Thesis Project Portfolio

Hoo-Rizon 1: Subscale Sounding Rocket

(Technical Report)

Exploring the Environmental and Socio-technical Impacts of Space Launch Vehicles

(STS Research Paper)

An Undergraduate Thesis

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Executive Summary

The rocket launch industry is a stirring research topic, and understanding the challenges and strengths of that industry requires a parallel investigation of the technical and social considerations of rocketry. The following capstone project report describes how the Hoo-Rizon One team designed, built, and launched a class-two sounding rocket. The team pursued that research project to advance their engineering competencies, establish the groundwork for future rocketry capstone teams, and collect various flight data. In parallel, the following science, technology, and society (STS) research paper aims to explore the socio-technical and environmental considerations of the rapidly growing rocket launch sector. Through an investigation of those considerations, the STS paper aims to highlight how different stakeholders understand the benefits and drawbacks of rocketry. Together, the capstone project report and the STS paper highlight rocketry's significant technical challenges, immense positive potential, and key areas that require improvement. This research portfolio contributes a new voice to the existing literature on rocket launch systems, and the resulting lessons may inform consequential policies and decisions that shape the rocket launch industry.

Understanding the engineering behind different rocket subsystems is a valuable asset that empowers students and future aerospace leaders to understand rocketry's socio-technical implications. Furthermore, experience with designing, building, and launching a rocket enables those leaders to capitalize on rocketry's positive potential and mitigate its limitations and negative environmental consequences. Using a variety of 3D modeling, analysis, and design tools and both off-the-shelf and manufactured components, 15 students built and launched a class-two sounding rocket to reach an altitude of approximately 3000 feet and collect flight data.

The team launched the rocket on April 5th, 2025, at the Tripoli Central Virginia launch site in Culpeper, Virginia. The rocket left the pad successfully but had a recovery failure and crashed on re-entry. An ejection charge that was supposed to deploy the parachute at apogee failed due to a problem with avionics. Nonetheless, the project achieved its primary objective: to advance the team's engineering competencies with an applied project and establish the groundwork for future capstones. The events on launch day served as a valuable learning opportunity for the team.

With the growing rocket launch industry, various stakeholders use rockets for diverse missions that empower areas like global communication, military operations, planetary sciences, and research. Therefore, it is important to understand how those applications weigh in comparison with the negative environmental consequences of rockets. The following STS research paper recognizes that rocket launches are not absolutely "good" or "bad." Therefore, it explores how different actors understand the pros and cons of social, environmental, and economic considerations of rocket launches.

The STS paper surveyed the current literature on rocket launches. It used the social construction of technology framework and a cost-benefit paradigm to highlight the various negative and positive socio-technical perspectives on rocketry. The discussion highlighted stakeholders' perspectives, including local citizens, governments, academics, economic markets, natural ecosystems, and endangered organisms. The study summarized the prevalent perspectives held by each of those stakeholders.