PRESS RELEASE

Intelligent sensor technology for railways – safety and service through LPBF and AI

Sensors in the chassis and doors of a passenger train contact the SAP system of Deutsche Bahn AG via 5G and report defects before they occur. Science fiction?

Defective components cause the "delays in operations" that are unpopular among rail passengers. At the same time, the replacement of still functioning components at rigid maintenance intervals does not make ecological and economical sense.

SenseTrAIn, funded by the Federal Ministry for Economic Affairs and Energy BMWi, is a futuristic-looking method to efficiently monitor functions relevant to safety in railway engineering. Since September, researchers from the Fraunhofer Institute for Laser Technology ILT have been working with industry partners to develop the future of maintenance and repair at DB Systemtechnik GmbH, Europe's largest competence center for railway technology. Until 2024, ME-Meßsysteme GmbH, vedisys AG, DATAbility GmbH and scientists at ILT will be developing an AI-supported sensor system for rail transport.

The SenseTrAIn project is now setting the course for intelligent maintenance, using the additive process Laser Powder Bed Fusion (LPBF), which has proven itself over many years. The layer-by-layer 3D printing process makes it possible to integrate electronic components, such as sensors and actuators, into metallic components. Stopped at the right time, the process enables sensors to be built into the part before the 3D laser continues its work. But the component alone is only half the story. Networked and controlled by AI, the finished system will in future signal itself whether, when and where a replacement or repair is necessary.

"We were awarded the contract by the BMWi because the overall package, put together by our project participants, adds up," Simon Vervoort is certain. He works as a research assistant at Fraunhofer ILT. The aim of the joint project is to develop a comprehensive solution for wireless and continuous condition monitoring of sensor-integrated, additively manufactured components: from sensor technology to reporting in Deutsche Bahn AG's SAP system.

For DB Systemtechnik GmbH, the system needs to be suitable for problem-free retrofitting, in other words, it has to be simple and cost-effective. In this context, there was

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also a desire for wireless data transmission, which can be implemented quickly and easily with the help of 5G, for example.

The project partners identified possible applications using technology scouting. Promising fields of application include door mechanisms, primary and yaw dampers and, above all, wheelset bearing caps, which seal off wheel bearing housings. The latter is a critical component from a maintenance perspective; here, under increased load, the temperature rises and there is a great risk of wear. Temperature and acceleration sensors integrated into the cover could detect hot runners and their causes at an early stage. The use of Artificial Intelligence (AI) in combination with the sensors makes detection and further processing possible in the first place.

No AI works well without a database. Simon Vervoort particularly emphasizes the need for a large, valid database. Actually, it should be generated directly on the systems to be controlled in everyday operation. Since this is not possible according to the ILT scientists, they are first using the TrainLab of the Deutsche Bahn Technik GmbH to test the new sensor technology under realistic everyday conditions. The data obtained in this way will initially be used to train the AI. In the following step, when the technology functions smoothly, the partners plan to test the system in everyday operation. Thanks to the bundled competencies of those involved, success seems to be within reach: The researchers at Fraunhofer ILT are certain – this is not science fiction! Rather it is the successful combination of experience, vision and innovative engineering.

Interested parties can find out about the current status of the project at the Fraunhofer joint booth at Formnext 2021 in Frankfurt am Main from November 16 to 19. One highlight is a practical demonstrator from Fraunhofer ILT: The component, which is additively manufactured using LBPF and incorporates sensor technology, serves to illustrate the many possibilities of this new technology.

Project SenseTrAIn

ME-Meßsysteme GmbH, Henningsdorf (project management): develops component-integrated sensors for force, temperature and acceleration as well as suitable transmission techniques for the measured values.

DATAbility GmbH, Darmstadt: develops a prognostics health management system (PHM) with a connected decision support system that processes the raw data obtained with suitable methods from the field of machine learning. This way, they can make predictions about a component's condition.

Fraunhofer ILT, Aachen: integrates sensor technology into the additive manufacturing process as the next step towards the building intelligent components required for the concepts of "The Fourth Industrial Revolution" and "Internet of Production."

DB Systemtechnik GmbH, Minden: Vehicle-specific know-how, provision of information on components and parts as well as their system integration; regular expert sparring partner for project participants; testing of demonstrators on test trains in the Advanced TrainLab.

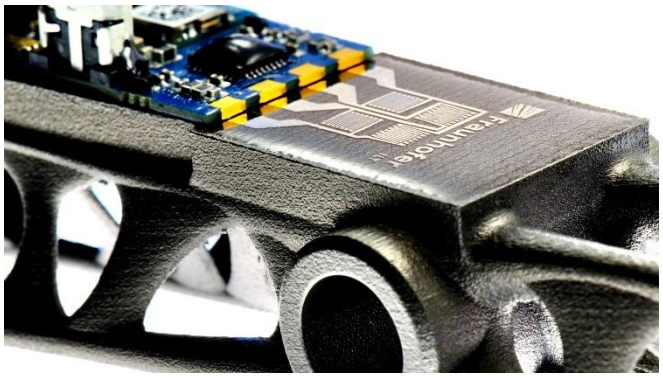

Image 1:
Practical demonstration: At Formnext 21, Fraunhofer ILT will be demonstrating the possibilities of sensor integration using an LPBF-printed demonstrator with a printed measuring grid including conductors.
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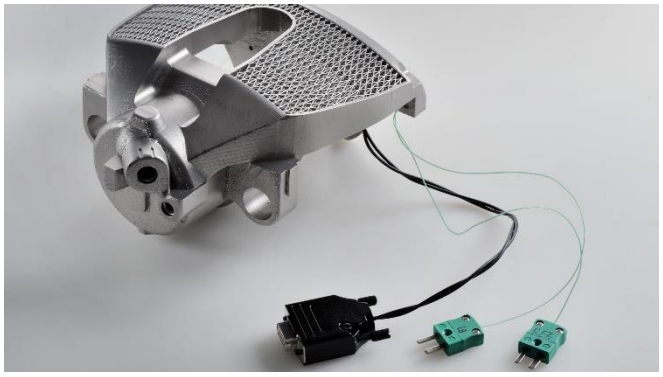

Image 2:
Mobility of the future: AM brake caliper with integrated sensors for measuring braking force and temperature.
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