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SPACE SYSTEMS SYMPOSIUM (D1)
Lessons Learned in Space Systems (5)

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SECONDARY ANALYSIS ON ON - ORBIT FAILURES OF SATELLITES

Abstract

The author statistically analyzed on-orbit failure data of recent medium and large satellites based on primary investigations of satellite failures. Eleven satellites which were launched between 2002 and 2006 have 33 failures on orbit. The primary investigations of these failures revealed the causes of failures and the reason why the defects have not been detected on ground. These information give us a good opportunity to reveals real situations of on - orbit failures caused by design and manufacturing problems. Random parts failures are only 11% among failures whose causes are identified after investigations. Instead failures caused by design problems (57%) and manufacturing problems (32%) are dominant for on-orbit satellite failures. Failures caused by design problems and manufacturing problems tend to occur in the first 50 days after launch. Instead random parts failures occurred with almost random intervals. Some onboard instruments include identical sets of subsystems or subsets. For example a propulsion system include the identical thruster channels. A solar paddle include the identical strings of the solar cells. It is found that failures occurs in eleven instruments with identical subsets. Among eleven, four instruments have failures in the more subsets than one. This fact indicates that redundant systems are not so effective for the situation of failures where design and manufacturing problems are dominant. Propulsion and solar paddle subsystems have a relatively large number of failures caused by manufacturing problems, against which redundant system are partially effective. Mission instruments have a large number of failures caused by design problems. Bus subsystems except for propulsion and solar paddle subsystems have a relatively small number of failures. This result concerning bus subsystems is different from past failure statistics by several authors. For these bus subsystems, failures tend to happen deterministically and redundant system may not be effective. Conventional reliability engineering based on the random parts failures seems not to be realistic in our space engineering. It is required to make a new reliability engineering that includes real situations of design and manufacturing processes.