



M Ű E G Y E T E M 1 7 8 2

Smartphone Based HD map building for autonomous vehicles

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List of Content

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Easy to change colors, photos and Text.

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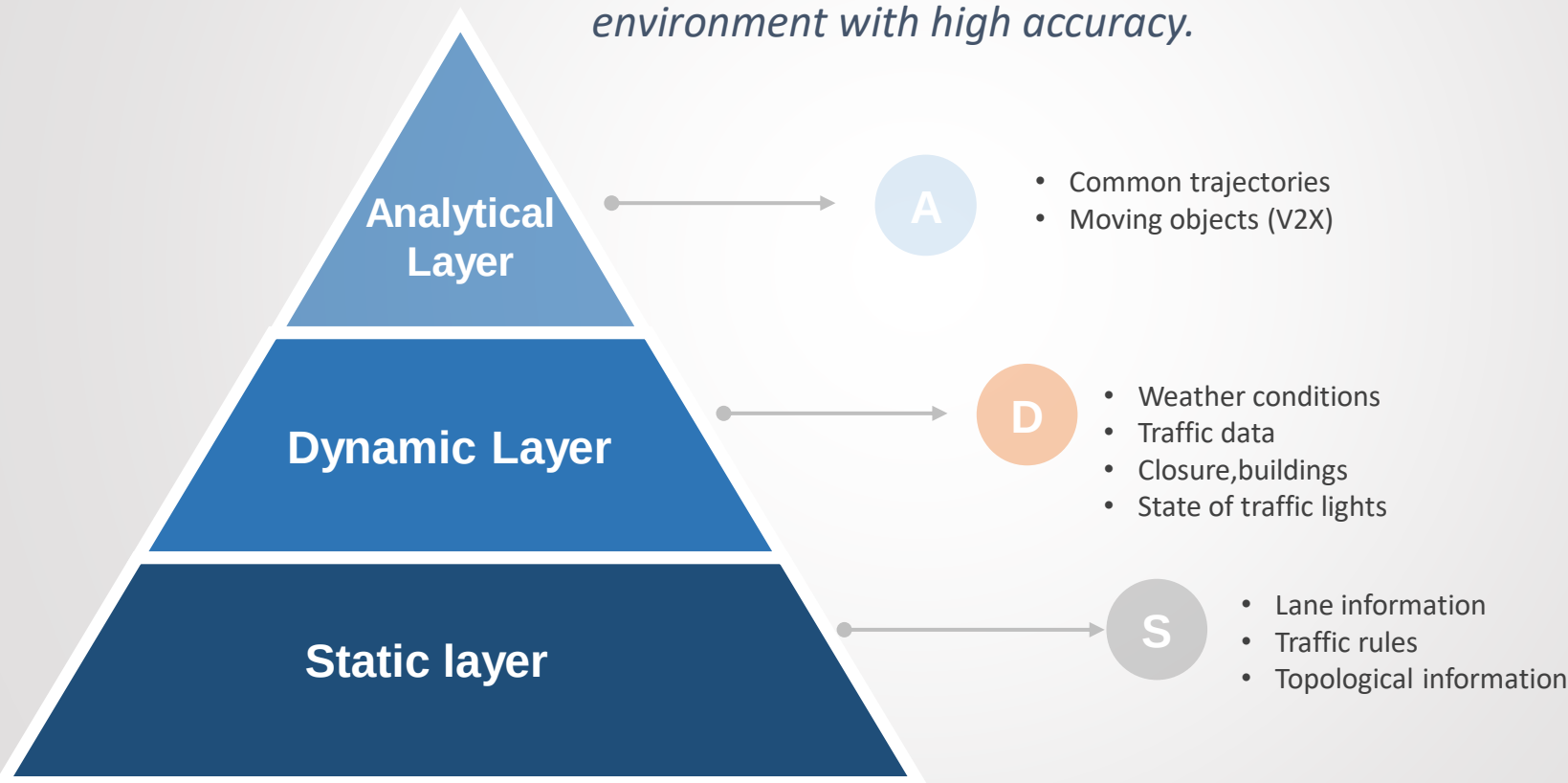
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What does HD Map stand for?

High definition map, including information about the features and landmarks of the environment with high accuracy.



