Thesis Portfolio

CECIL, 1U Amateur Radio CubeSat

(Technical Report)

The Effects of Advanced Ceramic Materials on the Recycling Industry

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Introduction

The exploration of space and advancement of technology in thermodynamics and engines go hand in hand. In order to explore space, and cement humanity in the solar system, humanity needs to be able to reliably perform experiments in space and improve our technology that brings us there. Both my technical and STS projects are connected to the advancement of human space travel and air travel. The capstone project I am a part of is working to send a cube satellite into orbit. This mission is motivated by the increasing ability and need to experiment and interact with technology in space. The STS research paper is related, but takes a different approach. The STS paper focuses on the ceramics that are being used to develop more powerful and faster engines and how these ceramics are going to be recycled and reused once these kinds of technologies become main stream.

Technical Project

The goal of this technical project by my team in the UVA Spacecraft Design capstone class is to design and implement an amateur radio satellite. The satellite is designed to be used on an amateur radio frequency, and we have partnered with the Amateur Radio Society to send an experimental satellite onboard as the payload of the satellite in order to run different communication tests. The goal of this mission is to be completed at low cost, and with low risk of failure, so that our payoff is larger and more permanent. The goal is for a satellite that can operate for a long period of time, allowing people to communicate and run tests using the experimental radio. This goal helps to solidify the spacecraft engineering prowess of the UVA Mechanical Engineering department and its students, who have designed this mission from the ground up.

Currently this satellite is designed to be outfitted with the experimental radio from the Amateur Radio Society, a wide range transceiver, and a camera. Along with the other parts and electronics necessary to run this payload and communicate effectively with the UVA ground station, this will allow people operating on amateur radio frequencies to contact the cube satellite and request the pictures it has taken of the earth. This also allows the Amateur Radio Society and students at UVA to run different communications tests with the satellite and learn more about space travel and communication. This project is currently set to be finished in the year 2022, however the current fourth years working on the project have set the groundwork for the mission that will be completed in the next few years.

STS Research Project

Recycling is the main focus of the STS research paper. Recycling is necessary in modern society as resources start to deplete and we begin to see the natural end to mass manufacturing. Eventually we will have used up all of a particular resource and will not have any choice but to recycle. Unfortunately, some of these resources are manufactured into a form that can be dangerous to the environment and to people. The question being answered is how America plans to prepare for the safe recycling of ceramics in the future once they become more prevalent. Recycling of is a major problem facing American society, seeing as no national policy is in place, and we trail far behind the countries in Europe and Asia that recycle efficiently and regularly. Many ceramic materials used in thermal protection applications are not only rare, but dangerous if left in the environment unchecked. These reasons give a need to determine a reliable method to recycle these technologies before they become mainstream in their usage, and end up discarded like many environmentally harmful products do today. This paper does focus on the future in its problem, but I have tried to use current methods of countries with successful

recycling programs to form a solution. The goal is to produce a policy and method of recycling in the United States that will not only help to solve the problem posited by this research paper, but also help to alleviate the recycling burden the US already creates.

Conclusion

In working on both of these projects I have learned about many things that I had never thought about before. Before coming to Charlottesville, I never lived in a county with a recycling system, and after living here for a year I figured Charlottesville had successful and impactful recycling policies. However, after performing research on the topic, and policy analysis of the different countries that are considered the top recycling countries in the world, I can see that the United States has a long way to go before we can develop a system that efficiently recycling the waste we produce. I am now more conscious of my consumer behavior and what I throw away. I try to make sure that what gets recycled in my house is actually recyclable, as well as buying things that waste as little plastic and packaging as possible. In working on my Capstone project, I have learned more about what it takes to design a mission to space and the hardships and setbacks that brings forth. There are many different things that need to be considered when designing these space missions, from the materials, to the time frame, to the very tiny details of the performance of the mission. These are ideas that I have never thought of before, but can now use in a broader sense to apply them to any project I am working on in any engineering field, as it is all built from the same core mission planning concepts.