HEDGE: Hypersonic reEntry Deployable Glider Experiment

(Technical Paper)

Inherent and Use Politics: An Analysis of Hypersonics Technology and Its Development

(STS Paper)

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

In aerodynamics, hypersonics missiles are those that reach speeds of five times the speed of sound (Mach 5) or above. To put this speed into perspective, the Tomahawk, a land attack missile widely used by the US Navy, travels at Mach 0.74, roughly 568 mph. Hypersonics missiles travel at minimum 3,837 mph (Banerjee, 2021). Beginning in the early 1900s, hypersonics has been a significant focus of world powers, mainly Russia, China, and the United States due to their superiority to common ballistic missiles. The United States began to dabble with hypersonic-speed missiles in the 1950s during the Cold War, only to be surpassed by programs led by Russia and China. Due to the United States falling behind, they've put an emphasis on hypersonics research in both the public as well as private sectors. With universities gaining the most funding for said research, organizations like CubeSat have sprouted, enabling students to contribute to hypersonics research, too. For the technical project, my team will develop a CubeSat miniature satellite, at only 10 cm x 10 cm x 10 cm in size, to be launched into space that can reconfigure itself into a shape capable of reaching hypersonic speeds upon reentering the atmosphere. With this, we hope to demonstrate the feasibility for using CubeSats as a low cost and effective method of hypersonic glider flight research.

For my STS project, I will discuss how Winner's idea of inherent politics versus use politics helps to categorize hypersonics research in both government propaganda and global political power. Understanding the methods at which the United States has developed hypersonics technology historically will aid in the understanding of its significance today. With this, we can also take a look at how propaganda in favor of students interested in the STEM field makes them the relevant social group, or more specifically engineers.

Technical Project

The field of hypersonics has been on the incline for decades, ever since the end of WWII when Germany launched its V-2 rockets at England (Atherton, 2022). Ascending at Mach 4.3, these missiles would take a sharp turn towards the ground and reach speeds of up to Mach 5 upon reaching their target. In 1959, the Atlas became the first intercontinental ballistic missile (ICBM) fielded by the United States, being able to reach Mach 21 with a range of 6,400 to 9,000 miles. This missile set the precedent for hypersonic technology to come, for both the United States as well as our enemies (Atherton, 2022). The Avangard, an HGV deployed from an ICBM, is one of Russia's main hypersonics weapons programs. With effectively an "unlimited" range, this missile can bypass any currently-used defense systems as the technology to notice and track HGVs is severely limited. China is also currently in the process of developing hypersonics technology, having tested "a [nuclear-capable] intercontinental-range hypersonic glide vehicle that could evade U.S. missile defense and warning systems" (Congressional Research Service, 2022). In August 2021, China tested the Long March rocket, a fractional orbital bombardment system (FOBS), which would put an HGV into orbit to then be deorbited onto its target, giving them the first space-based global strike capacity (Congressional Research Service, 2022). While Russia and China have put billions of dollars towards such research, the United States has lagged behind, rather focusing on building our defenses against ballistic missiles technology and overlooking hypersonics.

Many private firms and government organizations, though, are beginning to realize this issue. Thus, organizations have been created, the University Consortium for Applied Hypersonics and CubeSats being a couple of them. CubeSats was developed in 1999 by California Polytechnic State University, San Luis Obispo, and Stanford University's Space Systems Development Laboratory (CubeSat, 2022). Initially, CubeSats was developed to facilitate access to space for

university students. Due to the fact that they only weigh one kg and are the size of a Rubik's Cube (CAS, 2022), they take almost little to no payload space on a launch vehicle, enabling them to be inexpensively launched into space for tests. As time as well as our knowledge of space has progressed, private firms and government organizations have begun using CubeSats for their own research, with launch opportunities presenting themselves on most launch vehicles today. Miniature satellites have a wide variety of applications to science, including understanding weather patterns, communications over broad distances, and astronomy. However, a CubeSat can also be used to represent and provide data for hypersonics vehicles.

So, the question then to be asked is, "How feasible is it to use CubeSats as low-cost, hypersonic flight experiments via natural deposit and re-entry?" The goal of our technical project is determining if that question can be answered. We want to develop and design a working CubeSat prototype that can be launched by NASA as a CubeSat but reconfigure itself into a shape capable of reaching hypersonic flight speeds upon reentry. With the increase in desire worldwide for hypersonic technology, developing an understanding at its most basic components can help lead us to better understand the most complex components of hypersonics.

STS Project

Every major country is on their way to researching further into and developing hypersonics technology. With this arises the desire for more STEM majors. In an article speaking on how STEM majors at universities in the U.S. are essentially a pipeline for the defense industry, the author mentions how defense companies like Lockheed Martin scour campuses in search of new-grads to fill their positions and programs (Guardian News and Media, 2022). They set up recruitment

events, cash-prize competitions, scholarships, and even internship opportunities with 4 the hopes of incentivizing students in the STEM field to come work for them and their mission of defending the nation from foreign attacks. Companies like Lockheed Martin and Boeing understand the government's desire for new hypersonic technology, using their contracts to then incentivize students with money and a promise of a job out of college to then come help fill these programs and fulfill their government contracts.

The United States has utilized the looming fear of hypersonics weapons from our enemies as a propaganda tactic (Ni & Borger, 2021). This propaganda tactic can be compared to Winner's idea of inherent and use politics. The idea of hypersonics weapons itself creates a political climate of its own. Our enemies have weaponry we don't have and cannot defend against. The very nature of hypersonics creates the potential that we no longer are politically superior globally, and this frightens the United States. This would also "shift the balance of power, because it would dismantle the painstakingly constructed system of deterrence known as mutually assured destruction" that the US and its allies have set up in this world (Ross, 2020). Now more than ever, the U.S. values hypersonics research, "[pouring] more than $1 billion into military hypersonic research this year and [creating] a new university consortium to do basic studies" (Congressional Research Service, 2022). However, looking at this idea from the outside perspective, from someone not neck-deep in the STEM field or defense news, it's difficult to outright understand why the government is putting this value on STEM majors. By diving further into the agenda of the United States' defense in comparison to the defense of, for example, Russia and China, one can better understand why there is such an emphasis today on STEM majors and hypersonics technology.

My goal for the following paper is to discuss how Winner's concept of inherent and use politics applies to the hypersonics industry and its recent flourishment (Winner, 1980). More

specifically, I will examine how fear for an opponent's superiority plays a crucial role in determining what technology the United States values and puts in funding into. As time has progressed, there has become more of a schism between nations like the U.S. and Russia or China, giving more weight to certain technologies like hypersonic weaponry and more emphasis on research like that from STEM majors (Stone, 2020). While not all STEM majors go into the field of hypersonics, I believe that a lot of students indirectly contribute to its research. I aim to discuss why that is and why it is important.

Conclusion

The technical project will demonstrate the possibility of a CubeSat design capable of transforming from a small, box-shaped satellite to a hypersonics re-entry vehicle. This design will enable us to determine the feasibility of using CubeSats as a low-cost, effective research tool for hypersonic vehicles. Current research is granted usually by large private firms or government organizations, and so this will provide the opportunity for us to see whether or not universities can begin researching more on their own, without help from big money. Furthermore, we must also discuss why hypersonics is even valued today and how it affects politics globally. Hypersonic technology can be incredibly useful for defense but also offense. It can be used as a propaganda tool to persuade firms to push its research more, but also as a fear tactic to develop treaties for its prevention. Understanding its importance is crucial to understanding how it will affect our future for the better or the worse.

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