HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Interactive Presentations (IP)

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MISSION PLANNING AND SCHEDULING FOR RENDEZVOUS AND DOCKING OF MANNED SPACECRAFT BASED ON FINIT STATE MACHINE

Abstract

The rendezvous and docking (RVD) is the process that the active spacecraft (chaser) and the passive spacecraft (target) reach the same position on the orbit at the same time and physically connected together. The mission planning and scheduling for RVD of manned spacecraft should take various constraints into consideration, such as sunlight, TT&C condition and flight sequence. Now, the researches on mission planning and scheduling mainly focus on earth observing satellites. These methods cannot be used for manned spacecraft RVD mission directly. To realize mission planning and scheduling for RVD of manned spacecraft rapidly and exactly under multi-constraints, a method based on Mealy-type finite state machine (FSM) was proposed. Firstly, the multitudes of constraints, which must be fulfilled by the flight events during RVD, were described. The flight events of the chaser consist of parking, approach, docking, berthing, separation, department and parking according to the flight sequence. The constraints for each flight event were specified respectively. For example, the 'approach' should fulfill the constraints such as orbit sunlight angle, sunlight incidence angle and TT&C condition. Secondly, a Mealy-type FSM based mission planning and scheduling model was established by taking the flight events as states (S) and taking orbit sunlight angle, sunlight incidence angle and TT&C condition as input signals (Σ). Then, the input signals were computed according to the mission orbit. When the input signals fulfill the constraints described above, the state machine will shift from the initial state S0 ('parking') to the next state according to the flight sequence. After shifting to the state S0 again, the mission planning and scheduling was accomplished. Finally, the results can be output in form of graph or text, including the start time and duration of each flight event. Take the manual rendezvous experiment in China's RVD mission for instance, the mission planning and scheduling for the experiment was carried out. The result was consistent with on-orbit execution. It shows that the method mentioned above can complete the mission planning and scheduling for RVD of manned spacecraft rapidly and exactly.