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RESEARCH ACTIVITIES IN THE DEVELOPMENT OF DEMOP1: A LOX/LNG AEROSPIKE ENGINE DEMONSTRATOR

Abstract

As an alternative to classical bell nozzle designs, aerospike propulsion systems have been developed and tested since the 1950s. They were in discussion for utilization on the upper stage of the Saturn V launch vehicle and later as a candidate for the Space Shuttle Main Engine. In the form of a linear plug construction, aerospike nozzles were the single-stage-to-orbit propulsion system of choice for the X-33 prototype at NASA during the 1990s, which was meant to serve as a technology demonstrator for the VentureStar reusable launch system. Nevertheless, there still is a lack of ground and flight test data that would enable a verification of analytical or numerical flow predictions. This lack of data leads to a low Technology Readiness Level (TRL), which is the reason why there has not been an operational deployment of an aerospike rocket on a space mission yet. However, in recent years, aerospike engines experienced a renewed and growing interest because of their well-known altitude adaptation properties and further advantageous performance characteristics towards comparable bell nozzles. In addition to this, the ongoing maturation level of Additive Manufacturing (AM) techniques and materials for rocket propulsion applications, is enhancing the possibility to build a functional and economically-viable aerospike engine with reduced cost and lead time. The classical drawback of high integral heat fluxes, associated to this kind of engine, can be addressed with the increased design freedom introduced by AM.

While addressing particular aspects of engine design, this paper provides an overview on the research activities associated with the development of the DemoP1 demonstrator, currently ongoing at Pangea Aerospace. The requirements identified for DemoP1 are transversal to several research fields that are experiencing a rise in their TRL in the European space sector, such as: aerospike nozzle geometry, additive manufacturing, LOX/CH4 propulsion, new materials.

The development of the demonstrator will prove the various technologies involved and pave the way to a booster-class engine that is envisioned to serve the next generation of economically-viable launchers.