Technische Hochschule Ingolstadt

AWARE
Bavarian Center for Applied Research and Technology with Latin America

enGlobe

engineers go global

Scholarship Program for Research Stays

October 1, 2021 – February 28, 2022

for Master students of UFPR

at

Technische Hochschule Ingolstadt (THI)

Apply until **April 28, 2021**

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What is *enGlobe*?

enGlobe is a DAAD funded internationalization project under the roof of THI's Latin America Center **AWARE** which offers **scholarships each year from 2020-2023** to master students from UFPR for research stays of **5 months** at THI's research and testing center CARISSMA. The 16 topics you find below are offers from CARISSMA professors for which you can apply. If you are successful in the application for the research stay in one of the topics, you automatically receive the *enGlobe* scholarship (no separate application process necessary):

- Single travel allowance: 1,575€
- Monthly scholarship rate: 861€

The research stay itself does not include any remuneration or further financial support.

Who can apply?

Master students from any of the graduate programs of UFPR **with a level of English of minimum B2** (please consider the requirements of the offers). The stay should preferably be **connected to writing a final master's thesis**.

Exceptions:

- If you would like to plan your stay as "voluntary internship", i.e. not connected to your master's thesis, please indicate it accordingly in the application form.
- If none of the below listed topics fits to your thesis topic, you have the option to find a THI supervising professor yourself who supports your topic. You then need as additional application document a letter of support of the THI supervisor confirming he/she accepts you for the stay. Please indicate this accordingly in the application form.

How to apply?

1

1st phase: Documents are to be submitted until **April 28 (23:59, Brasília) in English in one pdf file (max. 15 MB)** to aware@thi.de:

- Application form, indicating the topic(s) you apply for[1]
- Motivation letter (1-2 pages) explaining choice of topic(s) and motivation for the stay
- CV (max. 2 pages)
- Filled form "TERMO INDIVIDUAL DE PARTICIPAÇÃO EM PROJETO INTERNACIONAL" from UFPR[1]
- Current transcript of records of master studies; if not available: scan of certificate of bachelor's degree with transcript of records [2]
- Proof of sufficient English language skills (B2 or C1, see requirements of offers)[2] [3]
- **Only** in case you do not apply for one of the offers (see exception above): Letter of support of the supervising professor at THI
- Optional: Proof of international experience (studies/internships abroad, participation in international conferences/seminars/courses etc., active membership in international organizations etc.)[2]

2nd phase: After the deadline, your application will be evaluated. If you pass the first phase, your documents will be sent to the prospective professor(s). If they agree, you will be contacted by the beginning of May offering an interview appointment with one representative of the selection committee and the professor(s). With the feedback of the professor, the selection committee will then decide on the scholarship holders **by mid-May**.

[1] Find the form under https://aware.thi.de/en/studying-and-internships/germany/englobe-research-stay-at-thi

[2] Can be submitted in Portuguese if not available in English.

[3] A confirmation of UFPR or a simple online test are also accepted. Latest during the selection interview it will be tested whether your English language skills are sufficient for the research purpose.

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3rd phase: After being selected for the scholarship, you must apply at THI as exchange student **until June 1st**.[4] THI's International Office will then support you in your preparation and offers an orientation week one week before the start of the semester on October 1st which will also be your first day of your research stay at CARISSMA.[5]

Contact

Lisa Hermsen, *enGlobe* coordinator THI aware@thi.de
Prof. Egon Walter Wildauer, *enGlobe* coordinator UFPR egon0910@gmail.com

Research Stay at CARISSMA

October 1, 2021 – February 28, 2022

The THI research and test center CARISSMA - *Center of Automotive Research on Integrated Safety Systems and Measurement Area* has been designed as leading scientific center for vehicle safety in Germany. The aim of this facility is to conduct applied research in order to enhance traffic safety in Germany and abroad. To this end, CARISSMA works with car manufacturers, scientists and research institutions all over the world. Working on an interdisciplinary basis, the scientists involved seek to tackle the social challenge of "Vision Zero" – achieving the ultimate goal of zero traffic deaths. Currently some 39,000 people are killed per year on Europe's roads alone.[6]

Three institutes are located at the CARISSMA research and test center:

The **CARISSMA Institute of Safety in Future Mobility (C-ISAFE)** is concerned with anticipatory accident detection and accident mitigation. It is concerned with global vehicle safety, which uses all the information available, including to guide unprotected road users safely through road traffic. With its predictive accident detection and mitigation, it makes an important contribution to the EU's Vision Zero. This includes safety systems ranging from sensors to actuators and their evaluation in the context of automated driving. One focus is on protection in bad weather conditions.

