

## **402d Multi-Scale Fisher Discriminant Analysis**

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As soon as a monitoring system detects a process fault, plant engineers need additional information in order to initiate appropriate corrective actions to nullify the effects of the fault. There are many types of process faults and a corrective action is often unique to a type of process fault. Hence, the plant engineer needs to precisely determine the type of fault that has affected the process.

Statistical tools have proved to be of great help in providing efficient classification of the faults. In situations where the correlation between two fault classes is large, that is, when separating closely related faults from each other, the discriminant function based models such as Fisher Discriminant Analysis have provided an attractive option. The fault classification methodology proposed in this work is developed by using the essence of Fisher Discriminant Analysis along with wavelet analysis. Fault classification is carried out by classifying the faults into predetermined fault classes and normal operating data. A wavelet-based multi-scale model is used to dissect the data into wavelet coefficients at various time and frequency scales. Wavelet decomposition is followed by Fisher Discriminant Analysis on wavelet coefficients in order to classify the faults. The scatter between the fault classes is quantified by measuring the discriminant functions. The multiple discriminant functions, which arise from various fault classes, are examined using the comparative values of the coefficients and a factor structure matrix in order to determine the data subsets the functions discriminate. Based on the relative values of the discriminant functions, the faults are diagnosed and exact location and time of their possible occurrence is determined. Appropriate process recovery actions are triggered for preventing the reoccurrence of the same faults. In tests with industrial data, the multi-scale Fisher Discriminant Analysis has proved to be an effective tool in real-time fault classification.

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