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A NOVEL DESIGN USAGE OF THERMOELECTRIC MATERIALS IN AEROSPIKE ENGINES

Abstract

The aerospike engines are physically the best design for rocket engine nozzles but their manufacturing complexity has forced the engineers to pursue bell nozzles over them. The cooling problem of the central plug of aerospikes has been tackled by many but later in the process, all the projects related to them were closed subjected to their complexity and availability of less experimental and practical flight data making them less reliable than their bell nozzle counterparts. The thermoelectric material has piqued the interest of many scholars given its unique property of converting heat energy into electrical energy, which can then be used to run various electronic and electrical devices on board the spacecraft, potentially reducing the size of the batteries carried to keep the spacecraft running. The principle of converting thermal energy to electrical energy is called the Seebeck process and is governed by the Seebeck coefficient along with a few other variables which owe to their overall power output. The prospect is promising, but excess heat generated by rocket engines can melt them before they can be used. The current research on thermoelectric materials and their use for cooling systems has been primarily on materials at near room temperature environments, which poses a lack of study for materials to be used at higher temperatures (a few hundred degrees) who may have the potential to drive the field. The proposed method is to use the thermoelectric material to convert the excess heat energy generated in the engine to electrical energy to drive various processes onboard. The material is proposed to be used at the fuel and oxidizer supply channels which will be carrying heated fuel and oxidizer to the combustion chamber. Since the energy can neither be created nor be destroyed, it will increase the engine's overall efficiency. By employing this method, we can utilize the otherwise wasted heat energy to run other systems onboard the aircraft to extract the maximum possible energy from the system to increase its overall efficiency. The model will be tested for the net volts generated and their efficiency. The results from the project will be used to understand the significant reduction in the mass of batteries/energy storage systems. The paper will then conclude with the prospect of whether their use has a significant advantage in reducing the mass of the spacecraft.