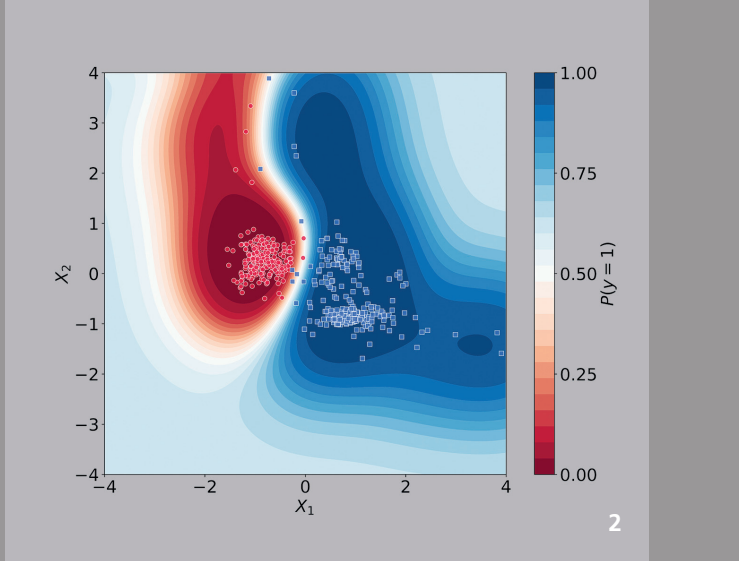
1



2

AI-BASED QUALITY ASSURANCE FOR BATTERY WELDING

Task

On behalf of 4D Ingenieurgesellschaft für Technische Dienstleistungen mbH, Fraunhofer ILT evaluated the application of AI-based methods for monitoring contact welds on batteries. In the system under investigation, a photo diode captures the process radiation emitted by the interaction zone during welding. Although they aim to develop a precise quality assurance system, classical approaches to interpreting sensor signals do not result in an evaluation that is pseudo-error-free and at the same time without error slip. To predict the actual quality state of a weld based on the sensor signals more reliably, the institute applied the methods of artificial intelligence, specifically machine learning, to reveal hidden patterns within the measured data.

Method

Fraunhofer ILT was able to use more than 32,000 measurement signals from individual welds, including their quality evaluation (OK or not OK). From these measurements, the institute extracted characteristic features and specific fingerprints of the signals. In addition to simple signal features such as mean value and standard deviation, it also extracted time- and frequency-dependent features such as Fourier, wavelet and autocorrelation coefficients from the signals. Subsequently, an algorithm from the field of supervised learning was used to teach a classification model with which welds and the associated quality categories (OK or not OK) can be evaluated.

Results

The AI-based evaluation allows the weld seam quality to be divided into not OK and OK. The classification result reaches an accuracy of more than 80 percent for this data set, although a visual evaluation of the signals, performed by a human expert, hardly recognizes the quality categories needed to be differentiated. During the development, 700 features were determined based on the raw signal. It has been shown that the error detection rate reaches a maximum with the most significant 31 features. This reduces the effort for the application by more than 95 percent.

Applications

The AI process can be applied to detect irregularities and defects in laser beam welding of battery components. In addition, the procedure can also be used within the framework of »Industry 4.0« for documentation and, in particular, for improving the quality of further laser material processing.

Contact

Christian Knaak M. Sc.
Telephone +49 241 8906-281
christian.knaak@ilt.fraunhofer.de

Dipl.-Ing. Peter Abels
Telephone +49 241 8906-428
peter.abels@ilt.fraunhofer.de

1 Welded battery composite consisting of several individual cells.
2 Decision limits of a classification algorithm in 2D feature space.