Thesis Project Portfolio

HEDGE
Hypersonic ReEntry Deployable Glider Experiment
Critical Design

(Technical Report)

Analysis of the Ethical Effects of Unmanned Aerial Vehicles in Modern Combat

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

In the following paper, I will explore both my Science Technology and Society (STS) research on the ethical use of Unmanned Aerial Vehicle (UAVs) and my Technical Design Project working on a hypersonic re-entry CubeSat. The STS paper was researched during my time with Professor Earle and worked on throughout my fourth year. The Technical project is the outcome of my time in Spacecraft Design with Professor Goyne and was similarly completed over a year of work. The Technical project is not unique to me and was worked on by a full class of thirty students to reach the deliverables that will follow in this paper.

The STS paper is an Actor Network Theory (ANT) analysis of literature and statistics covering the use of UAVs in combat throughout their relatively short history. My research was completed using a variety of sources including other STS works on similar subjects and official Government reports. I go on to analyze the relationships between the Governments that use UAV technology, the general population of those nations, and the service men and women that operate the UAV technology. As well as those group's attitudes towards and concerns about the deployment of UAVs. Most of the statistical analysis comes from reports on the accuracy and effectiveness of the combat systems, as well as effects on their operators. Based on ANT I dive into the ethical and moral arguments that fall both for and against the use of UAVs in combat as they relate to the actor groups identified. After identifying the actor groups, I will analyze and research the history and background for each of the groups. Then I will explore the interactions between the groups and see how their attitudes and positions fit together. After the background is established I start my own analysis of the UAV usage and compare how each actor relates to it. Finally I give a conclusion to the analysis with what I believe will be the future of UAV usage and why this will likely be the case.

My Technical Design project is a small CubeSat designed for hypersonic re-entry experiments. The basic structure of the craft is based on a simple 1U (10cm * 10cm *10cm) cube. This will serve as the “bus” or main compartment where the flight computer and major electrical components, such as the battery, will be housed. The main difficulty in designing the structure comes from the need for static stability, in more simple terms the ability for the craft to steady itself in the atmosphere and maintain a steady heading. As the team lead of the Structures and Integration (SI) group, this challenge was my (our) main concern. To solve it a system of hinges was devised to allow the craft to unfold into a flight mode that will allow it to exhibit the desired stability. This deployment mechanism is necessary as the craft would not fit in the desired 3U (30cm *10cm*10cm) volume in its flight orientation. The major design constraints for our group specifically are weight and volume of all of the parts. As the SI group the packing of every other groups components into the 1U bus as well as integrating them in a manner that power is getting to where it needs to go is very complex. The other factor that must be considered for hypersonic flight is temperature of the components. Because the craft is going to be reentering the atmosphere at high enough speeds to develop a plasma field around the front of the craft, the material choices become very important. As with all Aerospace applications the tradeoff between strength, or in this case thermal protection, and weight is the main fight in the design. As such, we chose to go with materials that are slightly heavier than optimal to help protect the sensitive electronics housed inside the craft.

The relationship between my Technical and STS topics are not immediately clear but I think when taken with a broader perspective the link becomes obvious. The driving motivation

between all hypersonic research is the military applications the technology would hold. The money that is supporting the Spacecraft design project is coming from defense industry partners and their interest lies in the military application of in atmosphere hypersonic flight vehicles. Due to the temperatures and stresses experienced during hypersonic flight, hypersonic flight vehicles are mostly missiles and small (relatively) drones. Thus, the ethical analysis of UAVs will apply directly to the technology that comes out of hypersonic research like what I have worked on for my Technical project.