ZalaZONE R&I activities

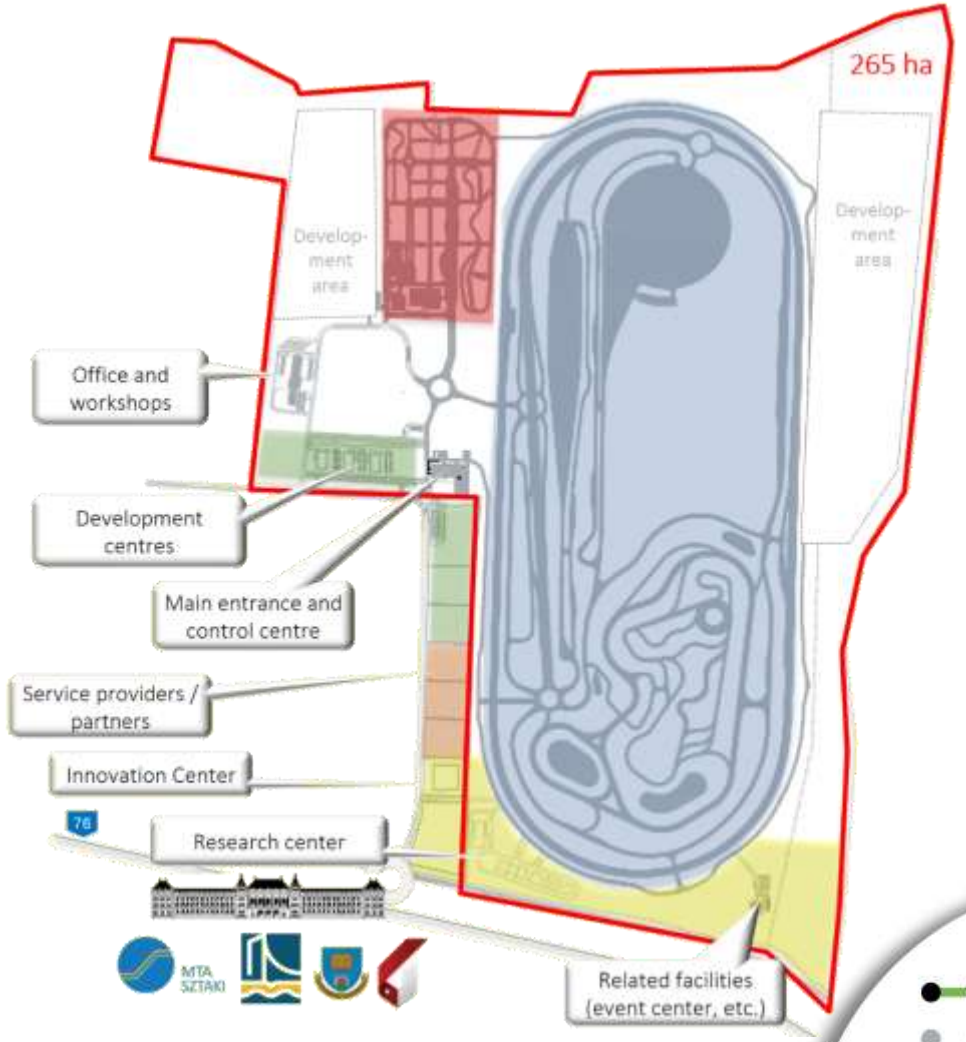
11.11.2021

Dr. Viktor Tihanyi

Research and Education in the DNA of ZalaZONE

ZalaZONE Research & Technology Center

- University research groups
- Dual-education programs
- Industrial laboratories
- Start-up incubation



ZalaZONE R&I cooperations

ZalaZONE Joint Research Projects – Industrial and Scientific Partners

ZalaZONE Research & Innovation

- ✓ **Cutting-edge Research**
- ✓ Future-proof Education
- ✓ Wide dissemination of research results
- ✓ Value-creating knowledge transfer

