Car Repair 4.0

AI-supported differentiated diagnosis via electric field quantities

Motivation

Proprietary diagnostic systems connected to the vehicle interface are mostly used today to diagnose errors in motor vehicles. These are used to read out the vehicle's internal error memory, which displays the error code and the associated supposed error. With this method, sometimes only the parts recommended by the system are replaced, and there is no search for the real cause of the error. These systems do not do justice to the high degree of complexity of the components and the integrated control technology in a modern vehicle. Sometimes, a symptomatic error pattern is detected, and the corresponding component is replaced, but the actual cause of the fault remains undetected. Consequently, either the error remains – and another component is replaced just to be on the safe side – or the customer finds that the error reappears after a short time. Both cases result in increased expense and dissatisfied customers.

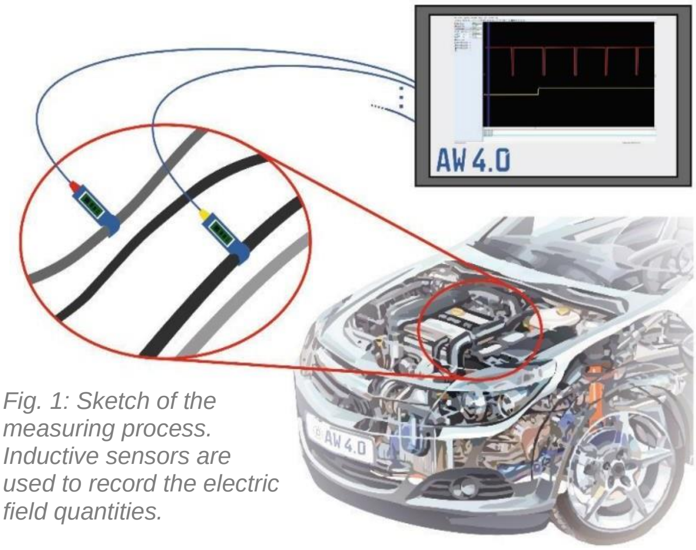

Fig. 1: Sketch of the measuring process. Inductive sensors are used to record the electric field quantities.

In view of the increasing proportion of electronic components in the automotive sector, there is also a need for more differentiated diagnostics. While the electrification of engines is reducing the number of mechanical components, the complexity of the electrical and electronic portions of vehicles is increasing. It is becoming more difficult for current professionals to maintain modern vehicles, as different background knowledge is required for structured troubleshooting and diagnostics.

Project goal

Our goal is a differentiated diagnosis based on the measurement of electric field quantities, e.g. in the engine compartment. This is a time-consuming process and the interpretation of the measurement data requires a great deal of experience on the part of the user. In the Car Repair 4.0 project, this process is to be significantly simplified through the use of AI and machine learning methods to enable targeted, resource-efficient and cost-effective repairs. For this purpose, a system consisting of measurement transducers, a web interface for connectivity, and a cloud-based server infrastructure for automated interpretation of the measurement data by a classification algorithm is being developed. This system will then be implemented in several car repair shops, evaluated and further optimised. As a result, an easy-to-use system for simple measurement data acquisition is available, which provides the user with a diagnostic suggestion for the recorded measurement data with high specificity in real time. The cloud-based infrastructure in real time means that the system can be made available to any number of car repair shops as a Diagnosis as a Service (DaaS) offer. Thus, the database increases with each use, which ensures continuous improvement and dynamic adaptation to further vehicle types.

In the development of the planned infrastructure, we follow the Gaia-X guidelines to leverage the associated principles of transparency, security, sovereignty, and trust. These principles make it possible for different players to work together collaboratively across company boundaries and along the value chain, so that the focus is on the absorbed knowledge and AI, and the technician can be supported as a result.

Scope

The planned system enables a lean and cost-optimised process of vehicle diagnosis. It thus has the potential to revolutionise the vehicle service market with Gaia-X in the age of digital transformation. The associated increase in expertise and value creation supports (electric) mobility throughout Europe and underpins the current structural transformation of automotive manufacturers.