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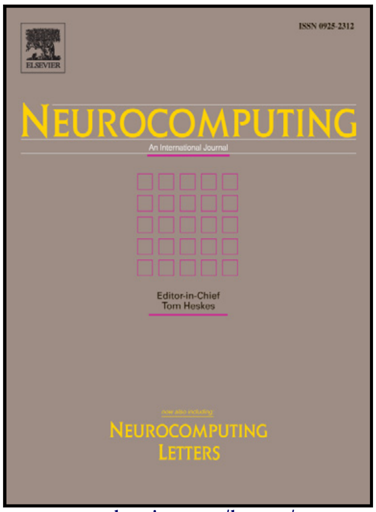

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Fault detection for a class of industrial processes based on recursive multiple models

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Abstract

Traditional multiple model process monitoring methods usually yield satisfactory results for multi-mode processes under the assumption that the processes are time invariant. However, for some petrochemical processes, such as ethylene cracking furnace, the process is time varying as the coking in the furnace tubes. To solve this problem, this study proposes a multiple model recursive monitoring method. A computational intelligence-based cluster algorithm is employed to separate different operating modes. Then, recursive kernel principal component analysis is used to reduce the dimension of the time-varying process data and extract the nonlinear principal components recursively. Furthermore, support vector data description is utilized to build models because the process data are non-Gaussian. Finally, the corresponding statistics are constructed to detect the process fault. The performance of this method is evaluated through a case study of ethylene cracking in a petrochemical plant.

Keywords: multiple models, time-varying, RKPCA, SVDD

1. Introduction

With the increasing demand for safe equipment and high-quality products in the modern petrochemical industry, process monitoring and fault diagnosis for petrochemical processes have become increasingly important. In the past decades, people focused on multivariate statistical process control (MSPC)[1][2][3][4]. Conventional MSPCs such as principal component analysis (PCA) and partial least squares yield satisfactory monitoring results for processes with a single operating mode without time varying under the assumption that the relationship between each variable is linear[5][6]. However, in practical processes, the operating mode often changes with the operating conditions, product component, etc. In addition, the process variables are time varying, and the process data are non-Gaussian and nonlinear. In this situation, conventional MSPCs often yield undesirable results.

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