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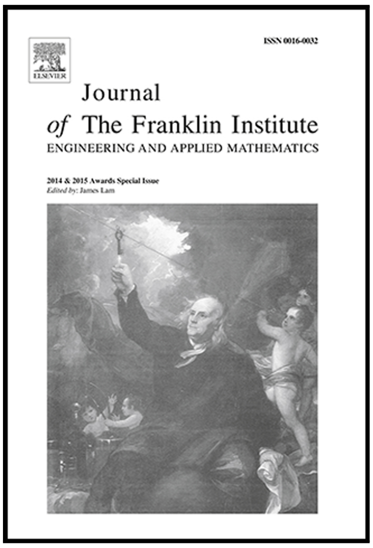

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A practical propagation path identification scheme for quality-related faults based on nonlinear dynamic latent variable model and partitioned Bayesian network

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Abstract

In this paper, a practical technology or solution of quality-related fault diagnosis is provided for nonlinear and dynamic process. Unlike traditional data-based fault diagnosis methods, the alternative approach is focused more on identifying the propagation path that combines diagnostic information and process knowledge. The new method addresses the quality-related fault detection issue with developed nonlinear dynamic latent variable model for extracting nonlinear latent variables that exhibit dynamic correlations, then the advantage of relative reconstruction based contribution approach is followed to analyze the potential root-cause variables. Meanwhile, a new partitioned Bayesian network methodology is proposed for propagation path identification of quality-related faults. Finally, the whole proposed framework is applied to a real hot strip mill process, where the effectiveness is further demonstrated from real industrial data.

1. Introduction

Due to increasing need for more stable performance, better product quality as well as lower product rejection rates, modern industrial processes become more and more complicated by integrating various functions and interacting control loops. Once a fault occurs, it may propagate through the process units in multiple paths, which poses challenges to identify the most probable propagation for maintenance staff. Accordingly, in order to keep high efficiency of operation and ensure stability of product quality, realtime quality-related fault detection, diagnosis and accurate propagation path identification are of urgent necessity, which have recently attracted more and more attention both in academia and engineering domains. For such purposes, model-based process monitoring and fault diagnosis (PM-FD) methods have been deeply studied, and a lot of fruitful results have been achieved [1–5]. However, these techniques present some implementation difficulties in complex industrial systems such as steel-rolling, chemical, paper-making, oil-refining and etc., where the analytical models of plants are generally difficult to be developed. In comparison, data-based

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