I am applying to the Masters of Science in computer science at Yale University to learn to build solutions to problems that are emerging in the aerospace industry today. As companies work relentlessly to increase safety and reliability while simultaneously striving to decrease cost, noise, and emissions, skills based in computer science will prove paramount to the advancement of the industry. The industry recognizes this, and is moving toward automation and computer solutions to problems. I am fascinated with this shift, and I want to contribute to meeting these challenges. My goal is to be at the forefront of the emergence of automation and AI in the aerospace industry, and to be able to combine principles from computer science with my mechanical engineering background to build state-of-the-art solutions in the aerospace industry.

There are many processes currently employed in the aerospace industry which could be vastly improved. For example, finite element analysis is used commonly to determine expected component and airfoil behavior. But this process takes a relatively long time and uses a lot of resources. Because of this, emulation is becoming increasingly popular as a computationally efficient way to quickly compute key component metrics such as vibration modes and stress concentrations. Across a design space, and based on a threshold for emulation variance error, the number of runs and their locations can be optimized to reduce computation requirements for building a model from which expected emulated results can be calculated. Regardless, creating these models based on multiple design permutations requires a substantial amount of computing power. This makes high performance computing an amiable companion to emulation model creation. The ability to utilize the performance a cluster can reduce the time to create a large model from hours on a single machine to minutes. Being able to efficiently work and communicate between emulation and HPC systems, therefore, is a key driver to future aerospace design and manufacturing technologies.

Another important driver to the strategic direction of the aerospace industry is machine learning. One implementation being discussed is in engine cycle fatigue. Based on the behavior during normal flight cycles, sensors can detect the performance of each stage of the engine. Using this data, one can determine the degree of wear on individual components, and from this extrapolate the time until an inspection is needed. If effectively employed, this can give airlines further notice for when they will have to ground engines for inspection, and will likely reduce the total down-time of fleets. This, in turn, would reduce the price of air travel and increase engine reliability. Effectively making use of machine learning principles to be able to accurately anticipate problems such as cycle fatigue before they become threatening to the operation of the engine is an important and challenging consideration for cutting-edge aerospace companies today.

These are just a few examples of opportunities for emerging technologies that I have been involved with in my experience at Pratt & Whitney, a large scale jet engine manufacturer. During my work at Pratt & Whitney I have had the opportunity to contribute to projects focused on advancing design and manufacturing technologies. One project, DART, focuses on allowing engineers to get rapid feedback for compressor blade and IBR (Integrally Bladed Rotor) design changes. Another project, Airfoil 2.0, automates the inspection process for engine components, focusing on functionally acceptable geometries, rather than blueprint constraints, which increases engine reliability while vastly decreasing inspection costs. With a combination of skills in aerospace and computer science, I hope to further be able to drive innovation to problems such as these as those problems continue to change and evolve.

During my undergraduate career, I was able to explore problems at the intersection of computer science and mechanical engineering. My freshman year I took a lab in MATLAB and Arduino, where I learned the principles of controlling mechatronic systems. Upon completion of the course, I was offered and accepted a position as a Teacher’s Assistant for the class. In this role, I got the opportunity to build and maintain the systems used in lab, as well as assist other students through wiring and software debug. Building off this early experience in my college career, being able to write code was a driving factor to my success in control systems and control systems lab, where I had the experience of designing controllers to increase performance of complex dynamic systems such as an electro-magnetic levitation system and a VTOL (vertical take-off and landing) fan system. For my research in orthopedic healing of tibia fractures my senior year, I developed a workflow which automatically generated plots that overlaid theoretical tissue behavior based on hydrostatic and orthopedic strains on top of real world callus zones, giving operators a novel view into the healing behavior of tibia fractures.

Yale is a nationally acclaimed research university in the computer science field, making it an ideal university from which to build the cross-discipline skills needed to succeed in the aerospace industry. Especially unique to Yale is an emphasis on intellectual curiosity and the combination of theoretical and applied research. Yale presents an environment where students are encouraged to explore what is, what could be, what should be, and how to get there. This type of program where students are truly allowed to roam is uncommon among analogous programs, and appeals especially to my inquisitive nature.

In summary, my goals as a graduate student are to expand my knowledge of computer science as well as computer system architecture to be able to solve next-generation problems in the shared space of computer science and aerospace. As the aerospace industry continues to evolve, new and innovative methods will need to be implemented to face emerging challenges in inter-discipline fields. Looking forward, I am excited to have the opportunity to face these challenges as they emerge.