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HYPER VELOCITY IMPACT ANALYSIS OF CUBE SAT AND SUBSEQUENT ORBIT DETERMINATION

Abstract

Remnants of space missions, defunct satellites, used parts of space crafts and eroded parts of already collided forms a major portion space junk also known as space debris. They pose extensive potential to critically hinder our access to outer space, permanently damage our space assets like International Space Station and Hubble Space Telescope and also start a cascade by colliding with already orbiting satellites. This threat is far greater in LEO than in any other orbit.

The research conducted aims at the impact of a very small piece of space debris with size 1cm 2cm on a cube sat orbiting the Earth in LEO. Change in directional velocity, orbit, altitude and attitude of the satellite along with the damage caused in form of erosion and deformation is studied in detail. A model of Cube Sat was made and its structure was analysed for weakest spot under variety of loading conditions using inertial relief analysis (IRA). Using Ansys 14.5 Explicit Dynamics, different orientations, strike directions and shapes of debris with respect to the Cube sat were analysed for resulting directional velocity, and deformation of the colliding bodies. A worst case scenario was constructed with velocities calculated to be that at an altitude of 500 Km and eccentricity of 0 to start with. Results for deformation, erosion and directional velocity in global co-ordinates were obtained from Ansys. Using directional velocities vectors; change in orbit, energy lost and change in attitude was calculated and evaluated.

Using this data new orbit of the satellite was plotted. As in new orbit this satellite is bound to act as debris itself and has potential to start a cascading effect, this new way can be helpful to predict the scenario after a collision between two debris or a debris with a functional asset.

These results can be helpful in determining and minimizing risks in space programs post-launch. This cites that besides the planned debris mitigation strategies for space debris which are lagging in functionality because of finance and technology, we must also consider prevention before mitigation works effectively. We must reduce the risk and hindrance to spaceflight, and hence to economic progress, that is caused by orbital debris.