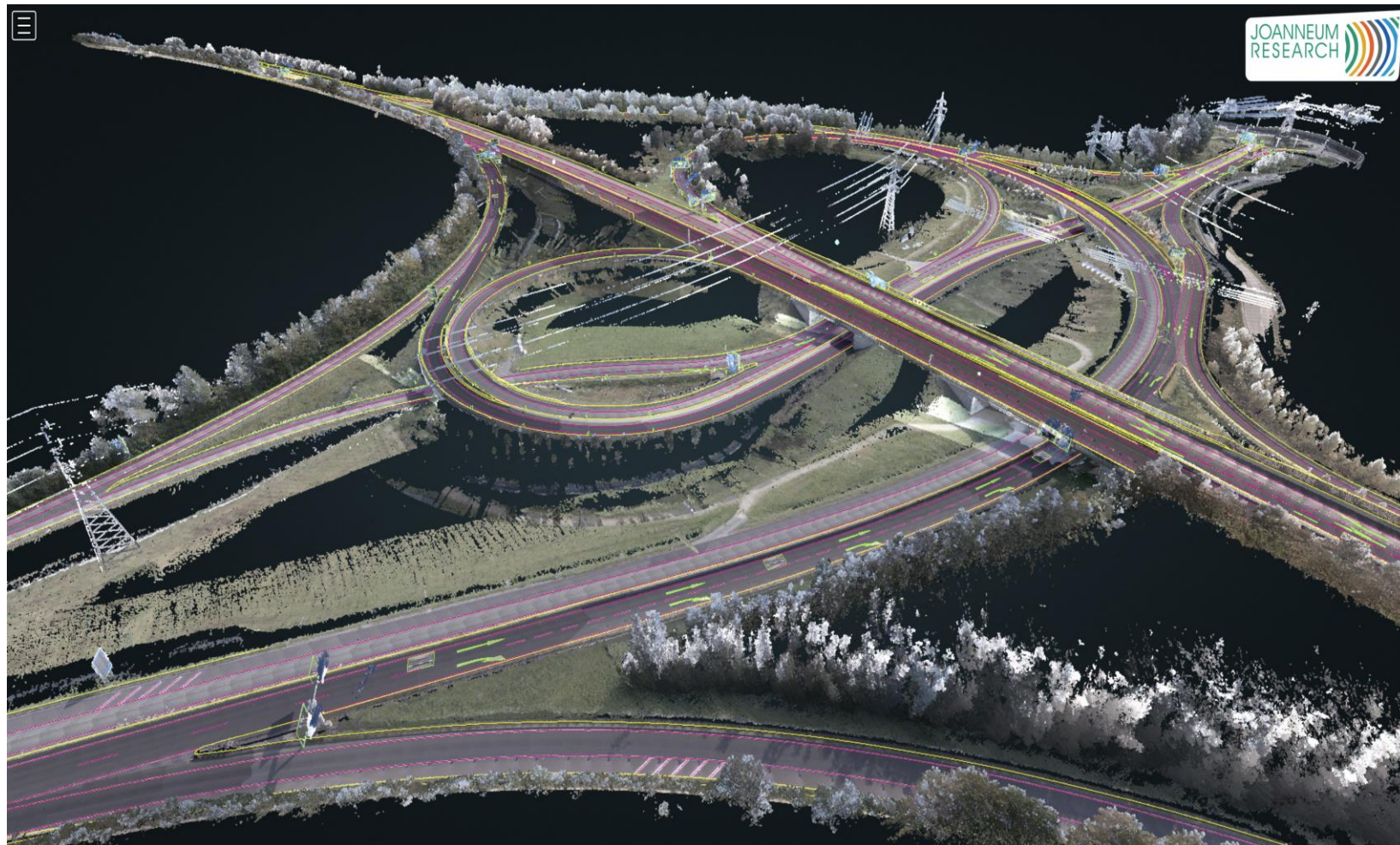


***DIGITAL TWIN LAB***  
***Reference Projects***





# Digital Twins - For ADAS/AD testing

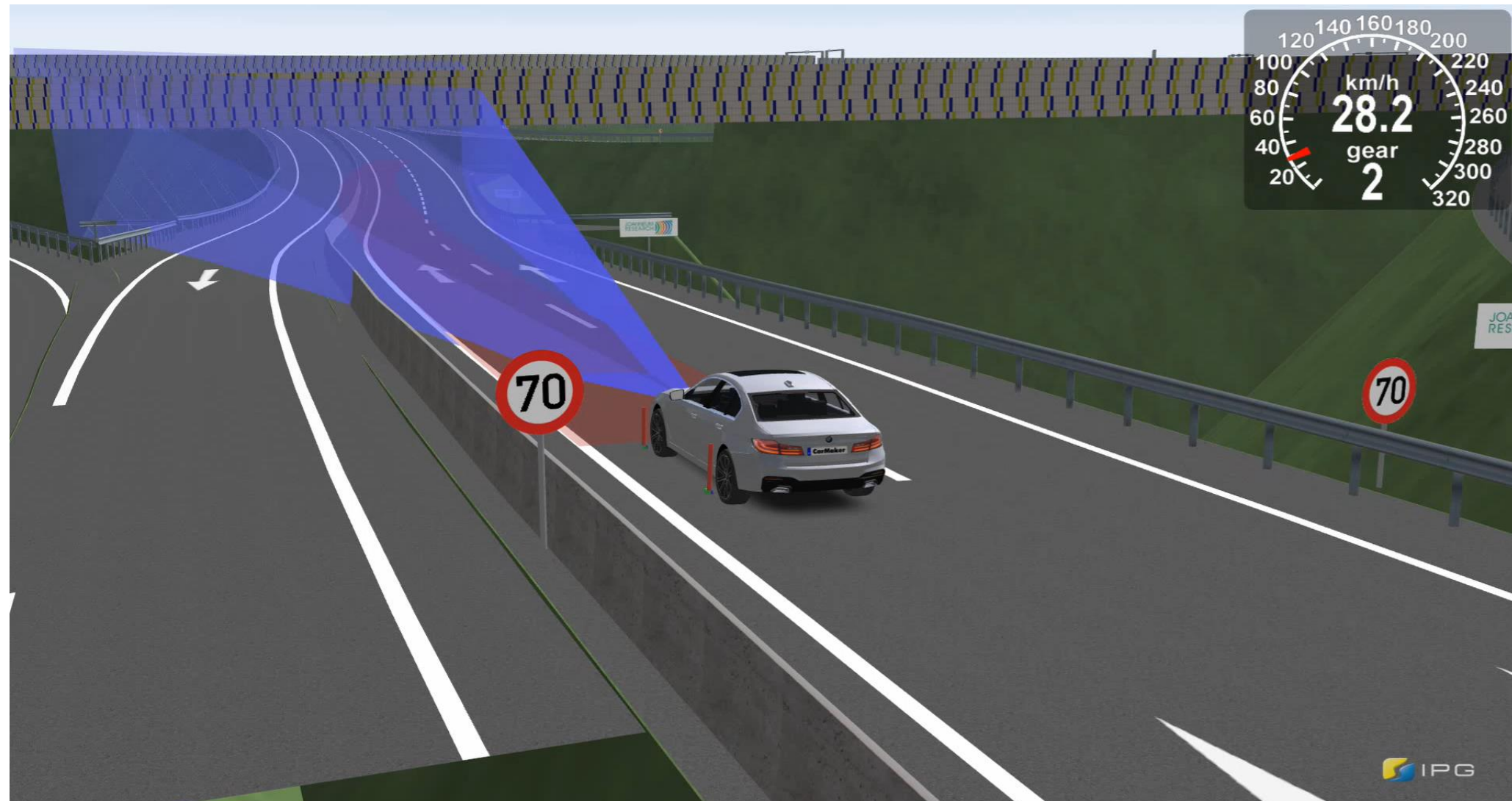


Highway intersection Graz-Ost

Digital Twin and UHDmaps® for ADAS/AD testing on 400km of highway in Styria, Austria (ALP.Lab, Magna)

