**Why Mach Industries**

I look for companies that can benefit our society the most because that is my professional goal. From my previous internship, I had a chance to lead a project to help HVAC technicians, and the magnitude of impact that I realized that I could have as an engineer as well as the appreciation that I received for helping them was so rewarding that I wanted to to seek a greater work to benefit a greater society. And I believe I have the opportunity to do so at Mach Industries. Your company aims to provide one of the solution to our National security. The tehcnolgoies you guys are developing like the cruise missile and high altitude weapons platform are the components that makes United States strong helps our nation. This aligns with my professional goal to do something to help our society. This position is the one where I could achieve my goals, so I want to contribute to providing solutions to our nation as a GNC engineer at Mach Industries.

**Tell Me About Yourself**

I am an integrated masters and bachelor’s student at the University of Texas at Austin. I am graduating this December, and my studies and experiences have been geared towards GNC engineering.

First, this position has a responsibility in modeling and simulating GNC algorithms. I am currently a Navigation Guidance and Controls Engineering intern at Sandia National Laboratory since May of this year. I have been developing an unclassified simulation for one of its flight vehicles in MATLAB and Simulink. I debugged existing models to make a functional simulation and automate simulation runs and git operations that save time in the Software-in-the-loop process.

I was also a Guidance Navigation and Controls Engineering Intern at Blue Origin. I did similar work there where I worked on MATLAB and Simulink Simulation for one of its rockets to improve its fidelity by introducing new features to its navigation model. Here I got a chance to collaborate a lot with other engineers through meetings and especially GIT for sharing work. I have also documented my work to show features I added, and common errors and solutions, so that people after me could pick up my work. It was a great opportunity for me here to demonstrate the qualifications for this job that wants experience MATLAB/Simulink. I expect that communication skills will be important as I am sure you guys collaborate a lot, and I don’t I would have gotten through Blue origin without a good communication skills.

In Academics, I got a chance to become familiar with C++. I was in a drone competition through a course, in which I got a chance to develop a path finding algorithm in C++ , and I could specifically talk about implementing 6-DOF simulations, modeling GNSS measuremnets and IMU measurements later on. I really loved that course.

In other courses, I learned the classical control concepts, took a stochastic estimation course where we got to implement different types of Kalman filters in a simple system. Currently, I amtaking a course in flight dynamics in which I learn about fight vehicle stability and control.

So, I matched my experiences with the qualifications of a candidate that you guys are looking for, Please let me know if there is anything missing that I could talk about if I have experience or have the knowledge in it?

**Sandia**

One of the issues that GNC engineers in my team had was the inconvenient work process in the classified network. There were extra steps and time that needed to be spent compared to working in a regular network. My mentor and I saw an opportunity to improve the process.

So I started working on developing a simulation in the unclassified network because not all the GNC work had to be done in the classified network, some work that can be done outside should have been done in the unclassified network to save time. Working in the unclassified side removes lots of inconveniences!

Fortunately, there was already a simulation in MATLAB and Simulink in the unclassified network, but it was broken and completely out of date. I studied the conops of the flight vehicle I was working on to understand what the simulation should be doing and debugged it to make it functional.

That process involved multiple meetings with my mentor to seek out for help to understand the simulation model and the vehicle itself. My previous experiences in MATLAB and Simulink helped to understand the exact issues with the simulation and come up with solutions for them. By the end of the summer, I was able make the sim functional and produce a result. I am currently still working on the sim to make it more reliable and produce more accurate results

In addition, I also worked to automate the simulations, Developers often took 10 mins~ 30mins a day or a week just waiting for a simulation to run. Since they had to run the simulations very often, say even if the sim took only 10 mins to run, but if he or she had to do it daily, that time adds up to almost an hour every week. This time could be saved.

So I used Powershell Script to schedule the sim at a designated time everyday by itself. Initially, my mentor and I were both unfamiliar with automating simulations, so we reached out to a software engineer to discuss different ways we could achieve that. One of the options we discussed was using Powershell Script. Considering compatibility with the current development setup it was most suitable.

I had never used PowerShell script before, but I was glad I got a chance to learn it and actually apply to a real work. So during the summer internship, I learned to use the script and wrote scripts that scheduled simulations to run at a designated time during the day daily, weekly or monthly, and also make the script to do GIT updates and produce the simulation results in a form of graphs( say a trajectory of the vehicle).

Currently, I have automated my unclassified simulation that I developed to run every morning at 1AM, do the git updates and save the results from the simulation in a designated folder, so that whenever I start working everyday I could just check the result folder without me actually running the simulation. This saves 30 mins a day for me which is how long my simulation takes to run

All in all, at the end of the summer, I was able to present my work on the unclassified simulation and automation of the simulation runs to my team. Engineers were looking for to use the unclassified simulation in the future and showed a huge interest to use the automating script for their own development process that can save time! Through this experience I have made and am making an impact in my team at Sandia by providing an option to improve the GNC software development process.

**Blue Origin**

At Blue Origin, as a GNC engineering intenr I worked on simulations in Simulink and MATLAB for the New Shepard rocket, specifically the ones that are used for verification and validation of flight software.

