

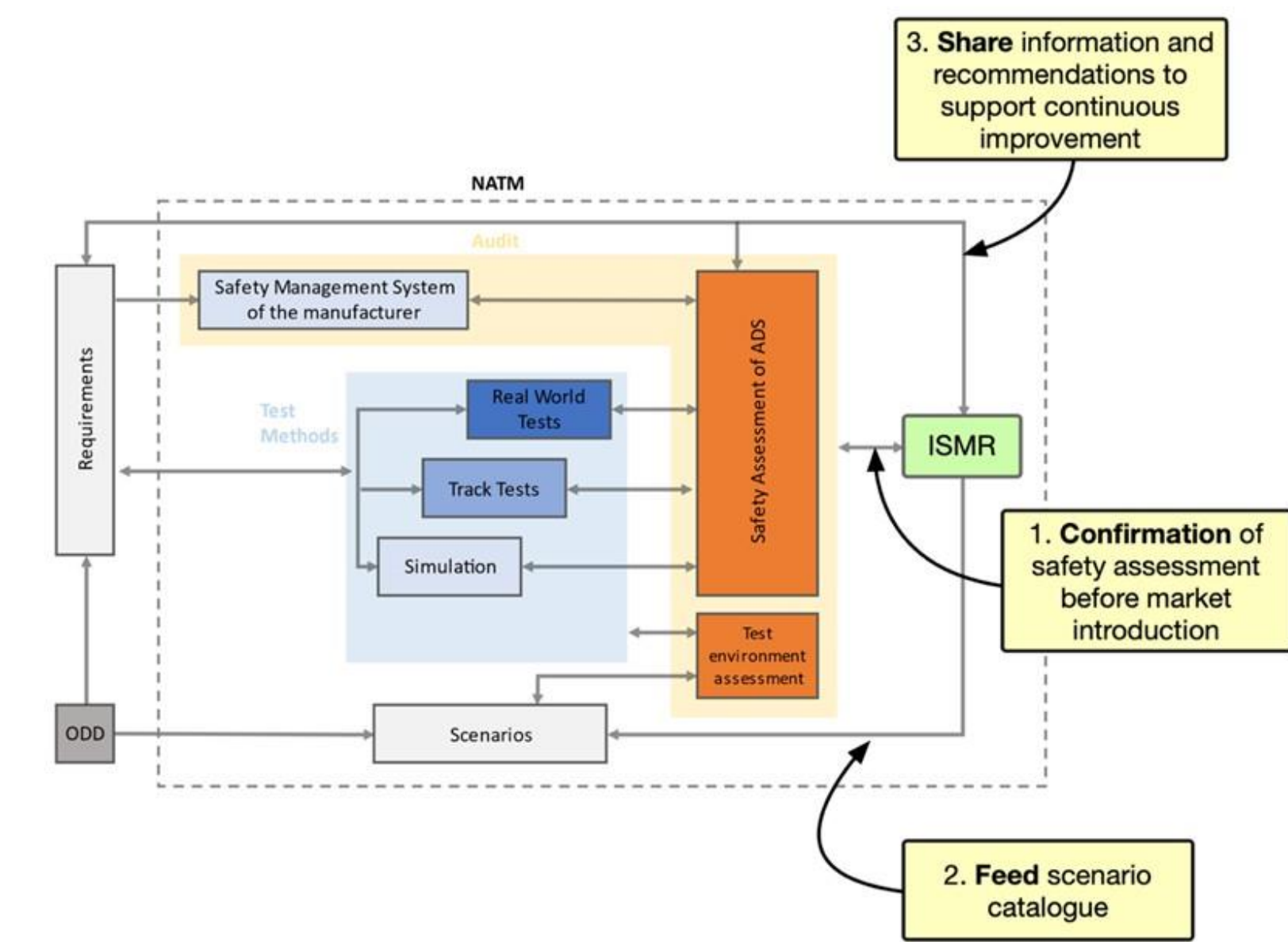


Transnational Testing, Operation and Certification of Automated Driving Systems

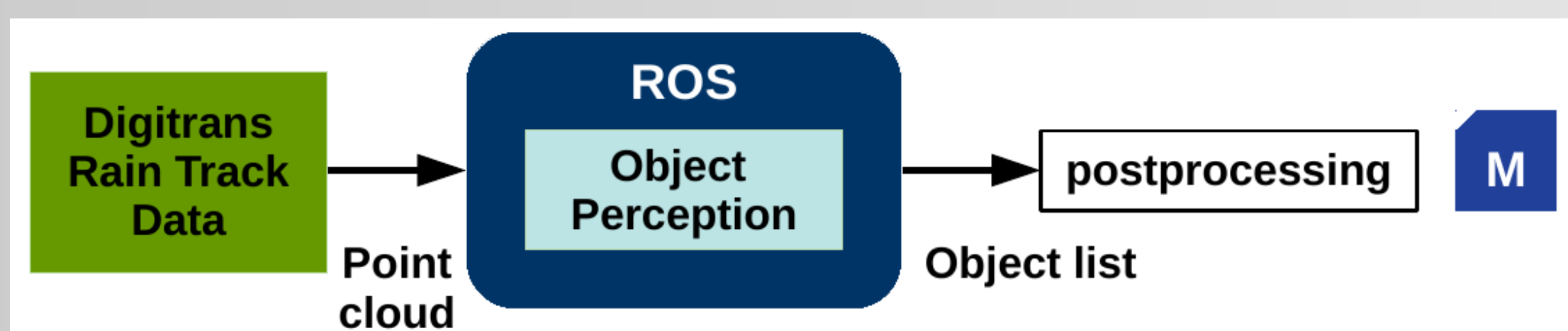
Building bricks for the NATM multi-pillar framework

Certification of Automated driving functions

