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ACTIVE AND PASSIVE PROTECTION OF LOW EARTH ORBIT SATELLITES FROM SPACE ENVIRONMENTAL EFFECTS

Abstract

The increasing threat of impact by micro meteoroid and orbital debris generated due to collisions and anti-sat missiles demands for better and more robust protection systems of satellites. Satellites might be subjected to multiple impacts over their mission life unless they have provisions for altitude and attitude control such as the ISS which uses propulsion systems, but incorporating such features on a satellite is difficult and is not economic. The important factor which determines the life and in turn influences the overall operational feasibility of the mission is the protection of the satellite from the extremely harsh and unforgiving environment of outer space where atomic oxygen, charged particles, large temperature variations and ultraviolet radiations are some of the agents of material degradation that must be taken into consideration in the design stage. Conventional protection systems extensively use blankets made of Tedlar, Kevlar, beta cloth, aluminium or ceramic shields etc. This paper deals with the impact of micro meteoroid and space debris on low earth orbit satellites and the methods used for protection against them. A system which uses an active electro-dynamic tether system for altitude control and a passive protection system reliable for space environment whilst being lightweight and cost-effective has been presented. Mechanical, thermo-optical and thermal properties form the basis of design of the passive protection system with respect to impact resistance and operation in orbit. This system if implemented can significantly increase the mission life as the electro dynamic tether requires only current drawn from the batteries, thus saving overall mass of the satellite as less fuel will have to be carried on board. If not, the fuel can be used exclusively for attitude control. For smaller objects which cannot be tracked and thus cannot be avoided by the tether, the passive protection system will be effective.