Contribution ID: **134** Type: **not specified**

Online Quality Monitoring in Selective Laser Melting via Image-Based Statistical Methods

A major challenge in Additive Manufacturing (AM) is the development of reliable in-situ and online quality monitoring methodologies. Visible and infrared cameras can provide near real-time image data that can be exploited for anomaly detection through Statistical Process Control and Monitoring (SPC/M) methods.
This work investigates image-based monitoring methods for Selective Laser Melting (SLM) processes, aiming to detect shifts from the in-control (IC) to the out-of-control (OOC) state. Two approaches are compared: a partial first-order stochastic dominance methodology and generalized multilinear models for sufficient dimension reduction with tensor-valued predictors. In addition, a hybrid approach combining elements of both methodologies is proposed.
The methods are evaluated using simulated datasets generated from images of a real SLM process, with emphasis on monitoring performance and sensitivity to training sample size. The results highlight the potential of statistically grounded, data-efficient image monitoring methods for next-generation smart manufacturing systems.

Special/ Invited session

Statistics and data science in the technological field: current issues and new proposals

Classification

Both methodology and application

Keywords

Non-Parametric, Sufficient Dimension Reduction, Statistical Process Control and Monitoring (SPC/M)

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Track Classification: Other/special session/invited session