Thesis Project Portfolio

HEDGE

Hypersonic ReEntry Deployable Glider Experiment

(Technical Report)

Impacts on U.S.-China Global Relations Due to the Wolf Amendment

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Spring, 2023

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Sociotechnical Synthesis

My technical work and STS research are loosely connected in the aspects of their motivation. The motivation for my technical work is researching hypersonic technology, which has both military and civilian applications, with military applications being a short-term goal. For the military, hypersonic weapons have a unique combination of speed and maneuverability that makes them difficult to defend against. On the civilian side, applications include advanced, high-speed air travel and space exploration. Hypersonic technology is being heavily invested into because rival countries like China have recently made major breakthroughs in this field. This connects to my STS research because it is motivated by seeking to understand the political relationship between the United States and China in the space sector, especially when complicated by developments in fields like hypersonic technology. In the following paragraphs, I will describe in more detail what my technical work and STS research entails and the value of working on both projects simultaneously instead of separately.

For my technical project, called the Hypersonic ReEntry Deployable Glider Experiment (HEDGE), we are developing a flight vehicle that can be launched by NASA as a CubeSat but can reconfigure itself as a hypersonic flight vehicle for reentry. The purpose of this project is to demonstrate the feasibility of using CubeSats for low-cost, hypersonic flight experiments via natural deorbit and reentry. CubeSats are small satellites that can be launched relatively inexpensively and designed with many commercial off-the-shelf parts, can be used for undergraduate education. Hypersonic flight experiments are usually expensive to perform on rockets and difficult to replicate with a wind tunnel or numerical simulation. By using a CubeSat, university students can conduct these experiments at a lower cost, and with greater accessibility than traditional means. Currently, HEDGE is undergoing the critical design review step of

NASA's project life cycle. The critical design review determines if a system 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 completely completed and feasible enough to proceed with fabrication. As part of the power, thermal, and environment sub-team on HEDGE, we ensure that all the subsystems on HEDGE are receiving their power needs, that the spacecraft remains intact, and that HEDGE remains within temperature ranges where systems can function. Through succeeding in these tasks, coupled with the success of the other functional teams, HEDGE will serve as a proof-of-concept for a hypersonic CubeSat and allow for the collection of temperature and pressure data in a hypersonic environment.

My STS research is on understanding the reasons for the implementation of the Wolf amendment and how it continues to hinder the complex and strained political relationship between the United States and China. I provide a literature review that examines previous cooperation between the two countries and the origins of the Wolf amendment. I analyzed opinions and reports from officials and journalists in the space sector on the bilateral cooperation between the two countries. I drew upon the social construction of technology (SCOT) theory to analyze how these groups view the effects of the Wolf amendment. I delved into sources to understand the possible benefits of cooperation between the U.S. and China in outer space. I provide explanations for why the Wolf amendment has persisted in law even though some groups have maintained efforts to have it repealed. The Wolf amendment seeks to isolate China while they are developing their capabilities in space, prevent China from stealing sensitive information from the U.S., and to change China's attitude towards its human rights violations. The Wolf amendment has not accomplished its goals that it set forth when it was passed in Congress.

From working on both projects at the same time, I was able to gain a broader perspective on technological research and how they impact political global relations. By considering the impact of foreign policies, I saw how that could play into the desperate and heavy investment of the United States into hypersonic technology. This allowed me to more deeply appreciate the technical work that I was doing and how it can have implications that will lead to real world effects. I also understand why the Wolf amendment has remained in effect because of all the sensitive information involved within my technical work, yet this begs the question of how cooperation between the United States and China could alleviate tensions through transparency and the sharing of research.