The **CARISSMA Institute of Automated Driving (C-IAD)** focuses on the development, testing and validation of automated driving functions. In the context of road safety, the focus is on accident prevention. Here the institute is closely networked with the Research Center for Artificial Intelligence and Machine Learning (AININ - Artificial Network Ingolstadt) located at the THI. As a cross-sectional topic, the institute is intensively engaged in research on human factors (e.g. trust, acceptance, ethics) as well as user experience/usability evaluation in the field of automated driving.

The **CARISSMA Institute of Electric, Connected and Secure Mobility (C-ECOS)** is thematically broadly based and pursues the focal points of safe electromobility and accident analysis, Car2X communication in connection with intelligent traffic systems and cyber-physical systems as well as the focus on automotive IT security.

The three institutes use synergy effects both among themselves and with other THI facilities, including in the areas of testing and validation and safe automated driving.

[4] More details on the application here: https://www.thi.de/en/studies/international-students/exchange-students
[5] Practical information for your stay here: https://www.thi.de/en/international/studies/international-students/practical-information-for-internationals#c6028
[6] Find out more about CARISSMA here: https://www.thi.de/en/research/carissma-1

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Topics of C-ISAFE

1. Detection of unstable driving conditions such as skidding and its effect on motion trajectories in vehicle pre-crash situations

Supervising professor/scientific employee: Prof. Dr.-Ing. Thomas Brandmeier/Robert Lugner

Part of the investigation should be to detect unstable driving situations such as skidding of surrounding vehicles with the environment sensors such as radar, lidar or camera mounted on the own vehicle. Based on this, the influence on the estimation of trajectories in pre-crash situations is to be examined. For this purpose, a suitable motion model should be implemented and a criterion for its use should be defined. The final step is to check the suitability of the approach for its feasibility in real time for pre-crash situations. Optional this approach can be implemented in a test vehicle. A participation in scientific publications of the results together with the research assistants at CARISSMA Institute of Safety in Future Mobility (C-ISAFE) is appreciated.

Special Requirements

None; comment: it is intended to extend the research activities in Ingolstadt to 12 months.[7]

2. Influences of weather on predictive sensors for automotive safety systems

Supervising professor CARISSMA: Prof. Dr.-Ing. Thomas Brandmeier/Dagmar Steinhauser

3

Robust object information is mandatory for the application of automotive sensors for safety-critical systems. However, this information can be impaired by weather conditions, as preliminary investigations have already shown. In this proposed enGlobe project, the influence of rain on radar signal processing and objection recognition will be investigated. For this purpose, a self-developed rain system is available in C-ISAFE, with which various rain characteristics can already be realized, but also optimizations and expansion are possible depending on the result and desired specification. The intended focus for the proposed project is in the area of radar technology, but if prior knowledge is available, an extension, e.g. with lidar or sensor fusion could be possible.

Special Requirements

Knowledge in programming; first experience and interest in signal processing and sensor technology (preferably radar sensor)

3. Reproducing different light conditions on a sensor test bench

Supervising professor CARISSMA: Prof. Dr.-Ing. Thomas Brandmeier/Kilian Schneider

The CARISSMA Institute of Safety in Future Mobility investigates methodologies for a safe prediction of road accidents using environmental sensors. At this, radar, camera and LiDAR are used to monitor the environment around the vehicle detecting other vehicles. Based on this information the probability and severity of a potential accident can be determined. However, with diffusing light situations, the camera gets in trouble to detect the objects reliable. To test cameras reproducible and optimize them for these situations, a test bench shall be developed in this project.

[7] For the second half, enGlobe cannot offer further funding. The AWARE team can support in the search of a new funding source if needed.

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Tasks to be completed include performing measurements in various lighting scenarios with a focus on camera or LiDAR as well as their scientific evaluation. In addition, an investigation and processing of different types of light is part of the work. At the beginning of the project a simple prototype will be built, which will be extended piece by piece during the project. A support in the optimization and further development including tests of the prototype completes the topic and gives it a practical reference. A participation in scientific publications of the results together with the employee of the THI is appreciated. A good knowledge of optical metrology and signal processing as well as optics is advantageous. Furthermore, experience in Matlab or Phyton is preferred, but not mandatory. An open and friendly attitude for dealing with our project partners is expected.

