Safety relevant imaging based applications for level crossings
Sicherheitsrelevante Anwendung bildbasierter Technologien an Bahnübergängen

Matthias Grimm, Markus Pelz, Dr.-Ing. Michael Meyer zu Hörste
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Institute of Transportation Systems
Institut für Verkehrssystemtechnik

Residence: Braunschweig and Berlin
Since: March 2001
Director: Prof. Dr.-Ing. Karsten Lemmer
Employees: Presently 100 employees from various scientific disciplines

Range of tasks
➢ Basic research
➢ Creating concepts and strategies
➢ Prototype development

Fields of research
➢ Automotive
➢ Railway systems
➢ Traffic management
Motivation

- Many level crossings (LX) exist all over Europe
- There are numerous incidents at LX with high damages to material and persons
  - The technical equipment of the LX only with flash lights or semi-barriers is not relevant for incidents
  - Many accidents occurred due to mistakes in noticing or obeying the warning signs

- Main Problem:
  - Safe and expensive technology vs. economic interests
Motivation

Main Target:

- New LX securing technology, which is
  - Adequate in safety
  - Affordable in investment and maintenance
  - Available and reliable during operation
  - Supporting technology to existing LX technology

These targets can be achieved by using imaging methods for LX securing technologies
State of the art and innovative approaches

- **State of the art**
  - Monitoring of LX danger zone
  - End of train monitoring
  - Train departure dispatching by the driver
  - All applications are only supporting tools without safety relation

- **Innovative approaches**
  - Catenary monitoring
  - Obstacle detection
Imaging based concept
Technical system requirements

- High availability and reliability
- Designed for rough environment
- Available in day and night times → object detection must be available under all light and weather conditions
- Replacement and/or assistance of human and/or technical operations

- At least same safety ← → Affordable safety

Alternatives of realization

- Support of existing control and safety technology
- Replacement and extension of existing operational functionalities by using imaging sensors (like video or infrared) combined with analyzing software
Imaging based concepts
System architecture

- Level crossing secured with half-barriers and flash lights.
- Four camera systems, two at each barrier.
- Each camera system consists of one camera for visible ranges and one for non-visible ranges, such as Infra Red camera.
- Control box with a GSM-R module
Imaging based concept

Applications

Two Applications can be performed by the system

Danger zone monitoring during a train is running towards the LX

Detecting an approaching train
Monitoring of the danger zone for vacancy proving
Sending the live pictures taken by the system via GSM-R to the approaching train in real time
Presenting the live pictures on a screen in the driver’s cab
Sending a warning or an “Emergency Stop” Command to the approaching train via GSM-R if an obstacle is detected in the danger zone

Vacancy detection of the danger zone while a road vehicle crosses the LX

Monitoring of the roadside approach areas
Communicating the approaching road vehicle to the securing system of the LX and – if technical or operational necessary – to the interlocking for locking the signal via GSM-R
Imaging based concepts
Vacancy detection of the danger zone

- Expect Vehicle
- Expectation value approaching Vehicle
- Vehicle detected - Frontside
- No Obstacle on LX [LX free]

- Vehicle detected - Frontside
- Obstacle in the danger zone
- Obstacle on LX [LX blocked]

- Vehicle detected - Frontside
- Obstacle left the danger zone
- No Obstacle on LX [LX free]

- Vehicle detected - Backside
- Obstacle in the danger zone
- Obstacle on LX [LX blocked]

- Vehicle detected - Backside
- No Obstacle on LX [LX free]
Demonstration

- Because of a wide operational area of such a technology, it is necessary to perform realistic tests.

- Especially with regards to the safety criticality of such an application, first tests will be done in a non-public area.

- For the field tests, a road-rail vehicle and a minivan will be used, in the first steps.

- After an initial phase of tests, a demonstration unit will be developed, that can be mounted at an LX in a non-public area.
Conclusion

- The implementation of imaging methods using camera based technology can help increasing the safety of railways especially at level crossings.

- To implement such an innovative system, intensive test campaigns are necessary in which the multiple requirements regarding safety targets, availability, maintainability and security have be evaluated.

- Innovative systems using camera based technology form an economical advantageous alternative to existing track-fixed monitoring units still reaching the required safety regulations formulated by standard books, laws or other official documents all over Europe.

- The Institute of Transportation Systems of the German Aerospace Center in Braunschweig will develop such a system and evaluates it in different field tests. First results will be presented in the near future.
Thank you for your attention

Contact:
matthias.grimm@dlr.de
markus.pelz@dlr.de
michael.meyerzuhoerste@dlr.de