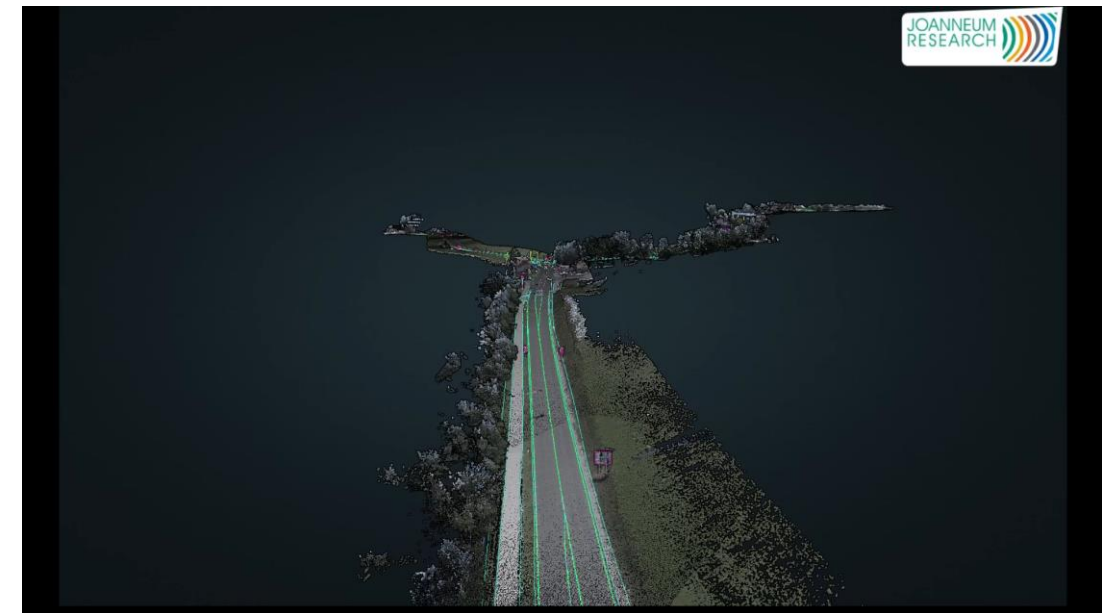
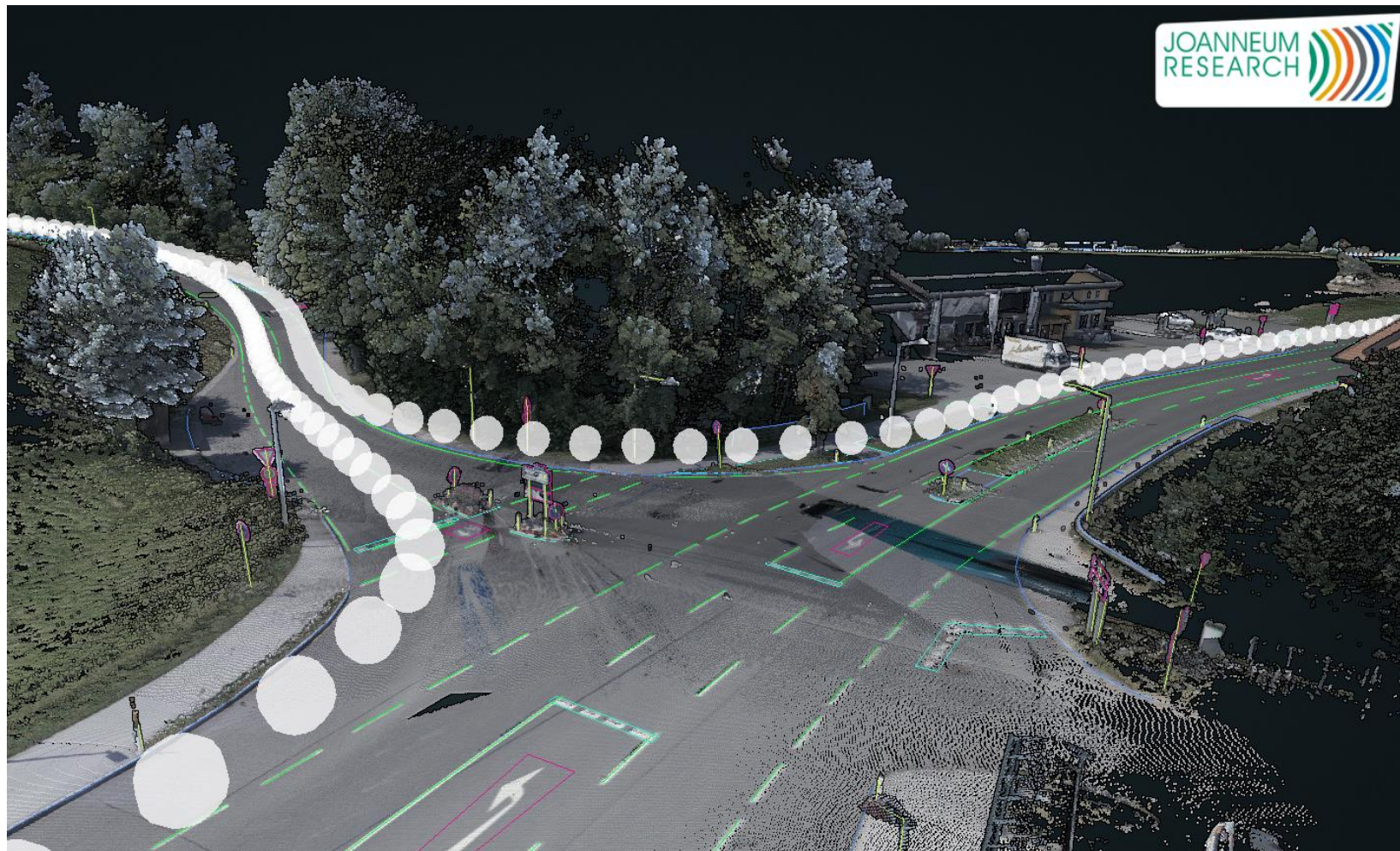


