Think back to when I saw the announcement for the master’s thesis at the University of Waterloo (UWaterloo), I was immediately excited as it seemed to be the perfect position to finish my studies with an extraordinary experience — working in a state-of-the-art laboratory in one of the best

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universities for engineering in Canada. I was finally much more excited when I received the acceptance for this position mid of November 2020. Because this project is the beginning of a starting research cooperation between KIT and UWaterloo I had to start with the organization at the very first beginning and had to figure everything out on my own. Obviously the first part was to figure out which permissions are exactly required to work/study at UWaterloo within this project. However, at this time we didn’t expect the progress of COVID19 worldwide and its atomic impact in each step of our project.

The first big challenge was to get the permission to enter Canada, because the boarder was still closed because of Covid. Without Covid, you just need to apply for an ETA (like ESTA in USA) which takes 5 minutes. With this pandemic situation it was a nightmare to get all permissions and to figure out what is required because it changed weekly, either the required visas were closed, or I didn’t fulfill the prerequisites to apply for. Finally, we postponed the beginning of the project by one month as well as shorten it to a duration of 4 months to increase the chance in case that restrictions will be lifted. Until one month ahead of the planned project start, there was no realistic chance to get a permission to enter Canada soon. However, everything changed with the acceptance for the scholarship one month ahead of the project start, which was the big game changer we needed. With this scholarship I was able to apply for a work permit which allowed me to enter Canada. With a delay of only two weeks, I started my journey to Canada and started the mandatory quarantine for the next 14 days. Upon my arrival in Canada I had to present more than 10 different documents to proof my eligibility for this permit and necessity of our project, compliance of Covid regulations and that the quarantine plan is proper. Entering Canada was definitely not a matter of course during this time and was only possible through very good planning. But it also showed that if you pursue your goal long enough, plan flexibly and carefully, you can achieve a lot.

I got a first experience how busy or how quiet Canada is when I was in the airplane – extremely quiet, at least for the first half of my stay! Ontario had a very strict lockdown and every non-essential retail was closed. Barbershops for example opened mid of July. Therefore, the entire university was empty and it didn’t change within my stay what was very unfortunate! Well, you can say I travelled from one lockdown to another lockdown - very unfortunate - but I was glad to be there and was excited to start

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my research in the lab. Life got better mid of July when a lot of restrictions were lifted, and I was able to get a bit more of a Canadian experience.

Waterloo is a nice and safe city so far with a lot of students. However, it is more a quiet city, compared to Toronto, Vancouver, and so on. Uptown Waterloo is more or less the main street/area of Waterloo, and it contains a couple of nice restaurants and some bars/pubs. Compared to Karlsruhe, Waterloo is way quieter and even Karlsruhe is not that busy. It was pretty good for a short term stay as in my situation, but for my entire studies I would prefer another city.

For accommodation you can either stay off campus, somewhere in the city as in Germany, or on campus. I found a room on campus in the graduate building of St. Pauls College. Because of Covid restrictions every student was located on his/her own which means that no one had a flat mate. That was kind of unfortunate because like that it was even more difficult to meet some people since the whole university was empty. However, it was just more difficult and not impossible, everyone I met in Canada was very, very kind and supportive and so I made some friends in the building I lived as well as in the lab I worked. In a way, you have to get out of your comfort zone and approach people. With everyone keeping a minimum distance from each other and therefore do not necessarily approach people they do not know, this is not so easy at first. Normally, you also look first whether the other person smiles back or looks grimly at you, which looks more or less the same with the mask on, but with a little sensitivity you can get it right and can make some new friends.

The student life in Canada differs from the one in Germany as it is more focused on studying. Somehow it makes sense because the tuitions are very high, and you don’t want to lose time. Furthermore, they assume that the students are kind of dependent and need support when they arrive at the University. That’s why its common that everyone stays on campus in their first year and has a don on its floor. A don is an upper year student who lives on the same floor and takes care of the new students as well as being their first contact person for everything. For that support, the dons don’t have to pay fees to live there as well as for the meal plan (breakfast, lunch and dinner 7 days a week) which is a pretty good deal.

