Thesis Portfolio

CECIL, 1U Amateur Radio CubeSat

(Technical Report)

On the Dangers, Implications, and Future of Low Earth Orbit Pollution

(STS Research Paper)

An Undergraduate Thesis

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

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Sociotechnical Synthesis

The applications of satellites in the modern age are numerous and far reaching. A satellite in itself is a very complicated piece of technology, and so too are the implications of their impact on society and the world. Thus, the goal of this thesis was to experience both the technical side of satellite technology and to also research and unveil some modern sociotechnical concerns relating to satellites. Specifically, this dichotomy was explored via the design of a small satellite known as a cubesat, and through a research paper conducted on how low Earth orbit pollution can possibly endanger such satellites and affect all of society in coming years.

The technical component of this thesis is the completion of a design phase of a amateur radio enabled satellite called a cubesat. This satellite was conceptualized and planned alongside a team of aerospace engineering undergrads at the University of Virginia organized by Chris Goyne, professor of the UVA spacecraft design course. The goal of the project was to work alongside a team of fellow engineers to create the design and layout for a satellite set to be fabricated and launched by February of 2021. From scratch, the satellite's main objectives, components, dimensions, and logistics of construction and launch were worked out with management and budget concerns being considered concurrently. The goal of the satellite is to provide capabilities for radio communication between the spacecraft and amateur radio users in various positions on Earth, as well as to enable communication between the satellite and UVA engineering students at the university's ground station. The project served also to provide the team of undergraduate engineers vital experience with the design of a large scale, complex spacecraft.

The research component of this thesis was the completion of a paper outlining the dangers that low Earth orbit (LEO) pollution poses to current and future satellites. Within the

paper, the societal implications and risks associated with this problem are also heavily discussed. Specifically, the paper seeks to answer the question: What are the societal dangers brought about by the threat of low earth orbit pollution on satellites? In order to answer this question, documentary research and analysis of articles produced by news outlets and government-run space agencies was performed to establish clearly what the real risks of LEO pollution are towards satellites. Further documentary research and analysis was performed on news and scientific articles to outline the importance of satellite technology to the world as well, thus creating a bridge for the reader to see how LEO pollution is a direct risk to society. Meanwhile, Actor Network Theory (ANT) was employed to establish a framework of the numerous players involved in the complex network of LEO pollution. The paper aims to find the issues perpetuating LEO pollution, and looks to expose areas within the network of the problem that can be improved and altered in the future in order to protect our satellites and the future of our society.

Working on both the technical design of a satellite while conducting the research component of this thesis was eye opening in the amount of meaningful experience it provided. Accomplishing both tasks in parallel allowed me to see the benefits and amazing things that satellites can offer the world, and offered me an even greater sense of pride in knowing I gained experience in designing a piece of technology that is truly remarkable and important. Having worked on both projects also revealed just how fragile and at-risk satellites can be, and the experience highlighted for me the importance of understanding and planning ahead for the societal implications associated with putting any piece of technology out into the world.