

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

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DISTRIBUTED SYSTEM ARCHITECTURE FOR ONBOARD AUTONOMY OF ASTEROID
EXPLORER

Abstract

Due to the distance between asteroids and the Earth and the uncertainty of their characteristics, the asteroid exploration requires highly spacecraft autonomy to complete a variety of onboard operations in dynamic unknown environment, including the auto-determination of attitude and orbit, the commands generation and execution, fault recovery etc.. In order to achieve highly autonomy of the explorer, a distributed autonomous system architecture based on multi-agent was designed due to the inherent distribution and concurrency of the asteroid explorer subsystem. This architecture overcomes the problems of efficiency and real-time performance of centralized autonomous system architecture. Two types of agents are included in this architecture, General Supervision Agent (GSA) and Subsystem Agent (SSA). Each distributed autonomous system has only one GSA, which stores global information of the system and capability of each subsystem. GSA will mainly take charge of the distribution of tasks and the coordination of the subsystems. SSA is an agent with simple function, which only stores partial knowledge and information. SSA receives the sub-tasks sent by the GSA and conducts autonomous planning and command execution. When the problem cannot be solved by SSA itself, an assistance request will be sent to the GSA for help and it will also inform the GSA the execution results. By the interaction and communication of the agents, the onboard autonomous system can synchronize their activities, operate concurrently, and react in real-time. The ground test for distributed autonomous system of asteroid exploration was established based on Vxworks real-time operation system and the hardware-in-loop dynamics simulator of asteroid explorer in Institute of Deep Space Exploration (IDSE), Beijing Institute of Technology (BIT). The experiments results show that the distributed autonomous system architecture presented in this paper is suitable for realizing the onboard autonomy of asteroid explorer.