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SIMULTANEOUS VIBRATION REDUCTION AND ATTITUDE CONTROL OF FLEXIBLE SPACECRAFT WITH ON-OFF ACTUATORS

QINGLEI HU
Department of Control Science & Engineering
Harbin Institute of Technology
Harbin, 150001, China

ABSTRACT—This paper deals with the problem of simultaneous vibration suppression and robust attitude control of orbiting spacecraft with flexible appendages. Based on integral variable structure control theory, a discontinuous attitude control law is firstly derived to achieve the desired position of the spacecraft, taking explicitly into account external disturbance and nonlinearity. To reconstruct estimates of the system states for use in a full information variable structure control law, an asymptotic variable structure observer is also employed and the fulfillment of sliding condition, including the case when estimated states are used, is also verified. To achieve the residual vibration free, the shaped input attenuator is also employed after the end of input in an open-loop manner. In addition, the system also employs the pulse-width modulation technique to achieve the desired control torque signals. The performance and efficacy of the proposed control scheme are illustrated with a comparison of different maneuvering strategies by extensive simulation.

Key Words: spacecraft, integral variable structure control, observer, attitude maneuver, adaptive control