

## AI in Action: The Potential of Test Data

Test systems in the industry generate large amounts of data every day. There's real money here – provided the data is processed and evaluated correctly. ZF Test Systems is therefore introducing Advanced Analytics to its business. Red-ant offers the hardware solution for recording and pre-processing NVH data (noise, vibration, harshness).

It's the last stop on the production line before a product departs the ZF world to reach the customer: the end-of-line test bench. Here it's either thumbs up or thumbs down, green or red, "OK" or "NOK". If ZF identifies in this phase any parts that are "not OK", this saves costs and underpins the Group's reputation as a quality supplier. If NOK parts – such as a car transmission – had been delivered to customers, this could have led to complaints or even a recall of the vehicle.

### Test Data – a Digital Treasure Trove

Consequently, ZF's end-of-line test systems test parts worldwide every second – and document the result digitally. End-of-line test systems generate in this way up to 30,000 datasets per day. "Our machines produce digital information that is suitable for further evaluation with AI algorithms," explains Simone Fuchs, responsible for Advanced Analytics at ZF Test Systems. "We combine the know-how as machine manufacturers, as AI experts and as specialists in discrete manufacturing – that is, wherever serial production of high-quality parts is concerned. We can turn this domain knowledge into attractive practical solutions." These can help to improve automation (and thus make production more efficient), to increase quality or to reduce emissions throughout the entire manufacturing process, rendering it more sustainable.

No wonder that many customers of ZF Test Systems also want to use their data – or are encouraged to do so by consulting companies or software providers. "Many want to use AI. But to put AI-based models in the right context in production, our domain-specific expertise is needed," Fuchs explains. Therefore, ZF Test Systems wants to offer its analytics solutions as an additional business in combination with the sale of the test benches. "The time is right. We have been able to demonstrate our models in several pilot projects in recent years. The resulting solutions are integrated into various production lines and create quantifiable added value on a daily basis."

### „Tatoo“ Makes Data Available

However, this didn't happen by itself. Anyone who wants to evaluate data with AI algorithms must first compile it at a central location, prepare it, standardize it and make it available. Since many analytics projects fail already at this stage, ZF Test Systems has developed its own product for automatic long-term storage in a central system in collaboration with red-ant. "Tatoo" can store all data during or after production in a central database, where it is available for evaluations.

An example with end-of-line test benches at the ZF plant in Saarbrücken shows how the potential of the data can be used. Together with experts from the ZF AI Lab Saarbrücken, ZF Test Systems has developed an AI-based algorithm with which the NVH behavior of transmissions and electric motors can be digitally assessed. In components that rotate at high speed – or those that transmit enormous forces – irregularities in NVH behavior can indicate potential damage later on. Sonograms provide information about which frequencies are present at which speeds. Dr. Nicolas Thewes and his colleagues have developed algorithms that create a pixel-perfect map from thousands and thousands of sonograms of OK-tested transmissions, which is used as a reference for all subsequent tests. Put simply, the sonogram of each new test run is compared with the reference model in real time. Based on any deviations detected, the AI provides important insights to the production experts.

### **Pilot Project Finds Noise Anomalies per Pixel**

This algorithmic approach enables end-of-line testing to find errors that have never occurred before. And the AI-based processing of the test data goes even further: The large amounts of data make it possible to train classification algorithms to assess very accurately the errors that occur in NOK-tested components. "The enormous potential of our solution lies in this automated classification," emphasizes Thewes. In the past, every NOK specimen, together with its data, had to be thoroughly examined by product experts in order to identify the cause of the error. Increasingly, an AI system can take over such tasks automatically, 24/7. The algorithm already handles one-third of the classifications autonomously and accurately, with the share expected to rise. The example shows how highly qualified personnel can be relieved thanks to AI applications. It's a convenient problem solution at ZF's plants, where the experts can now devote more time to their actual tasks. Additionally, this accelerates product optimization – because specific reference points for improved quality in production can also be derived from the NOK cases.

### **Rollout Approaching**

The producing ZF units are so convinced by the approach and product of the Group's Test Systems subsidiary that "wAlve Guard" will soon be used at several plants. And not only in the Electrified Powertrain Technology Division, but also in the Industrial Technology Division, specifically at the wind power transmission plants in Lommel (Belgium) and Tianjin (China).

"With the rollout, we will gain further experience and, above all, further data, the crucial fuel behind every AI solution," Thewes is convinced. By that time, Simone Fuchs and her team will have already developed further use cases on how to turn production and test data into more quality, more sustainability and more efficiency in production. A clear added value for ZF Test Systems' and red-ant customers and at the same time a concrete example of how relevant production and end-of-line test data can be used profitably.

