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Scalar-On-Function Regression Control Chart Based on a Functional Neural Network

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Modern data acquisition systems allow for collecting signals that can be suitably modelled as functions over a continuum (e.g., time or space) and are usually referred to as *profiles* or *functional data*. Statistical process monitoring applied to these data is accordingly known as *profile monitoring*. The aim of this research is to introduce a new profile monitoring strategy based on a *functional* neural network (FNN) that is able to adjust a scalar quality characteristic for any influence by one or more covariates in the form of functional data. FNN is the name for a neural network able to learn a possibly nonlinear relationship which involves functional data.

A Monte Carlo simulation study is performed to assess the monitoring performance of the proposed control chart in terms of the out-of-control average run length with respect to competing methods that already appeared in the literature before. Furthermore, a case study in the railway industry, courtesy of Hitachi Rail Italy, demonstrates the potentiality and practical applicability in industrial scenarios.

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Keywords

Functional neural network, Profile monitoring, Statistical process control

Classification

Both methodology and application

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