SPACE SYSTEMS SYMPOSIUM (D1)
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VERIFICATION OF SPACE FLEXIBLE CAPTURE MECHANISM AND ITS MULTI-BODY DYNAMICS BY ON-ORBIT TEST

Abstract

Space object On-orbit capture is the prerequisite and basic link of space manipulation and control. Research on these techniques takes great effect on the innovation of space system. Currently, space manipulator system normally adopts single/multi-rigid mechanism to implement on-orbit capture for space objects. This mechanism is called space rigid capture mechanism (SRCM) in this paper. The basic problem of SRCM is that the space capture manipulator is normally constructed by single rigid or multi-rigid arm. When carrying out space object capture operation, SRCM has to maintain a high degree of accuracy on the gesture and position between the two space vehicles, and the collision momentum caused by capture operation should be avoided or minimized. Otherwise, the uncontrollable collision momentum would be directly transferred to space manipulator vehicle platform by SRCM, and leads to manipulator platform to make a sudden change on its movement status, which then would cause manipulator platform rolling and out of control. The current SRCM bring a set of restrict operation conditions, which greatly restraint its application range. Focus on the technique bottleneck of SRCM, the author and his teams proposed space flexible capture mechanism (SFCM) concept for the first time in 2012, and then solved the control problems of collision momentum and disturbance during the flexible capture in 2014. In order to carry out on-orbit verification experiment on SFCM and its dynamics system, based on the current on-orbit SRCM system, for the first time, this paper implements the equivalent verification experiment by coupling of special flying task design and dynamics experiment, and obtained achievements in 3 aspects: First, how to use the current SRCM system to design the equivalent experiment for SFCM. Second, how to select on-orbit experiment data for SFCM. Third, how to implement experiment data to carry out variable parameters verification on SFCM. Based on the above theory and experiments, this paper obtains a complete design method of how to use current SRCM system to carry out verification experiment for SFCM technique. On the other hand, it also obtains a precious SFCM dynamics model. The research results support the future flexible capture, stability control and on-orbit experiment of multi-body space vehicle in the next generation.