Thesis Portfolio

A Space-Based Solution to Improve Roadway Safety and Efficiency in Virginia: Real-time Winter Weather Data for Navigation
(Technical Report)

The Issue of Space Debris and its Key Players
(STS Research Paper)

An Undergraduate Thesis

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

My technical work was a spacecraft design capstone class that developed a conceptual solution to address one aspect of Virginia's transportation problems using remote sensing and data fusion methods My STS Capstone is an exploration and analysis of the issue of orbital space debris, particularly in LEO. My technical research is important because several people each year lose control of their vehicles due to poor weather conditions, and potentially sustain severe or even fatal injuries. Besides safety, road conditions can affect shipping and other industries. Having more real-time weather data would help companies make more informed decisions that could save residents and companies money, benefitting the overall economy. My STS research topic is a critical because orbital debris could destroy our current satellite infrastructure and make it impossible to launch anything new into orbit for centuries if it is not managed properly.

During my technical research, I worked on a functional team assigned to the software and avionics portion of the conceptual spacecraft design. As a functional team, we selected a potential on-board computer that was compatible with the other hardware and sensors on the satellite. We also selected the data formats for each stage of transmission and diagrammed how the data would flow throughout the system.

My STS research is related because the use of space-based solutions by private companies, in the case of my technical work, potentially MITRE, is a rapidly expanding field. I explore this expansion of commercial satellite deployment and how it is affecting the issue of space debris and orbit pollution. I also investigate how the issue of space debris is evolving. On one hand, more satellites are expected to be launched which could cause the issue to increase in

severity. On the other hand, more parties involved and increasing interest in space from the financial sector might mean that cooperation or technical solutions may proliferate in order to preserve everyone's ability to use space and satellites to run our global infrastructure.

At the conclusion of the semester, a conceptual design review was presented to MITRE by the spacecraft design class, and the feedback was highly positive. Hopefully, next year's spacecraft design students can build off of our work and move into more tangible stages of the project. For the mission to come to full fruition, it would have to continue for at least another year after that as well. In my STS research, I got a much deeper understanding of the full orbital debris issue and just how complex it is. I do not feel the ability to fully predict what will happen with the issue moving forward, but I do feel that I have accurately uncovered and analyzed the motivations and goals of the largest sociotechnical players involved. If someone were to continue my research it would be fascinating to see how active debris removal has changed and evolved in the next five to ten years, with the first real-world missions taking place very soon.