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PREDICTION AND IMPROVEMENT IN FATIGUE LIFE OF LEO 1U PICO-SATELLITE USING FEA TOOL TO MAXIMIZE THE MISSION'S PREDICTED LIFE

Abstract

At the time of launch and till the satellite reaches the required orbit it is subjected to various static and dynamic loads. Due to these variable and uncertain loading, the satellite body experiences continuous fluctuations which are nothing but random vibrations. The cyclic loading due to random vibrations will result in stresses in structure and thereby structure is highly susceptible to fatigue failure. Now a days, high launching cost,fabrication cost, low mass and compact design constraints and predicted life of satellite determines the mission feasibility and hence it is necessary to estimate fatigue life of satellites. College of Engineering, Pune (COEP) has designed 'SWAYAM', a Low Earth Orbit (LEO) 1U Pico-satellite, having capability of self-stabilization without the need for electric power. The three Printed Circuit Boards (PCBs), four batteries and most importantly the delicate solar cells, are crucial for the proper functioning of satellite. The paper details the method used, measures adopted and results obtained during improvisation of fatigue life of the satellite. In order to assess and ascertain proper functioning of satellite,the structure was analyzed in Finite Element Method based robust analysis tool, ANSYS for which 3D design was done in Pro-Engineer. Modal analysis was performed for predicting parts susceptible to largest deformation at various frequencies. Also, a random analysis from 20-2000Hz, under PSD (Power Spectral Density) with Grms of 6.7 g^2/Hz was performed for observing the most natural response of structure under external loads. The equivalent stress obtained after random analysis was used for determining S-N curve. The cycles obtained were of the order of 10^7, a significant 10 times greater than a usual expected 10^6 cycles. The results were a testimony to the robustness and durability of the structural system.