

ON DETERMINING THE DESIGN PARAMETERS OF AN ELECTRODYNAMIC SPACE TETHERED SYSTEM

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The aim of this work is to develop recommendations for choosing the design parameters of a passive electrodynamic space tethered system (EDSTS). Based on models of EDSTS orbital and relative motion, EDSTS motion is analyzed with account for EDSTS–environment interaction. It is shown that the oscillations of an EDSTS about its equilibrium position decrease the tether tension force, and when the oscillation amplitude is close to 60 degrees, the tether tension vanishes (the tether sags). Since the charged-particle density, the Earth's magnetic field, and a number of other quantities vary at the orbital frequency, so does the Ampere force. This changes the orbit eccentricity, namely, increases it. Preliminary estimates show that for orbits under consideration these changes are insignificant, and near-circular (small-eccentricity) orbits will remain so. The deorbit time of a spacecraft with an EDSTS without additional contactors is analyzed as a function of the spacecraft mass, the tether parameters, and the initial orbit parameters. It is shown that EDSTSs without additional contactors can be used to advantage for nano- and microsatellite removal from low-Earth orbits. Increasing the EDSTS tether length and radius significantly reduces the spacecraft deorbit time. For EDSTS-equipped spacecraft, the deorbit time essentially depends on the orbit inclination. For near-polar orbits, the deorbit time is longer by 3–6 times and by more than an order of magnitude in comparison with mid-latitude and equatorial orbits, respectively. This is due to the smallness of the magnetic field components perpendicular to the orbit plane in the case of polar orbits. The models developed and the generalities established may be used at the initial design stage of small passive electrodynamic space tethered systems.

Keywords: *electrodynamic space tethered system, spacecraft deorbit system, initial design stage, design parameters.*

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Received on February 7, 2020,
in final form on February 25, 2020