SPACE DEBRIS SYMPOSIUM (A6)
Poster Session (P)

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THE IMPACT DYNAMICS IN RENDEZVOUS AND DOCKING OF FREE-FLOATING FLEXIBLE SPACE MANIPULATOR CAPTURING A TARGET SATELLITE AND THE POST-IMPACT CONTROL FOR CALMING

Abstract

The on-orbit satellite maintenance, refueling or retrieve are the main servicing assignments of space manipulator; the rendezvous and docking between space manipulator and satellite is inevitable when on-orbit servicing. In this paper, the impact dynamics in rendezvous and docking of free-floating space manipulator capturing a target satellite is discussed, and the post-impact dynamic control of the space manipulator and target satellite mix-bodies system is presented. Firstly, base on the assume modes method, the flexible link elastic deformation is described, and combining the Lagrange formulation, the dynamic formulation of free-floating flexible space manipulator system is derived; and the target satellite is assumed as a single rigid body, the dynamic formulation of the target satellite is derived by Newton-Euler formulation. Secondly, base on the above dynamic formulations, and focus on the impact during the rendezvous and docking of free-floating flexible space manipulator capturing a target satellite, the impact effect is calculated by the momentum impulse method, this is the impact dynamics. Finally, focus on the unstable post-impact state of space manipulator and target satellite mix-bodies, the feedback control is applied for calming the rigid motion, and linear quadratic optimal control is applied meanwhile for suppressing the flexible vibration of flexible link. The simulation result reveals the impact effect, and verifies the effectiveness of the above control.