Three-way Strategies for Monitoring Batch Processes

Ndèye Niang[1] and Flavio S. Fogliatto[2]

[1] Chaire de Statistique Appliquée & CEDRIC, CNAM
292 rue Saint Martin, Paris, France, *ndeye.niang_keita@cnam.fr*
[2] Departamento de Engenharia de Produção, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil, *ffogliatto@producao.ufrgs.br*

Abstract. Batch processes are widely used in several industrial sectors, such as food and pharmaceutical manufacturing. In a typical batch, raw materials are loaded in the processing unit and submitted to a series of transformations, yielding the final product. Process performance is described by variables which are monitored as the batch progresses. Data arising from such processes are likely to display a strong correlation structure, and are usually monitored using control charts based on multiway principal components analysis (MPCA-CCs).
Applications of MPCA-CCs to monitor batch processes assume firstly that all batches considered in the analysis have the same length and are aligned with respect to each process stage. When that is not verified, MPCA-CCs must be adapted to handle variable batch duration. Secondly process variables monitored through MPCA-CCs are supposed to be multinormally distributed, to use Hotelling's T^2 charts. Such multinormality assumption is not always verifiable in practice, thus the use of non-parametric control charts should be considered. In this paper we propose a non parametric quality control strategy based on three way methods for monitoring batch processes. In our proposition, the batch data sets are reduced using the Statis method (Escoufier, 1987). Graphical summarized representations of the batches become available. Monitoring of batch performance is accomplished directly on principal plane graphs, from which non-parametric control charts based on convex hull peeling are derived (Fogliatto and Niang, 2008). This strategy allows the monitoring of synchronized batches as well as processes yielding batches of variable duration. The proposed method is illustrated on a simulated data set and on a real one used by Nomikos and MacGregor (1995)

Keywords: Multivariate quality control, Statis method, Unsynchronized batches

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