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Hypersonic Air-breathing and Combined Cycle Propulsion, and Hypersonic Vehicle (7)

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DEVELOPMENT OF A HYPERSONIC ACCELERATOR VEHICLE (HAV) USING HYBRID PROPULSION SYSTEM

Abstract

In the last decades, there has been a growing interest in the development of new propulsive systems that combine low cost, low environmental impact, shorter development time, and reliability. The applicability of such propulsive systems includes nano-satellite launchers, sounding rockets, scientific experiments, and sub-orbital tourism. The relatively safe operation of hybrid propulsion systems is associated with the separation of fuel and oxidant, unlike solid propellant propulsion systems in which there is a mixture of the fuel and oxidant in the propellant grain. This configuration projects advantages over the traditional grain-propellant assembly model in the same physical state: flexibility in thrust control, low environmental impact, toxicity, propellant grain robustness, and lower cost, which makes hybrid rocket engines appropriate to the several sorts of missions. In addition to the advantages already listed, it can be included the safety in the transportation, once the vehicle can be shipped without risk of self-ignition or explosion. Recently, hybrid rocket motors have been used in low-atmosphere applications, such as NASA's Peregrine spacecraft rocket. Research and development of faster-burning fuels have made this possible, although progress is still needed before this technology can be viable for large-scale use. Even so, the hybrid fuel project is very promising in terms of research and development possibilities. In the present work, the development of a Hypersonic Accelerator Vehicle (HAV) using a Hybrid Rocket Motor is described. This solution aims to present an alternative for the suborbital rockets based on solid rocket motor (SRM) used as HAV, which provides hypersonic flight-testing conditions for fundamental research and technology development. Examples of such developments are SHEFEX, HIFiRE, and ScramSpace programs by using suborbital vehicles VS-30 Orion, VSB-30, and VS-40 in a total of eight missions since 2005. As reference design in this work, it will be used the vehicle VSB-30 in the flight configuration for testing the Brazilian Scramjet Engine 14XS. The flight dynamics parameters of this configuration will become the mission requirements for the hybrid motor design, and in the sequence, the entire vehicle, by changing the SRM into an HRM to achieve similar or higher performance.