Importance

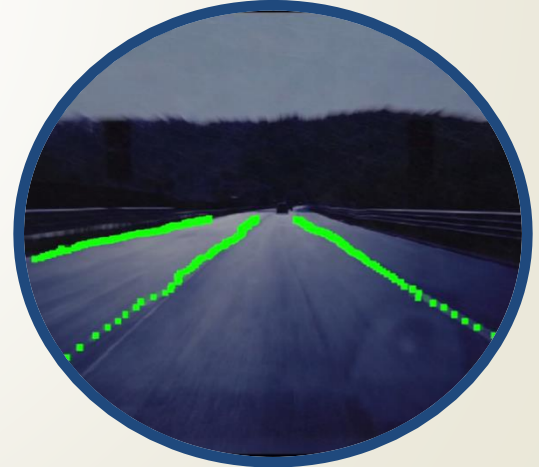
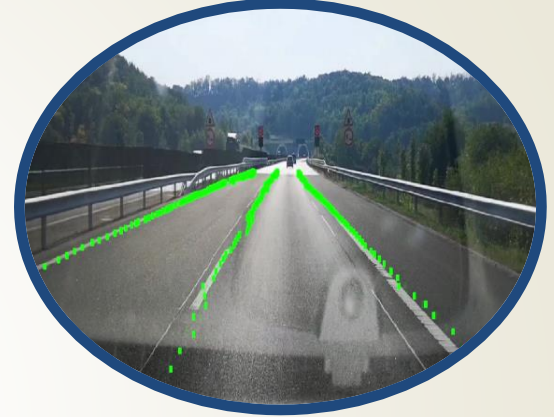


of autonomous vehicles

- Increase road traffic safety 
- Optimization of organization of transport 
- Economical benefits \$

of HD Map in the field of of autonomous vehicles

- Detection of static landmarks and features is hard sometimes by onboard sensors 



