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Ion Propulsion: Electrostatic Thruster Design and Optimization for Space Applications

Electrostatic thrusters are alternatives to chemical rockets in space applications. This engineering project focuses on maximizing key performance parameters by developing, implementing, and testing thrusters with various thruster lengths, and circular anode and magnetic field configurations inside a vacuum using the propellant argon. The goal was to identify configurations providing high specific impulse output.

My methodology consisted of eight steps: (1) gather information, (2) develop thruster evaluation criteria, (3) design thrusters, (4) build thrusters, (5) build apparatus, (6) conduct experiments, (7) interpret data, and (8) repeat 3-7, where and when necessary, based on data. Thrusters used argon as propellant. Measurements of movement and acceleration allowed calculation of thrust when a thruster was attached to strings. Exhaust velocity was unable to be measured. Each thruster is tested three times with 300 data points over a period of 4000 milliseconds. An Arduino was used for precision and timing.

Thruster 2 probably produces more thrust than thruster one. Thruster 2 produced a force of around 1.163 Newtons on average. Thruster 1 produced a force of around 0.892 on average. Though the standard deviations of both thrusters overlap, thruster 2 is probably more efficient. Thruster 2 has a 1.45 inch circular anode in length and thruster 1 has a 2.9 inch circular anode in length.

I conclude that shorter circular anode effects the efficiency of a thruster. More testing would be done to determine which length is most efficient. It is probable a shorter anode produces greater thrust, but is not certain.