2015

Lionsat

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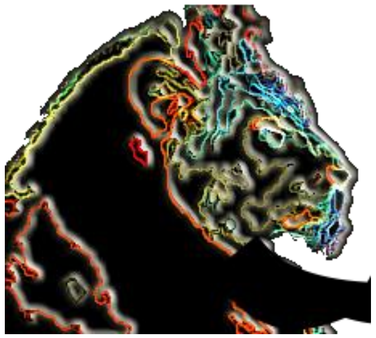
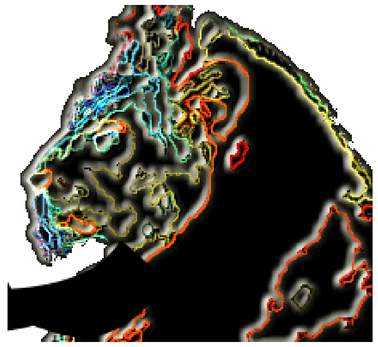


Purpose

This project seeks to expand the mission capabilities of CubeSats by developing an optimal propulsion system. By improving the propulsion system, CubeSats will have greater control over their attitude and will have the capability to perform some orbital maneuvers.



Introduction

In the previous semesters, a mission was designed for a cubesatellite to enter a low-earth orbit and take pictures of weather patterns. To overcome drag and provide essential correction maneuvers, a resistojet would be designed that can support a mission life of at least a year.

The primary goal of this project is to design, build, and test this resistojet to obtain values such as the thrust produced and the specific impulse of the thruster.

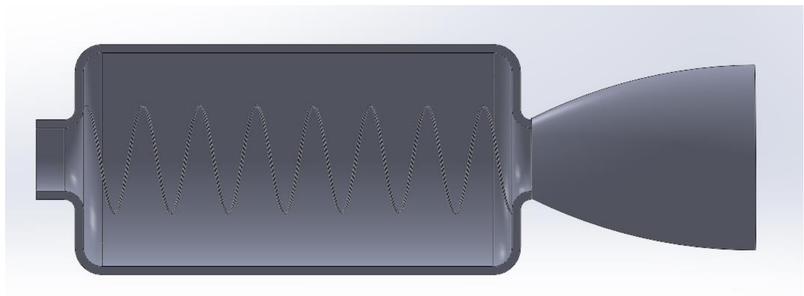
In order to accomplish, a thrust stand will also be designed and built. The thrust provided by resistojets is too low to be measured with traditional thrust stands. To accurately measure the typical thrust produced by a resistojet, the thrust stand would need an accuracy of about ±0.1 mN, since thrusts are around 10mN.

Goals	
Weight	60 g
Dimensions	Ø2.5 cm x 7.75 cm
Power Draw	20 W
Specific Impulse	40 s
Exit Velocity	416.5 $^{m}/_{s}$

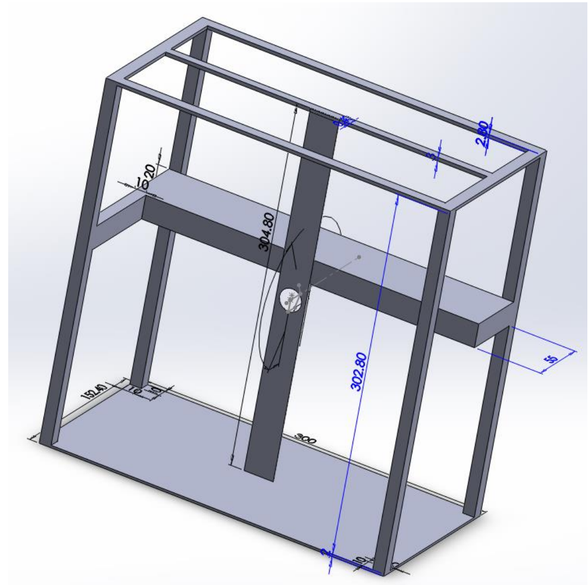
Thruster

The principle behind a resistojet is to pass a flow over a heating coil to add additional energy to the flow. This is then accelerated through a nozzle to produce thrust. In an energy-rich environment, this propulsion system is preferable to traditional methods, since it requires less propellant and instead uses electricity.

The resistojet will consist of an aluminum heating chamber with a nichrome heating coil inside. Helium will be the main propellant, which will be stored on-board, and will be fed into the heating chamber. Once there, the combination of an area change and heating will accelerate the flow to mach 1 at the throat. This will then be further accelerated to our desired exit velocity through the nozzle.



Cut-away of Resistojet



Thrust Stand

The thrust stand is based off of a torsional pendulum design. This design measures the thrust based off of the displacement of the pendulum arm. Based off of Euler-Bernoulli beam theory and elasticity, the tip deflection of the beam can be related to the thrust of the resistojet through the elastic force exerted by the arm.

The sensor being used is a SPS-L075-HALS by Honeywell. It uses a magnet mounted to the tip of the arm to measure how much it has deflected. It has a resolution of ±0.05mm which corresponds to a resolution of ±0.14mN, which is within acceptable limits.

NORTHROP GRUMMAN

Engineering & Science Student Design Showcase at Florida Institute of Technology