Paper ID: 88189
student

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures II Development and Verification (Orbital deployable and dimensionally stable structures, including mechanical and robotic systems and subsystems) (2)

Author: Mr. Pedro Alves
University of Brasilia, Brazil

Prof.Dr. Manuel Nascimento Dias Barcelos Júnior
Universidade de Brasília, Brazil
Prof.Dr. William Silva
University of Brasilia, Brazil
Prof. Cristian Vendittozzi
Universidade de Brasília, Brazil
Dr. Artem Andrianov
University of Brasilia, Brazil
Ms. Maria Fernanda de Sousa Pimentel
University of Brasilia, Brazil
Mr. Gustavo Malta
Universidade de Brasília, Brazil
Dr. Ignazio Dimino
CIRA Italian Aerospace Research Center, Capua, Italy

DEPLOYMENT MECHANISM DESIGN FOR ATMOSPHERIC REENTRY PROTECTION SYSTEMS

Abstract

SPLASH (Self-DePloyable FLexible AeroSHell for de-Orbiting and Space Re-entry) is a technology demonstrator for a 12U CubeSat carried out in partnership between UnB (University of Brasilia) and CIRA (Italian Aerospace Research Centre), which aims to perform atmospheric re-entry from a LEO orbit, making it possible to use it as a safe device for returning scientific payloads or data from LEO orbits. The opening mechanism is built similarly to an umbrella, and consists of 8 arms, each supported by a secondary beam, which is connected to a sliding ring. During re-entry, the main stresses will be generated by dynamic pressure. To obtain the dynamic pressure, a literature review was carried out using similar systems, so that the boundary conditions could be defined. An approximate estimate of the pressure acting on the shield can be obtained by considering that the satellite re-enters the Earth in a vertical direction and maintains a constant attitude, without any type of rotation. An analysis of the materials was carried out, using the allowable stress as a comparison, and consequently its variations as a function of temperature, density and melting temperature. A static analysis was carried out using the finite element method using line elements and solid elements, and their values were compared with the analytical model found. Initially, the proposed initial geometry was analyzed, followed by a parametric analysis to find the optimum value for the square cross-section and the positioning of the arm support. A geometric optimization was also carried out, changing its cross-section. The results show that the geometric optimization provided a significant improvement in the displacement values. The final mechanism was modeled using computer-aided-design software. To allow shield deployment, a spring system was used. The system will be fixed by nylon wires that will be broken by a resistor, releasing the mechanism. In order to validate its operation, a 3D printing model was produced, making it possible to identify possible improvements, ease of assembly and fixing methods.