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Data & Information

FREQUENTIS

All in Favour of Rail Track Safety Say AI

Is there a faster way to detect rail track anomalies and prevent delays? **Bettina Arendt**, Frequentis User Experience Expert, **Michael Kreilmeier** Mission Embedded, and **Prof. Axel Jantsch**, TU Wien, explore the use of artificial intelligence to keep passengers moving.

Railway travel has a positive impact on the environment, reducing road congestion and moving people and cargo in the most economical way; it is the essential engine that keeps urbanised society running while also tackling the climate crisis. But, to keep passengers moving, safety and reliability are crucial and only upheld through the careful maintenance of the track infrastructure. However, current maintenance methods consist of frequent surface checks

by rail operator staff and precise but infrequent and cost-intensive monitoring with measuring vehicles.

Experts estimate yearly maintenance costs of about €50,000 [1] per track kilometre and assume that a decrease of at least 15 percent up to 55 percent can be achieved through improved maintenance methods [2]. This has been the driving force behind the solution proposed in a project

funded by the Austrian Research Promotion Agency (FFG). It will provide an excellent cost-benefit ratio, with the cost efficiency arising from low sensor costs, allowing numerous rail vehicles to be equipped with a state-of-the-art system to reach high-frequency monitoring, covering the entire railway network.

Intelligent Track Infrastructure Monitoring

The FFG is funding the HARMONY project (Human-Assisted Real-time MONitoring of infrastructure and obstacles from railwaY vehicles) to explore a more efficient and economical method for monitoring track infrastructure.

The project proposes the use of artificial intelligence (AI) to detect irregularities on railway tracks in addition to and in support of the precise but infrequent and often cost-intensive measuring vehicles. The ultimate goal is to increase the safety and reliability of railway transportation.

The project, run by Mission Embedded, Frequentis, and the Institute of Computer Technology at the Vienna University of Technology (TU Wien), will investigate the use of an innovative track monitoring system that uses sensors and AI to detect anomalies on the track infrastructure. The aim is to be responsive to any issues at an early stage to prevent significant damage and avoid potential accidents.

The FFG HARMONY project is focusing on an intelligent system to be mounted on regular trains that uses sensors to scan the track infrastructure during normal operation as well as AI to automatically detect and report anomalies on tracks, track beds, and switches. In this way, potential hazards such as track breaks, track damage, or vegetation growth are detected at an early stage. This also helps rail operators to make informed decisions on necessary maintenance work. In addition to intelligent sensor data processing on the moving train, the HARMONY project also addresses human factors to increase end-to-end system security and user acceptance. A key element here is the development of the new role of the remote analyst, supporting the decision-making process remotely.
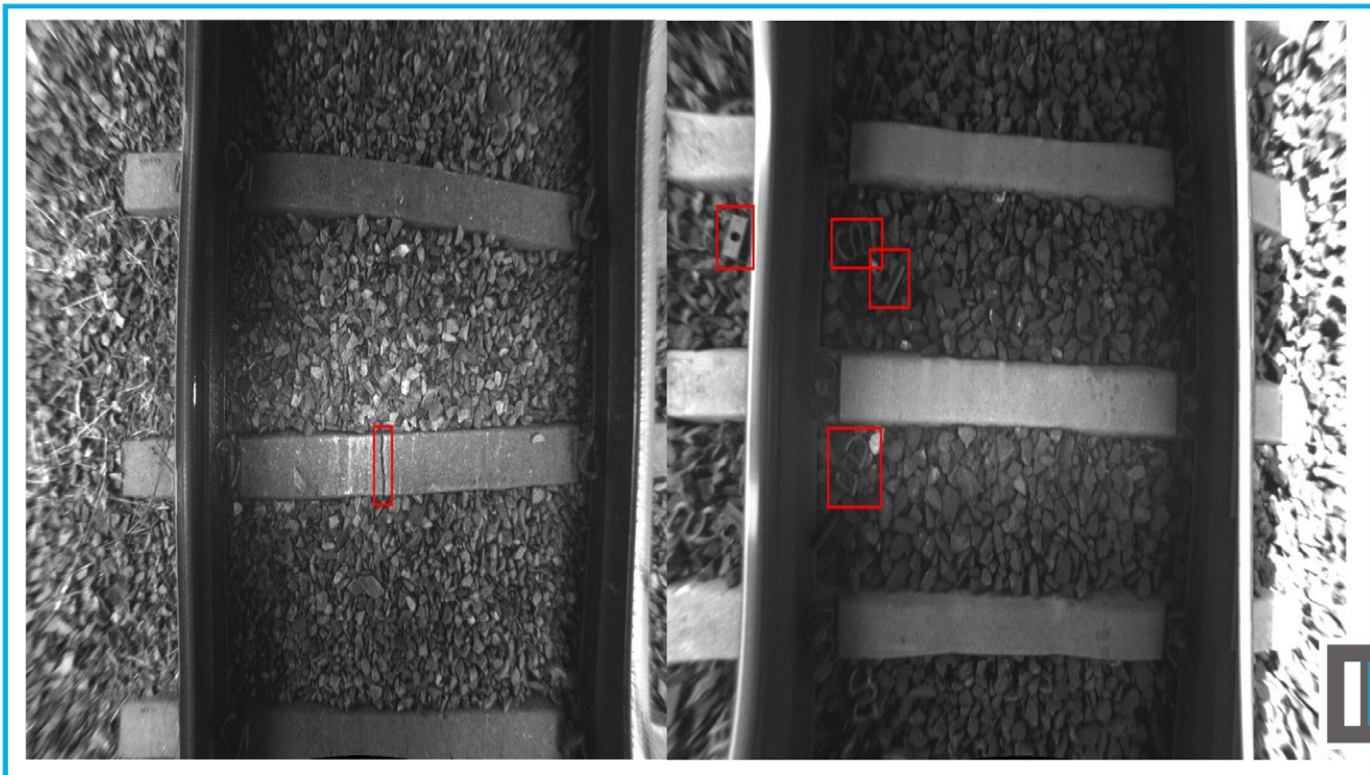
Informed decisions: Potential hazards such as track breaks, damage, or vegetation growth can be detected early

