**Thesis Project Portfolio**

# HEDGE: Hypersonic ReEntry Deployable Glider Experiment Critical Design

(Technical Report)

# Research that Reflects Values: Finding a Way for Students to Influence Universities' Technological Research Projects

(STS Research Paper)

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## Executive Summary

Hypersonic flight vehicles are complicated technologies that have grown and advanced since their introduction to the world in 1949. Today, the main use of this technology is in the development of hypersonic missiles. Many countries have invested significantly in their development as they are highly dangerous and effective weapons. Hypersonic flight is defined as any vehicle that reaches a minimum Mach number of five, which marks where additional complex physical phenomena start to begin. Extensive testing is thus required. All current methods of testing in this extreme environment are extremely costly.

The goal of the University of Virginia's Spacecraft Design class, and my capstone project, is to design a cost-efficient method to test in hypersonic environments. The project is called the Hypersonic ReEntry Deployable Glider Experiment (HEDGE). The strategy is to use a standardized miniature satellite called a CubeSat. The CubeSat is constructed so that after being delivered to the International Space Station and launched from a CubeSat launcher, it will open into a glider and orbit the Earth. Eventually, it will fall from orbit and re-enter Earth's atmosphere. During this re-entry phase, the glider will reach hypersonic speeds. Panels made of materials of interest are mounted on the sides of the nose cone. Pressure sensors and temperature probes are present on these surfaces and are used to collect data. An onboard computer will take the data and send it to the onboard transceiver. The transceiver will then modulate the data on radio waves to be sent via antenna to a satellite constellation communication network. From here it will be relayed back to the ground for collection. This communication series was the focus of my team. A battery and solar panels are used to power the system. Once all data is collected, the materials used can be analyzed. This analysis will help to develop hypersonic missiles. The Spacecraft Design class has finished the final design of the CubeSat. We created a conceptual

design review presentation, which has been pitched to the US Navy to secure funding for the building of the HEDGE CubeSat.

My STS research project looks at university technical research projects, such as HEDGE, and dives into the more complex social dimensions of these projects. The HEDGE CubeSat, for example, will be used to further hypersonic missile development. This has the potential to be very controversial. The essay seeks to answer questions regarding students' rights to belong to a university that reflects their values through these types of technical research projects. The framework used to analyze this topic is Technological Citizenship (TC), an idea where community members are given rights and responsibilities regarding technological developments. These include methods for people, who will in some way be affected by a technology, to hold the developers and the technologies themselves accountable for their effects. The specific research questions asked and answered are as follows: should students have a voice in the creation of new technological projects, even when they are not involved in the project? If so, what practices are used now regarding the issue? And how can universities ensure in a reasonable, applicable, and appropriate way, that students have a voice? Methods to answer these include literature synthesizing, student polling, and a professor interview. Research is based on the University of Virginia, but findings and conclusions apply to universities that have a similar structure.

The results are as follows. First, by looking through the framework of TC, it seems as if students should have TC because students are part of a university community. This would include having a say in the technical research projects the university pursues. Students, however, do not currently have any ways to influence projects. They also do not have significant knowledge of projects, and there is little information on them. Student want of influence is also analyzed. Overall, they are split on the idea of having TC. This presents an issue because TC

requires full participation to work effectively in making more ethical technologies. This data leads to the conclusion that TC should not be granted to students. Lastly, the effects having TC would cause are analyzed. Universities thrive on their ability to research and develop new technologies. It attracts highly regarded professors, increases the university's ranking, and draws in the most promising students. These projects also help to better and advance the world, increasing the standard of living for everyone. Students having TC put these two important factors at risk. The recommendation made from this data is that students should have a very small degree of TC. They should be given information access to projects, so students can know what projects violate their values. In addition, professors should bring prospective projects in front of the student council. They could then share views, and professors would know how this technology might affect students. Both allow for greater discourse between students and professors, without allowing for too many disruptions in progress.