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MODELING AND PERFORMANCE ANALYSIS OF A NEW INFLATABLE ELECTRODYNAMIC TETHER FOR SATELLITE DEORBITING

Abstract

This paper proposes a new inflatable electrodynamic tether concept using an inflatable lightweight beam with stiffness and damp in order to efficiently produce electrodynamic force with short length tether, which is beneficial to in-plane and out-of-plane libation control. To preliminarily investigate the performance of this EDT for satellite deorbit, we firstly construct a numerical electrical model of the inflatable EDT, and verify the model by comparing the simulation results to some previous work. The deorbit dynamics of the inflatable EDT system is modeled using Gaussian perturbation equations, and the critical beyond-OML current collection model is incorporated into this deorbit model. This paper also takes inflatable EDT system as a flexible multi-body system, and adopts finite segment method to study the quasi-static deformation. By numerical computational approaches, the nonlinear behavior variables such as potential, current, and electrodynamic force along the inflatable EDT length are analyzed. The deorbiting time and tether shape are also investigated, which is related to the design parameters, such as beam length and radius, inclination angle, end-body mass etc. The performance analysis indicates that the deorbit by an inflatable electrodynamic tether is efficient, and it can provide the comparable magnitude of electrodynamic force with shorter length compared to the round tether or tape tether.