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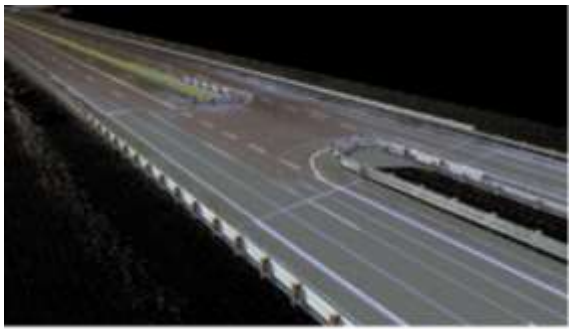
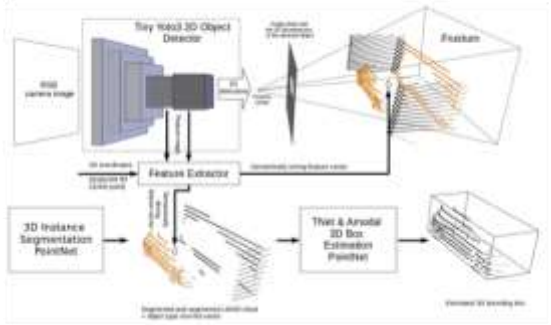
Fundamental research activities in CAM topic





Environment perception

- Sensor signal processing
- Object level fusion
- Object tracking methods
- AI based raw data fusion
- Testing methods of perception systems
- HD map application in autonomous vehicles
- HD map generation and formats

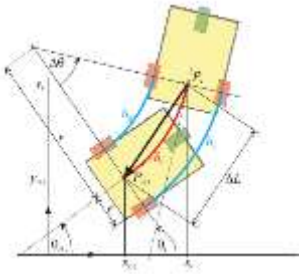
Decision control

- AI based decision methods
- Static and dynamic trajectory planning
- Trajectory following
- Lateral and longitudinal control
- Vehicle control in case of instability

$$x_{i+1} = x_i + \Delta L \cos\left(\theta_i + \frac{\Delta\theta}{2}\right)$$

$$y_{i+1} = y_i + \Delta L \sin\left(\theta_i + \frac{\Delta\theta}{2}\right)$$

$$\theta_{i+1} = \theta_i + \Delta\theta = \theta_i + \frac{\delta_R - \delta_L}{2e}$$



Simulation technology

- Own tools
- Commercial SW customization

Communication technology

- DSRC technology research
- 5G technology research
- Cybersecurity

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Applied research activities in CAM topic

Automated vehicles examples

- Smart fortwo (completely autonomous)
  - Valet parking
  - Traffic jam pilot
  - Platooning

