Thesis Project Portfolio

Student Researched and Developed High Power Rocket

(Technical Report)

Facilitating Alternate Career Paths for Mothers in the Aerospace Field

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Spring, 2024

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EXECUTIVE SUMMARY

The breathtaking rate of research and development in the space field leaves many wondering - what happens to those who are left behind? In my technical project, we designed and synthesized a model rocket designed to reach an apogee of 4000 feet. This project enabled us to dive deeper into topics that we had discussed more generally in previous aerospace classes and gain practical experience with the design cycle, as well as fabrication. In my STS research, I investigated the experience of women working in the aerospace field, particularly as it pertains to their family life and difficulties they may experience returning to the field after time off to raise children. Our experience outsourcing work to different subteams and sometimes struggling to make various systems compatible on tight deadlines was an experience that accurately simulates the situation in the space broader industry. The landscape of the aerospace field is changing as the government outsources more research and development to different contractors who must work together to meet deadlines, so policies are already in flux and it may be easier to implement new changes to support women who take career breaks.

In my technical project, we conducted the research necessary to synthesize a model rocket essentially from scratch. We divided our group into a mechatronics subteam, an aerodynamics/structures subteam, and a propulsions subteam, and designed our own electronics system, coupling/fin attachment methods, parachute deployment method, payload, and motor casing, among other things. We designed a glider as a rocket payload, which would be deployed at apogee and slowly circle down to the ground, recording footage and providing flight data. This was a potential first step towards launching a rocket that itself could transform into a controlled glider upon descent, allowing it to be steered to a particular location instead of descending entirely at the mercy of the winds. This would remove the necessity to land in the ocean, which

makes rockets costly to retrieve - if a glider apparatus could be deployed it could be directed to a specific location.

We conducted simulations to determine the likely trajectory and flight characteristics, but we were ultimately unable to launch. We encountered a number of issues, most of which centered around the fact that there are many restrictions on student researched and developed (SRAD) model rockets. As our capstone was a new class, our professors did not have prior information about these restrictions, so we learned about them sometimes after we had designed entire components. We learned that we wouldn't be allowed to launch with a student-built motor only after selecting the propellant formula, the design, and planning out the formulation. We learned that we would need to have an off the shelf altimeter ultimately detecting the trajectory of the rocket to determine parachute deployment only after designing our own system. The one that ultimately is the reason we chose not to launch is that we learned in February that the allowable glide radius at the location we planned to launch was ⅜ of a mile, which would be challenging even with just a rocket if the wind speeds were high, but near impossible with a glider being deployed as the payload.

In my sociotechnical research, I investigated the options currently available for female engineers who plan to have children in the aerospace industry, and how those options should be expanded. This topic is increasingly important as the number of women in the aerospace field increases, and relevant to me personally as a woman who will work in that industry. Since there are currently systems in place to support working mothers, I looked into the experience of those who wish to take time off to raise their children but then return to the field later on. Many women struggle to return to the field after a career break due to the changing technologies used and preference of employers for recent experience. I used the framework of care ethics to

showcase the importance of supporting mothers who want to take a career break, and showed that while it might seem discriminatory to assume that women will be the ones who stay home to raise children, having systems in place to support those who wish to is essential to truly support women in engineering.

I found that it is beneficial not only to women in the field to support return to the industry after career breaks, but also to the industry as a whole. If a woman takes ten years away from the field to raise her children, she has twenty to thirty more potential years in the engineering industry, which is more than enough to make significant contributions to the field, and she retains the problem solving skills she learned in her education and her initial years in the industry. Additionally, training programs for returning employees to learn to use new technologies will cost companies some money, but when viewed as an alternative to providing three months of paid maternity leave, sometimes multiple times for multiple children, for women who wish to be working mothers, it is unlikely to be more of a financial burden. Retaining the skill of these women also prevents brain drain from the industry and brings new perspectives into the field, which is essential for furthering innovation in the industry.