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DATA-DRIVEN ATTITUDE ROBUST CONTROL FOR MICROSATELLITE WITH AN 1-D UNDEPLOYED MECHANISM

Abstract

This paper investigates the attitude control system of a microsatellite with an 1-D flexible mechanism named as coilable mast. As a payload, it is also possible for coilable mast to deploy partially. In this situation, the satellite model information including mechanism deployed length and moment of inertia would be unknown. Considering about other uncertainties like parameter perturbations, external disturbances and vibration disturbances, it is difficult to achieve the high-precision attitude control for an on-orbit satellite. To address this issue, this paper proposes a data-driven attitude control method containing two steps. Firstly, the satellite is required to perform an attitude maneuver experiment. Then the satellite model can be identified based on the particle swarm optimization (PSO) algorithm. Multiple model information including mechanism deployed length, moment of inertia, damping matrix and stiffness matrix of coilable mast can be estimated. Secondly, an attitude robust control law consisting of a nominal controller and a filter-based compensator is proposed. The nominal controller is developed to drive satellite with desired attitude performance based on the identified model. The filter-based compensator is constructed to restrict the negative influence of an equivalent disturbance representing the identification error and multiple uncertainties. Finally, to verify the effectiveness of proposed method, numerical simulations are carried out in different scenarios where coilable mast deploys partially. Simulation results demonstrate that the identification accuracy based on PSO algorithm is sufficient for nominal controller design and the satellite attitude tracking errors can converge asymptotically. This method is meaningful for attitude control system management of on-orbit satellite.