IAF SPACE POWER SYMPOSIUM (C3)
Solar Power Satellite (1)

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ASSEMBLY SEQUENCE PLANNING OF THE SOLAR POWER SATELLITE

Abstract

Recent years have witnessed the resurgence of space-based solar power research, and in particular the solar power satellite (SPS) paradigm has received much attention due to its potential for generating clean electrical power. Subject to the launch capacity of a rocket and the extra-large size and mass, it is only possible to assemble such a SPS on orbit, and the modularized structural design seems to be more desirable. While the stability of the whole SPS structure during on-orbit assembly is closely related to the assembly sequence of different modules. The unsuitable assembly sequence could make SPS structure more flexible, and even cause structure vibration, which has great influence on the precision and efficiency of on-orbit assembly.

To guarantee the stability of a SPS during on-orbit assembly, the assembly sequence planning of SPS modules is investigated in this paper, taking the Multi-Rotary Joints SPS (MR-SPS), which is proposed by the China Academy of Space Technology, as the research objective. The dynamic model of the MR-SPS during on-orbit assembly is firstly proposed considering the impact among assembly modules and different perturbations, such as the gravity gradient and solar pressure. Then, selecting the maximum structural stiffness and minimum vibration amplitude after each assembly as optimizing index and coding each module and assembly position, the optimal assembly sequence is hence planned based on the genetic algorithm. Numerical simulations are finally provided to illustrate the above analysis, and the results will demonstrate that the stability of the MR-SPS during on-orbit assembly is well guaranteed using the proposed optimized assembly sequence. Using the proposed assembly sequence planning technique based on genetic algorithm appears to be a promising solution to achieve precise and efficient on-orbit assembly mission of the MR-SPS.