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IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations - IAF MATERIALS AND STRUCTURES SYMPOSIUM (IP)

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BENDING ANALYSIS AND TESTING OF A HYPERSONIC ROCKET FINS

Abstract

This paper will discuss the bending analysis and testing of fins for a hypersonic-bipropellant rocket. These rocket fins play a crucial role in stabilizing the vehicle during varying aerodynamic loads while enabling it to attain a maximum speed of around 5.23 Mach and reach an altitude of 100 km. To the rocket fuselage, these fins are clamped between metal brackets, called Chamfers, which are made up of CNC-machined aluminum bars. While, construction of the fins itself involves a sandwich-structured composite panel consisting of two carbon fiber face sheets pre-impregnated with epoxy and a foam core in between. This results in a structure that is both rigid and lightweight, with aluminum alloy sheet metal used for the leading and trailing edges. The Static Structural analysis will be done on the simulation software ANSYS, where boundary conditions relating to the test environment will be applied to the assembly. This analysis will address the expected failure modes of the materials involved in testing, and finally, its results will be used to anticipate and correlate the experimental results. The testing includes a substantial method of bending two full-sized rocket fins with constraints simulating close-to-flight conditions on a custom-designed testing jig. The structural durability of the selected components will be evaluated through targeted testing of the fin and the chamfers, focusing on identifying potential failure modes. Also, this experiment will include instrumentation and measurement devices such as Uniaxial and Rosette strain gauges which will be installed in a Data-Acquisition system to read the data from the testing materials. The outcomes obtained through this test will help optimize the design mechanically, if necessary. Finally, it will validate whether these fins can sustain the extreme aerodynamic forces and enable the hypersonic vehicle and its payload to attain an altitude of approximately 100 km.