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SPACE SYSTEMS SYMPOSIUM (D1)
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ON BOARD AUTONOMY FOR ISRO SPACECRAFTS

Abstract

Spacecrafts are becoming increasingly complex and the Interplanetary missions like Mars Orbiter Mission, have additional constraints of delays in communication with spacecraft. Considering the increasing trend in spacecraft launches, the operational man power required to support the missions are becoming multidimensional and spacecraft on-board autonomy is the only solution. Purpose: The autonomy features built On board spacecraft shall reduce the ground load, and provide continuous monitoring of the spacecraft bus systems and take corrective action, before the spacecraft enters into safe modes like loss of attitude lock or power emergency. The autonomy features are envisaged to bring the spacecraft back to nominal operation, once it enters the safe mode by taking autonomous decisions and actions. Method: The autonomy features are built part of OBC software. Fault detection and Identification and recovery logic are provided part of software and hardware. System level fault tolerant autonomy is provided in terms of redundancy and fail safe error identification and reconfiguration logic. The OBC is a hot redundant system. There is inbuilt internal logic, to take of auto change over to the redundant system if it detects main system is in faulty state. Choosing the space grade devices and stringent review and testing processes make OBC more reliable. The autonomy features incorporated in on board are: 1. Automatic sequence of operations to take care of initial acquisition, payload operations and orbit maintenance. 2. Features to modify the on-board software during mission time to handle any unforeseen mission requirements. 3. Editable command sequence, which can be triggered by on board event and series of command can be executed with a programmable delay. 4. A set of data or program that can be kept in EEPROM, for quick recovery of OBC in its basic and safe state if it undergoes to reset or any unforeseen error. 5. Different level of fault detection and isolation features: to avoid any transient data error, RAM or EEPROM data corruption, to isolate and reconfigure faulty sensors and actuators, to handle any contingency situation during spacecraft maneuver, payload operation, and to recover spacecraft from lose of lock and power emergency condition. Conclusion: The autonomy features are designed and implemented on board OBC and successfully validated the functionality. To achieve full spacecraft autonomy more and more features and AI/expert systems are required. The current design is made modular with scope for expansion. .