# Simulation of Automated Driving Functions





# Digital Twins - For automated Driving

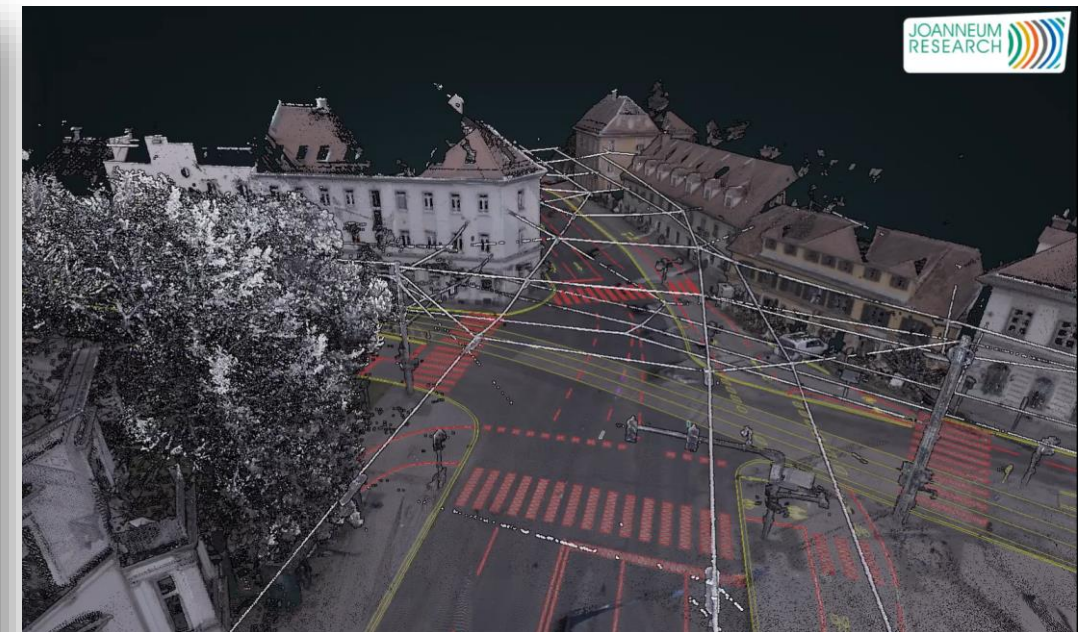
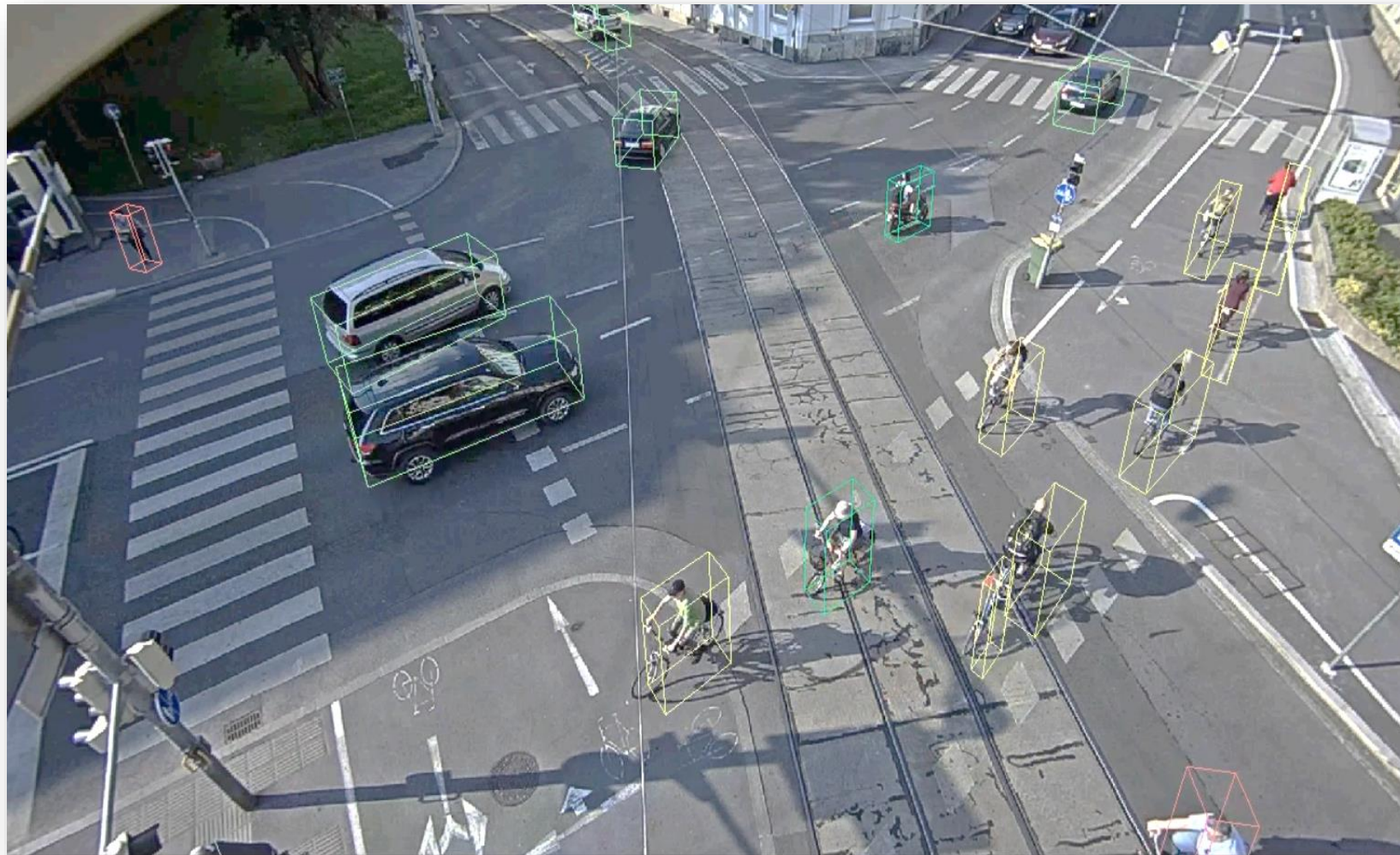


