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SPACE PROPULSION SYMPOSIUM (C4)
Propulsion System (2) (2)

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AN ITALIAN NETWORK TO IMPROVE HYBRID ROCKETS PERFORMANCE: THE STRATEGY, THE PROGRAM, THE RESULTS

Abstract

The new international attention to hybrid space propulsion points out the need of a deeper understanding of physico-chemical phenomena controlling combustion process and fluid dynamics inside the motor. Combined experimental and numerical research activities can improve the knowledge of different phenomena such as complex interactions among fluid dynamics, solid fuel pyrolysis, oxidizer atomization and vaporization (in case of liquid oxidizer), mixing and combustion in the gas phase, particle formation, and radiative characteristics of gas and flame. Also the ablation process of the nozzle thermal protection can be profitably investigated by combining experimental and numerical research activities. Finally, a multidisciplinary approach allows for identifying the most promising solutions, evaluating expected performance and optimal design parameters. This research project has been carried on by a network of four Italian Universities; each of them being responsible for a specific topic. The task of Politecnico di Milano is an experimental activity concerning the study, development, manufacturing and characterization of advanced hybrid solid fuels characterized by a high regression rate. University of Naples is responsible for experimental activities focused on the characterization at rocket motor scale of the solid fuels developed and characterized at laboratory scale by Politecnico di Milano. The University of Rome has been studying the combustion chamber and nozzle of the hybrid rocket, defined in the coordinated program by advanced physical-mathematical models and numerical methodologies. Politecnico di Torino has been working on a multidisciplinary optimization code for optimal design of hybrid rocket motors, strongly related to the mission to be performed. The overall research project aims to increase the scientific knowledge of the combustion processes in hybrid rockets, using a strongly linked experimental-numerical approach. Methodologies and obtained results will be applied to implement a potential upgrade for the current generation of hybrid rocket motors. This paper will present the overall strategy, the organization, and the first experimental and numerical results of this joined effort to contribute to the development of improved hybrid propulsion systems.

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