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Author: Mr. Riccardo Gelain
Université Libre de Bruxelles, Belgium, riccardo.gelain@ulb.be

Dr. Artur Bertoldi
University of Brasilia, Brazil, bertoldi@unb.br
Prof. Patrick Hendrick
Université Libre de Bruxelles, Belgium, patrick.hendrick@ulb.ac.be

INSIGHTS INTO MOUETTE HYBRID ROCKET SLAB BURNER TESTING ACTIVITIES

Abstract

This paper elaborates on the initial design and development process of the MOUETTE (Moteur Optique pour ÉTudier et Tester Ergols hybrides) optical access slab burner for investigation of the combustion behaviour of hybrid rocket fuels. The motor has been developed at Université Libre de Bruxelles to enhance the research capabilities of the rocket propulsion group of the Aero-Thermo-Mechanics Department. The burner has been designed to utilize gaseous oxygen as oxidizer with a mass flow rate of up to 100 g/s at a maximum combustion chamber pressure of 10 bar. The test chamber features two quartz glass windows to allow high-speed imaging of the fuel grain, and a graphite nozzle insert, to adjust the operative pressure. Ignition of the solid fuel grain is provided by a pyrotechnic igniter. While the functionality of the test bench has been proven with an initial test campaign carried out with paraffin fuel grains, some weak points have been identified, and several modifications of the subcomponents have been implemented, to increase the measurements quality and repeatability. This paper aims at giving an overview of the main test campaigns carried out with paraffin-based fuel grains on the MOUETTE test bench, with a focus on the continuous development approach adopted to improve the research output over time. Specifically, this paper will first address the various iterations on the solid fuel grain, encompassing changes in the composition, shape, and manufacturing process. Subsequently, we provide an overview of the burner feed system and pre-combustion chamber design and adaptations, aimed to stabilize the flow and damp combustion instabilities. Finally, leveraging the modular design of the test bench, the paper presents a summary of the experimental results obtained by reconfiguring the burner into a 50 N thrust-class small-scale hybrid rocket engine.