Digibus® Austria Test Track  
Salzburg, Austria

Automated People Mover Shuttle (Last-Mile)



# Digital Twins - For Traffic Monitoring

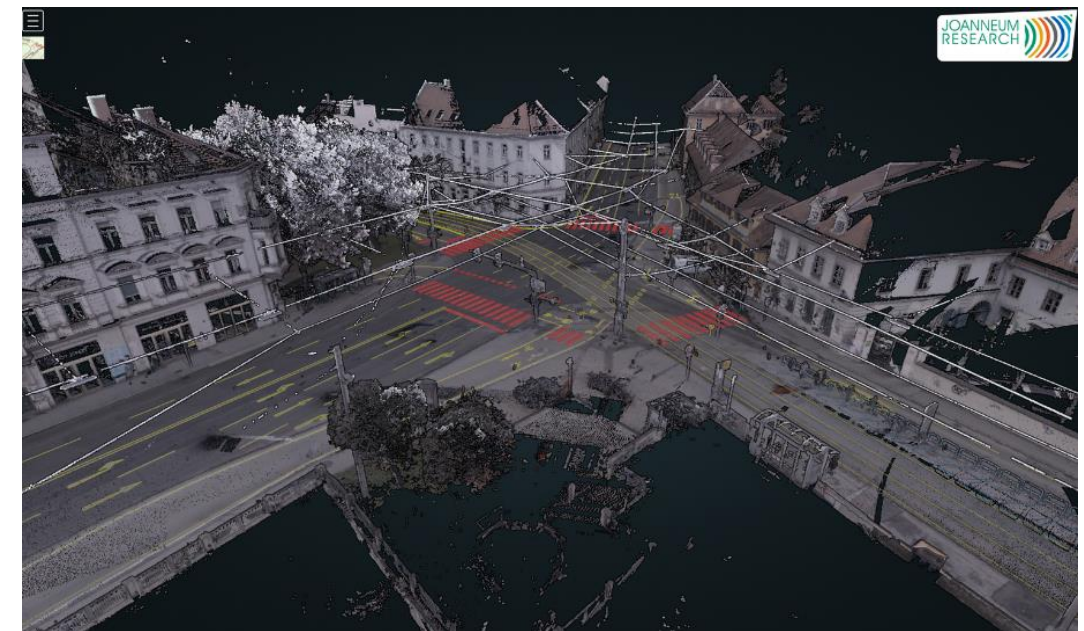
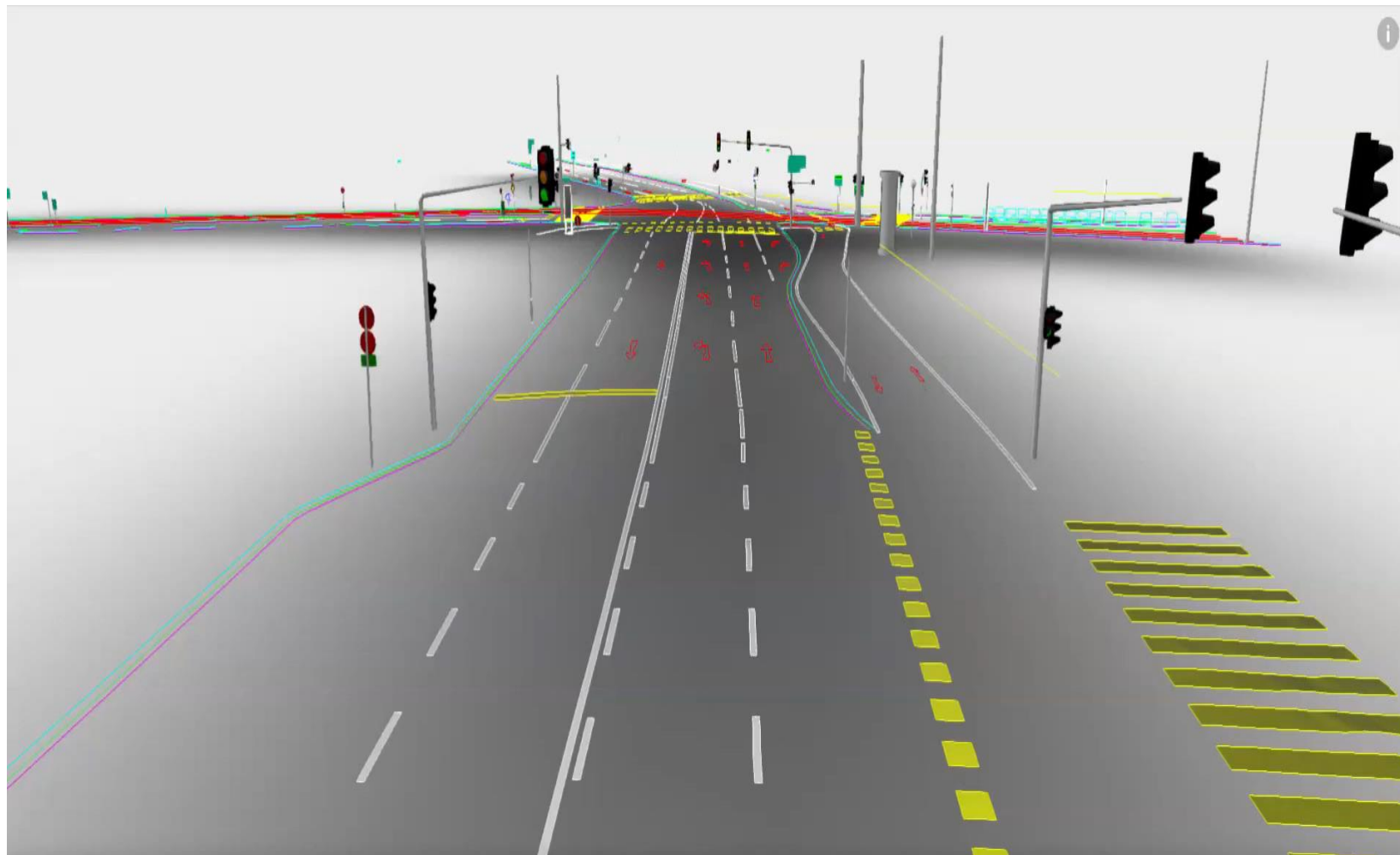


