Exchange program report
enGlobe – engineers go global
Winter Semester 2022-2023

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Preface

This report aims to briefly outline my experiences as a Brazilian Master's Degree exchange student that took part on the program **enGlobe – engineers go global** during the Winter Semester of 2022-2023. As a result of that, I had the opportunity of living in Ingolstadt and studying at THI for one semester. Here are some key points of my stay:

1 Life in Ingolstadt

1.1 Arrival in Germany

I come from a city in the south of Brazil called Curitiba, where I also am an Electrical Engineering Master's student at Federal University of Paraná (UFPR). To get to Ingolstadt I decided to take a flight from Rio de Janeiro to Munich, the only option I found that provided a straight path without connections in other countries. From there, I took the bus X109 (Airport Express) to arrive right on the center of Ingolstadt. If you manage to arrive with another colleague, this bus-line offers a family discount to make the ticket cheaper.

1.2 Accommodation

Regarding the accommodation, I managed to obtain one of the rooms offered by Ms. Brandhofer of the *Förderverein für Internationalität der TH Ingolstadt e.V.* in the dormitory Schäffbräu. This is a shared flat, where I lived with other 11 international students that I quickly became good friends with.

My rent was 385,- €, with a deposit of 770,- €. Additionally, on the first month a fee of 220,- € had to be paid for the cleaning service, internet, bed linen, etc.

Overall, living in this flat was one of the best decisions I took regarding my exchange semester. It is located right in the city center, so it is not hard to find supermarkets, stores and bus stops close-by. The accommodation is very well-equipped, spacious and each student has its own room. Also it is right next to the City Hall, so all the necessary paperwork could easily be solved without having to travel long distances.

1.3 Important Paperwork

Of all the documentation necessary to study at THI, one of the most important ones is the Health Insurance Certificate. I would recommend contacting one of the Public Health Insurance companies as soon as possible, even before arriving in Germany. That's because the lack of this document can be a real impediment to the enrollment in the University and also to obtain a Residence Permit.

In my experience, the enrollment at THI was very straight-forward and simple. I just followed the instructions presented by the International Office and cleared any doubts I had through e-mail or in-person during office hours.

Further discussing the topic of the formalities on the City Hall, the two important processes for an exchange student from Brazil are the city registration and Residence Permit. For both of these I followed the advice provided by THI's International Office and it made the bureaucracies much easier to understand and navigate through. The only point where my application differed from the standard procedure was regarding the Blocked Account, which I did not open. I took this decision because the enGlobe scholarship provided me with enough funds to prove to the City Hall that I could sustain myself financially.

It is important to point-out that as a Brazilian, it is not necessary to obtain a Visa to enter Germany, but you have 90 days to obtain the Residence Permit to further stay in the country. Even though a Visa is not mandatory, I would recommend having a copy

of the enGlobe scholarship letter to present at the Passport control in the airport at the moment of arrival in Germany.

1.4   Food

In the city center there are plenty of options of food stands and restaurants to choose from. Also, be aware that the supermarkets most of the stores don't open on Sundays, so plan ahead! During the week, another good option is the Mensa at THI, where you can eat lunch for much more affordable prices than any regular restaurant.

1.5   Differences to Brazil

When it comes to comparisons between Germany and Brazil, there are a lot of differences that can be mentioned. For example, I find that the public transportation in Germany is much more efficient and it is really simple to travel between different cities, specially by train. It is also very interesting to me how common it is for people to navigate around the city by foot or bicycles, while in Brazil the traffic is much more focused on passenger cars.

From Brazil, except from family and friends, what I missed the most is the warmer weather and the fact that stores and restaurants close later at night than in Germany. And of course, having to communicate in a language that is not your mother tongue can also prove very challenging. Even when it comes to everyday things, for example a simple purchase in the supermarket, it takes some time to get used to talking in German or English, instead of Portuguese.

