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Resistance Spot Welding Process Monitoring Through Mixture Function-On-Scalar Regression Analysis

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The advancement in data acquisition technologies has made possible the collection of quality characteristics that are apt to be modeled as functional data or profiles, as well as of collateral process variables, known as covariates, that are possibly influencing the latter and can be in the form of scalar or functional data themselves. In this setting, the functional regression control chart is known to be capable of monitoring a functional quality characteristic adjusted by the influence of multiple functional covariates through a suitable functional linear model (FLM), even though, in many applications, this influence is not adequately captured by a single FLM. In this paper, a new profile monitoring control chart is proposed to let the regression structure vary across groups of subjects by means of a mixture of regression models, after a multivariate functional principal component decomposition step is performed to represent the functional data. The performance of the proposed method is compared through a Monte Carlo simulation study with other methods already presented in the literature. Furthermore, to demonstrate the flexibility of the proposed to handle FLMs with different types of response and/or predictors, a real-case study in the automotive industry is presented in the function-on-scalar regression setting.

Keywords

Functional mixture regression, Profile monitoring, Statistical Process Control

Classification

Both methodology and application

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