

IAF SPACE SYSTEMS SYMPOSIUM (D1)  
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DESIGN OF IN-ORBIT ASSEMBLY OF LARGE REFLECTOR BASED ON PARALLEL ROBOT

**Abstract**

The demand of large/super-large space structures typically represented by large-scale radar antenna, large aperture optical mirror and large area solar array is obvious in the future. Highly modular in-orbit assembly can break through the constraints of rocket thrust and fairing envelope, and has the characteristics of high structural efficiency, strong expansibility, maintainability and upgrading, which is an important way to build large space structures in the future. After more than 40 years of development, in-orbit assembly technology has achieved good application benefits in the assembly and maintenance of the International Space Station and Hubble Space Telescope. However, in-orbit assembly of 100-meter reflector antenna involves a large number of rods, trusses, reflectors and other units, so there are many assembly and adjustment links and a long process. Moreover, it requires the robot to have high-precision and dexterous control ability, and large-scale and efficient mobility, which is beyond the current technical level of space robots. Aiming at the issue that current capability of space robots could not meet the requirements of in-orbit assembly of large reflector antennas, on the one hand, the operation types and steps of assembly tasks are simplified from the types of objects to be assembled, the mode of assembly connection, and the mode of module stack handling. On the other hand, the parallel mechanism with symmetrical configuration is used to improve the movement efficiency of the robot body and the operation accuracy of its terminal. Then, an in-orbit assembly scheme is constructed by taking the 45m reflector antenna assembly composed of 96 modules as an example: a long truss with 2 degrees of freedom which doubles as the antenna feed support bar is used to transport the module stack in a large range and efficiently, and the climbing parallel robot is used to move, assemble and adjust efficiently on the back of the reflector, which has the characteristics of universal module, good expansibility, high assembly accuracy and simple system. Finally, the dynamic simulation model of in-orbit assembly system was established, and the parameters such as the fundamental frequency of the whole satellite structure under bad working

conditions, the vibration of the robot base and the vibration attenuation rate of the long truss were calculated and analyzed, which shows that the scheme has good mechanical properties.