The University and the campus are very clean and beautiful with its well-maintained lawn everywhere. I had the luck that my project was in the shiny building E7 with its shiny room – the RoboHub, a state-of-the-art robotics lab. The engineering faculty contains a lot of different labs and if you are an engineering student you are allowed to use each lab, because you pay the tuition. For example if you are interested in robotics, and you want to conduct some tests or gather some experience with one of the robots. To do so you just have to contact the lab manager and ask for an appointment to use this robot. I think that is really great and helps students a lot to improve their capabilities and could be adapted in Germany as well.
The living costs in Canada are higher than in Germany. Especially the groceries are much more expensive. Therefore, a scholarship or other fundings are very supportive for a student. Public transportation is not really comparable to Germany. Canada is a car-land! Trains between the city do not really run often and are very expensive! There is an affordable bus system, but it is very slow. To travel from Waterloo to Toronto takes 1:30h by car, by bus it takes at least 3:25h. To travel within Waterloo, I mainly used a bike which is very convenient. I loved to go for a bike ride on weeknights or on the weekend. If you just ride 10 minutes out of the city you are only surrounded by farms and pure nature which is a very good change to everyday life.

Canada is well known for his scenic landscapes and yes, I can definitely confirm how great it is! A friend of mine has a cottage in the Georgian bay, also called thirty thousand islands because there are thousands of small islands which are either private property or government property and you are allowed to camp on government property wherever you want. He took me out to a 3-day kayak tour starting at the cottage and paddling from island to island. It was incredible and I could try to describe it, but I think pictures can say more than thousand words:
At the end of my stay, I went to BC and Alberta for some vacation before I had to go back to Germany. I travelled by car from Vancouver to Banff and Jasper national park and then back to Vancouver. The nature there is just awesome! I did a lot of hikes as well as visiting the classic touristic spots like lake Louise or lake Moraine. In my opinion the most incredible thing is that you have so much space in Canada which yields to a lot of “untouched” nature or at least very quiet areas with less people. Once I was hiking on a trail, which was popular and busier one, I heard some wood cracking to my right and well there was a grizzly bear having his dinner. I didn’t expected to see a bear on a more popular trail and absolutely not at this moment. Fortunately, he was not interested in me and continued with his dinner after he faced me for a short while. They look very cute and fluffy but they are very dangerous and normally you should have a bear spray next to you (a pepper spray only for bears which can shoot 10 meters) to prevent an attack or to get killed.
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The actual state of the overall project is proof of concept and my project is part of this. The overall goal is a robust and accurate state estimation system for autonomous mobile robots with a warehouse application. My part of the project aims to develop a reliable cooperative state estimation and navigation system for autonomous mobile robots through connectivity, in a distributed scheme, considering computational constraints as well as wheel slip components in local visual-inertial solutions. To continue the funding of the overall project, a paper is required to prove the success of the current stage.

As already mentioned, I was the first student in this starting research collaboration between the Institut für Regelungs- und Steuerungssystem (IRS) and UWaterloo. In this starting research collaboration, the IRS is aiming to get experience in how and what kind of research is conducted in the field of cooperative systems in Waterloo as well as expanding the exchange program for students. The UWaterloo is aiming to get research done as well as getting permission to deepen the research by submitting high-quality papers. They tried to connect their interests by offering this as a master thesis. Somehow you can say it was initially the idea of a win-win-win situation. Unfortunately, it was mostly an idea and the organization for a master thesis suffered of the assumption that everyone knows what is expected and how things have to be done but without discussing all the points. For example, upon my arrival in the lab, I got asked how a German master thesis looks like. This was something I didn’t expect because the job offer at KIT was a master thesis and therefore, I obviously assumed that those fundamentals things were already discussed. In Canada a master thesis has a longer processing time, at least two main contributions and one or more papers are required. The students also start earlier with literature research, and it is more focussed on preparing you for a scientific career instead of going to industry. All those things I got to know when I already was in the lab. However, the schedule for our research and my master thesis was already planned but it didn’t really fitted to a German master thesis. It was more a Canadian thesis than a German one but with German time constraints and additional elaboration. Furthermore, we had to deal with the limited time in the lab cause of Covid. The very first plan was that I will be in the lab for 6 months, then we reduced it to 4 months and in the end I only had access to the lab for 2.5 months. However, the objectives weren’t really adapted to our situation with Covid, limited time in the lab and the time constrained for a German master thesis, instead we just tried to do it in less time and compress everything. Well, you can imagine how comfortable and how long some days have been. Somehow it was like sitting between two chairs and...
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