MAE 4690 Rocketry Design

Colonization of Space: An Analysis of Weaponization and Militarization of Outer-Space and its Connect to Global Power Dynamics

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

Space, the new frontier, is something that humanity will one day live in just the same as they do on Earth. Building a rocket that is capable of breaching into orbit is something not easily done, let alone building the infrastructure necessary to put it there. Allowing humanity to live in the stars is a goal rocketry hopes to reach. However, once we're up there, what protects us from each other? Who has the power to decide and to implement what is necessary to protect ourselves, while also potentially having the capability to attack?

With a push from private corporations to take over the pursuit of Space and beyond, it is increasingly imperative that long-standing policies be upheld and enforced once we reach this new frontier. Through the design course, it is clear that launching a rocket is not easy through it's very intricate network of those that launch the rockets and the groups they have to abide by. When blown up to a global scale, unlike our small university level, this comes with the network of other countries and their politics, whether they exist to help or hurt your advancements. Seeing obstacles at our level makes me understand that when it comes to a highly political global landscape, there will always be a group focused on holding back progress. Framing this with the incoming colonization of our orbit and other planets, if a historically dominant country, for example the United States, has the capabilities to rapidly occupy this new space while also being able to sabotage the efforts of a less developed country (in the sense of launch capabilities), for example South Korea (Kim T.-H, 2010), what effect does this have on the socio-political landscape within the country, how great can a potential power difference become, and can that gap ever be closed? The development for infrastructure has been in progress ever since the Space Race, headed by the United States and the Soviet Union. In today's climate, this bears fruit as

countries with the means to launch need to primarily focus on scientific developments to reach further into Space, while other countries still have to focus on even developing a space program.

Politics do not vanish once we pass the Karman Line, even in outer space countries are vying for dominance and will do everything allowed to secure their footholds. With this in mind, there have been numerous policies, both binding and non-binding, that exist to limit the destructive capabilities of countries that occupy orbit and beyond (United Nations Office for Outer Space Affairs, 2017). These exist to suppress a potential power creep while also ensuring the safety and longevity of future Space exploration. Without these policies, countries at odds would aim to sabotage each other's operations, creating a wall for new actors to enter the scene, while also causing potential danger to the future occupation of the orbit (Kesser, D. J., & Johnson, N. L., 2010).

With innate difficulties to entering the fray of orbital occupation, there is a leering existence of countries who aim to quickly overtake and colonize, leaving nothing for those late to the taking and thus leading to the overwhelming existence of a few groups in outer space. Policies established aim to prevent this, however these policies also act to prevent active defenses that would aim to prevent from a single party's coordinated attack to takeover orbit. This very flimsy and "on my honor" approach to the "peaceful use" of outer space is something that should be honed and finalized (Francis G. & Sundaram J., 2018).

An Intro into Semi-Amateur Rocketry for Dummies

In a grand perspective, the advancement of rocketry is something that aims to be used to optimize space exploration, with the added "benefit" that comes with advancements in missile

design as the two are sides of the same coin. Our rocket is specifically a sounding rocket, which is used to carry a payload to an altitude where that payload will be utilized. Payloads can be a lot of things, although they are primarily scientific instruments used to capture data that will be recovered after landing. Two-fold, creating a better sounding rocket allows for a general bonus for rocket designs, but also allows for novel data to be collected. Due to the infancy of our project, most of our work deals with research and development, coming in the forms of abiding regulations while also creating, for my team specifically, a test-bed that will be used for collecting and relaying data to the team for analytics and crash-prevention. When it comes to amateur rocketry, these regulations exist to promote the safety of student-scientists and those around them. With these in mind, our ultimate goal is to experiment and optimize a novel sounding rocket design, while also using the Intercollegiate Rocket Engineering Competition (IREC) Design Regulations as a guideline for the project (Spaceport America Cup, 2023) (Spaceport America Cup, 2022). Following these guidelines initially is very important to our team, since our research would be wasted if in a year come to find out that it is illegal or dangerous to use certain ideas or approaches. Also included in these guides is a detailed layout of what parts should be included in a sounding rocket to ensure safety, which by proxy gives us a list of necessary data acquisition components, expediting research into that area.

