IAF SPACE PROPULSION SYMPOSIUM (C4)
Solid and Hybrid Propulsion (1) (3)

Author: Dr. Ozan Kara
Technology Innovation Institute (TII), United Arab Emirates

Dr. Carmine Carmicino
University of Naples "Federico II", Italy
Mr. Ahmet Eren Vahapoğlu
Deltav Space Technologies,Inc., Türkiye
Ms. Hessa Almarzooqi
Technology Innovation Institute (TII), United Arab Emirates
Dr. Francisco Bilendo
Technology Innovation Institute (TII), United Arab Emirates
Ms. Ghadeer Alkatheeri
Technology Innovation Institute (TII), United Arab Emirates
Mrs. Mariam Alhammadi
Technology Innovation Institute (TII), United Arab Emirates
Mr. Aijaz Khan
Technology Innovation Institute (TII), United Arab Emirates
Dr. Vito Salvatore
CIRA Italian Aerospace Research Center, Capua, Italy

PRELIMINARY DESIGN AND FLIGHT PERFORMANCE OF PARAFFIN/N2O SOUNDING ROCKET PROGRAM IN THE UAE

Abstract

Space has always been a source of wonder and mystery for humankind since its first mention in history. Humans have continually sought ways to observe space and have developed numerous devices and methods for this purpose. Rockets play a crucial role in space exploration, and hybrid rockets represent a compelling choice, offering a unique blend of safety, efficiency, and versatility. Hybrid rockets combine elements of both solid and liquid propulsion systems, harnessing the benefits of each while mitigating their respective drawbacks. These advantages include enhanced safety due to the non-explosive nature of the fuel and oxidizer when stored separately, the ability to throttle and shut down the engine during flight for better control, and a reduction in environmental impact thanks to the potential use of more eco-friendly fuel and oxidizer combinations. In this document, we will present a method for developing a paraffin/N2O-based hybrid rocket motor with a 500 grams per second oxidizer flow rate. This hybrid rocket will be the first of its kind in the UAE as a sounding rocket. The project's design phase involves a multidisciplinary approach, incorporating aerodynamics, material science, propulsion, and control systems to create a rocket that not only meets the 7km apogee target but also paves the way for scalable technologies for future aerospace applications. Key design challenges include optimizing the fuel grain geometry for efficient combustion, selecting materials that can withstand the harsh conditions of rocket flight while minimizing weight, and developing a robust guidance system to ensure precise trajectory control. The fabrication of the hybrid rocket will employ advanced manufacturing techniques for complex components and lightweight materials to enhance performance. The development of the propulsion system will focus on achieving a high thrust-to-weight ratio, reliable ignition, and stable combustion throughout the flight. The launch phase will

validate the design and engineering work, with a series of ground tests leading up to the actual flight. These tests aim to assess the rocket's structural integrity, propulsion system performance, and control system accuracy under real-world conditions. The successful completion of the launch will demonstrate the viability of hybrid rocket technology for reaching specific altitudes with high precision and safety, contributing valuable insights to the field of aerospace engineering.