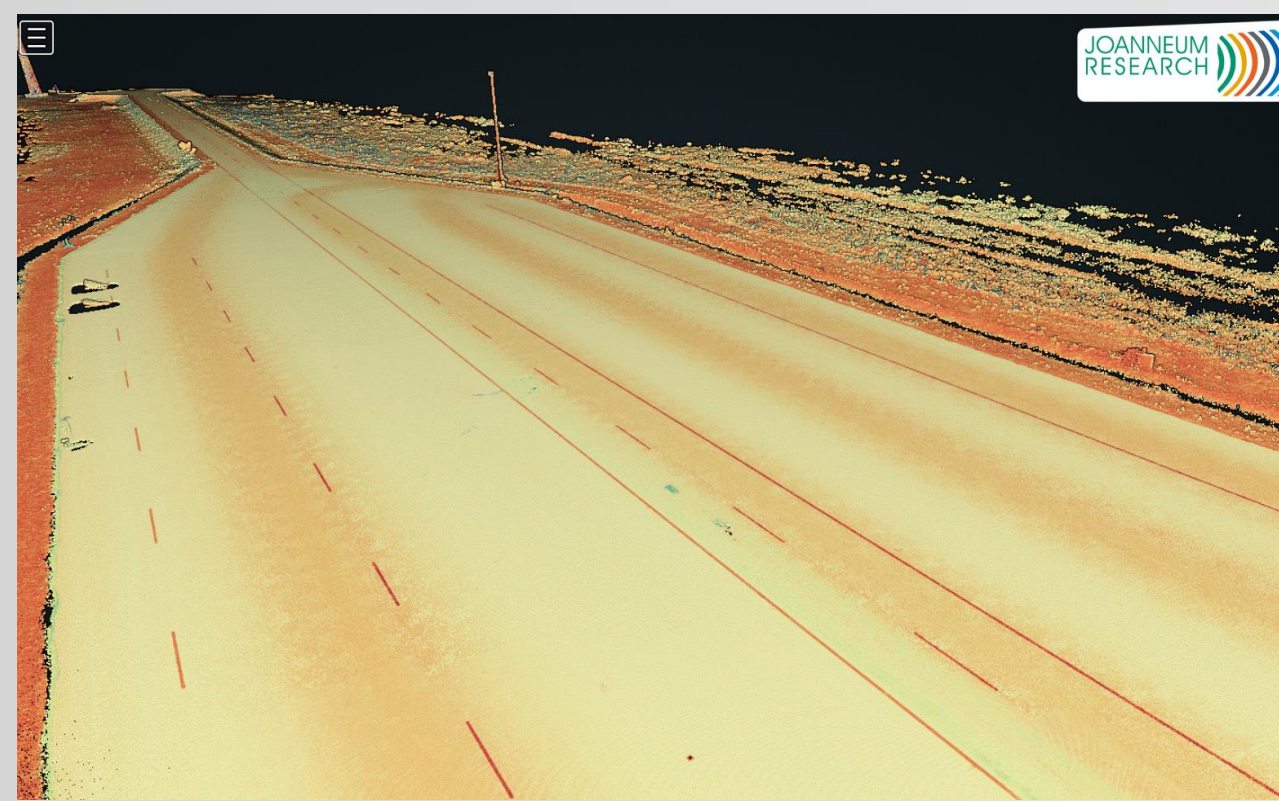
- NATM multi pillar framework includes scenarios, test methods & assessment for given ODD
- In-depth analysis of relevant standards as initial step for the certification
- Parallel testing of simulation, test track scenarios and in-service monitoring



