Paper ID: 72983
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IAF SPACE PROPULSION SYMPOSIUM (C4)
Interactive Presentations - IAF SPACE PROPULSION SYMPOSIUM (IP)

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HYDROGEN-ENRICHED LIQUID METHANE AND LIQUID ETHANOL AS A TRANSITIONAL SOLUTION TOWARDS SUSTAINABILITY IN TERMS OF TECHNICAL FEASIBILITY FOR AEROSPACE MISSIONS

Abstract

Over the previous decade, there was a growth in the commercial use of space; for the next decade, the major technical challenge in space will be the human exploration of the Moon and Mars. The efficiency of a rocket in terms of spacecraft propulsion depends on the achievable exhaust velocity and mass ratio; thrust is mostly important for the first stage of a launcher. All these parameters are defined by the rocket design and propellants combination. Hydrogen, methane, and ethanol are deemed to be the energy of the future, even though, besides the advantages their application can achieve, there are still barriers to their technical implementation and commercialization when it comes to a radical change in terms of applied technology for energy generation, harvesting, consumption and exploitation, such as production routes, storage, combustion performance and emissions, total cost of ownership, and so on. The objective of this work is to study, theoretically and thermodynamically, the main parameters controlling the rocket design (combustion chamber and nozzle) and propellants combination performances of various liquid-propellant system concepts injecting whether ethanol or methane enriched with hydrogen at different ratios. Results on thermodynamic properties, ballistic and combustion performance, emissions, and thrust-to-weight ratio are presented. Comparisons and conclusions in terms of high-performance, low-emissions, and economic and technical feasibility are made.