The Project DemoOrt
„Demonstration of safety critical localization of trains“

Michael Meyer zu Hörste (DLR), Jan Poliak (TU-BS, iVA)
DemoOrt
Structure – of the presentation

- Motivation
- The Project DemoOrt
  - Targets
  - Structure of the consortium
  - Timeplan
- Approach
  - Architecture
  - Components
- Results
- Perspective
DemoOrt – Motivation

- Current localization principles used by railways are basing on infrastructure-side sensors (e.g. axle counters). These lead to:
  - Significant maintenance effort
  - Difficult to adopt to modified operational requirements

- For up-to-date railway operational concepts as ERTMS/ETCS Level 3 a vehicle-autonomous localization with high accuracy, dependability and integrity is required

- Examples of advantages of autonomous localization:
  - Concentration on the vehicle
  - Reduction of trackside maintenance effort
  - Reduction of system complexity

ERTMS: European Rail Traffic Management System
ETCS: European Train Control System

DLR
mrt
BOMBARDIER
DemoOrt - Project
Structure of the Consortium

German Aerospace Center
Institute of Transportation Systems
Braunschweig, Germany

Technical University of Braunschweig
Institute of Traffic Safety and Automation Engineering
Braunschweig, Germany

University of Karlsruhe
Department of Measurement and Control
Karlsruhe, Germany

Bombardier Transportation
(Signal) Germany GmbH
Mannheim, Germany
DemoOrt – Project
Basic facts about the project

- Funded by the German Federal Ministry of Economics and Technology.
- Project Supervision by the TÜV Projektträger Mobility and Transport

- 2 Phases:
  - Phase 1: Specification and Development
  - Phase 2: Demonstration and Test

- Funding Framework: Rail Freight Transport 2010
DemoOrt – Project

Targets of the project

⇒ Specification and Development of a vehicle-autonomous localizations system (Phase 1)

⇒ Performing of demonstrations and one-year tests to show accuracy, reliability and availability under real railway conditions and collect data for the safety analysis

⇒ Development of a reference measurement system

⇒ Development of an approach for a Safety Case according to CENELEC

⇒ Analysis of Migration strategies
DemoOrt – Project Timeplan

System Specification

2 Months

Interfaces

2 Months

Components

4 Months

Integration

8 Months

Demonstration

18 Months

Safety Analysis

18 Months

Migration Study and Economic Analysis

36 Months

Phase 1

2 Months

4 Months

8 Months

18 Months

Phase 2

9 Months

18 Months
DemoOrt – Approach
System Overview
DemoOrt – Approach
Components
Integration of three different Systems to one highly available and vehicle autonomous localization platform

1. Global Navigation Satellite System
   - No terrestrial signal required
   - By using Galileo Integrity of the Signal is guaranteed

2. Eddy Current Sensing System
   - Precise measurement of metallic in-homogeneities of the track
   - Absolutely independent from weather
   - Robust

3. Map Matching
   - All captured data can be used for fusion
   - Visualization
DemoOrt – Approach
Eddy current sensing system

Global Principle

Typical Sensor Signal (free Track)
DemoOrt – approach: Multisensor system for on board train localisation

Integration of different sensors
- identification of the position is more accurate (than single sensors)
- tolerant to failures in sensors
- continuous identification of the position of trains
- due to different principals in the measurement the robustness of the system is higher
- By using a GNSS receiver the availability and quality of a 3-D position is guaranteed
- Eddy current sensor affords a high accuracy mean velocity as well as a position and direction of overrunning switch
- Digital route map affords a high accuracy data about track as well as about specifically switch properties
DemoOrt – Reference Measurement System

Idea

To Evaluate the precision of the DemoOrt System a different system is needed, which fulfills the following requirements:

- Higher precision according to the Schannon Theorem
- Different technological approach to avoid common mode failures
- Highly reliable

These requirements have been fulfilled by a system consisting out of:

- RFID
- Radar
- Digital Map
GNSS reference platform:
Reference platform for GNSS railway application
DemoOrt – Reference Measurement System
Realization

RFID:
• Absolute Position
• Direction

Radar:
• Speed
• Relative Distance
DemoOrt – Results and Perspective

- Demonstrations:
  - TeZ Poprad (SK)
  - AVG Karlsruhe (D)

- Development of a reference measurement system

- Approach for a Safety Case according to CENELEC fulfilled

- Analysis of Migration strategies started
DemoOrt – Approach
Global Satellite Navigation System

Currently in use is GPS –
In the future Galileo

Used for:
- Overall time reference for time stamps
- Absolute Position
- Initial position acquisition for the eddy current system: reduction of the search space
Reliability
Time to Alarm
< 1 s
1 s < Alarm < 10 s
> 10 s
Availability

Technische Universität Braunschweig
Institut für Verkehrssicherheit und Automatisierungstechnik

Prof. Dr.-Ing. Dr. h.c. E. Schnieder
Thank you for your attention

Ďakujem Vám za pozornost’