Source: UNECE, NATM Guidelines



Perception testing pipeline



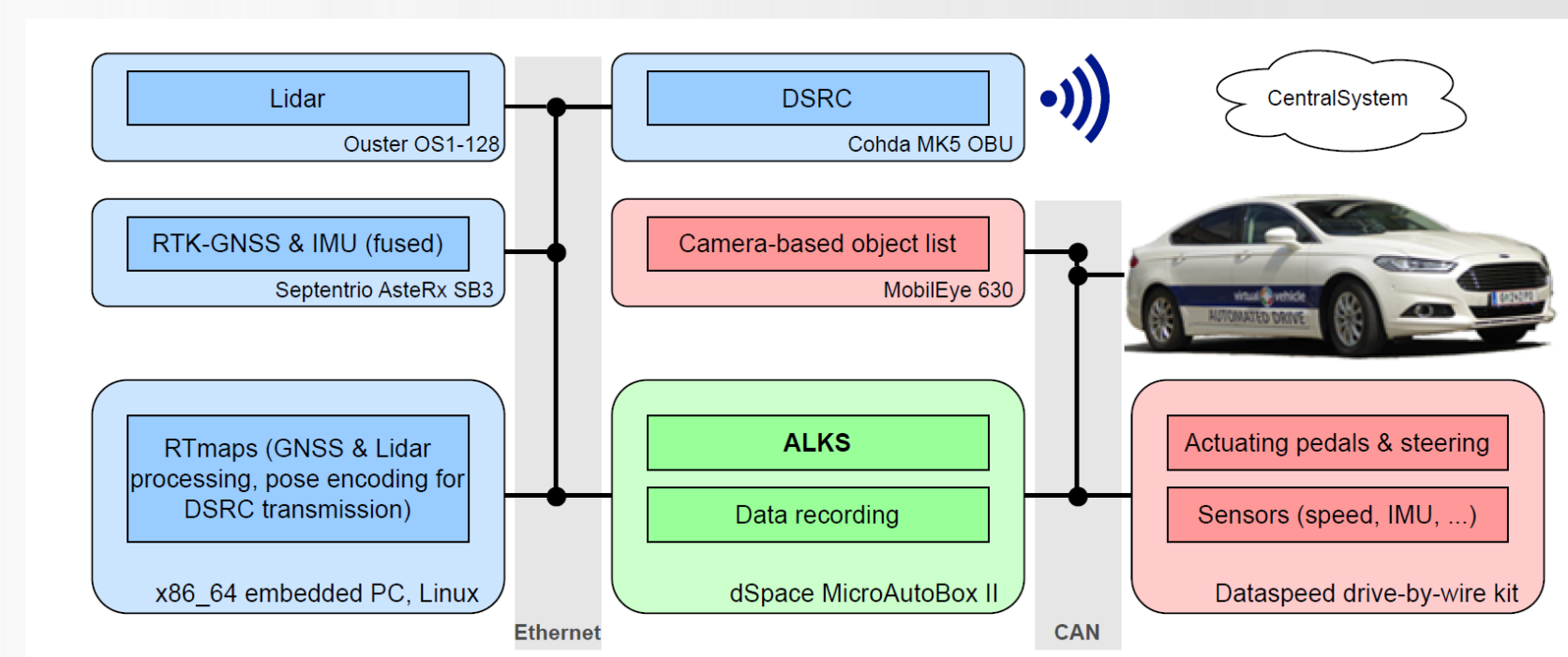
Point cloud scan as input to virtual environment building

