

TITEL | TITLE

Progress Report Birmingham

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My research internship at the University of Nottingham

1. Introduction

In this report, I will describe my impressions and experiences that I was able to collect during my IECP research internship at the University of Nottingham. I hope that both, the report on my internship and my experiences in Nottingham and England will generally help future applicants to choose Nottingham. I will try to list the most important aspects of my stay abroad. I will deal with the application phase, the journey, first impressions of Nottingham, the research activity, and, of course, a whole lot of life in Nottingham itself and England in general.

2. Application and planning phase

My original plan was to complete an ERASMUS semester at Imperial College London. During my bachelor's studies, I specialized in the field of energy technology, especially power electronics and control technology, and worked as a student assistant for two and a half years at the Institute for Power Converter Technology and Electric Drives (ISEA) at RWTH Aachen University. My goal was to gain deeper insights into the field of power electronics and control technology before finishing my master's degree during a stay abroad. Unfortunately, the place at Imperial College was not assigned to me. However, the faculty told me about the IECP program and encouraged me to apply there.

Colleagues at ISEA told me that the institute made an excursion to England in 2015 and that Nottingham was visited. They were very impressed by Nottingham and told me that the University of Nottingham, more specifically the Power Electronics, Machinery and Control Group (PEMC), is one of the best-equipped and most famous institutes they have ever visited. Based on this recommendation, I decided to apply for the IECP program for a research internship from October 2016 to the end of March 2017.

The application process was easy going: After submitting all documents, Professor De Doncker made a first contact with Professor W. in Nottingham. He introduced me, explained my interest in research and my previous work at the ISEA. Afterwards, I continued the contact with Professor W. via Mail, who was extremely sympathetic and very uncomplicated in the planning of this internship. It turned out to be very easy. I could choose my preferred duration of my internship and was insured that I will be a part of a current and relevant research project (I would know my exact subject after my arrival) and I started to look for an accommodation in Nottingham. The search for accommodation in Nottingham was probably the greatest obstacle to be overcome. In hindsight, I learned that students in Nottingham live mainly in jointly rented houses. Without a contact person, possibly without inspection and only for a relatively short period of time, such a flat share is difficult to find. I have looked for accommodation in different Facebook groups and at Unipol, a student housing agency. Student residences are much easier to find from Germany than jointly rented houses. However, without an ERASMUS status and without an enrollment in Nottingham, the dormitories of the university itself are not accessible. But there are numerous private residences. Unfortunately, they rent their rooms, preferably for a whole academic year beginning in September. Inquiries for short-term rental agreements were mostly answered by the fact that there might be places left after the beginning of the academic year (September). This was too short of notice for me, since I started my internship in mid-October. The dormitories consist mostly of apartments with 4-8 rooms each (with private bathroom) and a common kitchen. All in all, only two dormitories in Nottingham offered short-term rental contracts, but they costed about £ 120 a week, which is £ 90 higher compared to the normal student rates. Nevertheless, I chose Cotton Mills dormitory, because of the better plannability.

After both, the internship and the accommodation were organized, I was surprised that the main part of the planning work had already been done, I would have imagined it to be more difficult.

3. Arrival in Nottingham

On October 10th 2016, my girlfriend and I flew to Nottingham for the first time to set up my room and get to know the city. By the end of October 2016 there was a direct flight from Dusseldorf to Nottingham (East Midlands Airport), and from there it was still 30 minutes with the Skylink bus to Nottingham. However, after this connection was canceled at the end of October, the nearest airport was Birmingham. From there to Düsseldorf there are regular connections with Eurowings and Flybe and from Nottingham to Birmingham it is about 1.5 hours by train. In any case, it is advisable to buy a 16-25 railcard (as long as you are younger than 26), which gives you 1/3 discount on all rail travel in the UK, it costs only 30 £ and opens up many possibilities to get to know the country. With the railcard, a trip from Nottingham to Birmingham Airport and back costs approximately £ 16 (return tickets generally cost the same as a single journey ticket).

In Nottingham, we received my room. Cotton Mills is an old cotton factory converted into a dormitory. The old house has its charm, however, the rooms are a bit old, and so it is certainly not a dream accommodation. However, for a few months it is alright. The IKEA branch in Giltbrook, which can be reached by the "rainbow one" bus line in 20 minutes, is a good help. In addition, the management makes sure, that student of the same age live together. My flat mates were super nice and one of them gave free fitness classes in the fitness room of Cotton Mills two times a week.

There are two large bus companies in Nottingham and a tramline, which makes the traffic in the suburban traffic somewhat more difficult. The operators however, have a common "Robin Hood Ticket". It can be used in the urban area of Nottingham. For an academic year, the ticket costs £ 270.

