

STATEMENT OF GRANT PURPOSE

**Charlie Nitschelm, United Kingdom, Engineering
Additive Manufacturing and 3D Printing**

The aerospace industry, and more specifically rockets, are known for their precise and complex parts. To the common space enthusiast, these rockets magically appear to make their journey to the stars, but their real beginning is in design, the production floor, and a complex, refined, and developed manufacturing process. Computer aided design has enabled engineers around the world with the ability to create precision systems, like rocket engines that have the ability to power the modern rocket we see today. The problem is that these systems are not just computer files; they need fabrication in real life to make a difference. Since the beginning of time, engineers have been tied down by the limitations of available manufacturing techniques. In the case of critical temperature rocket nozzles, challenges like internal features and part fixturing requirements make it extremely difficult for qualification and acceptance. However, additive manufacturing (AM), which is the process of building up designed parts from the computer layer by layer, offers the ability to manufacture parts otherwise impossible or extremely difficult to create outside of a computer screen. A good way to conceptualize this relatively new field is picturing yourself assembling your favorite burger. You start with the bottom bun “layer”, then the patty, the cheese, lettuce and so on. AM is much the same. You build a part one layer at a time. The compromises that design and manufacturing engineering have shared for nearly 100 years has fizzled into the ability to create systems that were previously only an engineer’s dream. I am applying for a Fulbright-funded MSc in AM and 3D printing from the University of Nottingham to gain insights in the future of additive technologies. To make an engineer’s dream leave his or her screen and help the world, one layer at a time.

The University of Nottingham and its Institute for Advanced Manufacturing is a leading research powerhouse in AM and 3D printing, with its research in computational methods, printing materials, and overall process control. I plan to apply the knowledge and skills I learn from this program to the aerospace industry, the current leader in utilizing AM for many flight parts. Much of my experience so far in additive processes has been working with and around a direct metal laser sintering (DMLS) printer on an internship at Rocket Lab USA. I helped in the production of all the Electron’s engine’s thrust chambers, Rocket Lab’s small satellite rocket. This thrust chamber’s nozzle in nearly every modern rocket has been redesigned to improve its performance made directly possible by the introduction of metal AM. It was the first industry that could literally bring a propulsion engineers complex dream to life with the implementation of wacky internal features that could actively cool the nozzle’s wall, greatly reducing the overall mass of the engine and increasing its overall performance. It cannot be understated the impact this process can have in industries around the world, but an immense amount of engineering problems are still out there to be solved to reduce cost, increase print speed, and improve quality of every part coming out of a 3D printing machine, all of which are active research areas at the University of Nottingham. I have had preliminary contact with Professor Martin Baumanns, assistant professor of AM management and Director of the AM and 3D printing master’s program at the University of Nottingham, which has enabled me to get an inside perspective of the program and connect with a researcher at the facility. Earning this Fulbright and allowing me to take part in this master’s program will hone the skills required to make a difference in

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improving the quality and usability of additive processes. The process of rapid prototyping with plastics have been improved so much so that they can now be bought as a reasonable birthday present to a very lucky child. Metals are just too expensive to become a common household appliance, but they have the ability to transform the manufacturing industry as a whole. I am not only excited to live during a time of such innovation in additive but am tantalized by the opportunity to take part in the worldwide movement.

The post-graduate taught course with small research projects that the University of Nottingham offers directly aligns with my interests, as they research technology levels 1-3, meaning very new technologies that have not had the time to even develop industry standards for. It consists of block modules, normal lecture courses, and a large summer individual project that culminates our learning into a specific focus area in AM. Their advanced manufacturing course that reviews the current practices in post-printing conditioning and processing seems the most intriguing to me after talking to Professor Baumann. It is also a huge area in the aerospace industry that needs significant work. They also host smaller AM conferences and travel to a few large ones throughout the year to connect, learn and share knowledge to keep up to date with the industry. I am most excited about the Germany AM conference, FormNext, which the professors and graduate students at the university attend, as I have used several German-based additive machines and enjoy the build quality and user interface.

The community outreach that is currently active at the University is plentiful and interesting, especially Code Club. Code Club is an outreach program committed to educating young students on the power and future of coding and computers, one I look forward to the opportunity of volunteering. I was fortunate to go to an afterschool program during my elementary and middle school days that introduced me to not only coding but also having the freedom to be creative and build what was on my mind. To this day, I still code on multiple platforms to analyze data and control machines. Enabling young minds with the resources and professional assistance to be creative and create led me to my career as an engineer, and I know that there are children around the world that just need a little inspiration to find their passion in any STEM field.

A well-rounded educational background in mechanical engineering (ME), research in Inconel (a common 3D printed nickel-based super alloy) and hands-on additive and advanced manufacturing work as an intern at Rocket Lab USA in Los Angeles have equipped me to be successful in pursuit of this specific advanced engineering degree. Once I found the drive of the rising commercial space industry and its connection with additive manufacturing, I could not take my mind off it. It allowed me to have the passion to start a rocket club, UNH Students for the Exploration and Development of Space, and design and manufacture a working hybrid rocket engine, and create a space community that shares my passion for the excitement that is coming to space over our lifetime. The experiences and advanced topics I would learn at the University of Nottingham in this specific additive program directly aligns with my long-term professional goals to have an impact in manufacturing, which resonates around the world. The outcome will push me to continue my work in the fast-paced commercial space industry. The acceptance into the Fulbright program will pave the way to become a more globally minded, well-rounded leader and engineer.