Thesis Project Portfolio

HEDGE
Hypersonic ReEntry Deployable Glider Experiment

(Technical Report)

Exorbitant Prices of Ambulance Rides: What Possible Solutions Exist to Correct the Market Failure of the Air Ambulance Industry?

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Hypersonic flight is a rapidly growing field of research in the aerospace industry for both military and civilian applications; however, experiments to test flight conditions in a hypersonic environment are difficult to replicate in wind tunnels and are expensive to achieve on rockets and aircraft. Hypersonic technology is being used by the US military to develop several state-of-the-art weapons and defense systems, and civilian companies are seeking to design hypersonic aircraft to greatly decrease travel time on long flights. It is for this reason that there is significant motivation to determine an economical way of conducting regular hypersonic research experiments.

Another industry that is dependent on aviation is that of emergency medical air transportation. This industry is responsible for transporting critically ill or injured patients to a hospital where they can receive adequate care as quickly as possible via air ambulances. While a seemingly noble goal, a lack of normal market forces has distorted the supply-demand relationship of air ambulance rides in recent years, leading to a total market failure of the emergency medical air transportation industry, resulting in constantly skyrocketing prices for the service. This is problematic as most customers of these services are fundamentally unable to refuse the service and must cover the excessive costs themselves. Due to the Airline Deregulation Act of 1978, it is illegal for the government to intervene with any forms of regulation, making it challenging to find a way to correct the problem, however, with approximately 15,000 patients flying on an air ambulance every day (*How Often Are Air Ambulances Used?*, n.d.), it is urgently important to find a solution to resolve this problem.

The technical portion of this report focuses on the feasibility of designing a low-budget hypersonic reentry vehicle for conducting prolonged hypersonic research with minimal financial investment using the CubeSat platform. This goal is accomplished through the design of project

HEDGE (Hypersonic ReEntry Deployable Glider Experiment), a format where a hypersonic reentry glider vehicle is contained within a CubeSat and launched as secondary payload onboard a Northrop Grumman Antares rocket. After reaching orbit, the CubeSat will be launched from the spacecraft, followed by the reentry glider jettisoning the CubeSat frame. Each of the five component teams (Communications; Software and Avionics; Power, Thermal, and Environment; Attitude Determination and Control Systems (ADACS) and Orbits; and Structures and Integration) designed part of the spacecraft and glider system, culminating in this report as a proposal to NASA for funding to further develop the design and execute the mission.

The STS research paper portion of this report seeks to answer the question "What possible solutions exist to address the market failure of American emergency medical air transportation?" by presenting and analyzing previous solutions proposed by policy makers, as well as new ideas. The problem of the market failure is framed as a wicked problem to aid in the policy analysis. Nearly all solutions ever proposed have either failed to be legally implemented or did not address the problem directly enough to be effective at solving it. This paper hopes to contribute usefully to this discussion, and suggest solutions that may actually be successful.

As illustrated by the air ambulance industry, new technologies have the potential to be used to provide very beneficial services, but if they are mishandled it could cause significant problems that are difficult to solve in the future. Research to determine a solution for the market failure of the air ambulance industry provides an important perspective to this end. While HEDGE is an early stage of hypersonic technology development, this technology will progress in the future and could eventually be relevant for the average person. When this happens, it will be important that it not be misused, otherwise another major problem may arise, which could also appear to be seemingly unsolvable.

References

How Often Are Air Ambulances Used? (n.d.). Air Ambulance Worldwide. Retrieved March 27, 2022, from https://www.airambulanceworldwide.com/how-often-are-air-ambulances-used/