Semi-supervised Fault Classification and Process Monitoring Based on Manifold Learning

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Detecting and identifying anomalies at an early stage of process faults prompts corrective actions to be taken to bring the plant back to its normal state, which can reduce economic loss, and prevent fatal accidents. Many of the recent studies assume that sufficient labeled data are available and employ supervised learning techniques to improve diagnosis performance. However, labeling is costly and requires considerable expertise in practice, whereas abundant unlabeled data are often available. This paper proposes a process monitoring and fault diagnosis framework based on a manifold learning algorithm that can simultaneously utilize both types of data. The proposed algorithm first translates available metric and non-metric information of the data into a unified measure, *similarity*, and approximates a data manifold based on it. By seeking a low-dimensional representation that has the closest possible equivalent topological structure to this manifold, the complex mapping between the input space and latent space is learned. The effectiveness of the proposed method is assessed on a dataset obtained from the Tennessee Eastman process and compared with conventional statistical methods.