Thesis Project Portfolio

Hypersonic Atmospheric Reentry Deceleration Experiment (HARDE)

(Technical Report)

Examining the Failings of International and Domestic Policy to Address the Threat of Space Debris

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

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In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

My technical work was completed as a part of the spacecraft design capstone course. For our project, my team wrote a proposal for a CubeSat re-entry vehicle design that could be used to conduct hypersonic flight testing. Over the past decade hypersonic research has become a major field of interest due to its military and civilian applications, particularly the possibility of hypersonic weapons. Current methods include ground testing which is less accurate and flight testing which is extremely costly. The goal of this project was to assess the feasibility of using CubeSats, a more accessible and economical resource, to conduct hypersonic research. During the design process I worked on the functional team that was incharge of designing the CubeSat communications system. At the conclusion of the spring semester a conceptual design review was presented and a proposal was submitted to NASA to request funding. If the proposal is successful the project will continue with next year's spacecraft design course.

Due to their low cost and ease of use CubeSats act as an important tool for increasing the accessibility of space exploration, however, this technology is not without risks. In the past decade there has been a stark increase in the deployment of CubeSats and the rate of deployment is expected to continue to increase in coming years. As many as 1 in 5 of these CubeSats launched into orbit are expected to stay there for more that 25 years after their operational life span. This trend is contributing to growing concern over orbital pollution. CubeSats have much more limited functionality than other types of spacecrafts, and as a result usually lack the maneuverability to avoid collisions with other satellites. If CubeSats continue to pollute the orbital environment at this rate, they will pose significant threats to future space missions.

For my STS research, I examined the international and domestic policy landscape in place to mitigate orbital pollution. By applying Actor Network Theory (ANT) I analyzed the reasons that current policy has failed to adequately address the issue. Due to the complex motivations of different actors involved in policy making there has yet to be any significant binding legislation put in place that prevents satellites from turning into space junk at the end of their operational lifespan. Many of the actors involved in decision making are concerned primarily with their own interests and the immediate impact on individuals; hence legislation has failed to treat the protection of the space environment as a broader environmental issue. Additionally, many of the guidelines in place are highly outdated. Legislation needs to be updated in order to reflect changes in the aerospace industry such as the recent increase in the adoption of mega-constellations as well as CubeSats.