ASTRODYNAMICS SYMPOSIUM (C1)
Attitude Dynamics (2) (6)

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DYNAMIC MODELING AND CONTROL SIMULATION OF THE CABIN TRANSFERRING ASSISTED BY MANIPULATOR FOR THE CHINA SPACE STATION

Abstract

The large space manipulator is the core mechanism for china's future space station project. There are lots of restrict design requirements and key techniques to be addressed in engineering. Space manipulators play critical roles in the space projects, such as capturing and transferring of cabins, transferring and installing of instruments, and assisting astronauts for operation. In the cabin transferring operation, the space station is a complex dynamic system with features of varying mass and architecture, high flexibility, strong nonlinearities and cross-couplings. As a result, all these complex dynamic characteristics present significant challenges for engineers working over dynamic modeling and control system design. Due to limited ground test, dynamic and control simulation technique is usually used to predict and design various task operations. In this paper, a dynamics-control simulation test platform is developed and used to validate the cabin transferring control task. The space station is a multi-body mechanical system including spacecraft, large solar array, manipulators and mechanisms. For floating base and tree topology, a flexible multi-body dynamics approach is developed to perform the computer modeling and simulation with control system. Based on Lagrange equation and finite element method, the resulting dynamic equations take into account the effect of large-angle rigid rotations, solar array vibrations, and flexible joints deformations. Interacting with the base cabin attitude control, manipulator path planning and control, extensive task simulation capabilities are built into the dynamics-control simulation program, such as cabin transfer, assisting docking, cargo handling, instrument maintenance. The task analysis of cabin transferring assisted by manipulators is made as an example to demonstrate the valibility of the dynamics-control analysis tool.