I was tasked with adding a new feature to the navigation system, which was producing incorrect satellite skyplots during a certain phase of the flight. This required me to work within an Object-Oriented MATLAB framework, which was completely new to me, and I needed to learn about flight systems and navigation concepts.

To tackle the problem, I started by studying the object-oriented programming (OOP) approach in MATLAB. I actively engaged with my mentor and other engineers, asking questions about the navigation system and best practices for improving the simulation. I learned about key concepts like SIL, HIL, and process-in-the-loop (PIL) testing to deepen my understanding of the entire system. Why we are using this sim. So when I create a new script or variable, I would format it in a certain way or choose a distinctive and descriptive variable name, so anyone working on it could recognize what the variable is. One other issue I had to overcome was becoming familiar with navigation terms. At the time I didn’t even know what pseudoranges, L1, L2, Carrier phase ,etc. were about. I asked for 1on1s with my manager and mentor to teach me those, and I obviously looked them up myself. Besides that Communication was critical, and I didn’t hesitate to ask for help when needed. I would come up with a few ideas on why the simulation is acting certain way, say the sequence definition is defined incorrectly, or a certain trigger switches rocket states, and then I would have suggestions from other engineers regards to it. By having many technical discussions like this and breaking down the problem, I was able to adapt and implement a solution.

In the end, I successfully implemented a new feature that corrected the satellite detection issue, producing accurate skyplots. Additionally, I incorporated a navigation block that improved the simulation's fidelity, ensuring that it reflected real-world conditions more closely. Lastly, I want to put emphasis on how much of the GIT I learned here. It was my first time using it and my first exposure to git at Blue. The first month ,somedays I spent half the day working on the sim and the other half spent on Git. It was important for me to be comfortable, because I saw updates every single day. I needed to know how to constantly take those updates in and put my updates out. This experience really ramped me up to be proficient in using Git.

So, at blue , I was able to gain an experience developing and validating simulations in MATLAB and Simulink. I got to utilize source code management tools in Gitlab. Lastly, I demonstrated excellent communication skills. These are required by this position, and why I think I could be a fit for GNC engineer here at MB solutions.

**Aerial Robotics**

This course was basically a competition course where student teams competed to see whose algorithm could go pop ballons with a drone in an obstacle field the fastest. our team developed an algorithm that would enable a drone to pop balloons in the fastest time, navigate through an obstacle field. In the process, I created a 6DOF drone simulation in MATLAB, developed a path-finding algorithm in C++ on Linux

I started the work by modeling the drone's dynamics in MATLAB. So we would see in a visualization tool in matlab that how the drone flies based on a trajectory that we give. The dynamics was accurately modled that it moved as we gave it an input trajectory. WE also implemented a PD controller to control its attitude and trajectory. We also emulated GNSS and IMU measurements. the state estiamtes, we didn't fully develop it ourselves, but our professor gave us the unscented kalamn filter modeled in MATLAB and we had figure out how to utilzie it and incorporate it into our simulation. he state estimates, we didn't fully develop it ourselves, but our professor gave us the unscented Kalman filter modeled in MATLAB and we had figure out how to utilize it and incorporate it into our simulation.

After I built a complete 6DOF simulation, I then moved on to making a path finding algorithm in C++. I compared different methods, A\* Dijkstra’s and DFS and determined that A\* is the best. All this C++ developm,emnt was done on linux system and also utilized a game engine developed by my professor that was used to check the performance of our path finding algorithm. I got to use Ros visualization tool built into the game engine to check how well the algortih mfinds the optimal path to the ballons and the drone pops them.

Teamwork was key to this competition and facilitating it was proficiency in git and communication. I led the team in using Git for collaboration, ensuring everyone understood version control, since no one in the team had the experience before Also my team communicated alot. I thought communciation will be key in solving technical issues i ndeveloping software and also for time managing, since all of us were busy with other works and job seeking and extracurrricular acitivities too. so I suggessted we have designated times every week that we focus on working on this togetther. Being physically togehter helped us communicate much better than working remotely through zoom or email. WE would ask questions to each other right away or debug things together or discuss confusiong topics togther on the spot. I think this was essential in helping us develop a successful code.

Our team successfully developed the algorithm and placed 2nd in the competition. I gained lots of relevant experiences and qualities that this position specifically mentions through this course. To mention those qualities, I gained an experience in developing and validating models and simulations through the complete 6DOF simulation for the drone. Gained an experience in C++ , Linux and an exposure to a simulation visualization tool in ROSCORE for developing the A\* algorithm. I showed my proficiency in version control systems and Gitlab. Extensive work on MATLAB could show my proficiency in it. I also showed ability to apply knowledge towards a timely completion, which was three month for this drone competition. Communication is also a quality you guys are looking for and I couldn’t have succeeed without communication in this team project. Lastly, I want to add I used latex to produce multiple reports throughout this course.

SO I wanted to point out these qualities to show that I am a fit for this position, so please let me know what you think, if there is anything else I need to talk about or need work on too.