- BMW M2
  - Automated steering and throttle control
  - Automated drifting

- Range Rover Evoque
  - Robotized with ABD driving robots

Environment perception applications

- Vehicle with full sensorset
  - Data collection
  - Real time operation

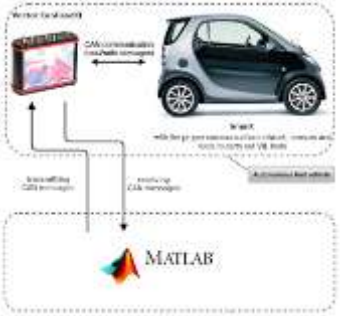
- Infrastructure sensors

Research of testing methods of CAM on proving grounds

Special testing methodologies

- **Vehicle in the loop methodology**

  Safe testing with bypassing perception

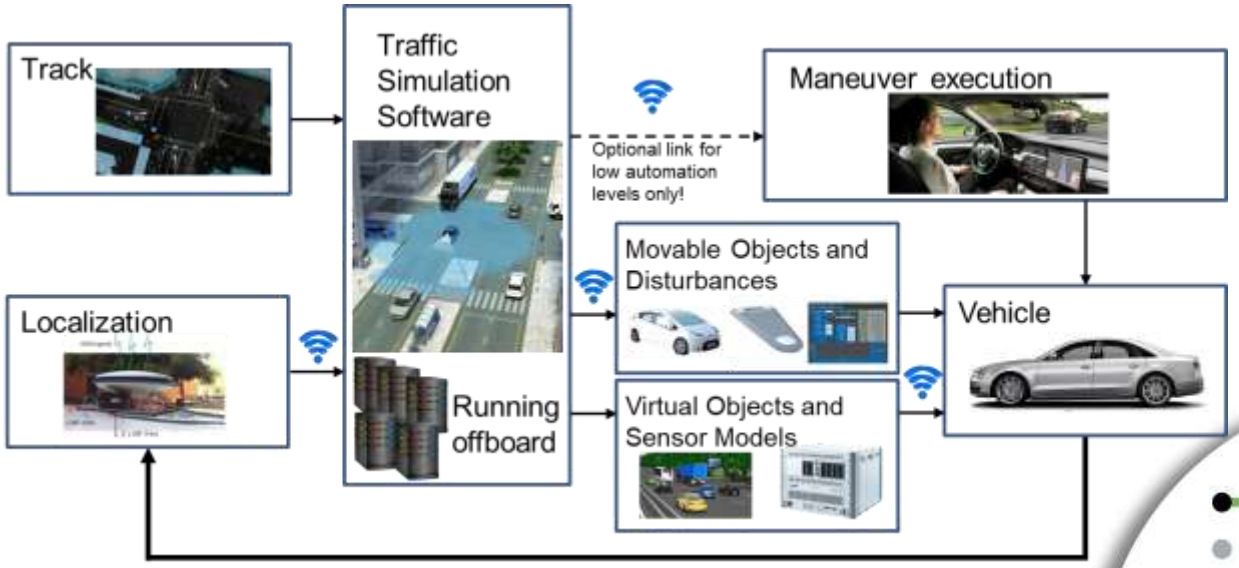


- **Scenario in the loop methodology**

  Simulation with digital twin of Vehicle under test

  Virtual object injection possibility

  Repeatable test with controlled elements



HD map support

Point cloud models

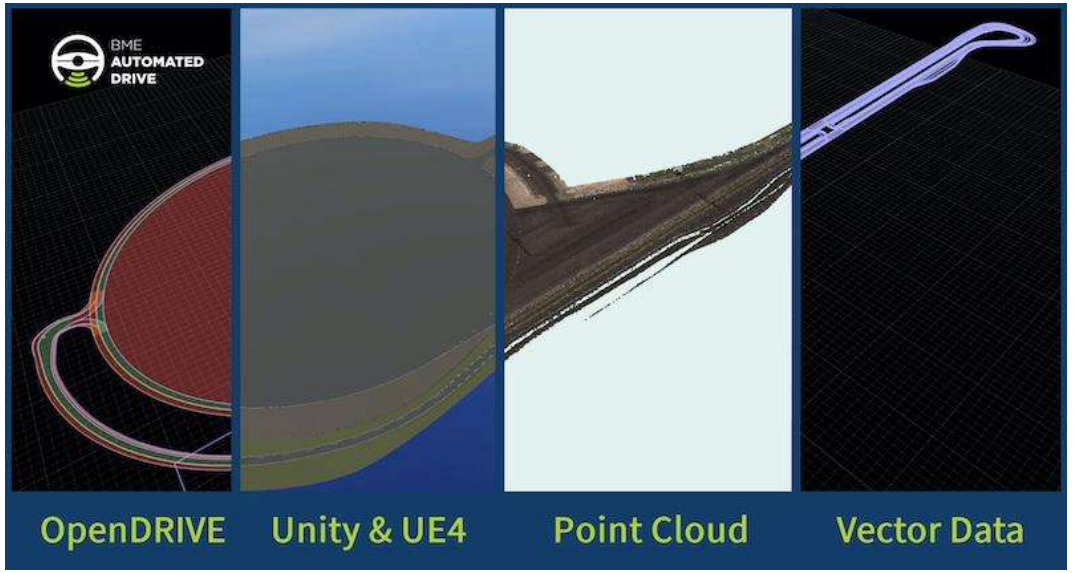
3D point cloud, models and HD maps:

