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Green Thruster Team, Engineering Department, Utah State University

Design of In-Flight Instrumentation to Characterize a Hybrid Thruster

HEIMDALLR

Project Overview

- The NASA Undergraduate Student Instrument Project (USIP) is a program with the goal to provide hands-on flight project experience to undergraduate programs, and to fly new technology in space to improve Technology Readiness Level (TRL).
- Utah State was awarded a USIP grant to test the hybrid thruster in space and to characterize potential effects of its use on spacecraft optical sensors, external electronics, and solar panels. Main topics of interest are
  - -Restart capability
  - -Vacuum performance
  - -Plume contamination
- Hybrid thrusters use fuel printed directly from a 3D printer. They are better than industry standard Hydrazine thrusters in the following ways.
  - -Cost -Safety -Ease of Use
  - -Versatility -Simplicity
- When the Terrier-Malemute rocket launches and reaches space, the outside of the body of the rocket sloughs off exposing the experimental section to space and allowing us to fire our thruster.

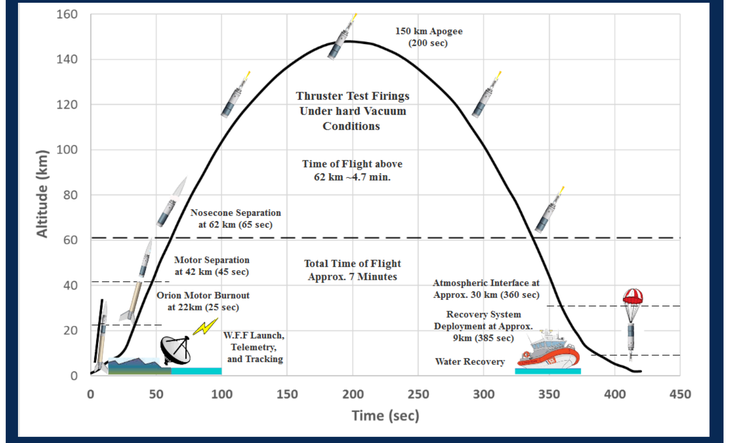


Figure 1 – Concept of Operations

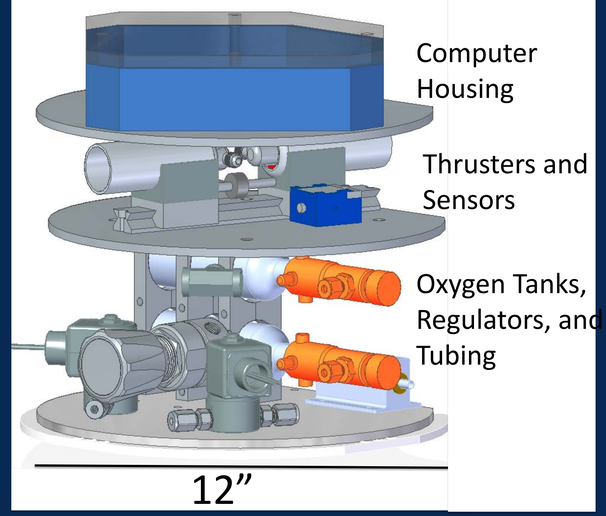


Figure 2 – Experimental Section

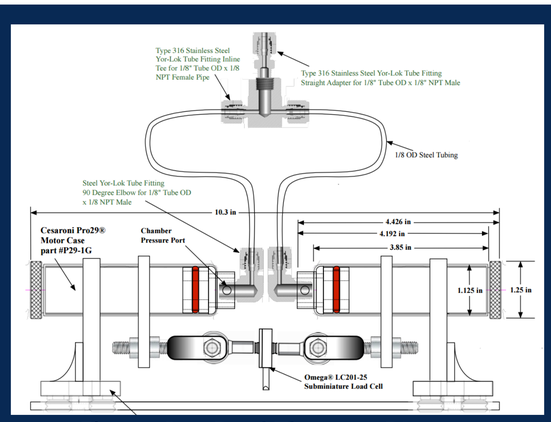


Figure 3 – Dual Thruster Diagram

Experimental Section

Thruster System

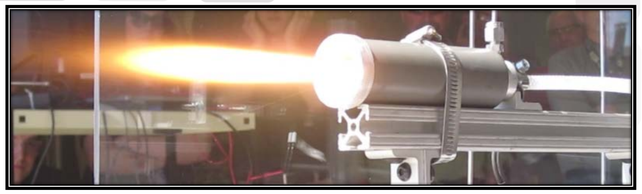
- Our design uses two, 3 Newton, nulling thrusters. Nulling thrusters will be used to minimize the moment acting on the rocket to keep it from tumbling.
- The thrusters are mounted on a rail system to allow a load cell to take thrust measurements.
- During the experiment, the thruster will fire in one second intervals for a total of ~15 seconds.

Plume Contamination Sensors

- A photometer will measure the illumination degradation of a pulsing LED light source.
- The photometer is placed next to the thruster nozzle to pick up the particle accumulation of the plume backflow on the photometer viewing window.

Current Progress

- Photometer concept was proven via vacuum test at NASA Marshall facility. The wheatstone bridge with a photoresistor shows a difference between a clean and dirty viewing surface.
- Glass slides were used to simulate optical surfaces during thruster operation. The particles were measured under a microscope to determine surface obstruction.



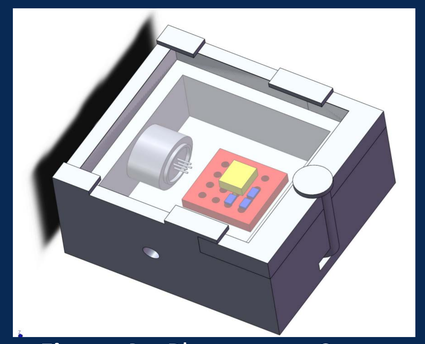


Figure 4 – Photometer Sensor

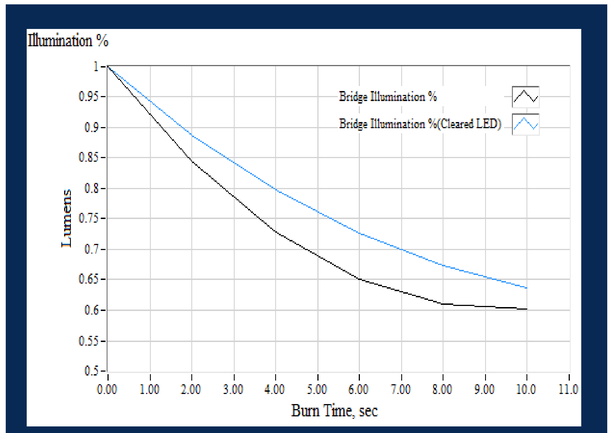


Figure 5 – Photometer light detection in a vacuum

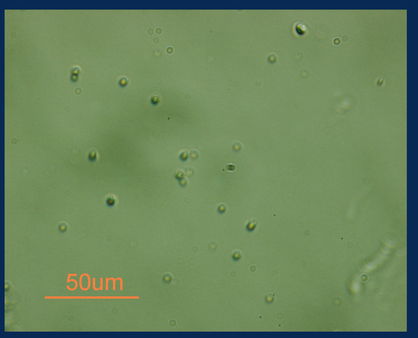


Figure 6 – Plume particles under an inverted microscope

Utah State University