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A Digital Twin Approach for Statistical Process Monitoring of a High-Dimensional Microelectronic Assembly Process

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We address a real case study of Statistical Process Monitoring (SPM) of a Surface Mount Technology (SMT) production line at Bosch Car Multimedia, where more than 17 thousand product variables are collected for each product. The basic assumption of SPM is that all relevant “common causes” of variation are represented in the reference dataset (Phase 1 analysis). However, we argue and demonstrate that this assumption is often not met, namely in the industrial process under analysis. Therefore, we derived a digital twin from first principles modeling of the dominant modes of common cause variation. With such digital twin, it is possible to enrich the historical dataset with simulated data representing a comprehensive coverage of the actual operational space. This methodology avoids the excessive false alarm problem that affected the unit and that prevented the use of SPM. We also show how to compute the monitoring statistics and set their control limits, as well as to conduct fault diagnosis when an abnormal event is detected.

Keywords

Statistical Process Monitoring; Digital Twins; High-dimensional processes

Special/invited session

Primary authors: SEABRA DOS REIS, Marco P. (University of Coimbra, Department of Chemical Engineering); RATO, Tiago; Mrs MARTINS, Cristina (Bosch Car Multimedia, SA); Mr DELGADO, Pedro (Bosch Car Multimedia, SA); RENDALL, Ricardo (Dow Chemical Co.)

Presenter: SEABRA DOS REIS, Marco P. (University of Coimbra, Department of Chemical Engineering)

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