SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (4)

Author: Mr. G.V.P. Bharat Kumar
Indian Space Research Organization (ISRO), India, bharat@isac.gov.in

Ms. shubha kapoor
Indian Space Research Organization (ISRO), India, shubhak@isac.gov.in
Mr. Jasvinder Singh K.
Indian Space Research Organization (ISRO), India, jsk@isac.gov.in
Ms. Rima Ghosh
U R RAO SATELLITE CENTRE (URSC), India, rimag@isac.gov.in
Mr. Aditya R
U R RAO SATELLITE CENTRE (URSC), India, adityar@isac.gov.in
Mr. Avinash K Kulkarni
U R RAO SATELLITE CENTRE (URSC), India, akkul@isac.gov.in
Mr. P. Natarajan
Indian Space Research Organization (ISRO), India, pnrajan@isac.gov.in
Mr. KiranKumar A.S.
Indian Space Research Organization (ISRO), India, kiran@sac.isro.gov.in
Dr. V. Koteswara Rao
Indian Space Research Organization (ISRO), India, vkrao@isro.gov.in

MASTER RECOVERY SEQUENCER FOR AUTONOMOUS ATTITUDE RECOVERY OF INDIAN MARS ORBITER

Abstract

Mars Orbiter Mission (MOM) is India's first interplanetary mission to planet Mars with the Spacecraft designed to orbit Mars in an elliptical orbit. MOM has been configured to carry out observation of physical features of Mars and carry out study of Martian atmosphere. The Attitude and Orbit Control Subsystem (AOCS) of MOM is configured as a 3-axis body stabilized zero momentum system with four reaction wheels to provide a stable platform and Reaction Control System (Eight 22N thrusters and one 440N Engine) for orbit raising and attitude control. It has high performance inertial measurement system, star sensor for fine pointing and Coarse Analog Sun Sensor. For such missions on-board autonomy becomes vital due to large round trip delay, limited visibility, limited uplink/downlink volume and the constraints on the communication link due to limited field of view. First level of autonomy is achieved through sensor and actuator FDIR (Fault Detection Isolation and Reconfiguration), which takes care of individual failures. The next level of autonomy is achieved by Master Recovery Sequencer (MRS). This takes a global view of the available resources, battery power and takes decision for optimum recovery path. In each recovery path a set of convergence and timeout logics are incorporated at various stages, failure of which leads to choose the next best option. At the end of successful recovery power generation and ground communication through high gain antenna are ensured. MRS receives recovery request flag on safe mode or on failure of intended operation from the respective module. The required pre-settings and data used during safe mode recovery are stored in EEPROM, which will be uplinked/ updated from ground periodically. Based on the recovery request and EEPROM pre-settings and sensor/actuator status from FDI modules, appropriate sequence will be initiated. Commands (like Wheel ON/OFF, Star Sensor

ON/OFF etc) will be generated on-board through Event Based Commanding at appropriate instants. Simultaneous/multiple failures are taken care by prioritising the recovery operations. Various failure scenarios are simulated and successful recovery was achieved through MRS during ground testing. This approach gave good reliability of on-board software and helped in faster realization of AOCS.