After we set up the room, bought a railcard and a bus ticket, we still had a day to get to know the city. My definite stay in Nottingham started a week later.

4. Research at the PEMC Group

The PEMC Group is one of the largest research groups in Europe, with over 100 doctoral students in the field of power electronics and electrical drives, supported by six professors, a lot of assistant professors and senior researchers, as well as many postdocs. Personally, technically and financially, the PEMC Group is extremely well equipped. This is probably because doctoral students have to pay the high tuition fees like many students there and generally get no salary, as it is customary in Germany. However, it makes it possible to carry out fundamental research in a special way. Thus the PEMC Group has remarkable possibilities, e.g. from the magnetic material characterization to the finished prototype, to construct almost any electrical machine or to produce novel packages for power electronic modules with integrated filters and a sophisticated cooling concept without the need for project partners.

My work was assigned to Professor W., who is mainly concerned with power electronics systems for aerospace. A key concept here is "The More Electric Aircraft" (MEA), which describes a trend in aviation where conventional actuator systems such as compressed air, hydraulics, pressure relief systems and even de-icing systems are increasingly being converted to electrical systems that are more efficient and reliable. The challenge here is to adapt the electrical networks of the aircraft to the significantly increased power, make it more flexible and secure. I was able to be part in a project, which is part of the European Clean Sky 2 initiative, and which promotes future-oriented technologies for a cleaner civil aviation of the future. The ASPIRE project deals precisely with the above-mentioned challenge of new DC-DC networks for aircraft. A very modular approach is used, which works with a variety of busbars, switches and converters of low power that connect the different voltage levels. A part of the project deals with the question of how the network can independently change its structure by closing/opening switches or switching on/off of converters in such a way that it is optimally adapted to a particular flight situation. The second part of the project dealt with the design of a prototype for exactly one inverter that connects two DC voltages bidirectional with a power of 3kW with a weight as low as possible.

I was allowed to participate in this field and my task was to optimize a special inverter topology for minimal weight. My colleagues developed alternative topologies, and at the end of my stay, we presented a design proposal to the project partners from all the findings. I was placed at the Aerospace Technology Center (ATC) on the Jubilee campus, which is relatively new and is comparable to Melaten in Aachen. The main part of the doctoral students

are accommodated on the main campus, the University Park Campus, but a large part of the "Clean Sky 2" projects are in the ATC. This was a good choice for me especially because it was possible to establish contacts faster due to the smaller number of employees. The Jubilee Campus is just 15 minutes' walk from the Cotton Mills.

I was able to work very independently at work. Every week I had a project meeting with my colleagues and the senior, Dr. R. We discussed the progress and further steps. Being treated like a doctoral student, enjoying great trust and a certain responsibility, was an enriching experience. I had the opportunity to deepen my knowledge about power electronics and get to know the fascination and challenges of self-responsible research. I also gained new insights into the course and organization of a research project and the tension between creative research and compliance with the requirements of the project plan or the fulfillment of the timetable. From time to time, we presented our progress to Professor W. and wrote corresponding reports. From all sides I received every possible support. I am extremely grateful that I have been given so much confidence. At the end of my internship, I was able to present a good design for my inverter topology.

For me, the PEMC Group is characterized by a very special feeling of belonging. The care was extremely good. My colleagues at the ATC were very close friends. There were both common professional activities such as small seminars, where individuals could present their projects and discuss all problems and ideas with everyone else, as well as common leisure activities, such as regular meetings in the pub, from students to professors all. With most of the technical problems one could rely on the fact that someone in the PEMC Group could help.

5. Life in Nottingham

Nottingham has a lot in common with Aachen. It has about 300,000 inhabitants, a large number of students studying at one of the two major universities in the city, the larger University of Nottingham (usually called "Uniof"), And the slightly smaller Nottingham Trent University ("NTU").

The city center around the Old Market Square is similar in size to Aachen's, but it lacks the medieval charm and the beauty of Aachen. Instead, Nottingham's streets are rounded off around the corner house and in the streets surrounding the Lace Market with the tenfold feel of bars, pubs, clubs, cafes and restaurants compared to Aachen. On weekends, the city center is full with anyone who is older than 16 and younger than 80 years old. You can start the evening late in the afternoon in a cozy pub (but you should avoid English beer), a student-friendly theater visit or a free concert at the Nottingham Contemporary Museum, join for the rest of the night at the Pitcher & Piano's, one to a stylish bar Rebuilt church, and pull through the bar, which is different and crazy, until early in the morning.

