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OVERVIEW OF THRUSTER PLUME EFFECTS AND COUNTERMEASURES ANALYSIS IN CHINA TIANGONG-1 MISSION

Abstract

As the second step of Chinese manned space project is aimed to make a breakthrough at space rendezvous techniques, the ShenZhou manned spaceship was improved and the TianGong-1 spacelab was newly developed. An overall view has been made at thruster plume analysis techniques, methods and alleviation countermeasures adopted for TianGong-1 spacelab in this paper. The plume multiple effects were lied in the form of plume perturbation, heat and chemical contaminations. Besides the plume flow field analysis and prediction, investigations on disturbance to attitude control, temperature rise and optics degradation of devices were carried on to make sure risks by all these multiple effects were well controlled, not only in its independent mission but also the rendezvous and dock missions with ShenZhou manned spaceships. Results of the analysis and validation were discussed in this paper, and alleviation countermeasures for the plume multiple effects were proposed and well approved by data for flight. By the success of TianGong-1 mission in the past three years, methods and code of process for plume effects prediction and alleviation were well proven, contributing to the reliability improvement for the spacecraft and mission. The whole loop of spacecraft plume multiple effects analysis, validation and alleviation was proposed. And methods introduced in this paper were well suggested for the design of manned and unmanned spacecrafts.