IAF SPACE SYSTEMS SYMPOSIUM (D1)
Technologies to Enable Space Systems (3)

Author: Mr. Lianxiang Jiang
China Academy of Space Technology (CAST), China

Ms. Peipei Xu
China Academy of Space Technology, China
Mr. Haiyang Chu
China Academy of Space Technology (CAST), China
Dr. Mingxiang Li
CAST, China
Ms. Fei Wang
China Academy of Space Technology (CAST), China

ON-BOARD SMART AVIONICS FOR ON-ORBIT SERVICEABLE SPACECRAFT

Abstract

Technology progress in space operations autonomy will disrupt the traditional paradigm of spacecraft design, acquisition, launch, operations, and maintenance. On-orbit service refers to on-orbit activities conducted by a space vehicle that performs up-close inspection of, or results in intentional and beneficial changes to, another resident space object (RSO). satellite designs will begin to incorporate cooperative servicing features such as standard quick-disconnect refueling valves; machine vision-friendly; grapple fixtures; and common structural, power, data, and fluid interfaces. Spacecraft currently being acquired are already studying serviceability features. This paper research the design of avionics for a serviceable spacecraft. Firstly, a switch-based architecture of on-board avionics was put forward, on-board computers, sensors and actuators interconnect with standard mechanical and electrical interfaces, functional modules supported plug and play mechanism, which were easily assembled on orbit. A plug and play mechanism and software reconfiguration was put forward to support the on-board maintenance. On board health management mechanism was also designed to detect and diagnosis faults. We put forward a data sampling withvaried rate method to ensure we get enough data to diagnosis the fault. When a hardware fault happens, the fault should be detected and located by fault monitor and diagnosis mechanism. On-orbit replaceable unit was designed with easy pluggable mechanical interface and standardized electrical interface. Once a replaceable unit was connect into the on-board avionics system, The on-board serviced spacecraft could recognize and communicate with the new replaced hardware module. Once a new on-orbit replaceable unit is connected into the on-board avionics system, The on-board serviced spacecraft could recognize and communicate with the new replaced hardware module or equipment. When a single event upset happens, the on-board computer relocate the fault address, and software module will be reloaded to recovery from the fault. Furthermore, in order to response a new requirement, an existed software module may need to be upgraded or a new task module need to be installed. The distributed computing system connected by a Ethernet router were built in the lab, the VxWorks embedded operating system runs on the distributed computers. The communication protocol and UDP based communication was applied, the task installing, uninstalling and task transference between the different computing nodes was demonstrated.