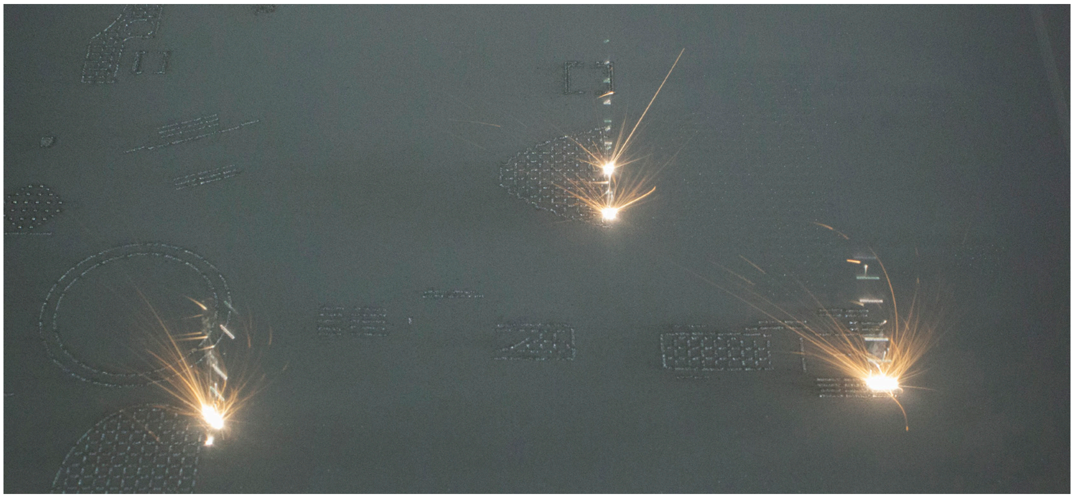
TECHNICAL DOCUMENT

USING MACHINE LEARNING FOR MANUFACTURING PROCESS IMPROVEMENT

Automated process gauging with help of inline ML routines accelerates SOP and reduces scrap rates at Renishaw



When manufacturing complex products, engineering teams typically need to establish a baseline monitoring process for equipment to ensure stability and productivity throughout the entire operation. In general, the simulation of a build takes longer than the actual build process itself, making process monitoring a priority for making design decisions. However, as product complexity increases and the tools needed require more intensive monitoring, efficient quality management can become an obstacle for manufacturers.

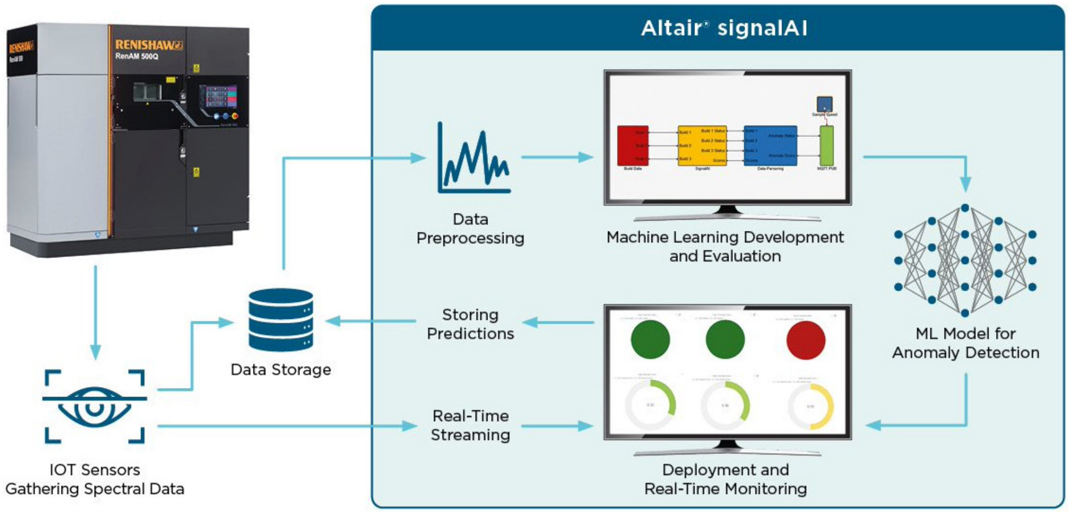
To address this challenge, Renishaw and Altair established an AI-driven quality assurance process using machine learning and advanced digital gauging to accelerate product development and production.

