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PRELIMINARY NOZZLE DESIGN FOR A NUCLEAR THERMAL PROPULSION TEST MISSION

Abstract

Nuclear thermal propulsion (NTP) is a technology that offers shorter interplanetary transit times than conventional chemical rocket engines. NTP achieves this by using the energy from a self-contained nuclear reactor to energize and expel hydrogen propellant through a nozzle. The shape of the nozzle needs to be designed specifically for the operating conditions of the NTP system. This research is an investigation into the design and optimization of a rocket nozzle to be used on a proposed NTP test mission. Initial design parameters are determined by applying nozzle theory to mission constraints and operating conditions. Methods of analysis such as computational fluid dynamics simulations and the method of characteristics are used to gather data for comparison. The flow through separate 3D-printed nozzle contours is then tested experimentally using pressurized cold gas. The data gathered through these methods allows for the determination of a preliminary nozzle configuration for use in a live-fire test of the proposed NTP system.