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# A FSM-BASED APPROACH FOR SYSTEM LEVEL FLIGHT PROCEDURE VERIFICATION OF DEEP SPACE EXPLORATION PROBES

**Abstract**

The system-level verification of critical mission sequence activities and flight procedures is very important and challenging for deep space exploration probes, due to high level of system complexity and information interactions. The traditional testing method is usually performed by nominal and fault cases, which leads to the issues of uncertainty of test coverage, time and energy consuming and difficulties in state control during the testing implementation process. This paper presents a FSM(Finite-State-Machine)-based testing approach for flight procedure of deep space exploration probes, which consists of three main steps. Firstly, a two-staged mean to define the spacecraft functional modes is given; Secondly, modeling the behavior of the probes and develop the FSM-based recognition towards flight scenarios; Finally, the test cases set is generated through traversing the FSM, so as to accomplish the probe's system level flight procedure verification in the end. Moreover, the paper presents an improved FSM heuristic algorithm UIOQ used in step 3, and it shows significant improvement in reconciliation between test costs and fault detection level comparing to traditional UIO(Unique Input-Output) algorithm. Take some deep space exploration probe for instance, the paper gives the evaluation results of the novel verification approach from three aspects of testing completeness, effectiveness and efficiency. The test data indicates its good performance in the complex logic verification for deep space exploration probes. In addition, the paper also discusses the test case generation strategies of combination use of three types of FSM-based methods corresponding to heterogeneous probe systems, namely stateless verification, state-oriented verification(UIOQ) and random verification methods, which makes the study for engineering applications in the future.