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COLLISION ANALYSIS FOR FREE-FLYING SPACE MANIPULATOR WITH FLEXIBLE ARMS IMPACTED BY A SATELLITE ADAPTIVE NEURAL NETWORK CONTROL AND VIBRATION SUPPRESSION FOR COMBINED SYSTEM

Abstract

Free-floating space manipulator is an important on space equipment in the outer space, and be installed on the satellite carrier or other floating base, which help the astronauts completed many space missions, such as space equipment maintaining, removing debris of orbital and filling control liquid for spacecraft. When space manipulator system to perform these space tasks, it is need for rendezvous and docking. In the pre-impact process, the space manipulator will collide with the captured target. Especially the target is spin non-cooperative satellite–has certain rotation velocity, collision will lead to the combined system with large angle rotation which is dangerous for space equipment. Space manipulator system is often with long arms and big load, in order to reduce the quality of the system the lightweight flexible are used at the same time. It will produce the flexible vibration in the process of movement, which make the system dynamics equation nonlinear. In order to ensure the control accuracy, flexible vibration should not be neglected, and need to design effective control scheme to suppress the structural vibration. The space manipulator with two flexible arms is the research object in this paper. With the assume modes method, the dynamic equations of space robot and target are derived by Lagrangian approach and Newton Euler method. The impact of the collision effect were evaluated is obtained by using the impulse law, the combined system is obtained by the collision theory in post-impact process. The calm motion control of joints and attitude angles is designed by use adaptive neural network algorithm. Based on the above control algorithm, using the linear quadratic optimal control theory, flexible vibration suppression control algorithm is designed, and a composite control algorithm calm motion control scheme of the combined system is formed. At last, numerical examples simulate the process of collision and the efficiency of the control scheme is verified by the simulation results.

Keywords: Free-flying manipulator; Flexible arms; Capturing satellite; Neural network; Vibration Suppression