

Thesis Project Portfolio

Hypersonic ReEntry Deployable Glider Experiment (HEDGE)

(Technical Report)

Protection or Privacy? An Analysis of Satellite Surveillance

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

My technical project is a spacecraft design capstone project called the Hypersonic ReEntry Deployable Glider Experiment (HEDGE). The main objective of HEDGE is to make hypersonics, a newer and innovative field of study in aerospace engineering, more accessible to undergraduate students. The project is based on using a CubeSat satellite to collect data in a hypersonic environment. A CubeSat is a type of small spacecraft that uses 10cm x 10cm x 10cm cubes to house spacecraft components. The CubeSat is a system used frequently in undergraduate spacecraft research and development because CubeSat parts are commercially available. The availability of the CubeSat parts lessens the price of building the spacecraft. The CubeSat will be essential to making hypersonics more accessible because of how cheap the spacecraft is to build and experiment with. The capstone project will add hypersonic design elements, such as sharp fins and a nose cone, to make the spacecraft achieve hypersonic speed during the launch experiment.

The class is split up into the following subteams: Project Management; Communications; Software and Avionics; Power, Thermal, Environment; Attitude Determination and Control System (ADACS) and Orbits; and Structures and Integration. I am a part of the Software and Avionics subteam, whose main mission objective is to orchestrate the data processing and manage the spacecraft's central operations. The software applications that will be used on the project to integrate the mission's operations are NASA's cFS and freeRTOS. These software applications have been used on multiple industry spacecraft missions and therefore have flight heritage. The main hardware components, also known as the avionics, are as follows: the onboard computer, thermocouples, pressure transducers, the satellite transceiver, and analog to digital converters. The onboard computer is the main processor of the whole spacecraft. The

onboard computer will take the signals from the thermocouples, pressure transducers, and transceiver to process the signals into data that can be used for post processing.

I am writing about the topic of satellite surveillance and privacy right infringement for my STS project. The project is focused on the government's usage and advancement of reconnaissance satellites and how it will affect the privacy infringement rights of US citizens. The main question is as follows: will the advancement of satellite surveillance technology used for the sake of national security be a compromise of the privacy rights of American citizens? The paper starts talking about the inception of reconnaissance satellite technology and how the government portrayed the technology. During this time, the United States government stated that the reconnaissance satellites would be the technology of the future and that it will only be used for protection purposes. The government would continue using this ideology to convince United States citizens that advancing satellite surveillance technology is a beneficial act for national security.

The paper then turns to the legal and philosophical discussion of satellite surveillance versus privacy right infringement. The discussion starts with reviewing two Supreme Court Cases: *Florida v. Riley* and *Katz v. United States*. *Florida v. Riley* covers the topic of aerial surveillance and privacy infringement, meanwhile *Katz v. United States* covers the topic of phone tapping surveillance and privacy infringement. These two cases are prominent in the discussion because they have differing opinions that contribute to satellite surveillance and privacy. Following the Supreme Court Cases, the paper gathers facts about government data collecting and American citizen's privacy preferences. These are important statistics to look at

because it shows a quantitative approach to the issue of American citizen's privacy and national security. After I analyzed all the data in the paper, I argued that the advancement of satellite surveillance will end up impeding the privacy rights of American citizens. I state this because in *Florida v. Riley*, the Supreme Court Case stated that American citizens do not own the air above their homes. Since space is essentially above air, it would mean that satellite surveillance would be legally allowed because the satellites are in space.

The two projects are related to each other because they follow the main broad topic of satellites and could potentially affect each other. HEDGE is essentially a satellite that will be designed to go at hypersonic speeds. Satellite surveillance uses satellites to capture information through imaging for surveillance purposes. One way these two topics can be related is through the fact that HEDGE uses small spacecraft. It is cheaper and easier to deploy small spacecraft, allowing for more spacecraft to be put into orbit. Imaging cameras can be added to the small spacecraft allowing for satellite surveillance to increase. Hypersonics will also allow satellite surveillance to retrieve data much faster than ever before.