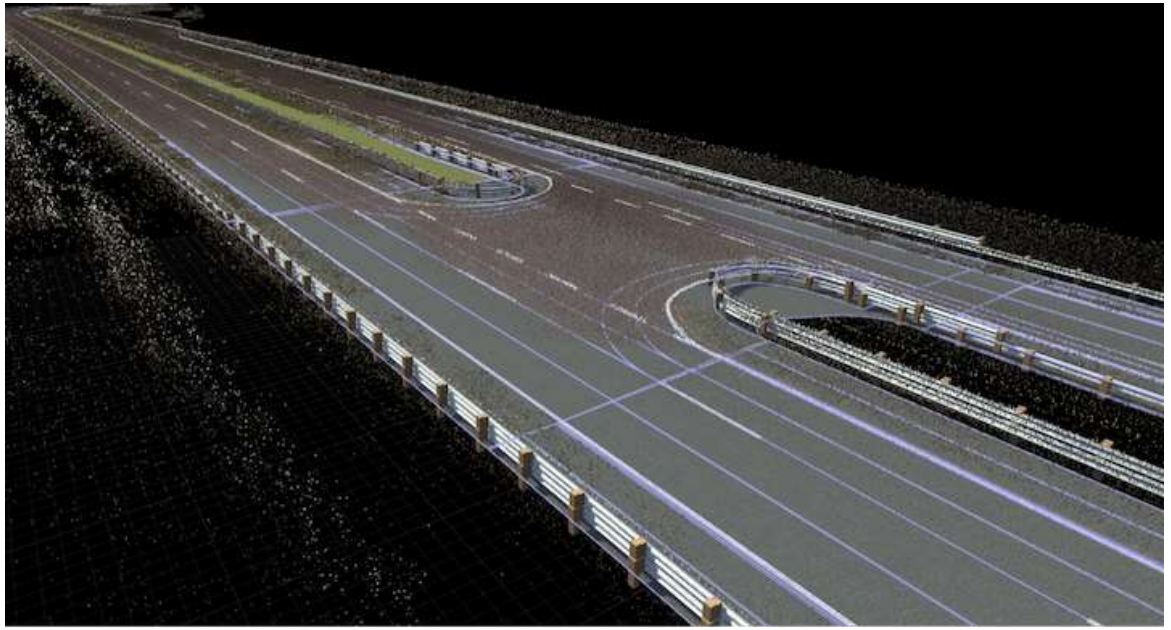
- Dynamics platform
- Handling course
- Motorway & ADAS surface – awailable soon

Basic file format is OpenDRIVE, but we can export:

- AutoCAD (.dxf)
- Unity 3D
- Unreal Engine
- Carla
- GeoJSON
- Simulation SW models will be upgraded accordingly
- Surface and material description handling is in progress

We are continuously updating our database. If the construction of a track element is done, we scan it and create road models with cm accuracy in simulation tools. We also update and correct the blueprints models with the scanned data. All these models and data will be available on https://www.automateddrive.bme.hu/ website.





DroneMotive plans

Offices

Airport

Motivation: drone related services might generate outstanding economical and social benefits

