Engineering an Environmentally Friendly 3D-Printed Rocket Engine

Chakmakjian, Caleb (School: Live Oak Classical School)
Lewis, John (School: Live Oak Classical School)

Full-size rockets often employ carbon-based engines that release hundreds of metric tons of greenhouse gases, in addition to large amounts of toxins including nitrogen oxides, soot, and alumina. As rockets become more prevalent with increasing activity from companies like Virgin Galactic and Space Exploration Technologies, their carbon footprint will become increasingly problematic. When used as a monopropellant, hydrogen peroxide catalysis poses a solution to this problem by presenting an exothermic chemical reaction that releases only water vapor and oxygen gas. This project is an attempt to create a small-scale environmentally friendly rocket engine that employs a 30% hydrogen peroxide solution and a manganese (IV) oxide catalyst. In order to rapidly develop prototypes while also significantly reducing weight, all bespoke parts for this project were designed in a CAD program and 3D printed by the exhibitors using polymer-based plastic. The control system, which consisted of a microcontroller and a display, controlled the valve on the engine and collected data from multiple sensors at 40 Hz. Over the course of this project's development, many revisions were made to component designs, circuit designs, and program designs. The exhibitors developed a series of tests to determine the effectiveness of the individual parts of the engine as well as the system as a whole, beginning with water tests and culminating in thrust tests. Overall, the engine design was successful, but in the future, the exhibitors would like to explore methods of increasing the mass flow rate of the engine in order to increase thrust.

Awards Won:

Aerojet Rocketdyne Foundation: First Award of $1500.00

Raytheon Technologies Corporation: Each winning project will receive $1,000.