Apart from this, Nottingham offers a lot more. What in Aachen is Charlemagne, is Robin Hood in Nottingham, who is said to have lived in the Sherwood Forest, which was close to his outlaw. Nottingham Castle offers some insights into the history of Nottingham, not only the famous forest inhabitants. On the edge of the city center flows a small cozy canal and a little further out the River Trent. There are numerous parks, probably the most beautiful and largest is the Wollaton Park with an old mansion, where on the weekends the best English tea time is served. Since Nottingham is built on sandstone, some caves have been built under the city, which can be explored. Especially the caves under the castle have already provided for some legends. Also carved into the Castle Rock is the (allegedly) oldest pub in England, "Ye Olde Trip to Jerusalem". But also the main campus of the University of Nottingham is a nice place to spend time, for example, a walk around the large lake on the campus or the botanical garden.

It was never boring in Nottingham, especially with my colleagues. We went to play at the Jubilee Sports Center Badminton regularly, which is right around the corner from the ATC. Often we went to work in the nearby pub "Rose & Crown", or went for some food. For the Christmas party of the PEMC Group a small band was founded, where I played keyboard and regularly rehearsed - at least until the Christmas party, afterwards the "rehearsals" took place rather in the pub or one of us at home, due to the fact that they were mainly Italians who understood a lot of pizza, it wasn't even so bad. In addition, I considered the rivalry between the "Uniof" and the NTU and played with the big band and the concert band of the NTU with my trumpet. Through the regular music tests at the NTU and with the band for the Christmas holidays, as well as the badminton playing with my colleagues and the fitness courses of my fellow-fellow was my week leisurely already well-filled. For future guest students in Nottingham,

however, it should be noted that there are dozens of different societies at the University of Nottingham, where you can pursue your favorite hobbies among like-minded people, be it the Travel Society organizing regular trips to different places in Great Britain The Choc Soc - the Chocolate Appreciation Society.

6. Outside Nottingham

On the weekends, I explored, except for some visits at home, Great Britain. With a 16-25 railcard, rail travel is relatively cheap compared to Germany. Nottingham is strategically located in the East Midlands to reach the most interesting cities. To London, for example, in 90 minutes by train. Even closer is Birmingham, there you go about 70 minutes.

My first trip took me to Lincoln, a town with over 2000 years of age on the River Witham. It is built on a large hill, with a cathedral and a castle. It is waiting in the pre-Christmas period with an old Christmas market and definitely worth a visit.

Cambridge was my second destination. The old university town is extremely charming and picturesque on the River Cam. Of course, it is worth visiting one or other of the colleges of the university; When I was there, unfortunately, only King's College was open, but it was very worth seeing. The contrast to the universities I already knew is, however, immense, and I am not sure if I would feel comfortable as a student in this place. The old buildings, the River Cam, on which student tourists stroll along boats, the gardens and the old town make Cambridge but one of the most beautiful places I have seen in the UK.

Two more day trips took me to the north-west of England to Manchester and Liverpool. Both are cities in which one can invest a very good day. In Manchester I found especially the downtown, the cathedral and the John Rylands Library, in which one feels as if one had been directly after Hogwarts. In Liverpool, of course, the modern Riverside is a must with its various small docks, the harbor basin, where the old warehouses are now restored in an environment of modern buildings, chic cafes, modern museums and auto breaded promenades. There is also the Beatles Museum, which was high on my list. You should also visit the Cavern Quarter, the epicenter of the nightlife of Liverpool, named after the famous Cavern Club, which has not only the Beatles, but many other rock and pop legends. This is a very special place to visit.

Not only the cities of Great Britain are worth seeing. As a holiday, I have never taken Great Britain seriously, but I had the opportunity to admire the partly breathtakingly beautiful landscape from the train window. Shortly before my departure, three colleagues and I took a trip with a rented car first to York, another very old and beautiful city. We continued through the North York Moors National Park, an impressive landscape. In the evening we arrived in Whitby, a small fishing village on the east coast of England, which is worth visiting not only for the (supposedly) best Fish'n'Chips, but also for its picturesque location on the rocky cliff.

7. Conclusion

My time in Nottingham was one of the most enriching experiences I have ever had. The PEMC Group is a really special place from the technical point of view. Extremely good personnel as well as technical equipment are here only the basis, to carry out leading research. However, it is the know-how, the level, the cohesion and, above all, the care that makes the PEMC so interesting for students and doctoral students. I could be confident that my supervisor and Professor W. would do everything to remove any obstacles to allow me to learn the most during my internship.

Also privately, my time in Nottingham was an incredible enrichment. Rarely have I had the opportunity to meet with so many people from so many different countries, all of whom are extremely open, welcoming and inspiring, so I now have friends from Italy, Chile, Malaysia and even Mauritius.

After all, the experience of living in the UK was an enrichment. Not only Nottingham, but also all the other cities I have visited, inspired me. In contrast to many stereotypes, the openness, the overbearing friendliness, the empathy and the amiability of the British fascinated me from day one. I will be able to look back on my time there and look forward to the experience.