

**Thesis Portfolio**

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

**The Impact of Satellite Data Retrieval on the Space Debris Crisis**  
(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

Mici Cummings  
Spring, 2021

Department of Mechanical and Aerospace Engineering

## **Table of Contents**

Sociotechnical Synthesis

A Space-Based Solution to Improve Roadway Safety and Efficiency in Virginia: Real-Time Winter Weather Data for Navigation

The Impact of Satellite Data Retrieval on the Space Debris Crisis

Thesis Prospectus

## **Sociotechnical Synthesis**

This thesis portfolio explores issues that relate to satellite development. The technical portion of this paper is about developing a new solution to obtain weather data in order to decrease roadway disasters. By researching the different areas of satellite development, the team was able to plan for a new satellite that can better detect climate conditions. Several functional teams were constructed in order to research these elements. Through the collaboration between the program management; communications; software and avionics; power, thermal, and environment; attitude determination and control system and orbits (ADACS); structures and integration; and instruments teams, this project came together to create a viable solution for the customer, The Mitre Corporation (MITRE).

The STS paper considers the implications of satellite data retrieval through discussing the space debris crisis and methods of solving it. Since there are hundreds of thousands of satellite and spacecraft debris pieces in Earth's orbit, it is becoming increasingly imperative that a solution be found to ameliorate this problem. Several solutions are considered, namely recycling satellites in-orbit and utilizing reusable spacecraft. Because this orbital debris issue has developed so drastically over the past decades since space exploration and satellite development began, the recyclable spacecraft concept could serve as a deterrent for future debris accumulation.

Weather conditions strongly affect the safety of the roadway system, particularly snow and rain. Since drivers do not always take precautions when it comes to road conditions, there is a higher chance of accidents during inclement or even slightly less ideal weather. Considering the importance of satellites toward the purpose of roadway safety, determining the effect the launch of satellites into space has on the future of space endeavors is essential. Since weather

data attainment is useful for society to function, it is important to contemplate the long-term implications of utilizing ephemeral products. Researching this topic further to discover initiatives being taken to ameliorate disastrous prospects could prove ground-breaking.

This project brings attention to an issue many people do not consider: space debris. While many humans may fantasize about future space exploration initiatives and possible life outside of Earth, most do not think about the social impact of this development. Space exploration is, of course, important for humankind's development. Therefore, in order to maintain and even increase the current space travel and research projects, the orbital debris crisis must be handled. The space debris conglomeration surrounding Earth impacts spacecraft launches, since crashes can happen if mission control is not especially careful. Therefore, there are many factors to consider when launching a spacecraft, certainly if humans are aboard the craft. By continuing the conversation of space advancement and debris decrement, future innovations can be developed to support the future safety of space travel.

The technical and STS portions of this paper work together to view satellite use from two angles. The technical portion involves building a satellite to prevent roadway disasters, while the STS portion discusses how an influx of satellite and spacecraft systems could be detrimental for future civilization. Researching and developing these topics simultaneously invokes the question: when are satellites necessary? When do the benefits of putting a satellite into orbit outweigh the rewards of keeping Earth's orbit free of debris?