Altogether, our research into sounding rocket designs aims to assist in advancing general rocketry designs to reach the goal of efficient space exploration, while also assisting sounding rocket endeavors by optimizing current designs. Sounding rocket capabilities could be much broader if the designs were expanded upon, creating new ways to collect data or break into previously impossible areas to collect data. Specific to my team, creating a novel testbed allows us to change how other properties of the rocket are, such as creating a more detailed data

acquisition system allows us to conduct new tests, or creating a smaller testbed allows for more space for other uses within the rocket.

What's in the Sky? Stars of Hope or Sattellites of Harm

From a scientific perspective, pushing towards an occupied and safe Space is the goal and barreling full force to achieve this as soon as possible is the best outcome. If we remember the last time that scientists went full speed without viewing the consequences and politics of their actions (looking at you Los Alamos), the world, and war, was forever changed. With the inevitable breakthrough that will push humanity into the stars, there has to be a serious discussion of how humanity will conduct itself off-world. When America pushed West, new land was taken from those already living there, and those who enjoyed living lives away from the hands of power took on the name of "Cowboy" and fought to escape the law. Historically, with a new frontier, comes the threat of a detachment from society, an urge to take from others, and a reactionary growth in the powers to contain the chaos. Knowing this, multiple groups have established legally binding and non-binding policies to regulate how humanity will treat each other and Space (Elder, D. C., & Rothmund, C., 2001), which humanity then retaliated with by pushing the boundaries of these treaties to ensure defense and safety from orbital danger (Holms, H.-H., 1986). Broadly speaking, countries are allowed to place non-offensive objects into orbit that hold civilians utilities such as satellites with GPS (Sariak, G., 2017). Even GPS technology blurs lines of "non-offensive", as GPS can be used by the military rather than civilians and this would then technically categorize this as an offensive item. This example clearly shows how obscure the line is for what Space can be utilized for, and how countries will actively seek to push this line to achieve their goals. Due to the inability to place defensive armaments into orbit, if there ever were to be a coordinated attack on stations in orbit, deterrence would be too late to

prevent the attack, attached with the fact that post-attack defenses could then also be countered (Stojanovic B., 2021). Viewing the likely suspects, the US or Russia, the issue reverts to a Space Race where political ideologies clash with humanity in the middle (Chayes, A., Chanes, A. H., & Spitzer, E., 1985), due to the fact that these actors already have an established foundation and network of allies that will take sides once we reach the point of occupation. One author points out how an "us vs them" mentality within the US, among others, is to blame for the fear of pushing into Space, while holding back progress (Cross M. K. D., 2019). Solving this would be a crucial step in securing a peaceful future in the stars, as without this peace we could doom humanity to be rooted to a dying Earth.

This problem of whether or not countries will abide by the law stems from the fact that each capable country has its own autonomy when it comes to what and when they can launch. Through my own research, I will analyze how a global architecture can be formed to centralize Space exploration, thus alleviating concerns and applying the law to a single entity. Analyzing previous attempts to do such and the roadblocks encountered with different countries will compose of the basis of this research, with the rest of the research aiming to prove the possibility or impossibility of an idea, and the implications of this on whether or not Space exploration can or should be achieved in its current geopolitical state.

Conclusion

At the conclusion of the design course, we will have produced a function data acquisition kit that will be accommodate for the dimensions our rocket and be able to withstand the propulsive force of the rocket. My research topic will be to analyze current geopolitical climate in regards to the weaponization and militarization of Space. Understanding the current state of the world will allow for a clear picture to what the future of Space will look like. It is imperative

to know whether the direction of Space Colonization will be peaceful or not, as knowing this now will allow for the proper steps to be taken before there is a war in Space. At the conclusion of my research on my STS topic, I will produce an argument on the feasibility of creating a global coalition for Space Occupation and Exploration.

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