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

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SPACE MULTI-RIGID ARM SYSTEM BASED SPACE FLEXIBLE CAPTURE ARM MODEL CONSTRAINTS DESIGN

Abstract

Space flexible capture mechanism (SFCM) is one of key techniques of solving the problem of developing space manipulation and control, which is the basis to make space system on-orbit maintenance and support being widely applied, and is one of the future space manipulation technique. Currently, for the research of on-orbit capture techniques, space dominant countries mainly focus on the research and experiments of special docking mechanism, space arm, tethered end, flying net, and electromagnetic connection etc. The above research can be classified into 3 categories. First is the special docking technique, which has been a mature technique, but can only be used to cooperative objects, and the way of docking is onefold. Second is space arm technique, which requires the relative position and gesture of two space vehicles to be kept in a high degree of precision. And there cannot be allowed to produce big disturbance during capture. In addition, this technique can only be used to capture cooperative objects as well. Third is non-directly capture technique, such as tethered end and flying net, which use flexible rope structure of flying net to capture space object. This technique can only be applied to on-orbit invalid space vehicles or space debris. However, it would make some damages to the space objects. In order to solve the existing problems of current on-orbit capture techniques, it is necessary to propose a new concept and technique to provide a on-orbit capture technique which can incorporate cooperative objects as well as non-cooperative objects, breaks through the bottleneck of collision momentum uncontrollable, implements the collision momentum "soft transfer" during the space capture process, and improves the application ability of on-orbit manipulation and control. This paper focuses on SFCM, and also focuses on how to implement capture and make the object control rapid and stable, in order to establish the technique concept of SFCM. It uses a whole new viewpoint to illustrate the theory, technique and method of collision momentum "soft transfer" between based space vehicle and space objects, and develops model constraints design on the concept and mechanism of on-orbit flexible capture arm. In the end, we carry out the simulation experiment on the key parameters of SFCM kinematics and dynamics, and the results show that the proposed SFCM model and the design of constraints parameters are advanced, scientific, and correct.