Motivation and Purposes



**Lane information
for autonomous
vehicles**



**Open source HD MAP
for research purposes**



**Localization on
the prebuilt map**



**Visualization and
evaluation of the
results**



**Feedback of the
results into Map
building**

Measurement



MATLAB®
& SIMULINK®

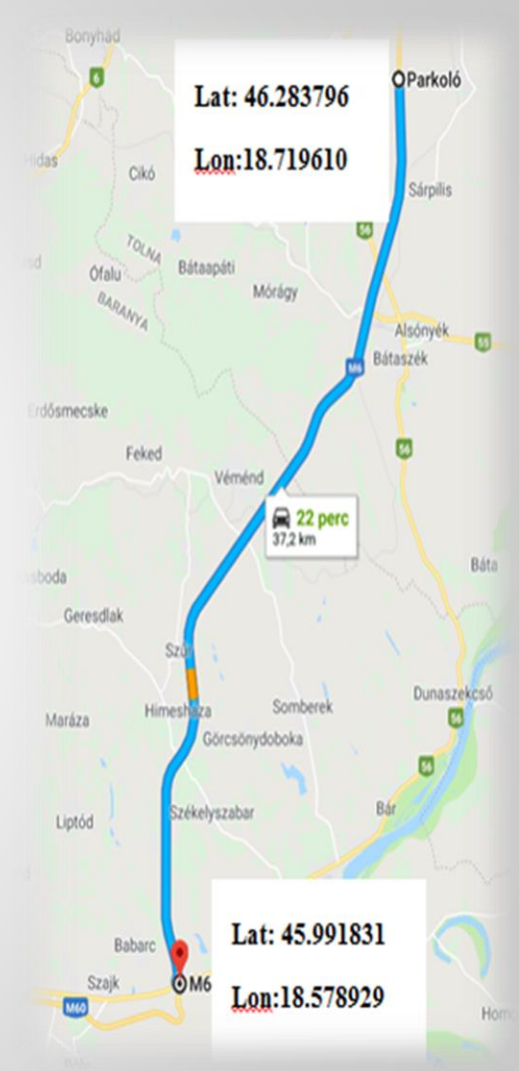


MATLAB

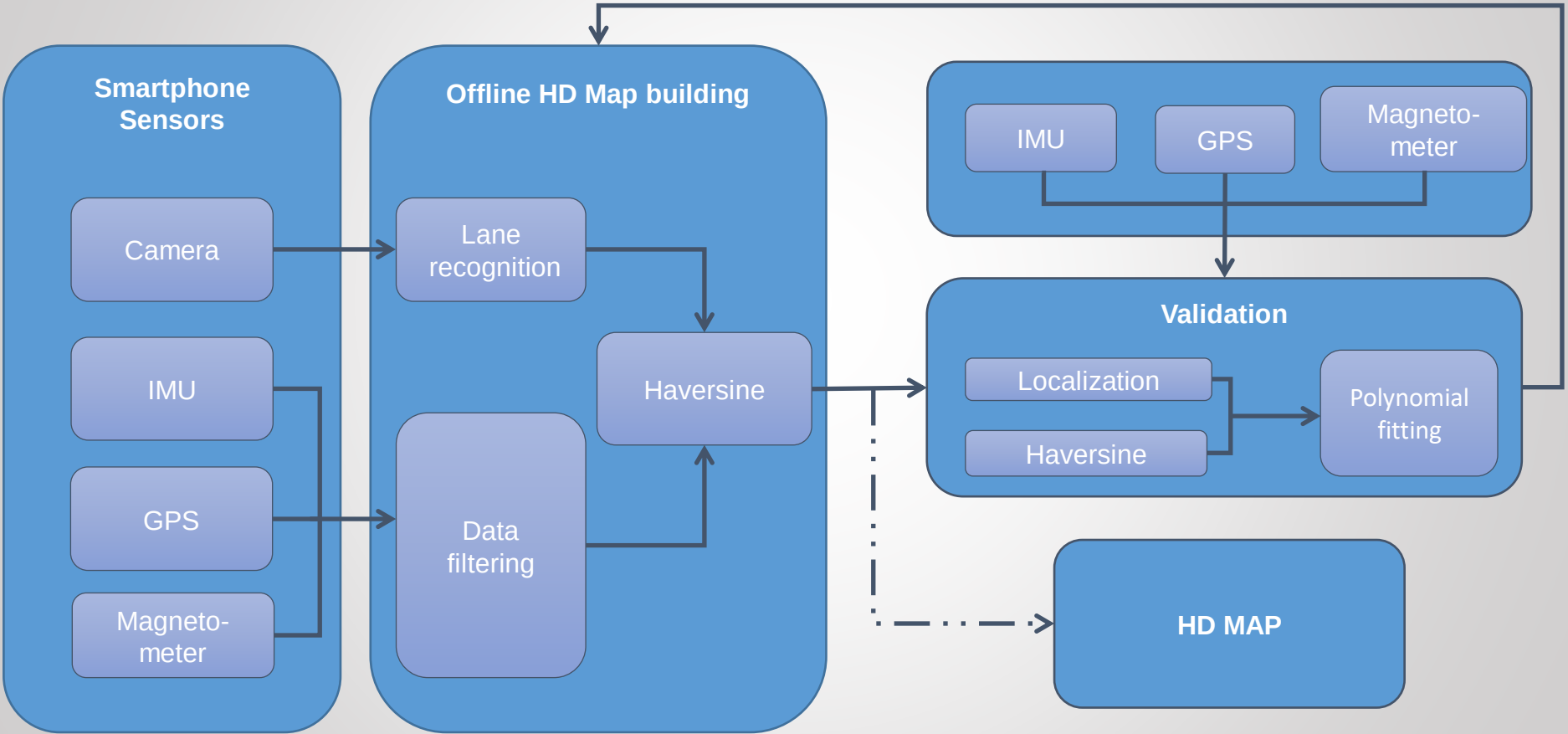
- **Highway**
 - Tunnels, Bridges
- **Sensors**
 - GPS – 1 FPS
 - IMU – 50 FPS
 - Camera – 30 FPS
 - Magnetometer – 50 FPS



- **Synchronization to video frames**



Software architecture



Data filtering, Localization



Process model

- Linear, discrete state space
- Separated yaw and linear dynamics



Measurement model

- Two Cases: GPS signal ON/OFF
- Accelerations has to be transformed into common coordinate system based on yaw angle



