Thesis Project Portfolio

Hypersonic ReEntry Deployable Glider Experiment (HEDGE)

(Technical Report)

How Ethical Guidelines are Upheld within Hypersonic Companies

(STS Research Paper)

An Undergraduate Thesis

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Table of Contents

Sociotechnical Thesis

My thesis portfolio takes a deep dive into hypersonic technologies and their diverse applications. Within this portfolio, both my STS thesis and technical capstone tackle different angles and the latest technology in hypersonics. In my STS research, I analyze how companies in the hypersonic industry adhere to their ethical guidelines. This exploration sheds light on the moral compass guiding advancements in this field. Meanwhile, my technical project involved collaborating with peers to develop a prototype satellite. Our small satellite was designed to gather essential data on hypersonic flights using more affordable avenues than what is used today. Our aim was to collect hypersonic flight data and broaden availability of hypersonic research by using cost-effective materials, making it more accessible to all. Each piece of my portfolio brings a unique perspective, advancing our understanding of hypersonic technology. While my STS research delves into the ethical considerations, my technical project offers practical solutions for data collection, paving the way for a more accessible, affordable and ethical future in hypersonic research.

My technical project, known as the Hypersonic ReEntry Deployable Glider Experiment (HEDGE), is all about being innovative. We are demonstrating that we can conduct hypersonic flight experimentation at a low cost with the use of CubeSats, standardized small satellites. Hypersonic flight, when a vehicle moves five times faster than the speed of sound, has historically been very expensive. The advanced materials and cutting-edge technology needed has made it accessible for others. This year, my peers and I completed the critical design and preliminary testing for HEDGE. Now, our design has reached a stage where it is ready for fabrication, testing, and subsequent deployment into orbit by the next group of students. The envisioned trajectory for HEDGE involves its initial configuration as a 3U CubeSat, which will

then transform into a glider with articulated fins upon entry into Earth's atmosphere. During reentry, HEDGE will transmit critical data including temperature and pressure at hypersonic velocities. Upon completion of its mission objectives, the vehicle will undergo controlled disintegration within the Earth's atmosphere.

In order to carry our goals, our project is structured around six teams, each dedicated to addressing specific aspects of the project: communications, software and avionics, attitude determination and control system (ADACS), power, thermal, and environmental control, and structural integration. My role was to serve as the team leader for the software and avionics team. In the software and avionics team, we focused on the data management and avionics components so that the mission can be successful. Throughout the development process, close attention has been devoted to iterative refinement and optimization of our designs, ensuring that HEDGE remains cost-effective and contributes to the rendering of accessible hypersonic flight research.

My STS research paper examines how companies that develop hypersonic technologies uphold their ethical guidelines. In my research, I focus on how Raytheon Technologies follows the ethical guidelines that they have publicly put in place. I utilize Actor network theory to analyze how various actors in the network play a role in the ethical consideration of the hypersonic technology industry. Through my analysis, I found that an understanding of the dynamics within a company's network can help effectively integrate ethical principles into its operations. Secondly, actor network theory demonstrates the significant influence of various stakeholders on ethical decision-making within organizations. Thirdly, I found that recognizing the power dynamics and motivations of different actors is crucial for aligning ethical guidelines with the needs of all the involved actors. Lastly, my STS research highlights the importance of clear communication and ethical training in fostering a company culture where ethical behavior

is prioritized. Overall, my STS research emphasizes the importance of examining diverse companies and ethical frameworks to develop a comprehensive understanding of how to promote ethical behavior and improve corporate performance.

Having worked simultaneously on my technical project and STS research has allowed me to find meaningful connections between them. I have learned how my work on my technical project is a part of the actor network for companies like Raytheon Technologies. I have also acquired knowledge how companies in the hypersonic industry rely on funding and expertise from engineers. This knowledge allows me to be better prepared to understand the importance of work, like my technical project, and the power that the work holds. By doing this research together I was able to always think about ethical consideration as they are what keeps us accountable and prioritize safety.