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基于分层有向图的航天器故障诊断

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Spacecraft Fault Diagnosis Based on Hierarchical Digraphs

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摘要

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摘要 针对航天器在轨故障诊断系统在实时性、准确性和完备性上的要求, 提出了基于分层有向图的新的定性诊断方法。采用有向图分层策略, 减小故障源搜索空间的大小; 利用故障传播路径上的测试节点间的定性关系, 回溯搜索不相容支路找出故障源候选集合, 并且通过部件故障概率和故障传播的权重对候选故障源进行故障可能性的排序。应用提出的方法, 建立了某卫星一次电源系统的定性诊断模型, 并进行了故障诊断的仿真测试。结果表明该诊断方法是高效的, 诊断结果准确而且完备。该方法适用于航天器在轨故障诊断。

关键词: 诊断 有向图 故障传播路径 相容支路 一次电源系统

Abstract: To meet the requirements of completeness, accuracy and real-time performance for the on-board fault diagnosis system of a spacecraft, this article proposes a novel qualitative diagnosis approach based on hierarchical digraphs. The hierarchical strategy for digraphs reduces search space for failure sources; an inference algorithm is proposed to identify fault propagation consistent branches by making use of the qualitative relations between the measured nodes, and to search backward the set of failure source candidates. Furthermore, the failure source candidates are ranked according to the probability rate defined by the product value of the failure propagation weight and the failure rate of the failure source candidate. The diagnosis system for the primary power system of a certain satellite is modeled with the approach, and the simulation test for the system shows that the approach is highly efficient, and the diagnosis result is complete and accurate. This suggests that the approach may be suitable for application in spacecraft on-board diagnosis systems.

Keywords: diagnosis digraph fault propagation path consistent branch the primary power system

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