Outline

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Introduction and Motivation

• As part of the accompanying research in the FeSH-project the TUD analyses the usage and long-time behaviour of the catenary
• Proven eHighway system feasibility with **limited capacity** for test purpose
• **BUT:** Experience from railways shows that 670 VDC “might be a little low” → We have set up a (scalable) simulation model of an eHighway track
• **ALSO:** Estimates regarding power demand, energy consumption and emissions (Simulation of whole highway A1 is planned)
Overall research questions

? Is the current system design (670 VDC) sufficient for the planned roll-out of the eHighway system?

? Does the infrastructure limit the operation? If so, where exactly are the limits?

? What impacts do adjustments of the electrical infrastructure have?
About the simulation tool(s)
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Road traffic simulation - vehicle

- Tractor + semi-trailer with 260 kW electrical power
- Based on the balance of forces for constant speed:
  \[ 0 = F_T - F_{RV} - F_{RT}, \quad \xi \ddot{m} = 0 \]

- Vehicle resistance forces are calculated:
  - Rolling resistance
  - Aerodynamic resistance
  - Transmission resistance
- Two different types were implemented:

<table>
<thead>
<tr>
<th>Type</th>
<th>Σmass</th>
<th>( P_{80 \text{ km/h}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>25t</td>
<td>100+5 kW</td>
</tr>
<tr>
<td>Heavy</td>
<td>40t</td>
<td>135+5 kW</td>
</tr>
</tbody>
</table>
Road traffic simulation - track

- The track model describes the topographical parameters of the track
- Field track in northern Germany serves as use-case for the simulation (5 km in each direction)
- Track resistance force is dominated by the Inclination of the track:
  \[ F_{RT} = (i + f_c) \cdot m \cdot g \]
- Basic case: Constant speed of 80 km/h along the track (no acceleration or deceleration)
Simulation of electrical infrastructure

- Two rectifier power substations, infeed voltage of 670 V DC
- Two-side power supply
- Two trolley catenaries, contact wire 150 mm² CuMg 0.5, messenger wire 120 mm² Bz II
- Cross coupling between the conductors at one section end
- No section insulator
Exemplary evaluation of three consecutive eTrucks
Exemplary evaluation of three consecutive eTrucks
Exemplary evaluation of three consecutive eTrucks
Evaluation and outlook

• Further usage of the simulation model:
  • Implementation of a whole highway
    • Analysis regarding power demand, energy consumption and emissions
    • Analysis regarding influence on public grid
  • Nation-wide implementation of eHighway sections with complex operation
  • Further development and resting (tracks, vehicle types, electrical design)

• Offer: Please approach us if you want to contribute to or make use of the simulation model

We have established a driving dynamics and load flow simulation tool that is already specialised on the eHighway...
Any Questions?

Dipl.-Ing. Markus Staub
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