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DEVELOPMENT OF A DE-ORBITING MECHANISM FOR A 3-UNIT SATELLITE

Abstract

A cost effective mechanical de-orbiting system based on aerodynamic drag enhancement principle is developed for a 3-Unit CubeSat, TURKSAT-3USAT, in Low Earth Orbit (LEO). The de-orbiting mechanism consists of spiral springs as energy producing mechanism for mechanical deployment as well as thin membranes which are used to provide orbit decay as aero-brake structures. Membrane storage is provided by a storing unit with storing cylinders when the system is de-active while the deployment of the system till the end of mission life is prevented by a lock mechanism. The sizing of membrane depends on the necessary drag area for de-orbiting while this deployable structure is even expected to be reliable with low mass and small volume requirements. The required drag area is calculated through maximum de-orbiting time of the satellite, which is determined as 25 years by considering the maximum orbital life time suggestion of United Nations Inter-Agency Space Debris Coordination Committee (IADC). De-orbiting time is calculated in Satellite Tool Kit (STK) by considering J4 perturbation propagator and NRLMSISE 2000 as a high-fidelity atmospheric model, and finally checked whether it satisfies the specified maximum life time criterion. Next, a forced vibration analysis in Nastran/Patran software is applied to the designed de-orbiting system to check the structural integrity and verify the mechanism safety. The final design is to be manufactured and tested in Space Systems Design and Testing Laboratory of Istanbul Technical University.