**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, and even oldest 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. From learning first-hand, additive manufacturing, which is the process of building up designed computer parts layer by layer, offers a company the ability to manufacture parts otherwise impossible to create outside of a computer screen. 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.

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, dedicated to allowing students passionate about the aerospace industry work together to support learning, outreach and professional networking. The community that can be built and the cultural exchange and appreciation that a SEDS chapter can foster is a fundamental reason I would like to see the start of a chapter at the University of Nottingham, continuing the naturally supportive and accepting culture that has been the aerospace industry. I also plan to participate in current initiatives at the University, including Code Club, an outreach program instilling the power and future of code and computers to young students in the area. Although I am an engineer, coding is the neckbone to make modern machines function correctly. To get introduced to the language of computers and systems early will let young students be exposed to a 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.

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, complex parts. To the common space enthusiast, these rockets magically appear to begin their journey to the stars, but the real beginning is the start of making it. Computer aided design has enabled engineers around the world with the ability to create precision systems, like rocket engines, that have the potential to turn into the modern rocket we see today. The problem is that these systems are just computer files, and they need to be made in real life to make a difference. Since the beginning of 20th century manufacturing, engineers have been tied down with its limitations, like no internal features, which are heavily used in critical temperature rocket nozzles, and part fixturing requirements, which are basically things to hold onto when cutting the part to fit the designed shape. But additive manufacturing (AM), which is the process of building up designed computer parts layer by layer (around 1/1000 of an inch at a time), offers the ability to manufacture parts otherwise impossible 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, then the patty, the cheese, lettuce and so on. AM is much the same. You build a part one layer at a time. The entire compromise that engineers and machinists have shared for nearly 100 years has fizzled into the ability to create systems that were otherwise 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 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 management. 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 a direct metal laser sintering (DMLS) printer on an internship at Rocket Lab USA. I helped produce all the Electron’s engine’s thrust chambers, Rocket Lab’s small satellite rocket. The thrust chamber’s nozzle in 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 wet dream to life with the implementation of complex 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 is 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 area 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 the leading researcher at the facility. Earning this Fulbright and allowing me to take part in this master’s program will home in the skills required to actively make a difference in improving the quality and usability of additive machines. The process of quick 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 world-wide movement.   
 The post-graduate taught course with small research projects that they offer 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. For me, their advanced manufacturing course that reviews the current practices in post-printing conditioning and processing with also a look ahead on new technologies looking to improve the final part quality seems the most intriguing to me, after talking to Professor Baumers. 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 (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.  
 I researched the community outreach that is currently active at the University was inspiring, especially Code Club, an outreach program committed to educating young students on the power and future of coding and computers which I plan to volunteer at. I was fortunate to go to an afterschool program during my elementary and middle school days that introduced me to not only coding but 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 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 superalloy) and hands-on additive and advanced manufacturing work as an intern at Rocket Lab USA in Los Angeles has equipped me with the ability to be successful in pursuit of this specific advanced engineering degree. When I started at the University of New Hampshire (UNH) as a ME major, I didn’t have a clear idea in what I wanted to apply my skills to. Once I found the drive of the rising commercial space industry, 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 most rewarding thing I have accomplished thus far was SEDS, and it drove me to be a part of the larger community that runs all the chapters throughout the USA. I do know that the University of Nottingham does not have a local SEDS chapter and will investigate starting one. The experiences and advances 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 acceptance into the Fulbright program will pave the way to become a more cosmopolitan, 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, shook hands with Buzz Aldrin, the second human to walk on the moon, and 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 time 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 physical location 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 rockets, hybrid engine design and community outreach. The family I have formed over the past two years with 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.

Working with printers at the local makerspace as part of SEDS and my passion for rocket engines led me to be invited into the Matthew Isakowitz Fellowship Program which 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 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 Kiwi people that not only think differently but offer creative ideas and concepts that would 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. I also had the opportunity to visit Hong Kong this past March with my family as my brother has been working there since the beginning of 2018, allowing me to branch out physically from the USA an experience Asian-rich culture.

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.