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# NUMERICAL ANALYSIS OF AERO-SPIKE NOZZLE FOR SPIKE LENGTH OPTIMIZATION

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## ABSTRACT

For future fully reusable SSTOs and rocket engines, light weight and high performance propulsion system from low altitude to high altitude are essential. Engines with aero spike nozzles are drawing attention as promising candidates which satisfy these requirements. A renewed interest into aerospike (plug) nozzles has surfaced for the possible replacement of standard contoured nozzles used for the propulsion systems of space vehicles. Although a more complex flow field develops on plug nozzles, the potential thrust and structural gains are attractive as the propulsive flow is free to adapt to the external stream. The commercial software Ansys-Fluent14.0 is used for the numerical simulation of the problem. Steady state analysis with implicit formulation is carried out. Mass, momentum and energy equations with k-e turbulence model is solved.

In this project a study on various types of aero spike nozzles and characteristics of its flow field is carried out. Numerical analysis of a typical aero spike nozzle with results analysis and discussion on flow characteristics, comparison on full spike and truncated spike configuration for different pressure ratios are included. In truncated spike configuration, 20%,40%,60%,80% of spike length are included. The flow characteristics such as shock waves and wake formation etc are discussed with the help of contour plots. The performance analysis is done by plotting maximum Mach number, average exit velocity and thrust produced. Based on the analysis it can be state that the maximum performance is given by full spike nozzle. But we can provide truncation upto 60 % in order to reduce the weight and catastrophic failure due to high load on the surface.

**KEYWORDS:** SSTOs and Rocket Engines, NASA and Rocketdyne Research