ZalaZONE connection

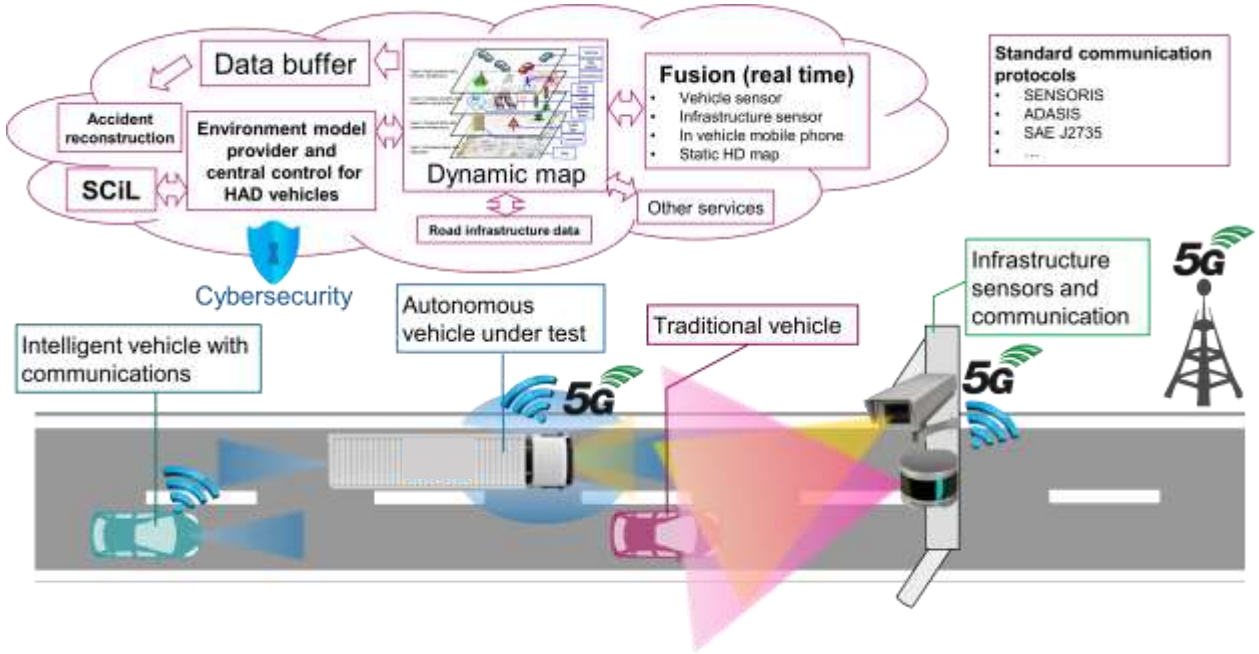
- The development of autonomous ground and air vehicles share numerous common problems (e.g. in communication, surveillance, navigation, conflict MGT)
- Establish synergies between the 2 transportation systems

Hangar

Physical and Digital Infrastructure – Central System approach

Ongoing development

- Real time digital world model including
  - Static 3D map
  - Low dynamic information (road works, weather, traffic..)
  - High dynamic information, vehicles, pedestrians…
- Central, real time fusion combining in vehicle and infrastructure sensor set
- Data record buffer
  - Supporting automated vehicle testing
  - Accident reconstruction support
  - GDPR compliant solution
- Using international standards for overall system (OpenDrive, ETSI CPM, Sensoris, Adasis..)
- Supporting automated vehicles (first testing and later operation) with real time environment data
- Ability to control automated vehicles and infrastructure elements (e.g. traffic lights)
- Supports mixed reality testing
- Cloud based scalable, distributed system



Central System approach - Locations for realization

Intelligent infrastructure plans in Hungary

Fixed and flexible infrastructure planned in
- Smart City
- Motorway (1.5km)
- ITS-G5 and 5G coverage

Data servers

Expected in 2022

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M1

M7

Intelligent infrastructure
- 1.5km long section
- ~100.000 vehicles/day
- VMS control integration
- ITS-G5 and 5G coverage
- 5 sensor stations

Expected in 2021 Q4

Strong governmental support

Very strong cooperation with Hungarian Public Roads

M76

Intelligent infrastructure
- 12 km long highway section
- ITS-G5 and 5G coverage
- Can be closed from public traffic
- 75 sensor stations in 50-200m distances

Expected in 2023

Flexible infrastructure is available inside the Campus of BME

Data servers

BME

Zalaegerszeg

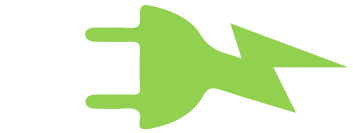
Intelligent cross section
- Sensors
- Traffic light control integration

