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MICROSATELLITES DEORBITING USING A COMPACT ELECTRODYNAMIC ACTUATOR

Abstract

In the last decade, the rapid growth in the number of satellites deployed in orbit amplifies the problems associated with the proliferation of space debris. Even though IADC indicates a lifetime limit of 25 years for a spacecraft operating in LEO, the deorbiting process depends on several factors that are difficult to estimate accurately during the design phase. We investigate here the effectiveness of a compact electrodynamic actuator in enhancing the deorbiting of microsatellites. The device can generate a magnetic field with flux density controlled by the intensity and modulation of the current provided: the interaction of the magnetic field generated by the device and the geomagnetic field results in a Lorentz force acting onto the spacecraft. Optimality conditions to maximize the effect of the device in reducing the semimajor axis over a desired time interval are determined in the dynamical framework of Lagrange's planetary equations of motion and converted into commanded attitude and current modulation. The effectiveness of the device in producing the desired deorbiting conditions is evaluated by means of numerical analysis, simulating the process on 6U CubeSats evolving along sun synchronous orbits with different altitudes. The device can operate in two different modes: continuous and impulsive. Both the operative modes are investigated, also considering the effective constraints of the attitude control and electric power systems The analysis indicates that the device allows concluding the deorbiting within the prescribed 25 years also in critical conditions corresponding to high altitude and ballistic coefficient.