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Mitigating raw material variation in manufacturing processes: A novel multivariate SPC scheme based on Sequential Multi-Block PLS

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In modern manufacturing processes, one may encounter processes composed of two or more critical input blocks having an impact on Y-space. If these blocks follow a sequential order, any cause of variation in a particular block may be propagated to subsequent blocks. This is frequently observed when a first block of raw material properties entering a production process influence the performance of a second block of process variables, and the final product quality. The goal is not to maintain the raw material variability under control, since it may be not feasible, but rather to manipulate the process to mitigate its effect on the product quality. This scenario would hinder the interpretability of the process monitoring by a conventional statistical process control (SPC) scheme due to the redundancy of information among blocks. In addition, this may trigger a time-varying process forcing the user to use either local or adaptive-based procedures. Nevertheless, would it be possible to establish a unique SPC scheme for process variations regardless of raw material variations?

The purpose of this work is to establish a SPC scheme based on the sequential multi-block partial least squares (SMB-PLS) when process blocks present correlated information. This scheme increases the interpretability of the process monitoring, and it prevents any special cause from propagating to subsequent blocks. Thus, these blocks can be monitored by a unique scheme even though there are special causes of variations in prior blocks. A real case study from a food manufacturing process is used to illustrate the proposal.

Type of presentation

Talk

Classification

Both methodology and application

Keywords

Multivariate Statistical Process Control; Sequential Multi-block modeling; Partial Least Squares Regression

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