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An Adaptive EWMA Monitoring Scheme for Multivariate Functional Data

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In modern industrial settings, the complexity of quality characteristics necessitates advanced statistical methods using functional data. This work extends the traditional Exponentially Weighted Moving Average (EWMA) control chart to address the statistical process monitoring (SPM) of multivariate functional data, introducing the Adaptive Multivariate Functional EWMA (AMFEWMA). The AMFEWMA modifies EWMA weighting parameters adaptively to improve the detection sensitivity under various process mean shifts, crucial for industries with dynamic scenarios. The AMFEWMA's advantages over competing methods are assessed through an extensive Monte Carlo simulation and a practical application with the automotive industry in the SPM of resistance spot welding quality through the analysis of dynamic resistance curves across multiple welds, which represent a comprehensive technological signature of the welding process quality. The practical application emphasizes AMFEWMA's potential to enhance SPM in advanced manufacturing.

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Talk

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Functional Data Analysis, Profile Monitoring, Statistical Process Control

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