Kalman Filtering

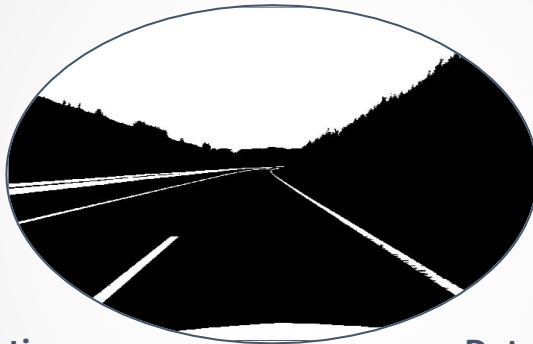
Lane detection



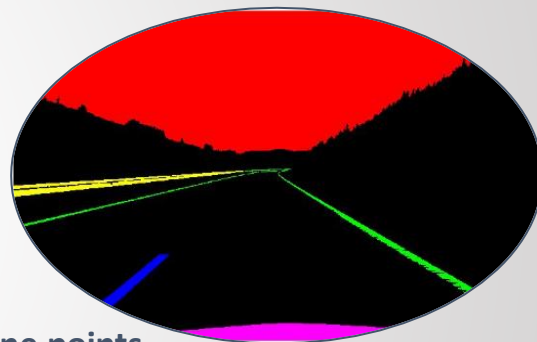
Camera picture



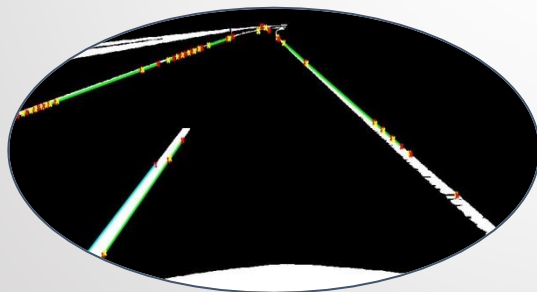
HSV color space



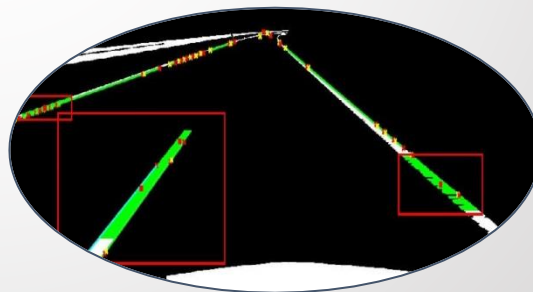
Classification



Classification

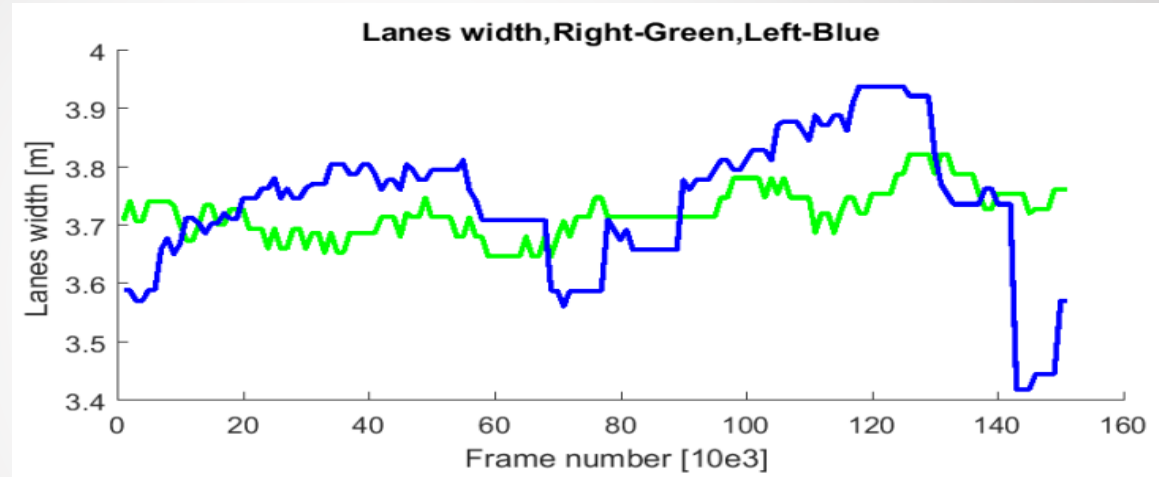
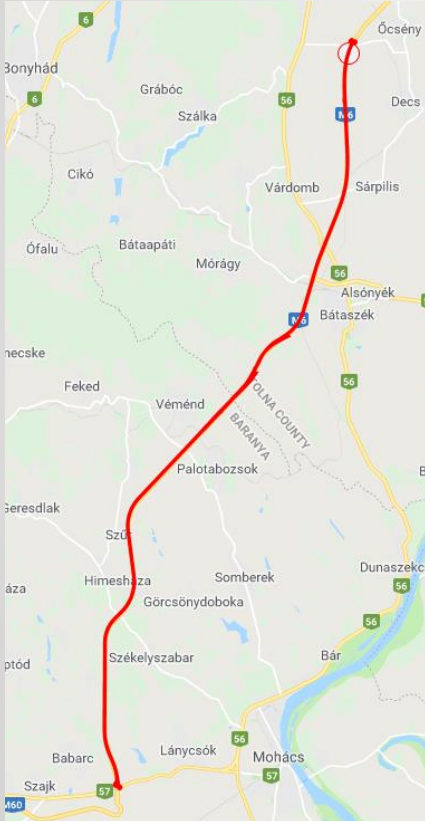


