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VIBRATION SUPPRESSION DURING CAPTURE OF A SPINNING SATELLITE USING INPUT SHAPING METHOD BASED ON NTSM CONTROL

Abstract

Capturing a space target using space manipulators has been one of the significant and promising researches these days. Impact analysis, trajectory tracking and stability control are key issues in the capture process.

In this paper, the capture task of a spinning satellite is carried out by a flexible dual-arm space robot which has two solar panels mounted. Contact between the target satellite and the end effectors of the manipulators can bring both objects' changes in position and attitude. Meanwhile, the solar panels vibration will have bad effect on the stability of the whole system which even can result in failure of the capture. An input shaping method based on non-singular terminal sliding mode (NTSM) control is presented to decrease the unexpected flexible vibration. To achieve this aim, in the interval of two contiguous contacts, attitude maneuver is necessarily needed.

Firstly, the recursive flexible multi-body system dynamics algorithm using spatial operators is studied. Besides, Hertz contact model is used for analysis of the contact between the target and the end of the space manipulators. Secondly, the input shaper can be obtained by solving the state matrix of the space robot system. The NTSM controller of input shaping is designed to realize vibration suppression during the interval of contacts. Thirdly, considering deviation in natural frequency and damping ratio, different input shapers (ZV, ZVD, EI, Two-Hump EI) are discussed. Moreover, thrusters and reaction wheels are alternative in attitude maneuver. Simulation results show that the NTSM controller of input shaping can effectively suppress the flexible vibration.