A facility for testing ERTMS/ETCS conformity and human factors

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Overview

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  - Information about the performance of the operators
  - Approach
  - Sensors, measured data and methods
- Concept and Architecture of the Lab
  - Error models and simulation of erroneous system behaviour
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- Perspective
Introduction: Safety implication of operational rules

Example for the safety allocation problem

- Identification and comparison of rules and regulations for safe normal and fallback operation needed.
- Comparison of rules for the allocation and distribution of safety responsibility to trackside and on board.
Objectives and Aims

Most accidents in Railways happen due to the interaction of the man machine system and more in fallback than in normal operation.

Perform research to improve safety of Railways, e.g.:

- The design of work places and driver desks,
- The design of signs and optical and acoustical signals,
- The optimisation of operational rules, e.g. to minimise ambiguous rules and misunderstandings (in real use!),
- The validation of usability, ergonomics and human factors of automation approaches,
- Experiments to safety-critical errors of the operators.

And to construct and operate the needed large-scale research infrastructure.
Human factors’ influence on the operational safety: Simulation approach

Consistent Chain from Interlocking Operator to Train Driver
Sensors, measured data and methods

Loggers, Sensors and measuring devices installed according to the requirements of the particular investigation

- Acquisition of information:
  - Inputs that the operator has recognised: “classical” logging, eye-tracking, …
  - Actions done by operator: “classical” logging, video, …

- Acquisition of the status of the operator:
  - Physical: activity of muscles and heart, resistance of the skin, electrical activity of the brain, eye movement, …
  - (Psychological: rating of the situation, questionnaires, …)
RailSiTe®: Principle

Trackside part of TCS\(^1\) (real or simulated)

- Signaler Interaction
- Position / Route

Onboard part of TCS\(^1\) (real or simulated)

- Driver Interaction
- Position / Brake Interaction

Communication

- Simulated Physics
- Position

Track

- Route Map
- Schedule

Train

- Driving Interaction (manual or automatic)

1) TCS: Train control system
RailSiTe®: Architecture

On-Board Subsystem

DMI

JRU

Onboard ETCS-System

TIU

Odo

Dynamics

Drivers Desk

Train

Air Gap

Radio

Balise

Loop

Signal

Trackside Subsystem

LEU

TRS

RBC

Interlocking

Detectors

Railway System

DMI: Driver Machine Interface
JRU: Juridical Recorder Unit
TIU: Train Interface Unit
Odo: Odometry
LEU: Lineside Electronic Unit
TRS: Train Regulation System
RBC: Radio Block Center
**RailSiTe®: Current State**

- Hard- and Software for Onboard and Trackside Equipment including the Environment Visualization
- Physical Odometry Simulator
- Interlocking Simulation
- Test Sequences (subset 76) can be performed

**Certified as:**

- UNISIG Reference Lab
- Inspection Body of the German Notified Body
RailSiTe® – Extended Functionality

- Operator Interaction
- Trackside Part of the TCS
  - Position of Road
  - Route Map
- On-Board Part of the TCS
  - Position of Brake Int.
- Train
  - Schedule
  - Simulated Physics
- Simulated Environment
  - Driving Interaction
- Simulated Dynamics
- Real Handling
  - Drivers Desk
- Simulated Operating Unit
  - VR-Cave
  - Movement Platform

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Conclusion and Perspective

Most accidents in Railways happen due to the interaction of the man-machine-system and more in fallback than in normal operation.

To improve operational safety, we must look on the interaction of the operators with the system as well as the operational rules.

The RailSiTe® is a large scale research infrastructure which allows the consistent simulation of the train control system and their interaction with the trackside and on board operators.
Contact

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Thank you for your attention!