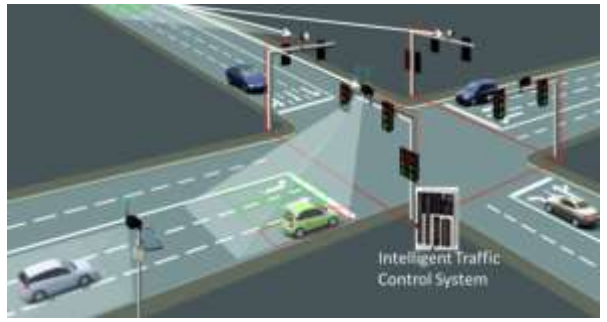
Expected in 2022

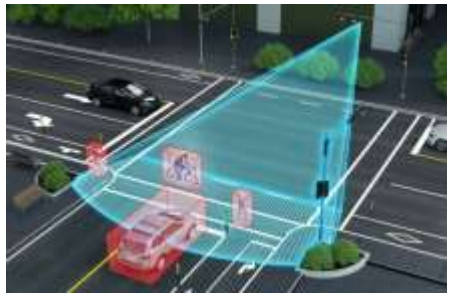
Central System approach - Dedicated infrastructure and test tools

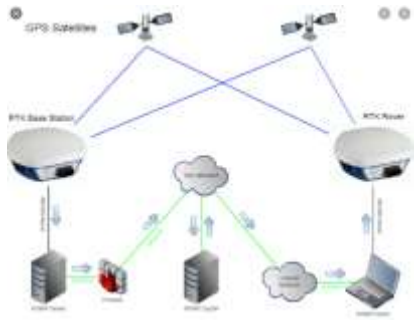
Planned elements

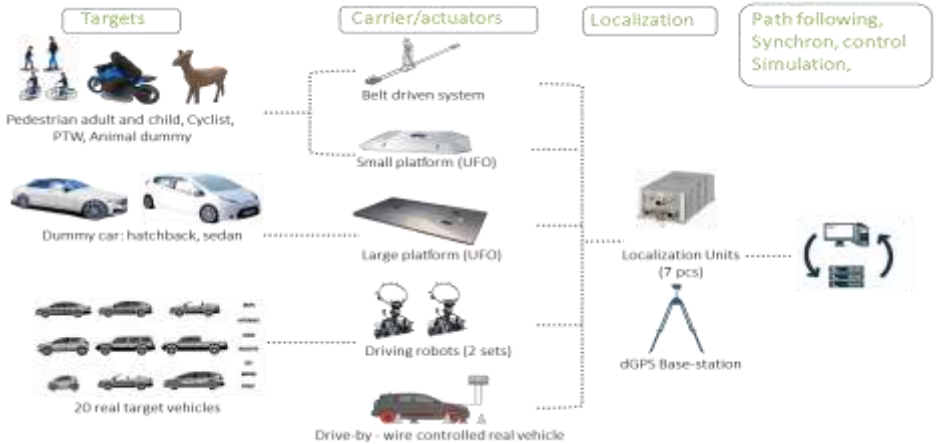
- Network/ power supply
- Traffic control (traffic lights, VMS)
- Sensors (Cameras, Lidars, Radars, Weather sensors…)
- ITS-G5, C-V2x, 5G communications
- Servers/Cloud/Edges
- Test equipment (AB-Dynamics and other devices)
- GNSS base station for RTK service
- HD maps of the areas with cm accuracy











Highlights from ZalaZONE research achievements

- PoC demonstration of SciL with 5G new radio
- Automated driving on dynamic limits - Autonomous drifting
- Central system – distributed perception of pedestrians

Scenario in the loop youtube video link

Scenario in the loop demonstration using 5G network

The video was captured during the opening ceremony of ZalaZONE proving ground in 2019 May. The fully automated smart vehicle do automated Valet parking and traffic jam pilot while a simulation server communicates with it through 5G network and provides the SCiL simulation with virtual object injection as well as real dummy control

https://www.youtube.com/watch?v=Ue3W7cjUtf8

Virtual object

Real object (Dummy)

Scenario in the loop

BMW M2 automated drift youtube video link

BMW M2 automated drifting

We are presenting our BMW M2 automated drift demonstrator vehicle. During the video, the vehicle fully controls the stabilized drift

https://www.youtube.com/watch?v=saFgazF2bcs

BMW M2 automated drift

Central system – Actualities

ZalaZONE - Region Zala

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