This new role is also relevant for AI applications in other areas where intelligent machines are used.

Disruptive Innovation

With the Austrian Federal Ministry for Climate Action (BMK) as a funding body, this research project can offer a customised high-tech solution made in Austria for rail operators from all over the world. Mission Embedded is one of the worldwide pioneers in the field of intelligent sensor and assistance systems for rail vehicles and has many years of experience and expertise in the areas of sensor integration, machine learning, automatic data processing, as well as safety and security for mission-critical applications. High-quality sensor data from several previous projects lay the foundation for the present project.
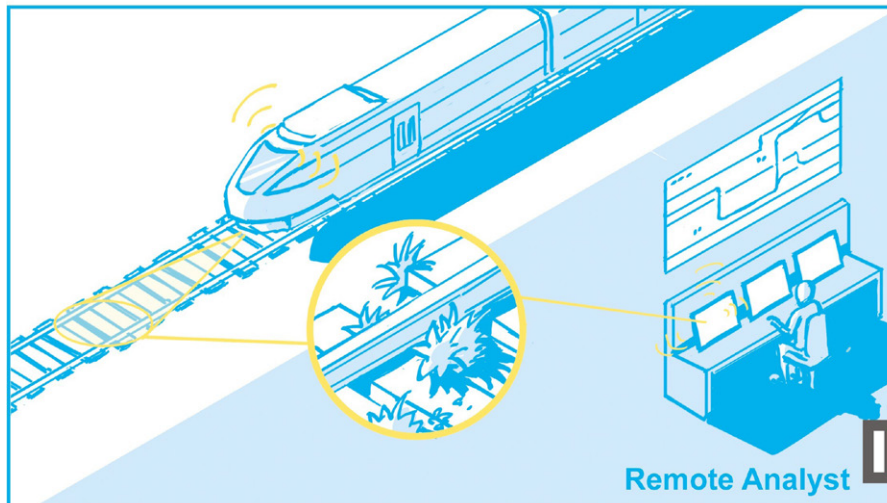
Human in the loop: The remote analyst supports the decision-making process

As consortium leader and expert for highly reliable software and hardware, Mission Embedded is mainly responsible for the technical development of the project. TU Wien contributes its long-standing research know-how, its extensive expertise in embedded systems, embedded machine learning, as well as sensor data analysis and makes an essential contribution to the technical development. Frequentis Control Room Consulting (CRC) contributes decades of experience in safety-critical environments with process analysis and information flow design and is responsible for maximising the end-to-end

security of the overall system. Frequentis CRC also addresses user-specific challenges including user acceptance, visualisation of multi-sensor data, and ultimately the role definition of the remote analyst, addressed by way of stakeholder analysis, information flow analysis, and human performance analysis, among others.