Urban Intersection in Graz

Object-based traffic monitoring and map based scenario analyses (ALP.Lab, Stadt Graz)



# *Asset Management and BIM - Road Infrastructure*

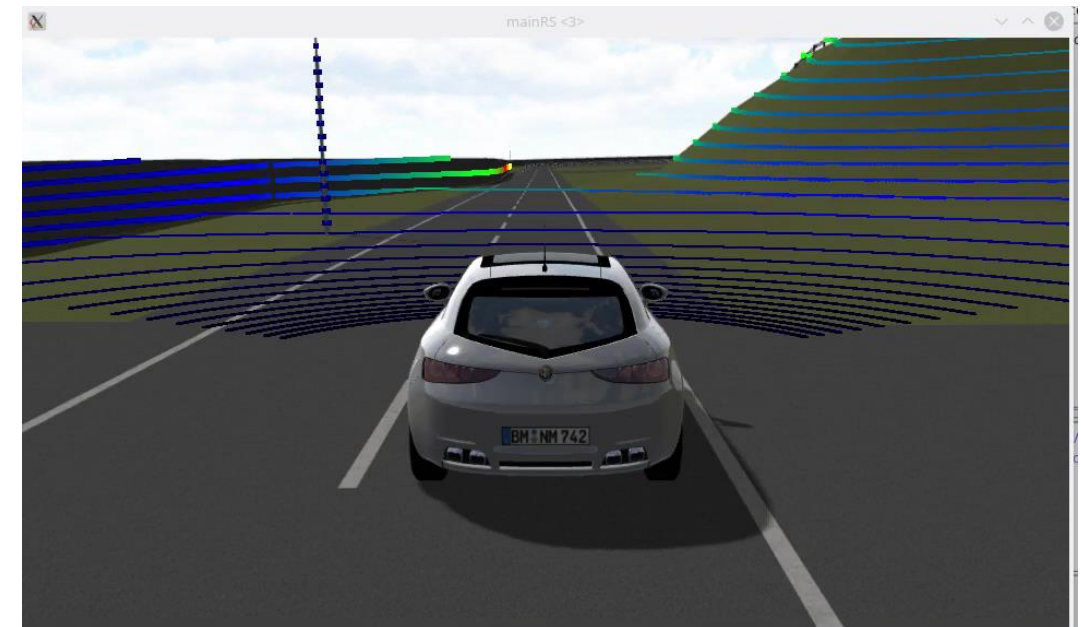
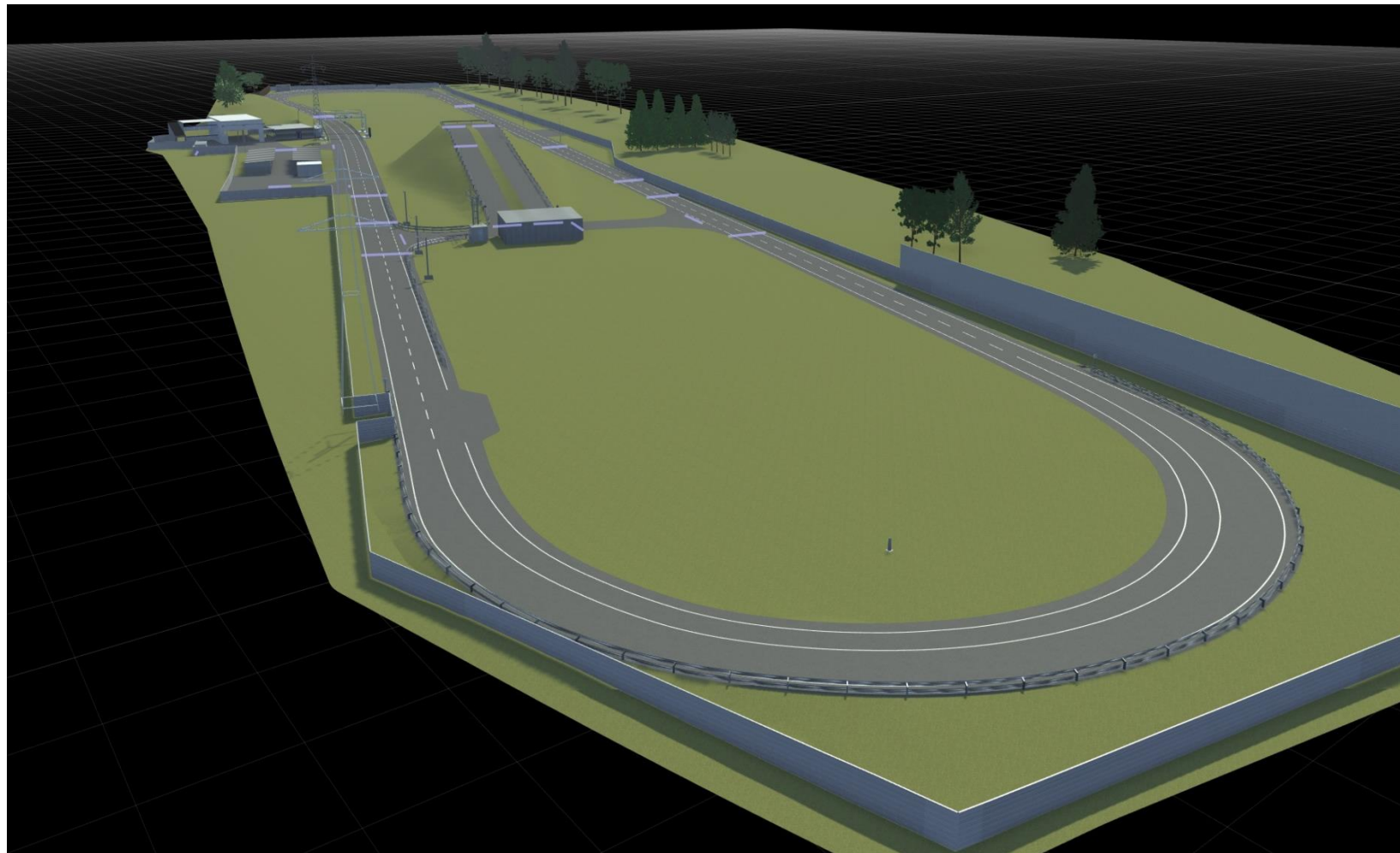