Challenge

During the additive manufacturing process, the laser fuses layers of powder together while the spectral emissions of the melt pool are monitored to ensure each subsequent run corresponds to the original.

Theoretically, teams could take the samples from one build (or print) and compare them to subsequent prints and determine whether or not process variation is occurring. The problem with this is that there is an incredible amount of data that gets produced during a print. For example, a typical print run samples at least 100,000 times per second, or about 20,000 samples in the time it takes to blink.

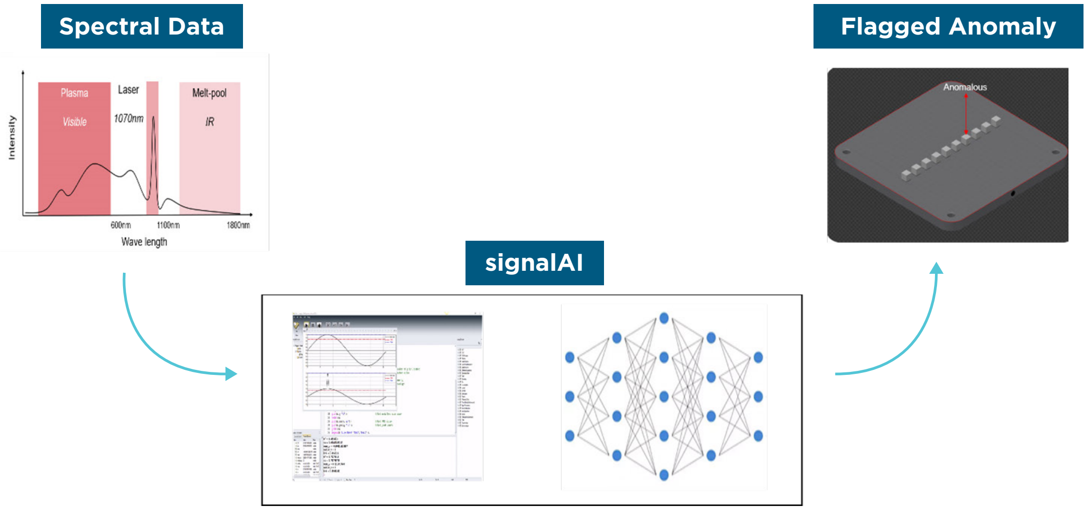
As more sophisticated sensors become available, there is generally a large increase in the amount of data being generated. Generally, this data is filtered, and relatively basic statistical models are applied to try and derive meaning from it. This provides some useful information, but due to the sheer volume of data being created, it essentially becomes impossible for a human to efficiently glean in-depth insight from the data.



Solution architecture for a Renishaw RenAM500Q for build data collection, analysis and monitoring using Altair Signal AI.

Now, sensors and bandwidth used to collect data are rapidly increasing in the manufacturing setting, while improved machine learning (ML) algorithms are in turn providing increased storage for manufacturers to tap into to make better-informed production decisions that no longer require intensive manual searching for key answers. As a family of algorithms, ML not only relieves the physical search for relevant data but can conveniently provide dashboard monitoring to alert floor operators of data deviations, suggested machine improvements, product arrival times, and run comparisons to inform teams of where and when changes could benefit production.

Renishaw leveraged Altair's AI technology that could flag anomalous builds and regions by analyzing spectral data in real time, allowing for quicker part development and more stable production. As machine learning algorithms have become more accurate with increased computation power, engineers can now depend on ML technology to make decisions from data without compromising floor efficiency.



Altair’s AI driven anomaly detection process for Renishaw LPBF machines

Solution

The Altair® signalAI tool was used to successfully detect anomalous builds during the metal additive manufacturing process. Without any prior knowledge of previous anomalous build patterns, the software was able to determine the anomalous volume and region, as well as reveal the specific 3D region of interest with further analysis. Time domain features extracted from raw spectral data performed better during the project, significantly reducing size and noise present in the raw data.

Implementing data-driven decision making from the ground up allows design and manufacturing teams to holistically analyze processes to improve an organization’s smart factory practices. Looking forward, an AI-driven manufacturing approach offers endless possibilities for machine improvement, such as identifying the best sensor type and location for an application, and shared learning to improve processes within an enterprise with a hybrid cloud approach.

For more information, visit altair.com/ai-powered-design.

The Altair® signalAI tool was used to successfully detect anomalous builds during the metal additive manufacturing process.