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VIBRATION ANALYSIS AND TESTING OF A HYPERSONIC ROCKET FIN CANISTER

Abstract

This paper presents a study on the modal analysis of the Fin Canister, which encloses the engine of a hypersonic rocket. The aim is to verify whether the assembly can withstand the excitation vibration generated by the engine during ignition. The Fin Canister comprises mainly the fins, made up of sandwich-structured composite, and a structural interface built up of aluminum 6061-T6 and 7075-T6. The fins are mounted on four structural beams using metal brackets called chamfers, supported by five bulkheads spaced longitudinally at optimum positions throughout the canister. These bulkheads prevent the twisting motion of the beams due to the rolling of the rocket. The fins are canted at an angle to provide stability to the rocket by inducing spin under variable aerodynamic conditions. Two methods are used to conduct an experimental modal analysis on the Fin Canister: Impact Hammer Test and, if necessary, Shaker Table Test. The main purpose of the former is to obtain the natural frequencies of the Fin Canister, while the purpose of the latter is to evaluate the reliability and durability of the assembly. The natural frequencies are obtained using the simulation software ANSYS by applying boundary conditions on the Fin Canister that simulate its connection to the rest of the rocket. The simulation results are compared against the data obtained from the Impact Hammer Test to validate the model on ANSYS. After determining the engine's natural frequency, a random vibration analysis is performed on the Fin Canister using ANSYS to understand the assembly's response to the expected dynamic loads. Measures will be defined to assess the design integrity of the fins and the Fin Canister while the rocket is in flight.