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

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MODULAR HIERARCHICAL CONTROL TECHNOLOGY FOR SPACE SOLAR POWER STATION

Abstract

The space solar power station (SSPS) is the largest feasible space system at present. Compared with the existing spacecraft, it is very difficult to achieve the control accuracy required by the system due to its super-large size, extremely low structural frequency, super-flexibility, long-time operation, high-precision pointing control, and different control precision requirements for each functional structural module, which also brings new problems and challenges to the field of dynamics and control. Since the concept of SSPS was presented, many configurations with different designs have been developed, therefore resulting in different control modes. This paper proposed a modular hierarchical control strategy, which considered the orbit/attitude stability control for SSPS from a new perspective. In this paper, the modular MW-level demonstrated SSPS (MMD-SSPS) is taken as the research object. Aiming at the optimal structural dynamic performance, the collaborative structural optimization of nonlinear multi-flexible structure topology and functional component layout is studied with considering the structure and task characteristics of MMD-SSPS. On this basis, the attitude-orbit-structure coupling dynamic model of nonlinear multi-flexible body system is established. According to the cooperative working mode, mutual influence and restriction relationship among the subsystems of the MMD-SSPS, the mathematical model of attitude-orbit-structure cooperation is established, and the cooperative strategy and optimization method are proposed. Finally, the optimized model of the MMD-SSPS is excepted to offset the control difficulty and cost to a certain extent, and then the orbit position keeping strategy and attitude control strategy are developed according to the optimized model in order to meet the control requirements of the MMD-SSPS.