Thesis Project Portfolio

Hypersonic ReEntry Deployable Glider Experiment (HEDGE)

(Technical Report)

The Socio-Political Impact on the Development of Hypersonic Technology

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Hypersonic technology, due to its increased speed and maneuverability, has garnered interest for both military and civilian applications throughout history. In recent years, it has been a focal point of research and development for both the defense industry and the private sector. Even though the idea of hypersonic technology is not new, significant attention has been brought to the resurgence of this technology. Due to the historically complex issue of gathering data, testing technologies, and analyzing results, hypersonic technology development is notoriously expensive and time-consuming. Because of this, innovative new methods of conducting research have been developed. In the realm of technological innovation and hypersonic development, projects like the Hypersonic ReEntry Deployable Glider Experiment (HEDGE) push the boundaries of scientific advancement and shape the modern reality of aerospace engineering. However, beyond the technical aspects lie a multitude of socio-political dynamics that both shape and are shaped by the development of hypersonic technology. This synthesis aims to underline the interplay between the technical HEDGE project and the STS research paper focused on determining the socio-political impact on the development of hypersonic technology. The relationship between these two bodies of work is to achieve a greater understanding of both hypersonic technology and the forces that impact its development both in modern day and throughout history.

The research and development of hypersonic technology can be summarized in one word: challenging. Real-world hypersonic testing and simulation is costly, and the purpose of HEDGE is to do so at a vastly reduced cost compared to larger-scale programs. The experiment incorporates the design of a small and inexpensive satellite called a CubeSat, that reenters the atmosphere at hypersonic speeds to collect data such as temperature and pressure. CubeSats

incorporate many commercial off-the-shelf parts which allow HEDGE greater testing accessibility. Ultimately, HEDGE is a proof-of-concept mission aimed at determining the feasibility of using CubeSats as a means of low-cost sustained hypersonic flight, and proving that hypersonic flight experiments can be conducted by a team of undergraduates.

Hypersonic technology is the new frontier of technological supremacy and geopolitical influence. In a current era defined by global power competition and the constant race towards technological domination, the pursuit of hypersonic technology stands as a testament to the socio-political forces shaping the future. The subject of the STS research paper is hypersonic technological development, and the paper answers the STS research question "What is The Socio-Political Impact on the Development of Hypersonic Technology?" This is accomplished through the lens of the Social Construction of Technology (SCOT) STS framework which emphasizes the social and cultural factors that shape the creation and use of technology. By conducting this research, the goal is to enhance the understanding of the complex interactions between the development of hypersonic technology, society, and politics and is thus critically important to the field of STS. In engineering, research on the development of hypersonic technology is significant for pushing the boundaries of our understanding and accomplishing things previously thought to be impossible. Addressing real-world challenges related to high-speed flight, propulsion, materials science, and system integration can lead to advancements not only in national security and defense, but also in civilian areas such as space exploration and transportation.

The technical and research papers provide key insight into both what is currently being done, and what has been done historically to develop hypersonic technology. Being immersed in the technical value of the HEDGE project provided a firsthand understanding of the engineering

challenges and innovative solutions required to achieve sustained hypersonic flight using CubeSats. Simultaneously, engaging with historical research provided a broader context to make conclusions from. The value of having worked on both projects simultaneously lies in the synthesis of diverse perspectives gained, and the holistic understanding gathered by the overall integration. Mixing both technical expertise and socio-political analysis, the conclusions made are more impactful and better equipped to navigate the complex issue that is the development of hypersonic technology. This understanding paves the way for more informed approaches to future technological innovation and highlights the necessity of bridging the gap between social and technical dimensions.