SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Issues (5)

Author: Mr. Michael Andoh Afful
Stellenbosch University, Ghana

Prof. Willem (Herman) Steyn
Stellenbosch University, South Africa

LIFETIME AND REENTRY PREDICTIONS OF LOW EARTH ORBIT SATELLITES AND DEORBITSAIL

Abstract

Spacecrafts are exposed to risk of collision with orbital debris and operational satellites throughout its launch, early orbit and mission phases. This risk is especially high during passage through or operations within the Low Earth Orbits (LEOs) region. Hence, understanding the lifetime of these spacecrafts in LEOs would be useful for studying long term evolution of space objects population, assessing the impacts of these objects on active spacecrafts, and the effects of increased drag on spacecrafts (DEORBITSAIL / Solar Sail de-orbiting). Depending on satellite size and orbital altitude, space debris present safety hazards to active satellites and manned space flight and can remain in space for decades. This study will investigate the present orbit decay progress of the SUNSAT and SUMBANDILASAT micro satellite by using relevant orbital parameters derived from historic Two Line Element (TLE) sets and comparing with decay and lifetime prediction models. A semi-analytical Liu theory will be employed to determine the mean elements and expressions for the time rates of change as well as relevant software would be developed to implement the decay theory. The effects of atmospheric drag coupled with Earth oblateness, which decreases orbital altitudes causing satellites to ultimately fall back to earth and burn up through atmospheric re-entry would be investigated and applied to the orbit decay prediction study. Also, influence of other perturbation forces are going to be removed by fast Fourier transform. Test cases of observed decayed satellites and other decaying satellites would be used to evaluate the predicted theory. A proposed orbital debris solution or technology known as DEORBITSAIL would also be investigated to get insight on possible phenomenon that could reduce the lifetime of spacecrafts and manned space flights with regards to de-orbiting using aerodynamic drag and solar radiation pressure and solar sail de-orbiting. The concept proposed in this work introduces a very useful technique of orbit decay as well as de-orbiting of spacecrafts. The main feature would be utilising atmospheric drag or aerodynamic drag thus a phenomenon which is normally considered as an unwanted disturbance, especially for Low Earth Orbit missions.