From Point clouds to CAD-Lines
Die Autobahn GmbH
300 nationwide locations

- 1 headquarter
- 10 branches
- 41 field offices
- 42 traffic & tunnel control centres
- 189 motorway operation & maintenance centres

Facts & Figures

- 13,000 km motorway
- 28,000 bridges
- 550 tunnels
- > 6,000 projects
- 13,000 employees

Assets

- Value of motorway network
  200 billion Euro
- Motorways are one of the most important transport networks and public goods in Germany.

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Die Autobahn GmbH - Mandate und Mission
Motorway A 99 – Munich Ring Road
From Point clouds to CAD-Lines
Challenges and Objectives

**Challenges**

- 500 projects to be realized, investment volume 8 bill. Euro
- Lack of inventory data and CAD models
- No uniform, consistent basis of geodata in existing network
- Traditional surveying is time-consuming and cost-intensive

**Objectives**

- Reduce effort, time and cost for starting a project
- Accelerate the process of providing geodata
- Reduce the share of manually processed surveying data in the workflow
The Vision

• Today data from kinematic laser scans are manually processed to generate CAD files.

• Can the existing point clouds and CAD files used to develop and train an algorithm for pattern recognition and automatically extract the CAD features?

=> Proof of concept
Proof of Concept: approach 1
Automatic classification of highways
Proof of Concept: approach 2
Deep Learning on Vector Lines of Highway Scans

- Training with data from ~5km motorway sections
- Inference with ~2km sections

Red = Model Prediction
Green = Ground Truth
1. Automatic detection of motorway outer edges and generation of corresponding CAD lines is possible.

2. Preliminary results:
   - 50% of deviations < 2.5 cm
   - 90% of deviations < 7 cm
   - 2.6% of deviations > 50 cm

3. Improvement with more training and further optimisation is certainly to be expected.
Estimated benefit

**Acceleration**
- Enable project delivery performance
- The automated, AI-driven derivation of infrastructure objects from (laser scan) point clouds as enabler:
- Provide information on infrastructure inventory faster and more accurate
- Minimize human error
- Increase in efficiency
- Cost reduction for inventory data management of road infrastructure.

**Cost reduction**
- Reduce actual project costs and duration
- Point cloud acquisition by kinematic laser scanning < 1,000 € / km
- Manual generation of CAD file >10,000 € / km (current situation)
- Automated processing target cost < 1,000 €/km

**Enabling use of data**
- Develop an integrated digitalization solution
- Continuous infrastructure recording instead of measurement campaign every few years
- Source of point cloud data – kinematic laser scans, surveying drone flight, carborne data
- Sustainable project delivery and asset lifecycle management
- Solution for nation-scale infrastructure management.
### Use cases

#### Noise mitigation
- Calculation of noise exposure needs geometric data for noise barriers
- New regulations require calculation update on ~ 1/3 of the network

#### Planning
- Providing geodata for planning
- Derive CAD lines
- Generate BIM objects (as built model)

#### Asset management
- Providing geodata after construction for asset management with consistent basis of geodata
- Use for operation & maintenance
- Administrative use
Die Autobahn.
One for all.