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From the skies to the rails: DLR scientists unveil a new collision avoidance system for trains

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The Integral test train equipped with RCAS technology

Trains are considered to be a safe mode of transport. Nevertheless, collisions do occur. The only way to prevent them is by having precise information well in advance. Researchers at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) have now devised a new kind of system intended to prevent rail accidents, and have named it Railway Collision Avoidance System (RCAS). On 11 May 2010, at a test track near Aachen, the developers gave a first demonstration of how RCAS functions.

Train-to-train communication without infrastructure

"RCAS is a system for preventing train collisions that operates independently of other safety technology deployed alongside the railway tracks," explained project director Prof. Dr Thomas Strang from the DLR Institute of Communications and Navigation, as he summed up the objective of this DLR project.



RCAS project director Prof. Dr Thomas Strang

The system uses the latest communication and sensor technologies, and these enable direct train-to-train communication. The trains exchange information about position, speed, loading gauge and the planned route as soon as they are within radio range of one another. "If the system detects an imminent collision, it warns each train driver and assists them by offering possible solutions," says Prof. Strang. He is convinced that RCAS could have helped to prevent tragic collisions such as the one on 15 February 2010 involving two Belgian regional trains near Brussels.

A multi-institute project

RCAS is a multi-institute research project at DLR. The team involves researchers from the Institute of Communication and Navigations, as well as researchers from the DLR Institute of Transportation Systems and the Institute of Robotics and Mechatronics. In addition, DLR is collaborating on its RCAS venture with Bayerischen Oberlandbahn, a Bavarian railway company. For the test runs at the Wegberg-Wildenrath test centre (in the Heinsberg / North Rhine-Westphalia region), the company made various facilities available, including one of its 'Integral' regional trains and personnel.



Test scenario at the test centre in Wegberg-Wildenrath

The DLR researchers delivered lectures and showed models to participants on the demonstration day, explaining to them the technology, operating method and potential applications of RCAS. On test runs, the audience of specialists was then able to experience the RCAS technology at work on board the Integral, equipped with RCAS and in communication with its simulated collision partner – DLR's road/rail 'RailDrive' vehicle.

Three different test scenarios

Integral and RailDrive exchanged information in three different scenarios. The first situation involved a side-by-side run during which the two rail vehicles were simultaneously approaching a section of single-track line. In the second scenario, the train headed for a set of points behind which one line was occupied and the other was vacant, but where the setting of the points was unclear. In a third test run, a train was left stationary near a set of points but did not constitute a hazard, and the system successfully recognised this fact.

In all cases, RCAS assesses the situation for itself and evaluates it. If a situation appears critical, the RCAS system prompts the train driver to apply the brakes. If the situation is not critical, the system does not raise an alarm and the train is able to continue on its journey.



RCAS intended to complement existing control and protection systems

"RCAS is initially intended for routes and situations where, at present, no other protection systems are employed – for example, routes with very low volumes of traffic, industrial railways, construction sites or shunting areas," explained project team member and DLR rail transport researcher Dr Michael Meyer zu Hörste as he mapped out the potential applications. Dr Meyer zu Hörste emphasised that RCAS is in no way intended to replace the European Train Control System, ETCS (the standard European rail traffic management system). "RCAS is an add-on system – train control and protection systems already play a successful role in preventing collisions. RCAS can act as what we call a 'Safety Overlay', to increase safety levels in places where conventional safety technology is not being employed." The existing prototype is based on standard commercial hardware and software, which in its existing form does not hold, and will not be awarded, official approval for safety-critical fields of operation.

Since RCAS is not reliant on functional elements in the transport infrastructure, the system can be designed and built very cost-effectively as a simple on-board unit for trains. "The precise timing of a market launch and the price will, however, depend on the functional and timing requirements of the first train operators to employ this system. RCAS is already available as a working prototype for trials under operational or close-to-reality conditions," explained project director Prof. Strang as he outlines the current project status.

On this project, DLR is also acting as a research partner for technology transfer.

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