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过程系统工程

基于特征样本核主元分析的TE过程快速故障辨识方法

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摘要

核主元分析（KPCA）在非线性系统的故障检测方面明显优于普通的PCA方法，但存在无法进行故障辨识以及在故障诊断过程常常出现核矩阵K计算困难等难题。针对上述问题，提出了一种基于特征样本核主元分析方法（FS-KPCA）非线性故障辨识方法。首先采用特征样本（FS）提取方法有效解决核矩阵K的计算量问题。然后利用计算核函数的偏导方法求取KPCA监控中每个原始变量对统计量T^2和SPE的贡献率，利用每个变量对监控统计量贡献程度的不同，可以辨识出故障源。将上述方法应用到TE过程，仿真结果表明该方法不仅能够有效辨识故障，而且提高了故障检测和辨识速度。

关键词

核主元分析 故障辨识 梯度算法 特征样本提取 TE过程

分类号

Fault identification of Tennessee Eastman process based on FS-KPCA

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Abstract

For several complex industry processes，the original fault sources are difficult to identify by using kernel principal component analysis（kernel PCA）methods. And during the modeling and online dynamic monitoring process，the calculation of the kernel matrix K is a bottleneck problem for a large data set. An integrated fault diagnosis method based on feature sample extracting and kernel PCA was developed. Firstly，a feature extraction method was adopted to pre-process the modeling data set for solving the calculation problem of the kernel matrix K. Secondly，Hotelling statistics，T^2 and SPE of kernel PCA were adopted to detect system fault. Once fault was detected，the gradient algorithm of kernel function was used to define two new statistics，C_{T^2} and C_{SPE} ，which represented the contribution of each variable to Hotelling T^2 and SPE respectively. According to the degree of contribution，the fault variables might be identified from these correlative variables. To demonstrate the performance，the proposed method was applied to the Tennessee Eastman（TE）process. The simulation results showed that the proposed method could effectively identify various types of fault sources.

Key words

kernel PCA fault identification gradient arithmetic feature sample extracting TE process

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