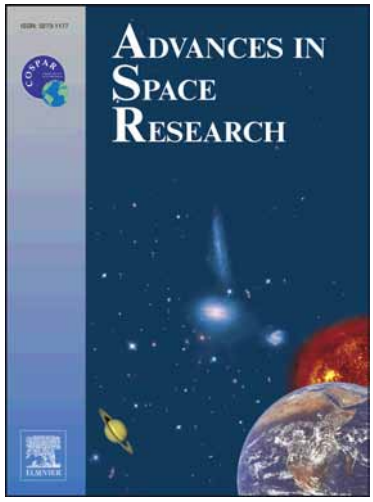

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Orbit Control of a Stratospheric Satellite with Parameter Uncertainties

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Abstract

When a stratospheric satellite travels by prevailing winds in the stratosphere, its cross-track displacement needs to be controlled to keep a constant latitude orbital flight. To design the orbit control system, a 6 degree-of-freedom (DOF) model of the satellite is established based on the second Lagrangian formulation, it is proven that the input/output feedback linearization theory cannot be directly implemented for the orbit control with this model, thus three subsystem models are deduced from the 6-DOF model to develop a sequential nonlinear control strategy. The control strategy includes an adaptive controller for the balloon-tether subsystem with uncertain balloon parameters, a PD controller based on feedback linearization for the tether-sail subsystem, and a sliding mode controller for the sail-rudder subsystem with uncertain sail parameters. Simulation studies demonstrate that the proposed control strategy is robust to uncertainties and satisfies high precision requirements for the orbit flight of the satellite.

Keywords: stratospheric satellite; parametric uncertainty; adaptive control; sliding mode control

1. Introduction

Near space is quantitatively defined as the range of earth altitudes from 20 km to 100 km, below which heavier-than-air aircraft can produce sufficient lift for steady flight, above which the atmosphere is rarefied enough

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