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A Non-Linear Mixed Model Approach for Detecting Outlying Profiles

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In parametric non-linear profile modeling, it is crucial to map the impact of model parameters to a single metric. According to the profile monitoring literature, using multivariate T^2 statistic to monitor the stability of the parameters simultaneously is a common approach. However, this approach only focuses on the estimated parameters of the non-linear model and treats them as separate but correlated quality characteristics of the process. Consequently, they do not take full advantage of the model structure. To address this limitation, we propose a procedure to monitor profiles based on a non-linear mixed model that considers the proper variance-covariance structure. Our proposed method is based on the concept of externally studentized residuals to test whether a given profile significantly deviates from the other profiles in the non-linear mixed model. The results show that our control chart is effective and appears to perform better than the T^2 chart. We applied our approach in an aquaculture process to monitor the shrimp weight over 300 ponds.

Keywords

non-linear mixed model; profile monitoring; control charts

Classification

Both methodology and application

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