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Robust MCUSUM for Phase II Linear Model Profile Monitoring

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Most of the previous studies in Phase II analysis in real-life applications focused on monitoring profiles assuming that the estimated models and control-limits from Phase I are correctly performed with no model misspecification. However, these models may not perfectly fit the relationship between the response variable and the independent variable(s). Thus, this research proposes two new robust Multivariate CUSUM control charts, namely, non-parametric and semi-parametric techniques for performing Phase II profile monitoring using linear mixed models. The proposed multivariate CUSUM control charts will help in detecting different shift's sizes in the slope parameter, considering different numbers of profile, sample sizes and different levels of misspecifications for in-control and out-of-control scenarios for uncorrelated and correlated profiles. The performance of the proposed control charts compared to other classical parametric approaches is investigated using comprehensive simulation studies and a real-life application, where Average Run Length (ARL) and Extra Quadratic Loss (EQL) criteria are used for these comparisons. It is found that the multivariate CUSUM based on the semi-parametric technique has the best performance and higher sensitivity in detecting different shifts compared to the parametric and non-parametric approaches.

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