

New trends of SPC and Data Analysis in Industry

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Abstract

Since the introduction of the first control charts by Shewhart in the 1930's, there have been many proposals of new methodologies to handle the challenges raised by the evolution of technology in industrial processes, sensors & instrumentation and information management systems. Rapidly the univariate procedures evolved to multivariate (Hotelling's T²) and then to mega-variate approaches (using latent variable methods, such as PCA and PLS) to cope with the dimensionality of the processes (number of variables). Another prevalent feature of industrial processes is autocorrelation, and dynamic versions of the proposed methods were also developed for continuous systems, especially for the large scale SPC frameworks (e.g., SPC based on dynamic PCA). However, new highly informative sensors are being developed and hooked in the process streams. They collect spectra, hyperspectral images, hyphenated measurements, etc., almost in real time, tracking product quality in a fast way. This speeds up product release, avoids quality losses by prompt control actions and decreases scrap and rework. However, once again, new challenges are being created, for which adequate solutions must be found. In this presentation, we will present, describe and discuss some current challenges and solutions for the following emerging trends of SPC and Data Analysis in industry:

PROFILES MONITORING. How to cope with the monitoring of measurements that are not scalars but higher order tensors, such as 1D (dimensional profiles, spectra), 2D (grey level images) and 3D (hyperspectral images) arrays? How can one combine measurements with a variety of structures (tensors of different orders)?

MULTISCALE MONITORING. Current monitoring methods operate at a single scale, meaning that they were designed to perform optimally for a given type of faults. However, most processes present processing units operating simultaneously at different scales. How can we monitor all these scales without incurring in trade-offs and compromising solutions?

FROM DETECTION TO DIAGNOSIS. In the real world, it is as important to detect a fault as to diagnose its root cause. In fact, this is where most of the troubleshooting time is spent. Current latent variable methods are good for detection but provide ambiguous diagnostics because they suffer from the "smearing effect" problem. Some solutions will be presented and discussed to handle these issue.

BATCH PROCESS MONITORING. Batch processes tend to increase in importance. They are now in almost every industrial sector (semiconductor, food, chemicals, etc.). However, due to their intrinsic non-stationarity, these processes raise many challenges for monitoring purposes. We will discuss some ongoing solutions and methods for handling such situations.