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EVALUATION OF THE PERFORMANCE POTENTIAL OF AERODYNAMICALLY THRUST VECTORED AEROSPIKE NOZZLES

Abstract

Aerospike nozzles are well known for their height adaption capabilities and performance advantage over conventional bell nozzles during endo-atmospheric flight. While thrust vectoring for aerospike engines with combustion chamber segments can be achieved with differential throttling, a different solution must be found for smaller single-chamber engines. A promising approach is aerodynamic thrust vectoring – diverting the main exhaust flow by injecting a second flow orthogonally into the primary one.

In this paper, we discuss potential use cases and scenarios, advantages and disadvantages as well as potential savings (e.g. in mass, volume and costs) for such a rocket engine. For a wide thrust range a tradeoff between single and multi-chamber engine design is conducted to determine the thrust threshold for using either design approach. A comparison of a derived thrust vector controlled aerospike nozzle design with other ambient pressure adaptive nozzles such as dual-bell or expansion deflection nozzles will conclude the discussion.

Furthermore, we present our succeeding research activities for describing the behavior of such a rocket engine. This roadmap will cover two- and three-dimensional numerical and semi-analytical flow examination and numerical simulations using the DLR TAU Code supported by various tests and experiments. These analyses and experiments are used for an optimization of the aerodynamic thrust vectoring on aerospike nozzles and the development of a corresponding controlling algorithm.