Detected lane points



Results

HD Map projection



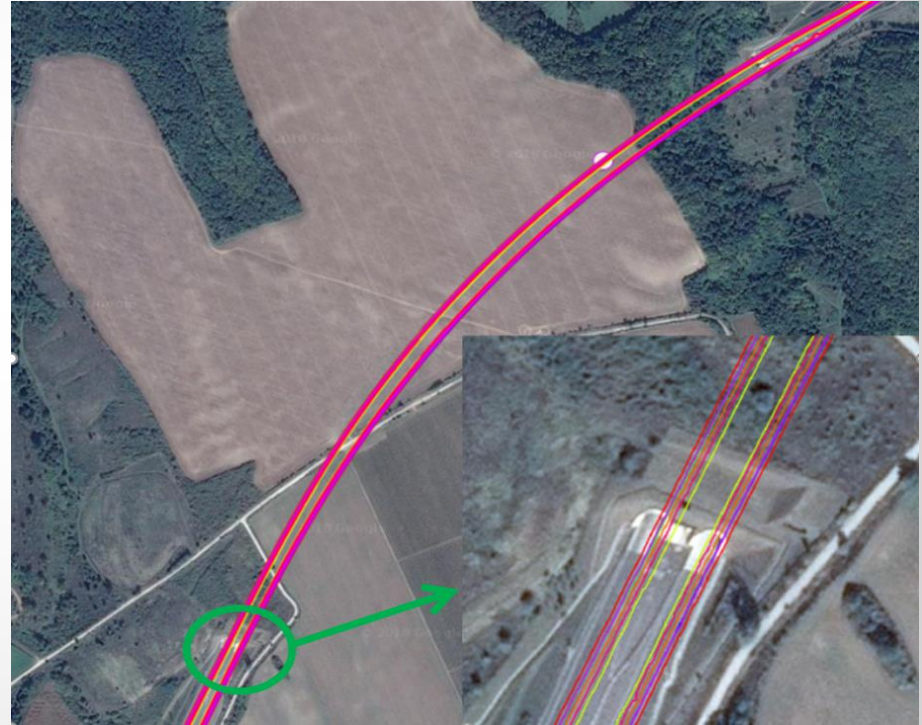
- HD Map static layer is built over 80 km
- Expected value is around 3.7 m with a distribution of 10 cm.
- 3% difference from the highway regulation.