Urban Intersection in Graz

Detection and 3D reconstruction of  
traffic infrastructure



# Digital Twins - For Driving Simulation



AVL Proving Ground  
Gratkorn, Austria

Advanced Sensor Simulation based  
on high-detail 3D reconstruction





# *Driving Simulator - User acceptance testing*



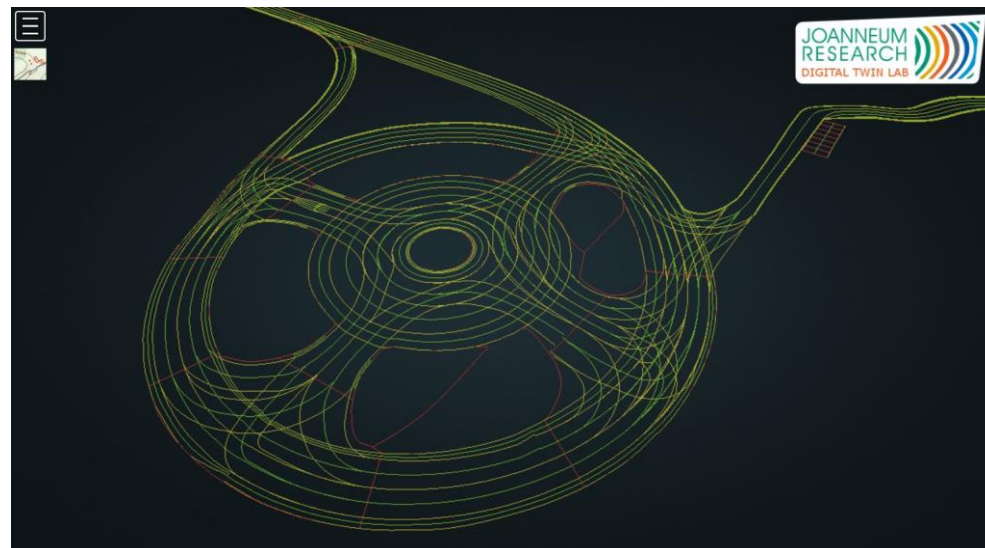


# Digital Twins - For Proving Grounds





# ***DIGITRANS Proving Ground - UHDmaps®, 3D-Models***





# *Automated Train Operation - Simulation*

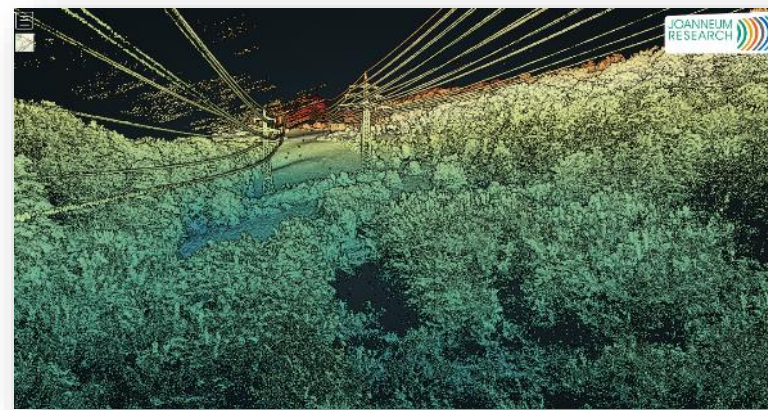




