Colorado Science and Engineering Fair

2024 Individual Project Abstract Form

Please print 2 copies of the completed form. Sign both copies, keep 1 for your notebook and submit 1 copy to your Regional Fair Director with your other paperwork.

Title of Project: Bending Fire: A New Approach to Steer Rockets Using Electric Fields

Finalist's Name: Ersel Serdar

School and City: Cherry Creek High School, Greenwood Village

Sponsor's Name: Burak Serdar

Category: Engineering (ENGR)

Division: Senior (9th - 12th grades)

Abstract (250 words or less):

Existing methods for steering rockets, known as thrust vector control (TVC) systems, are complex, use hazardous chemicals, and account for up to ⅓ of the engine's mass. Because rocket exhaust is a plasma, a strong electrical field can split the differently charged ions, creating thrust vectoring. This project builds and tests the prototype of a novel approach to steer chemical rockets using electric fields. If proven successful, electric field thrust vectoring (EFTV) can offer a breakthrough in rocket propulsion. Initial viability tests showed that an 18 kV electric field bends a turbulent Bunsen burner flame by 45.5°. Hot tests were then performed at the University of Colorado Boulder's Engine Testing Facility where 18-24kV electric fields were applied to model rocket motors. The electric field was switched on/off every second, and load cells measured the forward and sideways thrusts of the motors. Sideways thrust was constant without an electrical field. Under 18, 20, and 24kV, sideways thrust values peaked every 2 seconds, consistent with the pattern of the electric field. The sideways force was highest under 18kV at 19.2g and lowest at 20kV at 3.5g. The corresponding vectoring angles ranged from 1.4° to 0.3°, comparable to angles achieved by existing TVC systems. These results are very promising and support further research in a more controlled environment with larger engines and more powerful electric fields. EFTV can potentially revolutionize rocket propulsion providing more agile maneuvering with a cheaper, lighter, and safer alternative to existing TVC systems.

I hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I also attest that the above properly reflects my own work.

Finalist's Signature: Date:

In addition, all students must complete the ISEF Student Checklist (1A), Research Plan, Approval Form (1B), and Checklist for Adult Sponsor (1), and any other ISEF forms required for this type of project. See the International Rules and Guidelines for form requirements. Return COPIES o all of these forms to your Regional Fair Director with you Finalist Verification/Permission Form. A signed copy of this form must be included in your notebook.