Thesis Project Portfolio

Hypersonic ReEntry Deployable Glider Experiment

(Technical Report)

How CubeSats Represent a Paradigm Shift in the Space Industry

(STS Research Paper)

An Undergraduate Thesis

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Executive Summary

Introduction

In its most basic form, the STS research paper explores the events and innovations that allowed the Capstone Project to happen. The ability for an entirely undergraduate team to design, develop, and fly a satellite was unheard of just a few decades ago. The Capstone Project is centered around a CubeSat. Exploring and understanding the history of the technology enriches the understanding of the Capstone Project, contextualizing its novel nature.

Summary of Capstone Project

Hypersonic flight occurs at speeds exceeding five times the speed of sound and is an expanding research field in the aerospace industry with military and civil applications. Military applications include hypersonic missiles, both offensive and defensive, and high-speed aircraft. Civil applications include access to space and commercial air travel. A CubeSat is a small satellite flown in low earth orbit that is well suited for undergraduate education. This technical project team will utilize a CubeSat to perform a hypersonic glider flight experiment. These experiments are difficult to replicate in wind tunnels and expensive to achieve on rockets and aircrafts. By using a CubeSat, university students can conduct these experiments at a lower cost, and with greater accessibility than traditional means.

HEDGE is a proof-of-concept mission determining the feasibility of using CubeSats as a means of low cost sustained hypersonic flight. Created and designed by University of Virginia aerospace engineering undergraduates, HEDGE demonstrates the ability for Undergraduate students to perform hypersonic experiments at lower cost and greater accessibility than traditional programs. Currently HEDGE is undergoing the critical design review step of NASA's project life cycle. The critical design review determines if the system design is mature enough to

proceed with full-scale fabrication, assembly, integration, and test. In other words, to pass the critical design review the design must be almost finished and feasible enough to proceed with fabrication.

Summary of STS Research Paper

This research paper in Science and Technology Studies (STS) explores the significant transformation that has taken place in the aerospace research industry since the introduction of the CubeSat Standard in 1999. Specifically, the paper aims to answer the following research question: How have CubeSats and microsatellites contributed to a paradigm shift in the aerospace industry? To achieve this goal, the paper adopts the Paradigm Shift STS framework to analyze the changes that have occurred in the aerospace industry. By examining the paradigm of space research both pre- and post-CubeSat standardization, this paper will provide a convincing argument that the introduction of the CubeSat Standard represents a true paradigm shift. Furthermore, the paper will also examine the impact that the CubeSat standard has had on the modern space research industry, including the emergence of new opportunities and possibilities.

The democratization of space research is a relatively new phenomenon that has the potential to transform the way we think about and conduct space exploration. Historically, space research has been dominated by a few powerful governments and large corporations, which has limited access to space and scientific discovery. However, with the rise of private space companies, citizen science projects, and international collaborations, the barriers to entry in space research are gradually decreasing. A paper that analyzes this trend and its implications could help us better understand the changing dynamics of space research and the potential benefits and challenges of a more democratized approach.

Conclusion

Doing research on CubeSats and their place in the aerospace industry while actively developing a CubeSat for a future launch provided a lot of insight to the industry. One of the objectives of HEDGE is providing real world experience to undergraduate students in satellite development and hypersonics research. So, learning about how things were done in the past versus the present day provided useful context to solidify what we are learning in the capstone project. My role on the HEDGE team is that of compliance officer, where it is my job to know the rules regarding CubeSats and the relevant laws for rocket launches. In conducting the research for the STS paper, I have gained a wealth of knowledge relevant to my specific job on the team, allowing me to contribute more as a member.