

SPACE SYSTEMS SYMPOSIUM (D1)  
Enabling Technologies for Space Systems (2)

Author: Prof. Zhenghong Dong  
Academy of Equipment, China

Dr. Fan Yang  
Academy of Equipment, China  
Prof. Shucui Zhang  
Academy of Equipment, China

THE INNOVATIVE CONCEPT VERIFICATION FOR ON-ORBIT SOFT CAPTURE USING THE  
SPACE MULTI-ARM SYSTEM

**Abstract**

How to realize the non-cooperative space target On-Orbit Capture (OOC) under the complex space condition is a hot topic to the world's space power. The current researches on OOC are mainly focused on the Single/Multi-Rigid Arm Capture (SMRAC) technologies, such as space docking and space multi-arm robot, etc. A bottleneck of SMRAC is how to effectively discharge and control the pulse collision momentum (which can be introduced by different capturing position/ orientation of the space target, disturbance of spacecraft attitude control system, residual momentum of disabled space target, etc. ) in the process of capturing a target.

Aiming at the above problems, this paper establishes an innovative concept mechanism of On-Orbit Soft Capture (OOSC). Its core mechanism idea is to achieve the pulse collision momentum transfer to the harmonic style conversion by building the controllable momentum transferring mechanism model of OOSC between the main spacecraft and space target. Meanwhile, the key parameters of the harmonic momentum transfer amplitude, phase and time of convergence are all constrained within the working boundary of main spacecraft attitude control system, thereby achieving the collision momentum controllable buffer and discharge. To verify the concept mechanism of OOSC, this paper is based on the existing robotic arm system in the space station, where the concept mission and mechanism verification methods for OOSC are designed, and a on-orbit testbed using SMRAC system to realize the complex rigid/flexible dynamics equivalent test and control of OOSC is constructed. The on-orbit test results show that, compared with the existing SMRAC technology, the impact of pulse collision momentum caused by the target satellite can be effectively reduced by using the OOSC technology both in time and energy domains. These researches mentioned above are important to the future operation of non-cooperative space target servicing.