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Fault detection in continuous chemical processes using a PCA-based local approach

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Early fault detection in the process industry is crucial to mitigate potential impacts. Despite being widely studied, fault detection remains a practical challenge. Principal components analysis (PCA) has been commonly used for this purpose. This work employs a PCA-based local approach to improve fault detection efficiency. This is done by adopting individual control limits for the principal components. Several numbers of retained components (d = [5:45], in steps of 5) were investigated. The false alarm rate (FAR) was set at 1%. The level of significance (⊠) for the control limits was a function of d. The well-known Tennessee benchmark was used as the case study, whose faults can be grouped into easy, intermediate, hard and very hard detection faults. Significant improvements were reached for the intermediate and hard groups in comparison to the classic use of PCA. Relative gains around 50% in MDR (missed detection rate) were obtained for two out of the three intermediate faults, given the T2 statistic. In the hard to detect group, all six faults except one presented relative gain in MDR above 50% for both statistics T2 and Q. In general, the local approach was superior for 16, equivalent for 2, and inferior for 3 (easy detection faults) faults given T2. These values were, respectively, equal to 11, 5 and 5 (four easy and one intermediate detection faults), for the Q statistic. The overall results suggest that the local approach was more prone to detect more difficult faults, which is of most interest in practice.

Keywords

Process industry, Fault detection, PCA

Special/invited session

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