Thesis Project Portfolio

HEDGE: Hypersonic ReEntry Deployable Glider Experiment

How has Space Commercialization Impacted the Environment?

An Undergraduate Thesis

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Sociotechnical Thesis

Hypersonic technology is a huge focus for the aerospace industry. Hypersonics are praised for their speeds and maneuverability, and have large applications in the defense sector. My technical project is called Hypersonic ReEntry Deployable Glider Experiment (HEDGE) and is worked on by a class of 4th year engineering students at the University of Virginia. HEDGE aims to demonstrate the feasibility of conducting hypersonic experiments using CubeSats. CubeSats are a form of satellites that follow a standard size and often use commercial off the shelf parts for ease of build and affordability. Because hypersonic technology is very complex and new, the goal of the HEDGE project is to gain more understanding of hypersonic reentry at a low cost. The project is currently in the design and prototyping phase. In HEDGE, we are split into different teams including Software and Avionics, Power Thermal Environment, Communications, Structures and Integration, Attitude Determination and Control System, and Program Management. Each of these teams works together to ensure the requirements of their subteam are met, as well as working with other subteams to make sure their design doesn't prohibit another team from completing their requirements.

My team is Software and Avionics. We have been working on establishing the communication between the sensors (thermocouple and pressure transducer) as well as the transceiver with the onboard computer. Our team has worked in conjunction with some Electrical and Computer Engineering students at the University of Virginia. They have designed the boards that hold all the sensors and transceivers and connect to the onboard computer. Data transfer protocols have also been established.

The mission has two main stages that the Software and Avionics team has outlined. The orbiting stage which is where HEDGE is orbiting the Earth. The second stage is the reentry stage. One of the important jobs that our team was tasked with is ensuring that data gets transmitted during both stages of the mission. We have outlined what data will be transmitted during each stage. The reentry phase has the most uncertainty so we have prioritized what data will be transmitted in case of certain disturbances.

CubeSats have paved the way for students to get involved in real space mission engineering. In fact, space has significantly become more accessible through CubeSats and companies like SpaceX making launches more affordable. With the growth of anything new, the question, Is it too much growth?, always comes up. This question inspired the question for my paper, How has Space Commercialization Impacted the Environment? The increase in space commercialization is very exciting with companies like SpaceX promising to bring humans to Mars, and other companies like Virgin Galactic promising to offer tickets for a flight into space.

The possibilities for space are endless, but as companies are trying to leave earth is anyone protecting the earth? Rocket launches use tons of fuel, so the increase in rocket launches should cause concern for what is being pumped into the atmosphere. Another concern is the amount of satellites and space debris that is in Low-Earth Orbit. Companies like SpaceX are creating satellite networks in Low Earth Orbit for various purposes like having internet connectivity anywhere in the world or national security. Space debris is satellites or other space technology that breaks down or breaks apart due to collision. The amount of space debris and satellites existing in Low-Earth Orbit is increasing and will continue to grow. Right now, there is nothing to combat space debris or technology that can clean it up. As the density of objects in Low-Earth orbit increases, the possibility of collisions increases, and collisions create space

debris, which can turn into a cycle called the Kessler Syndrome. This is the idea that once the density of objects in Low-Earth Orbit is too high, a never ending chain reaction of collisions will occur.

There are currently no policies addressing the increase in space commercialization. Right now, any billionaire can decide to start a company and go to space, with next to no regulations. My paper will address the impacts that space commercialization has on the environment, current policies, and propose new policies.