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基于多Agent卫星遥测数据实时监测与诊断技术

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Real-time Monitoring and Diagnosis Technology for Satellite Telemetry Data Based on Multi-Agent

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摘要

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摘要 为了提高根据遥测数据进行卫星故障诊断的速度与精度,提出了集成多信号模型诊断Agent、模糊诊断Agent以及专家系统诊断Agent等多Agent监测与诊断系统。多信号模型诊断Agent,采用模糊阈值进行监测,并引入可信度因子对Deb原实时诊断推理方法做了改进,解决了Deb方法可能因虚警而导致的诊断结果冲突的问题。模糊诊断Agent采用Mamdani算法,能给出部件故障的可能性。专家系统诊断Agent采用基于规则的产生式系统,同时采用加权不确定推理解决了规则的不确定性问题。研究了3种诊断Agent的协作方式,采用D-S证据理论对各Agent的诊断结果进行决策融合,给出故障元件的置信区间。通过某卫星仿真遥测数据验证,该集成诊断系统充分利用了各种诊断方法的优点,诊断精度高且速度快(一般诊断时间小于0.3秒,P111800/256M计算机),适用于卫星地面站对卫星遥测数据进行自动实时在线监测与诊断推理。

关键词: 卫星遥测数据 故障诊断 多Agent 多信号模型 证据理论

Abstract: To improve the speed and precision of the diagnostic results based on satellite telemetry data, an integrated monitoring and diagnosis system using Multi-Agent including the diagnosis agent based on multisignal model, fuzzy diagnosis agent and expert system diagnosis agent is proposed. For the diagnosis agent based on multisignal model, the fuzzy range is introduced into monitoring system, and the confidence factor is presented to modify Deb's real-time diagnosis algorithm in order to overcome the possible conflict of diagnostic results because of false alarm. Mamdani algorithm is used in fuzzy diagnosis agent that can give the failure probability for suspected components. Productive expert system based on rules is used in the expert diagnosis agent, and uncertain reasoning technology with weight is used to deal with uncertain information. The cooperation mode between agents is investigated, and the final diagnostic results are obtained by D-S evidence theory. The program is validated using some simulated telemetry data for a satellite and the results show that the integrated diagnosis system, which utilizes most of the advantages of three diagnosis methods, is accurate and fast to locate the failure components (the diagnostic time is generally less than 0.3 second for P111800/256M computer) and is suitable to real-time online diagnosis for satellite based on satellite telemetry data.

Keywords: satellite telemetry data fault diagnosis Multi-Agent multisignal model evidence theory

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