Results

HD Map projected on google maps

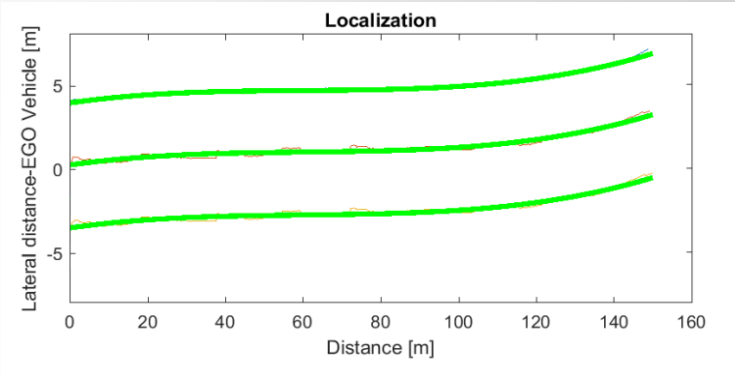
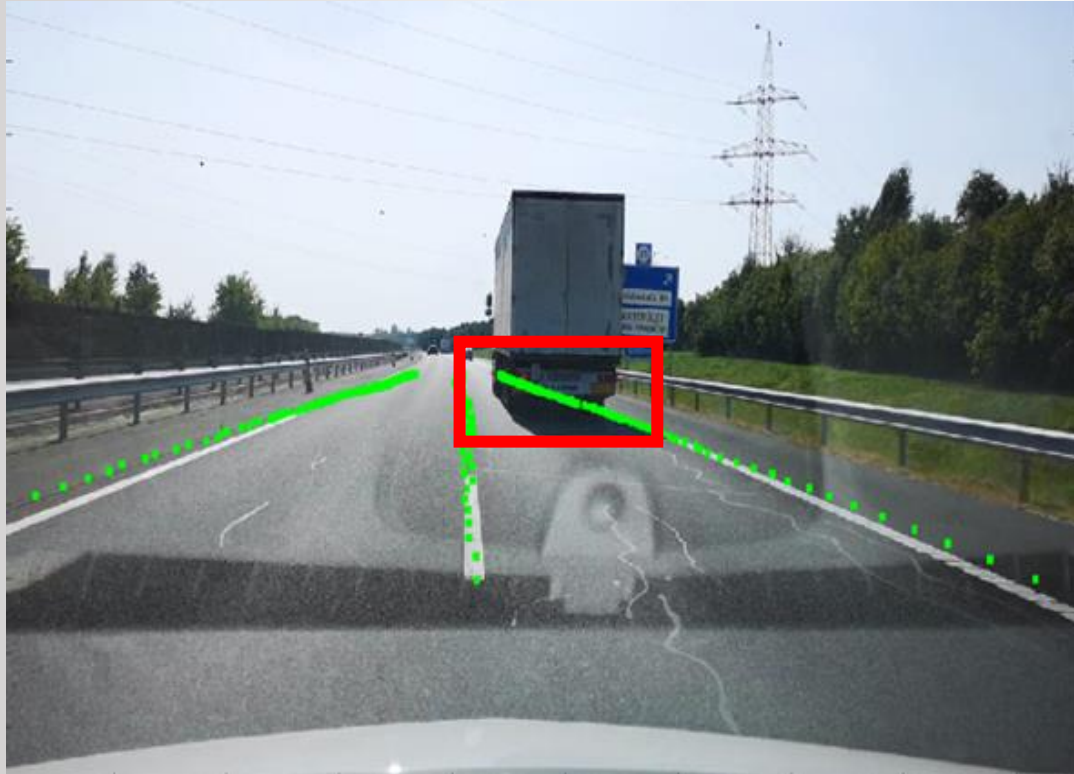


HD Map in tunnels



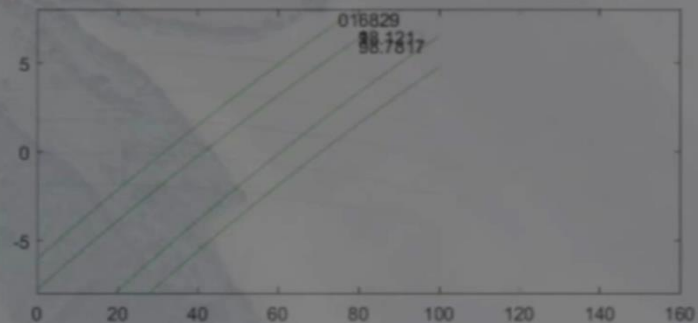
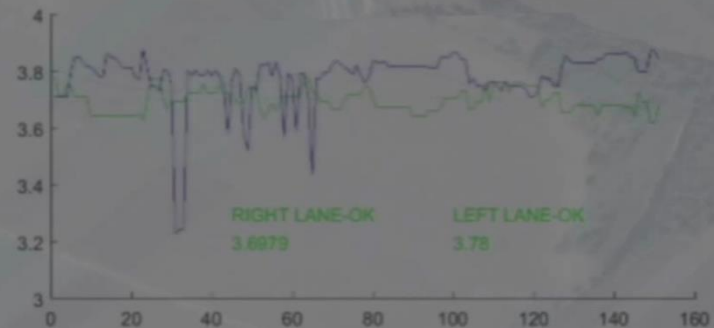
Results

Online evaluation



- Map evaluation during online localization
- Lateral accuracy is under 3% of the lane width, coming from latency of the algorithm and sensors.

Results



Results

- Offline
 - Automatic HD Map building, and fusion of more measurements : M6/M5/M0 highways > 300 km
 - HD Map 300 km/30 mb data
- Online
 - Color, Gradient, Neural network based Lane Detection
 - Localization
- Future works:
 - Automatic evaluation of build HD Maps
 - Particle filtering based localization
 - Neural network based localization

Thank you for your attendance !