

## **Thesis Project Portfolio**

### **Decelerating Hypersonic Flight Experiment Using a CubeSat Platform**

(Technical Report)

### **How Commercialization is Changing the Approach to Space Missions and Investments** (STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science  
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree  
Bachelor of Science, School of Engineering

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## **Sociotechnical Synthesis**

My STS and technical capstones were both chosen based on my love of space exploration and technology. My STS research, which is about the emergence of private businesses in space flight since the beginning of the century, relates directly to my technical capstone. This is because part of the STS research explored the types of missions private companies are likely to fund and one category included missions that further scientific understanding and education. My technical capstone, a CubeSat mission hitching a ride on a government contracted rocket (Antares), falls within this category. Private companies, I found, would be less likely to fund this sort of mission unless a wealthy donor personally approved it. The reason is clear; there is no profitability in launching student-made projects.

The technical report portion of my capstone project documents a proposal and design for a CubeSat. The goal of the CubeSat is to obtain hypersonic flow data during atmospheric reentry. The reasoning behind this project is that computational fluid dynamics often need to be verified due to uncertainties within models for hypersonic fluids. CubeSats could be a reasonable method to accomplish this verification because their relatively light weight makes it simple to find a rocket with cargo space to house them. Our segment of the overall project focuses on a blunt design reminiscent of landing modules used to transport astronauts back to Earth. The blunt design is used to slow the craft to a reasonable velocity while keeping pressure and heat away from the aft compartment containing crew. In addition, radio communications can take place in the lower pressure trailing air, which we are using to communicate temperature, pressure, position, and other data to a satellite network. If the satellite successfully transmits data, we will be able to determine if CubeSats could be a viable Research and Development platform in the future.

The STS research portion of my capstone focused on the impact emerging private businesses are having on the space industry. Some key areas of focus are the types of missions approved, the costs, the success rate and safety records, and the controversies surrounding some business ventures. By compounding this data, the benefits and potential issues of these businesses entering the industry could be determined. In the end, the conclusion was that private businesses are well equipped to reduce the costs of launch platforms if competition remains healthy and well-regulated and have already done so in just the last 10 years. However, issues such as light pollution impacting astronomy, space junk, and even undocumented activity threaten the future of the industry if governments and Collaboratory entities like NATO cannot successfully serve as a watchdog. In addition, public entities such as NASA must continue to approve and fund missions if our understanding of science and exploration of the stars is to progress.

By exploring the space industry through two avenues, one of research and one of technical planning, a clearer picture of the direction the industry is headed began to form. Incredible technologies are reducing the barrier to entry such that even students can reasonably launch space missions, something unfathomable in the past. I believe that through education, careful planning, and the fostering of a competitive but responsible space industry, humanities relationship with our celestial neighborhood will transform. However, if businesses aren't kept in check, we may doom generations to stay within the confines of our atmosphere if they aren't able to clean up our orbiting scrapyards of metal scrap and long-dead machines.