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# Audi optimizes quality inspections in the press shop with artificial intelligence

- **First application case goes into series development**
- **Crack detection in the press shop to be automated with machine learning**
- **The process is another building block for the company's digital transformation**

Ingolstadt, October 15, 2018 – As one of the first automobile manufacturers worldwide, Audi plans to apply machine learning (ML) in series production. The software Audi has developed recognizes and marks the finest cracks in sheet metal parts – automatically, reliably and in a matter of seconds. With this project, Audi is promoting artificial intelligence at the company and revolutionizing the testing process in production.

Due to the increasingly sophisticated design of its cars and the high quality standards at Audi, the company inspects all components directly after production in the press shop. In addition to visual inspection by employees, several small cameras are installed directly in the presses. They evaluate the captured images with the help of image-recognition software. This process will soon be replaced by an ML procedure. Software based on a complex artificial neural network operates in the background of this innovative procedure. The software detects the finest cracks in sheet metal with the utmost precision and reliably marks the spot.

"We are currently testing our automated component inspections for series production at our Ingolstadt press shop. This method supports our employees and is another important step for Audi in the transformation of its production plants into modern smart factories," stated Jörg Spindler, Head of the Competence Center for Equipment and Forming Technology.

The solution is based on deep learning, a special form of machine learning that can operate with very unstructured and high-dimensional amounts of data such as with images. The team spent months training the artificial neural network with several million test images. The biggest challenges were on the one hand, the creation of a sufficiently large database, and on the other hand, the so-called labeling of the images. The team marked cracks in the sample images with pixel precision – the highest degree of accuracy was required. The effort was worth it because the neural network now learns independently from the examples and detects cracks even in new, previously unknown images. The database consists of several terabytes of test images from seven presses at Audi's Ingolstadt plant and from several Volkswagen plants.
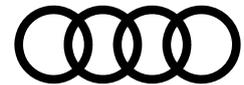
"Artificial intelligence and machine learning are key technologies for the future at Audi. With their help, we will continue to sustainably drive the digital transformation of the company," emphasized Frank Loydl, Chief Information Officer (CIO) at AUDI AG. "In this cross-divisional project, we are jointly developing a production-ready solution that Audi will use exclusively in the company and which is unique in the market." The software was mainly developed in-house, from the idea to the finished prototype. Since mid-2016, the innovation department of Audi IT has been working hand in hand with the Production Technology division of the Equipment and Metal Forming Technology Competence Center.

In the future, quality inspection using ML will replace the current optical crack detection with smart cameras. This involves a great deal of manual effort. Whether doors, engine hoods or fenders – the camera currently has to be reconfigured for every new component produced in the press shop. In addition, false detections regularly occur, since the simple algorithms of the image-processing program are highly dependent on ambient factors such as lighting conditions and surface properties.

In the future, it will be possible to apply the ML approach also for other visual quality inspections. If a sufficiently large number of labelled datasets are available, the system can also support paint shops or assembly shops, for example.

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The Audi Group, with its brands Audi, Ducati and Lamborghini, is one of the most successful manufacturers of automobiles and motorcycles in the premium segment. It is present in more than 100 markets worldwide and produces at 16 locations in twelve countries. 100 percent subsidiaries of AUDI AG include Audi Sport GmbH (Neckarsulm), Automobili Lamborghini S.p.A. (Sant'Agata Bolognese, Italy) and Ducati Motor Holding S.p.A. (Bologna, Italy).

In 2017, the Audi Group delivered to customers about 1.878 million automobiles of the Audi brand, 3,815 sports cars of the Lamborghini brand and 55,900 motorcycles of the Ducati brand. In the 2017 fiscal year, AUDI AG achieved total revenue of €60.1 billion and an operating profit of €5.1 billion. At present, approximately 90,000 people work for the company all over the world, more than 60,000 of them in Germany. Audi focuses on sustainable products and technologies for the future of mobility.