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SYSTEM ENGINEERING

本知合研入扩展卡尔曼滤波的在线性分析及其非线性故障诊断

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摘要 Unknown input observer is one of the most famous strategies for robust fault diagnosis of linear systems, but studies on nonlinear cases are not sufficient. On the other hand, the extended Kalman filter（EKF）is weakknown in nonlinear estimation, and its convergence as an observer of nonlinear deterministic system has been derived recently. By combining the EKF and the unknown input Kalman filter, we propose a robust nonlinear estimator called unknown input EKF（UIEKF）and prove its convergence as a nonlinear robust observer under some mild conditions using linear matrix inequality（LMI）. Simmulation of a three-tank system "DTS200", a benchmark in process control, demonstrates the robustness and effectiveness of the UIEKF as an observer for nonlinear systems with uncertainty, and the fault diagnosis based on the UIEKF is found successful.

关键词 未知输入扩展卡尔曼滤波；鲁棒性分析；非线性故障诊断；鲁棒观测；

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Unknown Input Extended Kalman Filter and Application in Nonlinear Fault Diagnosis

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Abstract Unknown input observer is one of the most famous strategies for robust fault diagnosis of linear systems, but studies on nonlinear cases are not sufficient. On the other hand, the extended Kalman filter（EKF）is weakknown in nonlinear estimation, and its convergence as an observer of nonlinear deterministic system has been derived recently. By combining the EKF and the unknown input Kalman filter, we propose a robust nonlinear estimator called unknown input EKF（UIEKF）and prove its convergence as a nonlinear robust observer under some mild condition using linear matrix inequality（LMI）. Simmulation of a three-tank system "DTS200", a benchmark in process control, demonstrates the robustness and effectiveness of the UIEKF as an observer for nonlinear systems with uncertainty, and the fault diagnosis based on the UIEKF is found successful.

Key words extended Kalman filter; fault diagnosis; unknown input; convergence analysis; linear matrix inequality;

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