**Fulbright Program Information**

**Award Type**: Study/Research Award

**Country**: United Kingdom

**Award**: University of Nottingham Award

**Program:** Additive Manufacturing and 3D Printing MSc

Field of Study

**Engineering**

Project Title

Enter a descriptive Project Title. If awarded a grant, this Project Title will appear in the Grantee Directory.  
90 character limit.

**Additive Manufacturing and 3D Printing**

Abstract/Summary of Proposal

Prepare an executive summary detailing the what, where, and why of your proposed project․ If you are proposing the pursuit of a graduate degree program, summarize the program and relevance to your career/education plans․  
*200 word limit.*

It is rare to play a role in the disruption to the biggest industry in the world, manufacturing. The University of Nottingham, notorious for its world-leading research, hosts the most prestigious masters in additive manufacturing and 3D printing. Not only will the program teach me advanced skills and knowledge in 3D printing, but it will allow me to look forward and play a role in the future of the technology. My first-hand experience in additive manufacturing enabled me to understand how much companies can prosper by the freedom of producing parts otherwise impossible or very difficult to make. The aerospace industry, which is well known for complex parts and mind-bending challenges, has been able to use this tech, although still infantile to its potential, to improve performance and manufacturability of some of the most complex parts in the world including rocket engine nozzles and injectors. The connections between accelerating the path to make humans a multi-planetary species and the opportunity for advanced additive manufacturing to play a role is not only tantalizing but drives me to develop the skills to make a significant difference in the world.

Host Country Engagement

A key purpose of the Fulbright program is to be a cultural ambassador while living abroad.  How will you engage outside of the workplace to fulfill this mission?  In what ways do you plan to share your culture and values in your host community?  Provide specific ideas.  
*200 word limit.*

I had the privilege of starting a local Students for the Exploration and Development of Space (SEDS) chapter at my university that is dedicated to allowing students passionate about the aerospace industry work together to support learning, outreach initiatives and professional networking. The community that I have built at the University of New Hampshire has enabled the team to chase their passions into the space industry, finding work that they enjoy and find rewarding. I plan to start a chapter at the University of Nottingham for the same reasons because space isn’t for one country, but for all. I also plan to participate in current organizations at the University. 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. To be introduced to the language early will allow young students to be exposed to the current blossoming field in the tech industry. The final thing I would like to actively participate and assist in is local makerspaces, as that is what can help so many people in a community imagine, design and build their own work locally.

Plans Upon Return to the U.S.

Describe your career and/or educational plans after completing a Fulbright grant.  
100 word limit.

My passion is commercial space and accelerating the rate of making humans and life multi-planetary. The biggest impactor to this goal is the manufacturing component. After my Fulbright grant and the master’s program at the University of Nottingham in additive manufacturing and 3d printing, I will be more equipped technically to handle the upcoming roadblocks in production of the most advanced rockets getting built today. SpaceX’s Starship will be the vessel carrying humans to the surface of Mars to stay during the late 20’s and 30’s. I plan to work on that project, carrying humans closer to the stars.

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 Baumers, 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

Charlie Nitschelm, Grant Purpose, Page 2  
  
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 Baumers. 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.

PERSONAL STATEMENT  
Charlie Nitschelm, United Kingdom, Engineering

July 25th, 2019 was the best day of my life so far: I met Elon Musk and was asked to talk to him privately about the future of space and manufacturing at SpaceX; I shook hands with Buzz Aldrin, the second human to walk on the moon; and I spent the day and night with fellow space students and current space leaders. I wasn’t always a space-nerd though. It was during the middle of my freshman year at the University of New Hampshire that I witnessed the first sub-orbital flight booster reenter and land on a floating drone ship by SpaceX. I have always followed Elon Musk and his adventures into the space and automotive industry with Tesla, but seeing live what commercial space is capable of completely defined my dreams. My uncle Allen, who started his own newspaper company and genuinely enjoys his work, told me there is sometimes a moment in people’s lives that make them realize what they are passionate about, what they are inspired to work on. For me, it was that moment. I wanted to work on the development of space.

Space is a unique industry, and one that is inherently cosmopolitan. It is the only industry that is the same distance away from everyone, just 100 kilometers above your head. The one challenge for me was to become a member in the commercial space community, as it is the hardest industry to get into as an engineer. I didn’t want to wait for my university days to be done to begin my venture into commercial space, so I started a local Students for the Exploration and Development of Space (SEDS) chapter where we specialize in the design and manufacturing of rockets and hybrid engines, and community outreach. SEDS has given me the opportunity to work with like-minded engineers on aerospace projects that are exciting and difficult. It was my first experience in difficult manufacturing challenges, and my initial work with plastic 3D printing.

My work with SEDS and my passion for rockets and commercial space led me to be accepted into the Matthew Isakowitz Fellowship Program. The fellowship is a selective internship and mentorship program for students passionate about commercial spaceflight. It led me to work at Rocket Lab which is a rocket company based in New Zealand. I worked in their Huntington Beach factory manufacturing the rocket engines for their Electron rocket launched in Mahia, New Zealand. The Fulbright program also pairs perfectly with my belief in the strength of cultural connections. Working at a New Zealand based company let me interact with the engineers there that not only think differently but offer creative ideas and concepts that could not have come from any of the engineers here at the US factory. Just recently, I was working on designing a tool for machining a nozzle extension for our engines. I was able to reach out to the lead engineer in New Zealand to work directly with him on coming up with the most optimal design for our needs.

Space is grand, and it will take minds from around the world in every industry to make humans a multi-planetary species. Being a team player and working with people regardless of cultural upbringing or religious beliefs is imperative to the future of everyone on Earth.