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Author: Prof.Dr. Huifeng Xue
China Academy of Aerospace Systems Science and Engineering, China, 370353249@qq.com

RESEARCH ON AEROSPACE SOFTWARE FAULT DETECTION AND LOCATION TECHNOLOGY

Abstract

With the continuous development of lunar exploration, Mars detection and other projects, operating environment of aerospace software is becoming more and more complex, and the demand for safety and reliability is higher. Spacecraft failures due to software failures also occur frequently. For example, in 2015, the Russian's "proton-m" carrier rocket encountered an accident and crash when entering the orbit, which is caused by software design problem. The software design problem leads to the imperfection of the balancer system, which causes the rotor imbalance and too high vibration load and leads to this accident. In order to reduce the loss of software failure and to ensure normal operation of spacecraft, this paper delivers a research on aerospace software fault detection and location technology.

First of all, this paper purposes a method to detect and locate aerospace software runtime fault by runtime verification. Software specification is described by using linear temporal logic with three-valued semantics and a runtime monitor based on three-valued linear temporal logic is built to monitor and record software running process. To construct a runtime monitor is to construct a finite Moore state machine using a three-valued LTL formula. Monitoring of runtime aerospace software is implemented by the monitor. And fault location is achieved by statistical analysis based on the results of runtime monitoring.

In addition, the method of aerospace software vulnerability static location is realized. This paper studies the calculation method of program slice and the calculation method of vulnerability suspicious degree of statements. It optimizes the program spectrum by using program slice technology and calculates the suspicious degree of statements. Through static analysis aerospace software vulnerability is located. Finally, fault location of aerospace software is determined by the results of both dynamic location and static location.

This paper focuses on the above three aspects to carry out research. Based on linear temporal logic with three-valued semantics, software runtime fault detection and software vulnerability static location, aerospace software fault detection and localization can be realized. It is very important to realize this technology, which can ensure the normal operation of aerospace software and avoid the huge loss caused by software failure.