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MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures I - Development and Verification (Space Vehicles and Components) (1)

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DESIGN, SIMULATION AND ANALYSIS OF CARBON-FIBER COMPOSITE AND ALUMINUM HONEYCOMB ROCKET FINS USING FLUID-STRUCTURE INTERACTION FOR FLUTTER ANALYSIS

Abstract

A sounding rocket's fins are essential to its safe and stable ascent, yet the same fins can add considerable weight to the rocket and are susceptible to destructive fin-flutter. Therefore, it was necessary to create a fin which would minimize weight but still be able to resist aerodynamic forces. This fin was tested on a sounding rocket travelling to an altitude of 3 kilometers at Mach 0.83. The final fin was designed with an aluminum honeycomb core coated with sheets of carbon-fiber, bonded to the core by wet manual layup. The layup sequence was designed using ANSYS composite Prep-Post to determine the weight, the final manufacturing procedure, and the mechanical properties of the fin. To successfully analyse the fins, a coupled fluid-structure interaction to investigate the flutter response at the design speed was used. This investigation was carried out to predict the efficiency and reliability of the newly designed fin when subjected to aerodynamic loads. This study shows the vibration response of the fin under aerodynamic forces and will provide design validation. Computational fluid dynamics analysis was conducted using ANSYS CFX to provide the aerodynamic load data, and this data was coupled with ANSYS Mechanical for the flutter and finite element analysis. The results of this project will allow for more efficient design of aerodynamic surfaces which use both metal and carbon-fiber composites.