**Why Mach Industries**

I look for companies that can benefit our society 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. Also, one of the responsibilities of this job is to be collaborative. I think without communication and collaborative skills, I wouldn’t have gotten through Blue origin.

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. I think this course also translates to my proficiency in simulation tools MatLAB and Simulink and C++.

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 am taking 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. They were usually, incorrect flight sequence call or some sort of condition that was manually put in to force the sim to stop. 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 modeling and simulation process, which is one of the responsibilities for this job..

**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 with simulations in MATLAB and Simulink. I got to utilize source code management tools in Gitlab. Lastly, I demonstrated excellent communication skills. That are required by this position, and why I think I could be a fit for GNC engineer here at Mach industries

**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. With this course in addition to Sandia and Blue experience, I got a chance to be proficient at MATLAB and Simulink, again

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 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. This a\* implementation helped me become more familiar with C++.

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++ , MATLAB, Simulink ,.and Git. Communication is also a quality you guys are looking for and I couldn’t have succeeed without communication in this team project. Lastly, regards Kalman filter, I simply used a unscented Kalman filter that was made, I had to integrate into mysim for this project, but I have taken a stochastic estiamntion course, in which I got a chance to apply different klaman filters, unstntted and extended kalmana filters and also ran MC analysis to see how results come out and how well they estimate the states of asimple system.

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.

**Military-** In Korean military, there is quarterly, squad team qualificaition test that measures the team and the individuals’ abiltiy to operate missions. So physical tactical, and other miltiary basics a solider should know. On the team missions, for the first two quarters I took, we could not get that above 90 points that we needed for our company’s goal. those two first times, it jsut seemed like coordinating the entire squad was hard, the directors for the tests seemed just harsh for no reason. I wanted do something for us change our squad’s performance. So When I rose to the rank when I can start commanding other fellow soliders, I started discussion sessions within the squad before we took a test. we came up with the plans together, rehearse them. talking about each other’s movements, strategeis, tips they have heard over the months. This really solidfied our operation during the test and we did recieve that high performance grade that we needed. IT was really an accomplishment for us. From that I learned that it’s just a discussion and the planning together is what makes a huge differenece and gave us the result we wanted. All we needed to do was communicate among us. and I think Engineering is not much different from that. Communication is the key and discussions are wehre we find solutions in any engineering roles and projects. I have been working since to communciate and at the same time lead my team members through verbal communication in any engineering projects

**Samsung**

This was my internship last summer. The work I did there was not something I expected, but it was a chance for me to learn an entire new thing from the start and apply to work right away. In my life, I ve never coded before, I did not how to make websites. But during that internship I was tasked to learn Javascript, HTML, CSS SQL, VBA and all to create a website and excel tools that helps technicians report failures and record manufacturing data without error and quickly.So I learned all those and at the end I presented my work to engineers and especially the technicians. It was really rewarding again to see technicians appreciating my work and seeing my work at practice. I believe it is still functional in the semiconductor fab right now saving about 1 hour for each of the technicians every shift. I also gained confidence that I can learn new things and quickly adapt to it as well. I am sure there will be new knowledge that I need to learn working at Mach as well, so I want to show here that I have an open mind set to learn and will learn and apply my learnings in this GNC position. Also,while learning, I ran into numerous problems. It was daunting at first, but I struggled and produced a result that benefited the company at the end. So, this experience also shows my grit to overcome obstacles and make progress.

**Trane**

This was my first professional engineering experience. Among couple of things I was responsible for, most memorable was a component qualification project. I led the project, and the product had potential to save installation time for technicians, and I had to test its performance, check its standard compliance, and price to help the company decide whether to use this product or not. This type of product was not a typical component in HVAC, so I had many discussions with other professional engineers on how to test the performance and interpreting the standvsard. I also met with manyh technicians to receive their feedback reflect them on the methods of testing.I have also come up with a safety measure incase the component fails during tests. Experimented it and showed other engineers that it does perform properly as a safety mesure. I loved this project, it was really fun coming up with my own tests, interacting with actual users of the product, technicians, and learned alot from other engineers. It was great chance to show my written and verbal communication skills and was great leadership experience that I believe you guys are looking for this position.

**Guadaloop**

I was the lead suspension engineer for the team last semester. First of all, the team’s design when I became the lead did not have sufficient engineering justification. Meaning, We did not run a thorough stress, cost analysis, etc., so we could not answer anyone who asked why our suspension is built this way. So I scrapped the entire design and began from the scratch. Just like I had done in other design courses, I led the suspension team to take methodical approach to clarify performance specification, brainstorm, picking a design and analyze our selection. We used Pugh charts, gantt charts, multiple sessions of 6-3-5 method, and ran stress analysis through FEA. All these activities provided a solid justification for our team’s design, and if anyone asks why certain things were designed such a way, we could give them a sufficient engineering reason. They involved lots of communications and especially, the FEA required lots of background knowledge in Statics and dynamics. So at the end of the last summer, the team created a CAD of Gudaloop’s suspension along with documentation of the entire engineering process and its justification. The team just has to manufacture it now!

**Grocery-**

My team and I were tasked to make a product to help grocery shopping. WE first went through surveys and interviews to indentify the problems the grocers were having and to dfine a specific problem statement. What is our design going to achieve. And we concluded that our design has to reduce the time it takes for people to check out their groceries. We did HoQ to come up with specifications for our design. When specifications were set, I was mainly responsible for the selection of the materials for our structure. We had three different materials we can get hold of, and I ran FEA based on the estimasted stress that our structure will experience and considered cost and how fast we can get hold of them, and I suggested to our team that we go with wood. Then we went through pugh chart and other brainstorming sessions to finalize our design, and we created a prototype to finish our product. Because this project ran on a timely schedule and was a team project, I think this is another hands on project experience that demonstrates my ability to deliver necessary work on time and work as a team, which will also be qualities necessary as an

**Senior Design Project**

The team I led was tasked with designing an impact test machine for equipments on naval ships. Because we were designing such a big system from the ground up in three months, the project was very timeline driven. Projects like these, I think it is important to have every member on the same page without much confusion. If the team is confused, it delays the time for it to do actual work on the project. In order to reduce such misunderstandings and miscommunications, at the end of every meeting, I clarified action items and their due dates for everyone, so everyone knew what to do and made progress on the project until the next meeting. Also, I stayed open minded as a team leader. When a member thought that he could not finish his work in time, I discussed about it before the due date with the team and tried to see if we can distribute the work or reach out to our sponsor and the faculty to see if such extensive study was necessary given the time. At the end, we successfully met every single deadlines and produced a CAD model of the machine. So, With this senior design project, I helped my team deliver the deliverable on time and stayed open minded to run the project efficiently, which I believe are part