SPACE PROPULSION SYMPOSIUM (C4)
Propulsion System (1) (1)

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THE FUTURE OF LIQUID PROPULSION: THE FRENCH VIEW

Abstract

As the French Space Agency, CNES looks also after the preparation of the next generation of launch system beyond Ariane 6. The ultimate goal is as usual to identify, for a given need in terms of payload and orbit, the launch system that will lead to the lowest recurring cost with the same reliability objective. For this purpose, the 2 main classes of solutions are in competition: the very low cost of Expandable Launch Vehicle and the Reusable Launch Vehicle. These targets drive the ambitious program of research and technology that CNES is funding. This program deals together with researches for mastering complex physical phenomena, set up of robust and efficient numerical tools for design and justification, and identification of innovative hardware, technologies and manufacturing processes. It starts from low Technical Readiness Level (TRL 2) up to a maturation of TRL 6 with the use of demonstrators, level that allows being ready for a development. This paper focuses on liquid propulsion activities that CNES conducts with Airbus Safran Launchers, French laboratories and European partners to prepare next generation of liquid propulsion system. The physics in that type of hardware addresses a large range of highly complex phenomena, among them subcritical and supercritical combustion and possible associated High Frequency oscillations in combustion devices, tribology in bearings and seals, cavitation and rotordynamics in turbopump. The research activities conducted to master those physical phenomena are presented. Moreover, the operating conditions of these engines are very challenging, both thermally and mechanically. The innovative manufacturing processes and designs developed to cope with these conditions while filling cost reduction requirements are described. Finally, the associated demonstrators put in place to prepare the implementation of these new technologies on future engines are presented, either for the low cost ELV or RLV potential solutions.