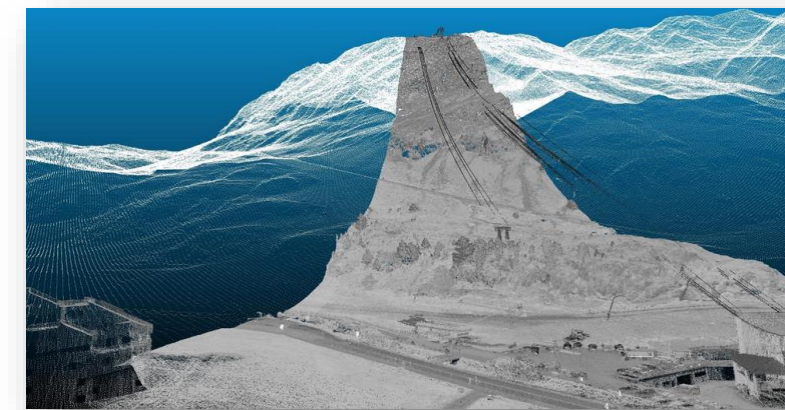
# Future Application - DIGITAL TWIN LAB



Road Networks

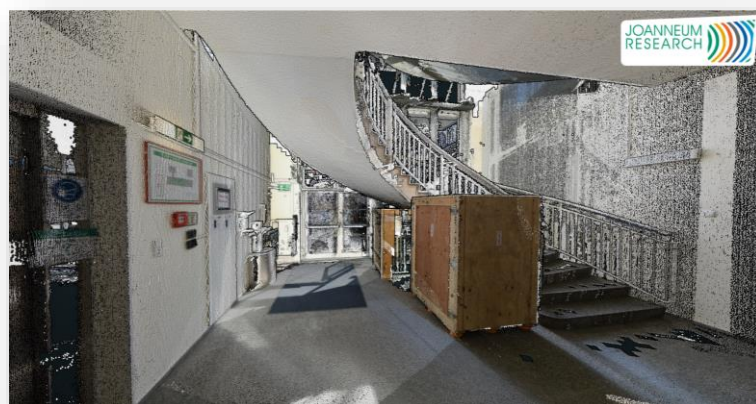


Critical Infrastructure Monitoring

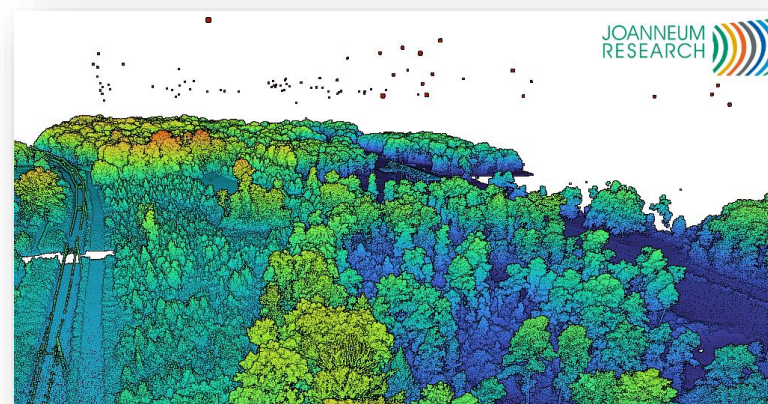


Quelle: Alto Drones

Tourism



Building Information Models



Environment and Wood



Quelle: Cezar Suceveanu

Urban planning and climate





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[www.joanneum.at/digital](http://www.joanneum.at/digital)