Designing an Aerospike Nozzle

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Bell nozzles have been used universally across the rocket industry for decades but due to their design become inefficient as the rocket rises through the atmosphere. An alternative nozzle is the aerospike nozzle that uses the lowering air pressure to form a wall that will automatically adjust the rocket's exhaust so that the engine stays at its most efficient. A mathematically perfect aerospike was designed using a python code interface and imported into a CAD macro in order to design the contour line of the spike. Computational Fluid Dynamics and real life tests with a 3D printed aerospike were performed on the nozzle designed to have the intake of a 125 psi air compressor. The expected average thrust of the aerospike was calculated to be 27 newtons of force. Test results from the Computational Fluid Dynamics test indicated that the aerospike nozzle was designed correctly and produced the expected shock waves. The force plate tests showed a statistical decrease in expected thrust from the CFD models. The aerospike nozzle could not be fully evaluated due to the lack of a proportional bell nozzle. Designing and testing a proportional bell nozzle is an ongoing extension to this project. With new rockets like the massive reusable rockets like Starship and New Glen, an engine such as the aerospike that is just as reusable and is even more efficient throughout the atmosphere would allow similar rockets to fly higher and farther than ever before at a much cheaper cost than ever before

Awards Won:
Aerojet Rocketdyne Foundation: First Award of $1500.00