Thesis Project Portfolio

Hypersonic ReEntry Deployable Glider Experiment (HEDGE)

(Technical Report)

Interaction Between NSF Funding and College Social Science Programs

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Hypersonic research is historically expensive and difficult to carry out, and so is hardly conducted at the undergraduate level. Hypersonic research includes any sort of science conducted in a flow regime of over Mach 5. These conditions aren't often reached by conventional aircraft, but are rather common during spacecraft re-entry. Traditionally, collecting data under these conditions requires extremely expensive wind tunnel equipment. In attempts to make hypersonics testing more feasible at lower price points, the University of Virginia's aerospace engineering department has endeavored to utilize the pre-existing cubesat framework to conduct such research under the HEDGE program.

The UVA HEDGE CubeSat is a small satellite currently being constructed by the students of the spacecraft design course under the leadership of Professor Chris Goyne. The goal of this project is to construct a satellite which will intentionally reenter the atmosphere shortly after deployment to collect hypersonic pressure and temperature data in the upper atmosphere. To manage many of the functions of the satellite, a centralized computer system is needed to interface with the various instruments on board. Because the craft is expected to disintegrate on reentry, its OBC must send data back to the ground station as it is collected. This means that any failure in OBC functionality could threaten the success of the entire mission, which is not only the last major project for many undergraduate aerospace engineers, but also has thousands of dollars in funding from both the University and the Navy riding on its success. Managing and constructing the components of this computer is the main task of the software and avionics sub-team.

Among its many duties, the computer must manage various components, continuously compute geospatial data, monitor internal temperature readings, calculate solar panel efficiency, and continuously check all systems to ensure they are working as they should. During the mission, the craft will behave completely autonomously, so the OBC must be able to diagnose and solve potential problems without human input. Further, the amount of data the craft can send is bottlenecked by hardware limitations, making formatting and compression of transmissions another problem to overcome.

The STS research stems from the current system of undergraduate research in the U.S. and how it interacts with different departments and educational institutions. In the United States, the majority of research funding comes from federal sources. Of this federal funding, the vast majority of it goes into the “hard” sciences. Hard science is a blanket term used to describe fields with more quantitative and mathematically based research methods. This tends to exclude departments such as social sciences, and consequently, leaves them with much less funding.

Specifically, the STS research conducted aims to quantify the difference in federal funding between social sciences and the harder sciences, and extrapolate this to visualize how it has coincided with overall changes in the college level educational landscape within the past seventy years. This is done by analyzing funding dollars provided by the National Science Foundation, the largest national provider of federal research funding, to visualize funding trends since their founding in 1951. These trends are then cross referenced with changes in college curriculum, funding patterns, enrollment, and other metrics that are used to draw conclusions about the overall state of college research during this period.

Federally funded research at the collegiate level is extremely important to the field of aerospace engineering. For most universities, the field of aerospace engineering is a rather new

department, only becoming popular around the second world war. Due to the newer nature of the discipline as a whole, and the extremely expensive barrier to entry required to conduct aerospace research, federal funds are a vital source of money for many programs. Because of this, it is important to understand the history of federal funding in the United States, and how certain fields have been able to attract large sums of money while others have struggled. By learning the history of such funding, researchers in this industry may be able more effectively attract money, and researchers in fields that have historically received less money may be able to tip the odds more so in their favor.