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KONSAT-1: STUDY OF RADIATION SHIELDING WITH GEANT4 AND EFFECT OF ATOMIC OXYGEN ON THE SURFACE OF THE CUBESAT

Abstract

The KonSat-1 is a satellite mission developed by the National University of Engineering (UNI), aimed at studying oil spills in the ocean. The space segment of the project consists of various subsystems, with this study focusing solely on the structure of the nanosatellite. This research primarily addresses the protection of the CubeSat against ionising radiation and atomic oxygen, employing advanced simulations using the GEANT4, Spenvis, and FreeCAD software tools. The study adheres to the NASA project life cycle, concentrating on the design and verification phases through simulation.

An analysis of the available launch vehicles for the next two years was conducted to identify the most viable options. Subsequently, Spenvis was used to simulate space weather conditions, including cosmic and solar radiation, as well as the atomic oxygen environment expected to affect the CubeSat. The GEANT4 software simulates the interaction between radiation and the components of the CubeSat, calculating radiation doses and evaluating the effectiveness of shielding. Additionally, the effects of erosion on the surface of the CubeSat and its deorbitation were analysed using atmospheric data. The simulations indicate that the proposed shielding effectively protects the electronic components of the CubeSat from ionising radiation. Minimal erosion is expected in the materials, though areas of potential long-term wear were identified. Estimated deorbitation times were also calculated, assisting in the planning of a controlled reentry at the conclusion of the mission.

This study validates the viability of the KonSat-1 CubeSat under extreme space conditions, demonstrating that the simulations can reliably predict the behaviour of the CubeSat in response to radiation and erosion. It is recommended that the construction and physical validation of the CubeSat proceed, followed by operational testing to ensure the success of the mission.