This research project is a great example of disruptive innovation (innovation that does not build on existing processes) through automation and artificial intelligence. To prepare for the transition in a significant but safe way, the current and future situation must be evaluated in depth. The results of this challenging research project will provide a solid basis for monitoring the track infrastructure more seamlessly and cost-effectively, enabling even safer and more reliable rail operations, ensuring an enjoyable journey experience for passengers to keep them returning.

[1] C. Esveld and C. Esveld, Modern railway track, Second., vol. 385. MRT-productions Zaltbommel, Netherlands, 2001.

[2] Jovanović, S., Božović, D., & Tomičić-Torlaković, M. (2014). Railway infrastructure condition-monitoring and analysis as a basis for maintenance management. Građevinar, 66(04.), 347-358.

About Frequentis

Frequentis is an international supplier of communication and information systems for control centres with safety-critical tasks, with solutions that leverage over 70 years of experience in safety-critical communications
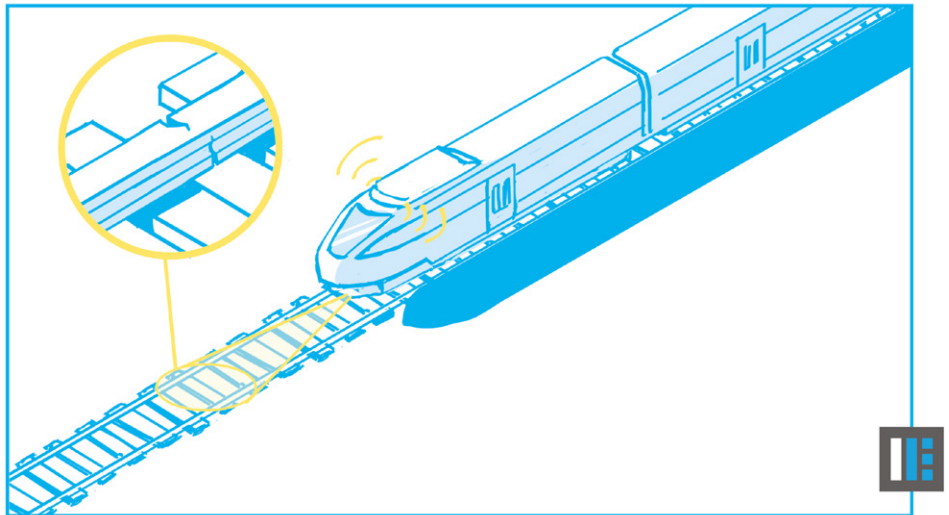
Automatic reporting: Sensors mounted on regular trains will scan track infrastructure during normal operation

and applications. Such 'control centre solutions' are developed and marketed by Frequentis in the business sectors Air Traffic Management (civil and military air traffic control, air defence) and Public Safety & Transport (police, fire brigade, ambulance services, shipping, railways). The company also holds the number one market share in GSM-R dispatcher terminal positions; more than 8,000 units are currently deployed in customer control centres in over 25 countries.

About Mission Embedded

Mission Embedded is a member of the Frequentis Group, which develops and supplies highly reliable embedded systems for professional applications in safety-critical areas such as railway, special vehicles, industry, medical technology, and air traffic control. The high-quality tailor-made solutions enable customers to turn their innovation projects into reality within the shortest possible time. All phases of the product life cycle are covered – from conception and

system design to production and maintenance.

About Institute for Computer Technology, TU Vienna

The Institute of Computer Technology (ICT-TUW) at the Faculty of Electrical Engineering and Information Technology at Vienna University of Technology focuses its research on embedded systems, systems on chip and software-intensive systems. The areas of embedded machine learning, sensor data analysis, safety and security, smart energy systems and requirements engineering represent important research activities, which are currently pursued in 30 externally funded projects with a total volume of about one million euros.

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