Thesis Project Portfolio

HEDGE

Hypersonic ReEntry Deployable Glider Experiment

(Technical Report)

The Benefits of Space Colonization

(STS Research Paper)

An Undergraduate Thesis

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Executive Summary

The subjects of both projects are intertwined in their interactions and presence in space. The capstone project is focused on designing a spacecraft that can be used to test hypersonic materials on a CubeSat platform. While the STS research paper is focused on the long-term benefits that will permeate into society from the advancements of space technology and celestial colonization. By expanding on both the technical and societal impacts of a presence in space, the subject can be further researched in all lights. As new programs are initiated into space, it is important that new techniques are researched, and the effects from the programs are analyzed.

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. The technical project 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 aircraft. By using a CubeSat, a similar experiment can be conducted at a significantly lower cost. Hypersonic entry deployment glider experiment (HEDGE) is a proof-of-concept mission determining the feasibility of using CubeSats as a means of low-cost 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 testing.

With the increasing presence in space, and the plans towards the colonization of the Moon and Mars, the impact it will leave on the Earth will be significant. The research question to study the benefits of space colonization's impact is "How can humans colonize other celestial bodies while leading to improvements in the conditions on Earth?" The framework used to answer this research question is the Wicked Problem framework since it is suited to analyze complex problems such as the benefits produced by space technology and colonization. The anticipated outcome of this research is to analyze the effects of space colonization, and determine whether or not those effects will benefit or harm life on Earth. By conducting this analysis, it works to evaluate the sociotechnical implications of space colonization, and whether or not it can have a net positive or negative influence to life on Earth. Before undertaking a feat, such as colonizing another celestial body, it is crucial to assess whether or not the cost of money, resources, and manpower will be worth the benefits produced from the undertaking.

The simultaneous efforts into both of these projects have proven beneficial. By working on both projects at the same time, the projects were able to inform each other and provide a technical view of the STS research paper, and a view on the societal impacts of the capstone project. If these projects were conducted separately then they would have remained focused solely on the subject matter without having a more diverse perspective, and would have suffered in quality from it. The expanded perspective afforded by the projects allowed for better and more holistic work on both projects. Overall, both projects were completed to satisfaction and expectations. While they did vary from the initial conception of the project, both projects remained within the range of material and expected alterations befitting projects of this scale.