Railway Simulators at the German Aerospace Center – Testing, Research and Development

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German Aerospace Center

Research Institution
- Aeronautics
- Space
- Energy
- Transport
- Defense and Security

Approx. 8000 employees across 33 institutes and facilities at 16 sites in Germany

Space Agency

Total income 2015: 891 Mio.€ (research, operations, management)
German Aerospace Center

Research Institution
- Aeronautics
- Space
- Energy
- Transport
- Defense and Security

Space Agency
- Surface Transport
- Human Factors Division in Berlin/Braunschweig, Germany
Agenda

• Introducing our simulation facilities
  • RailSite
  • RailSet
  • Modular Mockup Rail

• Current areas of work
  • Human factors research
  • Prototyping of assistance systems
  • Specific training concepts

• Future directions of development
  • Train protection functionalities
  • 3D visualisation
  • Future Workspaces
  • Training
Introducing the RailSite

- RailSite simulates ETCS railway operation (Baseline 2/3)
  - Interlocking
  - Radio block center
  - Onboard unit
  - Driver machine interface

- Every part can be replaced by the real component for conformity testing of that component

- This ETCS simulation provides the computational framework for our train simulators
Introducing the RailSet

- The train cabin within the RailSite infrastructure
  - Real cabin (BR424)
  - 3 touch displays
  - Front and side windows
  - Inductive NTC/ ETCS (L1/L2)

- RailSet is used
  - as experimental setting for human factors research
  - For the evaluation of prototypes (e.g. assistance systems / controls)
  - As training environment

- RailSet logs
  - Driving data, EVC log and panel input parameter
  - Video/ Audio data
  - Eyetracking- and physiological data
Introducing the Modular Mockup Rail

- Modular Mockup Rail
  - Modular interior design and display layout
  - Can be used as well in the dynamic as in the and 360° static simulation environment at DLR

- Goals:
  - Standardized usability testing of new HMI concepts
  - New configurations can be explored
  - Can be adapted to various training scenarios

- Logging is comparable to RailSet
Current work – human factors research

• What is the influence of automated driving (ATO) on the train driver in high speed railway operation? (Next Generation Train Project)

• Key characteristics
  • 26 train driver participated in two groups (ATO / manual driving)
  • 3 hours experiment (400 km/h/ high speed track/ ETCS L2oS), underloading scenario
  • Eyetracking, EEG, ECG, questionnaires, driving performance indicators

• Main findings:
  • Slower reactions towards critical events associated with ATO
  • Situation awareness, routine performance and attention allocation not impacted
Current work – human factors research

• Does ATO influence the quality of the situation awareness of the train driver approaching level transitions (e.g. ETCS L2 -> NTC)?

• **Key Characteristics:**
  • 2 hours experiment (280 km/h/ level transitions ETCS L2/NTC)
  • Eyetracking, EEG, ECG, questionnaires, driving performance indicators

• **Main findings:**
  • Let’s see in February 2017

• Findings as such translate into workplace and assistance system design
Current work – Prototyping of assistance systems

- **Dynamic control stick** based on side stick from aeronautics
  - The dynamic control stick provides
    - haptic backpressure to convey the optimal speed input

- **Goals:**
  - Increased punctuality
  - Decreased energy consumption

- **Main Findings:**
  - Dynamic control stick helps to stick closer to the speed profile
Current work – Specific training concepts

• Both RailSet and Modular Mockup Rail can be used for training

• The RailSet offers
  • High fidelity environment
  • Standardised training scenarios

• The Modular Mockup Rail offers
  • Highly adaptable environment
  • Dynamic (moving) simulator
  • 360 degree virtual reality
  • Programmable road users

Example:
• Light rail training concepts
Future Directions

• RailSite/RailSet/ Modular Mockup Rail
  • Keep up to date with ETCS development and specifications
  • Improve import of real world 3D models (RailML)
  • Extend scenarios for training for main line operation and light rail

• Build up future train driver workspace
  • for high levels/ grades of automation
  • Remote- control and supervision / tele maintenance
    • Multi-Train, part- time
Conclusions

- German Aerospace Center offers multiple medium/ high fidelity train simulators

- Adaptable to customer preferences
  - Dynamics
  - Visual information
  - Train protection system
  - Szenarios (light rail to high speed main line operation)

- Simulators can be used for your
  - Scientific research
  - System evaluation and testing
  - Safe prototyping
  - Customized trainings
Thank you your interest!

Thanks for this very interesting conference!

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