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Fault Diagnosis of Nonlinear Systems Using Dynamic Neural Networks

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Abstract : This paper presents a novel integrated hybrid approach for fault diagnosis (FD) of nonlinear systems. Unlike most FD techniques, the proposed solution simultaneously accomplishes fault detection, isolation, and identification (FDII) within a unified diagnostic module. At the core of this solution is a bank of adaptive neural parameter estimators (NPE) associated with a set of single-parameter fault models. The NPEs continuously estimate unknown fault parameters (FP) that are indicators of faults in the system. Two NPE structures including series-parallel and parallel are developed with their exclusive set of desirable attributes. The parallel scheme is extremely robust to measurement noise and possesses a simpler, yet more solid, fault isolation logic. On the contrary, the series-parallel scheme displays short FD delays and is robust to closed-loop system transients due to changes in control commands. Finally, a fault tolerant observer (FTO) is designed to extend the capability of the NPEs to systems with partial-state measurement.

Keywords : hybrid fault diagnosis, dynamic neural networks, nonlinear systems, fault tolerant observer
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