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High Dimensional Streaming Data Analysis for Process Monitoring and Defect Detection

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Real-time analysis of high dimensional streaming data for process monitoring and fault diagnostics has become an attractive research area due to rich information that modern sensors can provide. However, existing process monitoring methods fail to fully utilize the information of high dimensional data streams due to their complex characteristics including large dimensionality, the spatio-temporal correlation structure, and non-stationarity. In this talk, we present a real-time analysis framework for high dimensional streaming data including profiles and images that can effectively address foregoing challenges. We introduce spatio-temporal smooth sparse decomposition (ST-SSD), which serves as a dimension reduction and denoising technique by decomposing the original tensor data into the functional mean, sparse anomalies, and random noises. ST-SSD is followed by a sequential likelihood ratio test on extracted anomalies for process monitoring. To enable real-time implementation of the proposed methodology, recursive estimation procedures for ST-SSD are developed. ST-SSD also provides useful diagnostics information about the location of change in the functional mean. The proposed methodology is validated through various simulations and real case studies.

This is a joint work with Hao Yan and Jan Shi.