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ON-ORBIT INSTALLATION MISSION PLANNING OF SPACE TRUSS WITH SQUARE CROSS-SECTION CONFIGURATION

Abstract

The space truss structure, as the mostly common component in large space structures, is mainly used to support and fix, and is the most basic part of the entire structure. Space truss structures are generally fixed by rigid body members via hinges. Common truss structures are triangular cross-section structures and square cross-section structures. In the current research, in order to reduce the structural quality, the flexible string is used instead of some rigid body members in the space truss structure, but it increases the installation difficulty of the entire system. This paper studies the conceptual design and planning of on-orbit installation tasks for a square-section space truss structure containing flexible strings. First, suppose that multiple robotic arms are used for coordinated installation, then the truss structure on-orbit installation task scenario is established. The space truss model is simplified. The basic components and installation methods of the truss structure are designed, and the geometric constraints between the installed components are determined. Secondly, the space truss structure with square cross section is modeled, and the method of adjacency matrix in graph theory is used to describe it. A novel hierarchical planning algorithm is proposed. First divide the installation components according to the task priority and determine the installation order of each basic unit. An improved genetic algorithm is used to optimize the optimal installation path in each unit to obtain the installation sequence with the lowest fuel consumption. Finally, the installation task was simulated according to the above-mentioned layered optimization algorithm. Contrast simulations are performed for a single robotic arm installation scenario and a multiple robotic arm installation scenario. In the multi-robot task scenario, each robot arm installation task is assigned according to the conditions of the shortest moving path and the constraints of the robot arm joints.