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Dynamic Fault Diagnosis for Semi-Batch Reactor Under Closed-Loop Control via Independent RBFNN

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Abstract : In this paper, a new robust fault detection and isolation (FDI) scheme is developed to monitor a multivariable nonlinear chemical process called the Chylla-Haase polymerization reactor when it is under the cascade PI control. The scheme employs a radial basis function neural network (RBFNN) in an independent mode to model the process dynamics and using the weighted sum-squared prediction error as the residual. The recursive orthogonal Least Squares algorithm (ROLS) is employed to train the model to overcome the training difficulty of the independent mode of the network. Then, another RBFNN is used as a fault classifier to isolate faults from different features involved in the residual vector. The several actuator and sensor faults are simulated in a nonlinear simulation of the reactor in Simulink. The scheme is used to detect and isolate the faults on-line. The simulation results show the effectiveness of the scheme even the process is subjected to disturbances and uncertainties including significant changes in the monomer feed rate, fouling factor, impurity factor, ambient temperature and measurement noise. The simulation results are presented to illustrate the effectiveness and robustness of the proposed method.

Keywords : Robust fault detection, cascade control, independent RBF model, RBF neural networks, Chylla-Haase reactor, FDI under closed-loop control
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