1.6   Leisure

In addition to classes, it is also possible to participate in many activities at THI, such as excursions and other leisure activities organized by different entities, N.I.C.E. for example. This is a great way to meet more people, travel to different cities and also practice or learn new languages.

Also regarding traveling, Bavaria offers plenty of places to visit, both for people that prefer getting to know new cities and for the ones that like hiking and landscapes. A good option to travel in the state is splitting a Bayern-Ticket with other 4 colleagues. Here are some recommendations:

Cities

- Würzburg;

- Munich;

- Nuremberg;

- Regensburg;

- Passau.

Nature/Landscapes

- Garmisch-Partenkirchen - Eibsee, Zugspitze and Partnachklamm;

- Prien am Chiemsee - Chiemsee;

- Schwangau - Castle Neuschwanstein.

2 My Research at THI

2.1 Participation in Lectures

First of all, with the intention of gaining more knowledge in the vehicular field, I decided to attend several of the lectures offered in the THI's International Automotive Engineering Master program. Those classes were: "Automotive Electronics", "Artificial Intelligence and Automotive Systems", "Mathematical Modeling and Simulation" and "Power Supply and Energy Distribution". Furthermore, I also took German A2.1 classes in order to improve on the basic knowledge that I had on the language from a course that I had previously done in Brazil.

2.2 Summary of the Laboratory activities

As part of the scholarship provided by the enGlobe program, I came to THI with the goal of conducting research to develop studies related to my Master's Degree program and thesis. With that in mind, I was put in contact with researchers Prof. Christian Facchi and Silas Correia Lobo from the CARISSMA Research Instute to work alongside them in the Car2X Laboratory in the the topic "QoS for Channel Overloaded by VAMs and the Safety Impact on a dense VRU environment".

To that effect, I participated in the implementation of new services and functionalities for the Artery Framework, a simulation tool that is developed by the Car2X Laboratory and used in order to conduct research on vehicular networks. Those new modules are related to the safety of Vulnerable Road Users (VRUs), which is the name used in Car2X European standards to categorize the actors that are in higher risk in the event of a road accident, such as pedestrians and cyclists.

With the intention of assuring that these VRUs are safe in a connected vehicles network, the VRU Awareness Messages (VAMs) have been proposed by the European Telecommunications Standards Institute (ETSI). To evaluate the viability of this standard in a wireless channel with many users, the Artery Framework was extended to be able to simulate scenarios where those messages are exchanged between a high volume of pedestrians in an road crossing.

The focus of my work on the Car2X Laboratory was then to further develop the VAM Basic Service by implementing the clustering functionalities described in the ETSI Standard. In this context, clustering is the act of grouping VRUs that are geographically close-by and moving in a similar speed. One of the VRUs in that group is then turned into a cluster leader and is responsible for communicating for this entire group, thus eliminating the need for all nodes to communicate. The purpose of the clustering is then to reduce the amount of VRUs communicating in a certain area, reducing the wireless channel overload.

All this development was done using the already existing framework and extending it with more classes written in the programming language C++ and using CMake to

configure the build system. This version of the simulation tool can be found in a public GitHub repository called artery-VRU. Due to the complexity of the Clustering Containers proposed by ETSI, this project is still in ongoing development. Furthermore, a paper is being written by Silas Lobo and me, describing the decision and design process of the VAM Service in Artery and evaluating the improvements of performance that VRU clustering can provide.

2.3   Continuation of the project

As already mentioned, this project is still active and I am still working on the development of the simulation tool. At UFPR I am a communication systems researcher with focus on vehicular wireless networks, so the opportunity to further my knowledge in this area was of great importance for my development as an electrical engineer. Because of that, I decided to apply for a Master's double degree program between UFPR and THI, being successfully approved earlier this year.

Due to this, I was able to continue the project in CARISSMA, working on the Car2X Laboratory and providing further support on this research topic. As a result of this continuation, I am actively developing my Master Thesis with the support of both UFPR and THI, using the potential benefits of the VAM Clustering as the subject matter.