Technische Universität Braunschweig

Dynamisches Eisenbahn System Modell
Modèle dynamique d'un système ferroviaire
Dynamic model of a railway system

Research at the Institute for Traffic Safety and Automation Engineering

The DESM research laboratory in the Bernapark Deisswil

The development of technology and the increase of traffic by rail lead to an ever greater complexity in the system of railways. The automation in the fields of operation management, safety installations and vehicles have resulted in considerable loss of knowledge of the system as a consequence. At most stations there are now no longer train operators. They used to work closely with the engine drivers and knew exactly the installations in their area of responsibility. The construction of modern motor vehicles no longer allows the engineer to remedy a failure of engineering components with their own professional experience. This raises the question today of whether the replacement of many years of experience with technology there are certain limits and whether they affect the whole system.

For the analysis of operational and technical processes in the railway system, simulation programs are used today. Common examples are driving simulators or simulation programs for train traffic operators. What is missing today, however, are largely systemic simulators, summarizing the activities of the two railway workers categories.

All programs and electronic simulation models for railway investigations in the system require as a basis precise data on the infrastructure (tracks, switches, signals, tunnels, bridges, overhead, etc.) and operation (trains, functions, signal boxes, timetable, etc.). Merging and processing data for simulations are often not easy. To make things worse, changes in railway infrastructure and operation are subject to ever shorter intervals.

The research under the direction of the Technical University of Braunschweig, concerns these problems. It wants to make a contribution to understand the railway system better to counteract the above-mentioned loss of system knowledge. To this end, a research laboratory for the development of a model railway system is operated in the Bernapark Deisswil. In a former factory building there are train and interlocking simulators, so that the methods for the modeling of railway infrastructure and operations can be investigated and developed.

As the first object of investigation is the signal station at Obermatt near Langnau in the Emmental. In a first step, the former electromechanical interlocking device has been faithfully recreated. This signal box will be connected with the locomotive simulator Locsim from the Bern University of Applied Sciences in Biel. For this simulator, an original cab of locomotive Re 4/4II is used which was developed as a simulator years ago by the University of Applied Sciences Winterthur as part of several graduate works.

Interlocking replica of the signal station Obermatt for research use.

The train simulator of the type Re 4/4 in the research laboratory on the line near Langnau in the Emmental.

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In a next step, the predecessor and successor types of signal boxes of this station will be built. To this, a mechanical signal box, a relay interlocking device, type “Domino 69" and a model of an electronic interlocking system will be used. This experimental setup makes it possible to gain new insights into electronic models of railways in space and time.

Parallel to the above-mentioned investigation Obermatt station was taken over by the Swiss Federal Railways SBB a locomotive simulator, type Re 460. With the help of this simulator, important insights about the required level of detail to be obtained in the modeling can be provided, because the facility has a system for simulating the movement dynamics. Furthermore, it is a current type of locomotive with a high level of automation, which provides interesting possibilities for the investigation of human / machine interfaces.

In the years 2012 and 2013 a number of case studies, situation analyzes and measurements will be performed in the laboratory. The goal is to gain knowledge about the (electronic) modeling in the field of railways for the study of complex systems. Such systems are networks of heterogeneous components that interact in a nonlinear way. This interactions of their parts cannot be predicted from the properties of the parts.

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