



Contribution ID: 95

Type: **not specified**

Monitoring Resistance Spot Welding Profiles via Robust Control Charts

Tuesday, 12 September 2023 17:50 (20 minutes)

Monitoring the stability of manufacturing processes in Industry 4.0 applications is crucial for ensuring product quality. However, the presence of anomalous observations can significantly impact the performance of control charting procedures, especially in complex and high-dimensional settings.

In this work, we propose a new robust control chart to address these challenges in monitoring multivariate functional data while being robust to functional casewise and cellwise outliers.

The proposed control charting framework consists of a functional univariate filter for identifying and replacing functional cellwise outliers, a robust imputation method for missing values, a casewise robust dimensionality reduction technique, and a monitoring strategy for the multivariate functional quality characteristic.

We conduct extensive Monte Carlo simulations to compare the performance of the proposed control chart with existing approaches.

Additionally, we present a real-case study in the automotive industry, where the proposed control chart is applied to monitor a resistance spot welding process and to demonstrate its effectiveness and practical applicability.

Keywords

Profile Monitoring, Robust Estimation, Casewise and Cellwise Outliers

Classification

Both methodology and application

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Session Classification: CONTRIBUTED Quality 2

Track Classification: Quality