

Personal Testimonial

Research Internship Information	
Institute: Elektrotechnisches Institut (ETI)	
Project: LeMoStore – MMC with Integrated Batteries	
Supervisor: M.Sc. Niklas Katzenburg M.Sc. Lars Leister	Duration: May 15 th 2024- August 15 th 2024

MINTernship Program 2024

My name is Lucas Pereira. I am an Electrical Engineering master's student and I had the privilege to go to Karlsruhe, Germany for an internship in the summer of 2024 as part of the Transatlantic Energy Research Experience (TE-Rex). This research internship has been the most culturally enriching and exciting trip I have been on, and I am forever grateful to say that this is the first internship I have been a part of. The country of Germany is incredibly fascinating. From the beauty of its architecture to the delectability of its currywurst, there is truly a lot to experience here. When I arrived in Karlsruhe for the first time, I was incredibly jetlagged and stressed from the trip from Charlotte. During my first night in Germany, I went to bed at around 1-2am and woke up at 4pm the next day, which was very odd for me because typically I do very well with jetlag and am not affected by it, but in this case, it was very different. Going to my local Aldi for groceries and other toiletries was not too stressful though. The fact that I studied German for two years helped me in reading labels and interacting with the cashier well enough to get by, but there was still a lot I did not know how to read or understand properly.

Getting used to my new life in Germany got easier and easier as the days went by. I became accustomed to where all the necessary stores were, and I even joined a gym close by. It also was very nice to see friends I made from previous MINTernship groups from KIT that went to UNC Charlotte. Something else I noticed very quickly was how safe Germany was, even at around midnight. Since there is not much crime in the city, it made me feel a lot better while living in Karlsruhe. After a few days of being in Germany, we started working. At first, I was a little nervous as the topic was not something I was incredibly familiar with, and I had no idea how my supervisors would be like. Thankfully, they were incredibly nice and helpful throughout the entirety of this internship program. Even when I had a lot of questions to ask, they were always willing to answer them by helping me figure out something in the MATLAB code or if I needed something reiterated. Something that always intrigued me was the community that I saw in the building I worked in. Every day, the Ph.D. students would go to the Mensa together, and all the master's students would go to the Mensa together. I and the two other UNC Charlotte students working in ETI would go with the master's students since we fit more with that group. Not only that, but the master's students would have their own weekly catch-up meetings to see the progress of everyone's thesis research. I find this interesting because at UNC Charlotte, these types of activities do not occur. I like the fact that the master's students have this

emphasis on helping each other out even though their topics may be different. When I go back to the United States in a few days, I will see if this kind of thing may be implemented and if it benefits the greater student body in the Electrical and Computer Engineering Department.

The project I was placed on is called “LeMoStore – MMC for Integrated Batteries” where I was tasked with getting efficiency measurements for a cell of the modular multilevel converter looking at parameters such as input voltage, duty cycle and output current. The cell that was tested on is a Full Bridge converter. Though efficiency measurements sound like a simple task, it was anything but. The first thing that needed to be done was code an efficiency calculator in MATLAB to simulate what sort of efficiencies we expect to see. They were extremely high. Upwards of 99.999% which are very unlikely for any realistic converter. After some research I realized there were a lot more losses I needed to consider for this to be as close to real as possible. After adding all losses possible with a MOSFET, the graph looked more and more realistic, and we were getting a range of 80-98% in normal operating ranges. Afterwards, I needed to start interfacing with all the different hardware for the final measuring phase. This required me to become familiar with connecting to 4 different devices using 4 software to have a proper measuring procedure. MATLAB was at the center of it all and would be what I use to connect to everything and run the actual measurement and the post processing. I would argue that interfacing was the most challenging aspect of the project as I had to become familiar with the other programs and the fact that I had a lot of simple yet frustrating issues with connecting to hardware. For example, for the system on chip (SoC), it took roughly 2-3 days for my supervisors and I to realize that all we needed to use was a different browser for it to connect perfectly every time. After those frustrating few weeks, the measurement phase of the project started. Of course, there were some issues I and my supervisors came across, but ultimately, the efficiency graphs were able to be acquired, and I would finally have something to show for the 3 months of working here at KIT. Looking back at the original graphs I was able to get during the efficiency calculator phase, they were not as different as I originally thought they would be. This was relieving to see as it shows that my methods for the calculator were legitimate. Though I was here in Germany to work on this project, I was also able to travel to plenty of different cities in the country and other countries as well.

The places I was able to travel to in Germany included Heidelberg, Frankfurt, München, and Berlin. The first two were trips I made with my fellow UNC Charlotte students while the last two were organized by the university for us. Going to all these places helped me to see how different every city is in Germany. Every city has its own culture and architecture, and it was astonishing to see every bit of it. I was especially a fan of each different Altstadt I was able to visit. The feeling of being in a medieval town with the architecture all around was not something I am able to experience in the United States, so I truly tried my best to take it all in whenever I had the chance to. The food in Germany is something else I have enjoyed a lot. For example, in München, I had the chance to have Weißwurst with sauerkraut and a pretzel for breakfast. Since this is the traditional Bavarian breakfast, it was something I needed to try, and of course, it was amazing. The food will most definitely be one of the top things I miss when I go back to Charlotte. I was also able to travel to Milan in Italy, and Basel and Lake Luzerne in Switzerland. All three of these places were also astounding in their own regard. All the architecture of Milan and Basel as well as the nature displayed at and around Lake Luzerne were some of the most

incredible things I have ever seen. No picture or video I take of any of these places can capture the full beauty of the scenery I was able to experience while being there. I would sincerely like to come back to Europe and travel where I haven't been able to. Even though I was able to see a lot of different places, there are still many countries and cities I would absolutely love to visit. If I were to recommend any of these places I traveled, it would be Switzerland. Everything there is more expensive, but it is surely worth the trip. The scenery you can see there is incredibly breathtaking.

As I finish this internship program, I can gladly say that I recommend this internship to anyone who is willing to travel and experience new things. It has been one of the best decisions I have made and the memories I have made here are some that will last a lifetime. Rarely ever does such a program like this exist that can give you so much more on top of expanding your technical skills and abilities. Though I have traveled to Brazil, stayed in Europe for three months was something completely different culturally. It was also nice that I was able to be in a group with friends of mine that I made while doing my bachelor's at UNC Charlotte. Having this experience together with them made it all the better throughout the entirety of the three months. I would like to sincerely thank KIT, the staff of the international students office working to organize this exchange and the activities they had for us, and the supervisors/mentors helping us learn and grow during our time here.

Sincerely,

Lucas Pereira





