Final Reflection on
My 2015 Summer Research Experience at the Missouri University of Science and Technology

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This summer, I attended the Summer Research Academy at Missouri S&T, in Rolla, Missouri. For six weeks, I worked in an actual, advanced college laboratory--the Advanced Systems Research Laboratory--on my own project.

In the Lab

For the first two weeks of the program, I worked in the lab, studying different topics of control theory for mobile robots and practicing using MatLab and Simulink software, which were crucial foundations for my project. After surmounting the learning curve, I was given substantial freedom to write code and design algorithms to improve the controller that I was given for our ground robot. I would work for hours, brainstorming in my notebook and consulting my advisor, Dr. Tansel Yucelen, and his graduate students in the lab, followed by writing more code and running actual performance tests.

Some of the most exciting moments came when I discovered mathematical solutions to problems encountered when trying to improve the robot's performance and counteract limitations to the data collected by sensors in the lab. I was utterly surprised and thrilled to find that my profuse and passionate studies of algebra, geometry, trigonometry, calculus, and physics during the last three years of high school turned out to be critical in my research, as I would sketch complicated situations in my notebook and use mathematical analysis and modeling to solve real-world problems. I remember a few specific instances when I was working in the lab or in the dorm lounge and found a fix to a major problem I was grappling with. In those instances, I would slam down my pencil and yell, "There it is!"–only to have one of the graduate students think that I had broken something in the lab, when in reality, I had found an exciting solution.

This all culminated in my creation of a research poster, which I presented to other students and parents on the last day of the program. Overall, my project turned out to be greatly successful, as I was able to stabilize and improve the major control features of the robot and create algorithms for it to perform point-to-point position tracking. And, throughout the process, I enjoyed working on stimulating problems and finally getting to use knowledge learned in school for something so intriguing.

Summer College Life

Outside of the lab, I was given many of the freedoms that the college student on campus enjoyed, as I had a free schedule and my own student I.D. and meal card. I usually woke

up around 7 or 8 a.m. for breakfast before heading to the lab; however, having the freedom of choice in a college setting, I sometimes opted for extra sleep and ran to the Havener (student) Center's Einstein Bagels for breakfast, which I would then work off through frequent treks to the fitness center after finishing up in the lab for the day.

My typical schedule involved working in the lab from 10:00 to 11:30 a.m. and from 1:00 to 4:30 p.m. every weekday. With the company of my new friends, we would always meet up for lunch at one of the various campus eateries, whether it was our dorm's cafeteria or another vendor like Rustic Range Burgers in the Havener Center. (We were an ambitious group, but none of us were brave enough to eat their FIVE (5!) patty burger.)

After leaving the lab, I would often go the fitness center as mentioned, or relax and enjoy the summer weather on campus. Then, every night, I would meet up with my fellow Research Academy friends, and we would take advantage of our freedom as students on campus, exploring campus or playing board, card, and video games, followed by a movie every night … and that is not an exaggeration. We literally watched more than 40 movies, ranging from horror movies to the Disney movies of our youth. It was an incredible time and allowed us to bond as friends and have real discussions about our personal lives and the worlds we come from.

Lastly, every Saturday, we were taken off campus for an exploration of fun activities in Missouri. The main places we went were: Six Flags, Splash Zone in Rolla, Fantastic Caverns, Skyzone Trampoline Park, the Bass Pro Shop headquarters, various shopping malls, and Big Surf Waterpark. We also spent the 4th of July in Rolla, watching endless fireworks across the Missouri horizon. It was a great escape from the challenges of lab work, and it allowed us to bond as a group and with actual college students who joined us. It also enabled me to grow as a person and overcome fears, as I managed to conquer a couple rollercoasters at Six Flags with the mutual support of a few other coaster-phobia friends on the trip.

Skills and Lessons Learned

The biggest challenge of this program was building the endurance and independence to live on my own for six weeks. Honestly, the first week or two were a real adjustment from home life and the comfort of my family. The skills of independence I learned from everything I did on campus cannot be overemphasized. I learned to teach myself much of the material necessary for rigorous lab work, learned to worked on my own to solve problems, learned to make personal choices about how to use my time productively and healthily, and learned to find ways to make friends in a world of strangers (though a very unique and interesting universe of strangers). All of these were challenges that promoted the growth of my independence and social skills, which combined to create a wildly successful and enjoyable experience.

Socially, I learned so much by becoming good friends with many people from around the country, who often shared diverse interests from my own. It was fun to learn about

others' research projects and discuss their passions and knowledge of activities, like marching band, while on my end I tried to teach them the basics of many sports. It was a great bonding experience with my new friends of many backgrounds, who I will be sure to stay in touch with in the future.

Moving Forward

Taking all of the skills that I learned from working in a college laboratory, whether it be how to work independently or how to utilize mathematical skills and tools like MatLab, I feel I am much better equipped to move into college studies than I was before this program. The whole research process of working in an engineering lab has ignited a strong interest in conducting future research, as I look to further my advanced study of engineering in college. This experience has also provided me with a glimpse into the various fields of engineering and will surely help me choose a major based on my interests in continuing to study robotics and systems control theory, while giving me a great mentor in Dr. Yucelen to ask for guidance or just discuss the intriguing world of engineering.

In the end, I really can't thank the Garwin Family Foundation (GFF) enough for everything they've done. Not only did they support me in actually attending the program, but also their outreach to provide this unique and rare opportunity to Carbondale Community High School is what inspired me to even consider doing something productive with my summer. I feel like this outreach is the real testament to the gift that the GFF has been for my school and for me, for:

"To be inspired is great; *to inspire is incredible*."