Introduction

In recent years, there has been rising interest in hybrid propulsion systems as an alternative to conventional solid or liquid propellant rockets due to certain advantages in terms of safety and cost. Current research in the Aero Fluid Mechanics Lab is aimed at furthering the understanding of hybrid rocket combustion, developing design tools and methodology, and advancing the commercial value of this technology.

Objective

The Peregrine Sounding Rocket is a joint project of Stanford University and NASA Ames Research Center to demonstrate the advantages of liquefying hybrid fuel technology for responsive launch applications. This will be achieved through the design, fabrication, testing, and launch of a paraffin fueled sounding rocket that will lift a 5 kg payload to an altitude of 100 km.

In pursuit of this goal, the project will be carried out in two phases:
- Ground test series for motor validation at NASA Ames, California
- Flight Vehicle launch from NASA Wallops, Virginia

Fuel Regression Rate Study Results

Regression rate, a critical parameter in the design of hybrid rockets follows the classical regression rate law:

\[ r = a \rho^n \left( \frac{T}{T_0} \right)^m \]

where \( a, n, \) and \( m \) must be empirically obtained. The data collected were used to calculate the space and time averaged ballistic coefficients in the regression rate law using two methods: a least squares fit, and the averaged* method. The data were used to validate the performance of the ground test vehicle and to plan the flight vehicle design.

Ground Test Facility

A ground test facility was built at NASA Ames to enable hot fire testing of the flight weight combustion chamber for validation before launch. The test series will consist of approximately 3 cold flow and 9 hot fire tests, culminating in 3 full duration burns in flight configuration.

Sub-scale Testing

In support of sounding rocket development, subscale testing was conducted whenever possible to verify analysis and test subsystems. For this purpose, a portable facility was developed to test various fuels using a supercharged nitrous oxide feed system. Over 100 successful hot fire tests have been conducted with this facility over a large range of operating conditions with over 10 different fuel configurations.

Acknowledgments

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Bibliography

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Further Information

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