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## Distributed Statistical Process Monitoring based on Causal Network Decomposition

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As data collection systems grow in size, multivariate Statistical Process Monitoring (SPM) methods begin to experience difficulties to detect localized faults, the occurrence of which is masked by the background noise of the process associated to the many sources of unstructured variability. Moreover, these methods are primarily non-causal and do not consider or take advantage of the relationships between variables or process units. In this work, we propose a new systematic approach based on the functional decomposition of the system's causal network. The methodology consists in inferring the causal network from the data of the system under study and finding functional modules of the network by exploring the graph topology and identifying the strongly connected "communities". Two hierarchical monitoring schemes (aggregating the modules' information and interactions) are applied to monitor the global state of the process. The results obtained demonstrate an increased sensitivity in fault detection of the proposed methodologies when compared to conventional non-causal methods and causal methods that monitor the complete causal network. The proposed approaches also lead to a more effective, unambiguous, and conclusive fault diagnosis.

### Keywords

Distributed Statistical Process Monitoring; Causal Network; Community Detection.

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