Simulation

- Driving Function - IPG CarMaker with simulink interface guarantees that the virtually tested functionality is the same as the one in the car
- Object perception algorithm testing: pipeline in ROS, operating on point cloud inputs from virtual sensor models or real-world data measurements
- Extensive ground truth mapping also as input to virtual environment modelling

Test Track Testing

- Challenges: Definition of relevant scenarios and time-synchronization of measurement participants
- UDH Map with Riegl VMX-2HA mobile mapping system
- Mobile Environmental Sensor Rack (MESR) for measurement of environmental conditions during testing
- Live feeds from infrastructure data to enhance digital twins



VuT: VIF Ford Focus



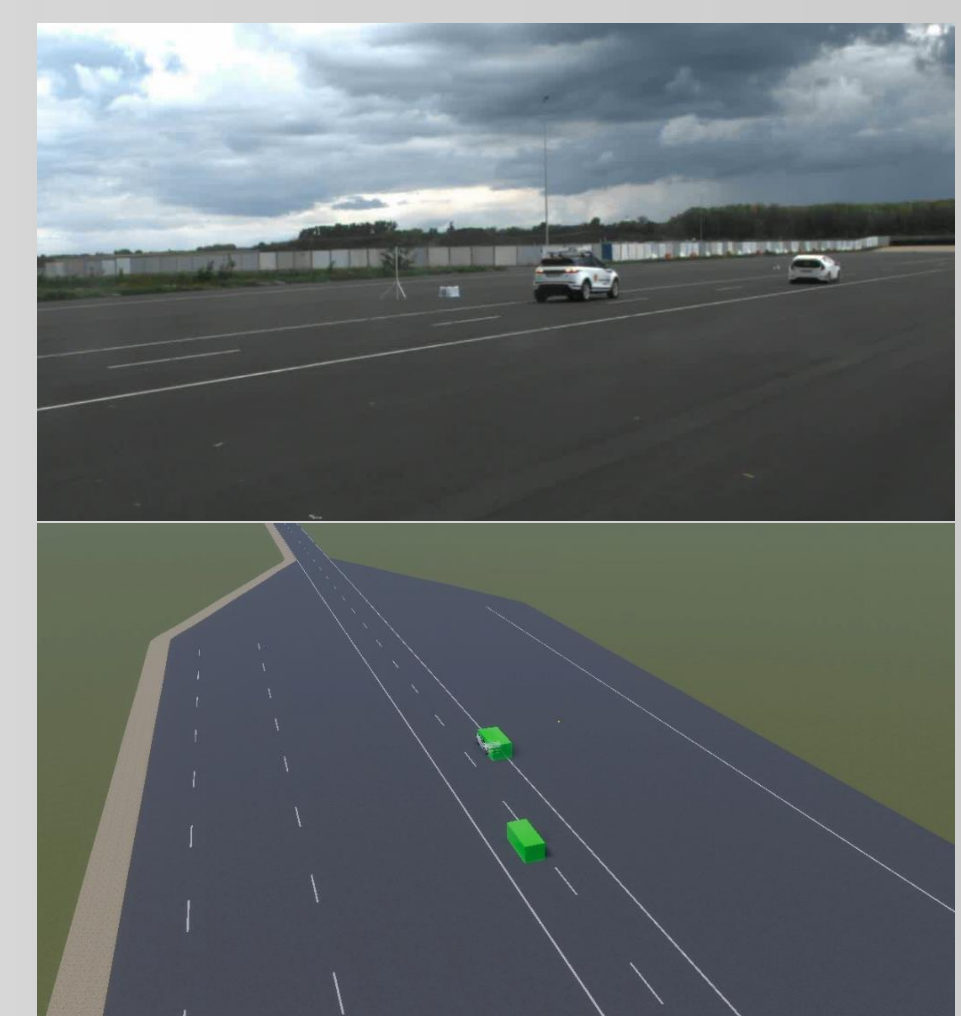
Target: Honda Civic



MESR for environmental measurements



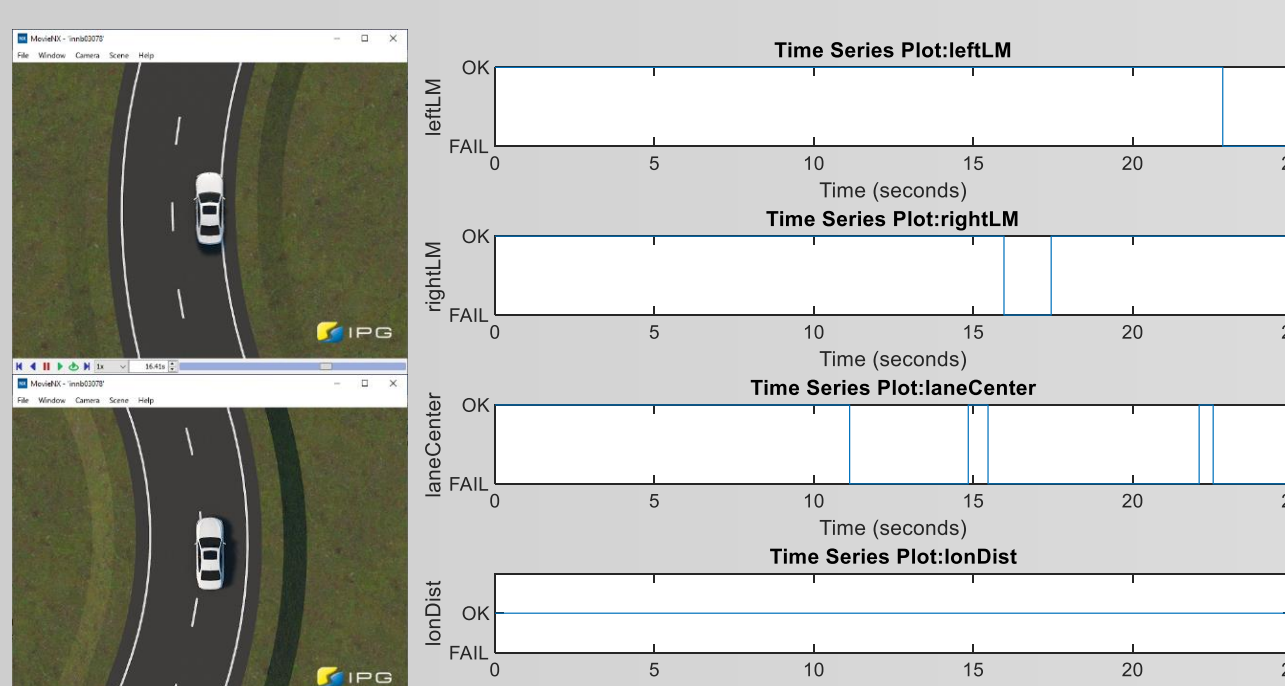
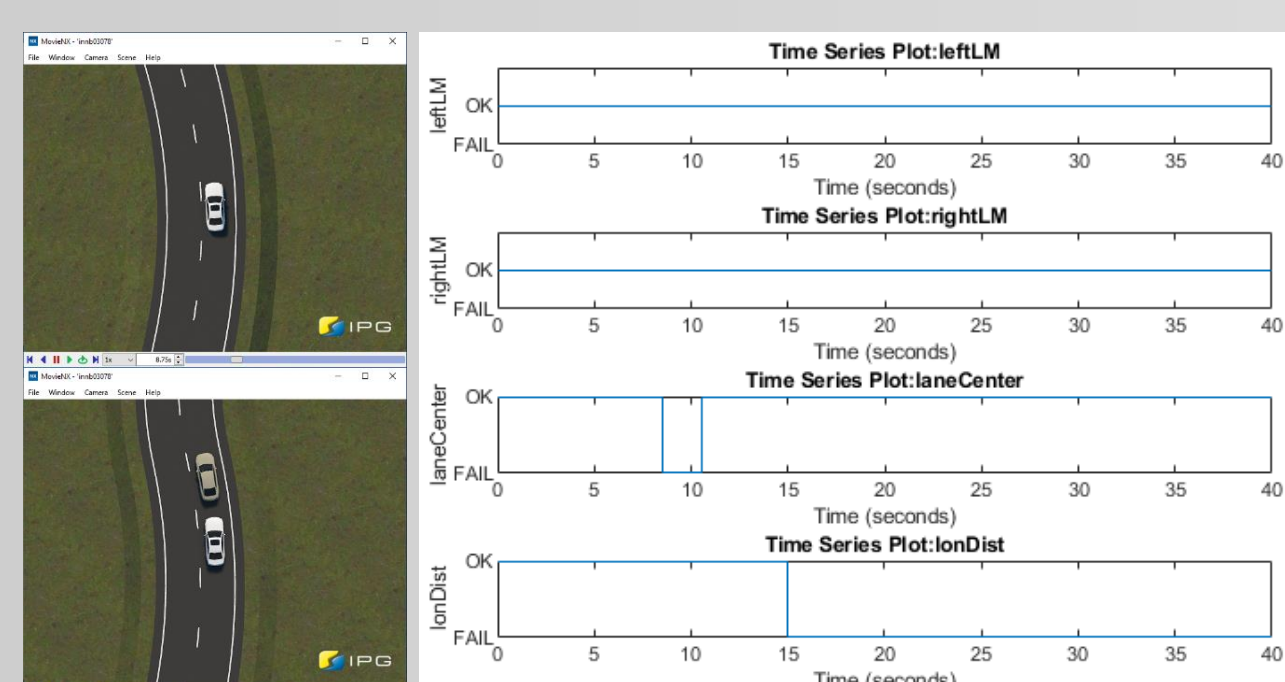
UHD Map: Joanneum Research



Real-time „digital twin“

In-Service Monitoring (ISMR) using the example of ALKS

- Lane keeping: the car does not leave the lane for different speeds, road curvatures, and lane markings.
- Following a vehicle: the ALKS maintains a safe distance to a vehicle in front.
- Cut-in: the ALKS avoids a collision with another vehicle entering the ego driving lane.
- Cut-out: the ALKS maintains a comfortable driving behaviour, if the leading vehicle leaves the ego lane and a previously occluded (possibly stationary) object is detected.
- Pedestrian crossing: the ALKS avoids a collision with an unobstructed pedestrian crossing the street.



Lane-Keeping monitoring for two different scenarios