Paper ID: 60093
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27th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Operations (3)

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COOPERATIVE MOTION PLANNING FOR MICROSATELLITES APPROACHING SPACE TARGETS

Abstract

As the space environment becomes more and more crowded, it is a new development in on-orbit service technology to use microsatellites to remove inactive spacecrafts or take over their motion ability. The microsatellites can approach and adhere on the target surface to form a combinant, then restore failure target's maneuverability by microsatellites' control. Compared with traditional single spacecraft, the use of multiple microsatellites (microsatellite cluster) to work together is flexible and scalable. The redundancy of the system is improved, too. Because the relative states during the approaching inactive targets change greatly, and a slight mistake will threaten the safety of the microsatellites and targets. It is necessary to construct the approaching motion planning for microsatellite cluster to adhere the the surface of the targets. A collaborative motion planning method based on RRT* algorithm is designed to close approaching target for microsatellite cluster. The cooperative motion planning under the constraints of complex environments, obstacle avoidance between satellites, time consistency and fuel balance is researched. Based on the motion planning algorithm of one single microsatellite, the relative state information between satellites and treating the remaining microsatellites as dynamic obstacles, mutual obstacle avoidance among multiple microsatellites is achieved. Aiming at imbalanced fuel consumption of microsatellites during approaching, the judgment of fuel consumption information based on sampling-based planning methods is introduced to the motion planning algorithm of microsatellites. Then the fuel consumption of microsatellites could be kept basically same. With these works, an efficient and balanced motion path ,which ensures microsatellite cluster approach the target at a close range with the required attitude, is designed. Numerical simulation shows that the satellites can maintain a safe distance from each other during approaching the target, and the fuel consumed when reaching the target position is basically the same. The simulations test the effectiveness and usefulness of the motion planning algorithm.