Special Requirements

Valid driving license for Germany[8]

4. Automated Valet Parking

Supervising professor CARISSMA: Prof. Dr. Ondřej Vaculín/Thiago de Borba

THI develops an open platform ANTON for research, development and testing of different functions of connected and automated vehicles. The platform is built on Renault Twizy and Autoware, open-source software for autonomous driving technology, together with Carla simulator. The objective of the proposed enGlobe project is to develop and verify a concept of an automated valet parking system, implement it to Autoware and the vehicle platform. The research should focus on the methods for positioning and planning of safe trajectories in the parking house. In the first stage the candidate will get familiar with the open-source environment Autoware and Carla simulator. Furthermore, the concept will be developed and implemented in Autoware. In the next stage it will be verified by the simulation for different test scenarios. In the last stage the concept will be implemented to a real vehicle and tested with selected test scenarios.

Special Requirements

Basic knowledge of Python, target-oriented, driven workstyle with analytic problem-solving skills

5. Verification and Validation of a Test Field for Connected Automated Vehicles

Supervising professor CARISSMA: Prof. Dr. Ondřej Vaculín/Martin Slavík

An advanced test-field for connected automated vehicles (CAVs) with infrastructure-based sensors and car2X communication features is developed as part of the so called IN2Lab project. The test field consists of a public road track system and combines several functions to improve the safety of CAVs. Verification and Validation (V&V) of the system is important to ensure that requirements are met. The V&V will be based on testing scenarios, which will be derived from use cases. Based on the project phase, the tasks will be summarized as follows:
- to define a test plan including pass/fail criteria
- to support conducting of defined tests and collect data for analysis
- to analyze captured data

Special Requirements

Knowledge of python, GIT, first experience/interest in scenario based testing

[8] https://brasil.diplo.de/br-pt/servicos/dirigir/1010126

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6. Augmentation of assessment methods from passive vehicle safety with machine learning methods

Supervising professor CARISSMA: Prof. Dr. Ondřej Vaculín/Franz Plaschkies

We are developing approaches to augment assessment methods – namely finite element simulations – with machine learning. Therefore, we concentrate on occupant safety and the variety of human body anthropometrics. It is the objective to create robust metamodels while keeping the number of required finite element simulations low. Depending on the student's background, the tasks are either more focusing on the finite element model or the metamodel.

Special Requirements

First experience in either finite element simulation, passive safety or machine learning

7. Sensor Data fusion for Environment Sensing in Embedded Platform

Supervising professor CARISSMA: Prof. Dr. Alessandro Zimmer

Analysis of near field and far field of an EGO vehicle to determine the position, speed, angle and direction of possible targets in the environment (approaching cars, motorcycles, pedestrians, bikers, etc.). Fusion of Radar, Lidar and Radar sensors will be done in real time in one embedded platform to have the best possible accuracy in different weather and light conditions, focused on SAE autonomous driving levels 3-5.

Special Requirements

English language skills of C1; knowledge on Phyton and C/C++ is required

8. Sensor Data fusion for Inside Vehicle Monitoring System Embedded Platform

Supervising professor CARISSMA: Prof. Dr. Alessandro Zimmer

The system to be develop should be able to detect all vehicle occupants in real time, estimating their position relative to a fixed reference inside the vehicle. It will use data fusion from different cameras, LIDARs and/or Radars and will be processed in an embedded platform in real time. This application is focused on future mobility concepts, such as in a full autonomous vehicle with living room style interior.

Special Requirements

English language skills of C1; knowledge on Phyton and C/C++ is required

9. Scene Analysis from Drone Sensors

Supervising professor CARISSMA: Prof. Dr. Alessandro Zimmer

Analysis of urban and road images to detect real time dangers in the road (accidents, fires, disasters, etc). When an accident is detected, estimate the severity of the accident by reconstructing the scenario in 3D, informing the authorities. The environment awareness will be captured either by cameras and/or LIDARS and processed real-time by deep learning algorithms or other computer vision algorithms and classifiers.

Special Requirements

English language skills of C1; knowledge on Phyton and C/C++ is required

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Topics of C-IAD

10. Development and Testing of Urban Automated Driving Function

Supervising professor CARISSMA: Prof. Dr.-Ing. Werner Huber/Maikol Funk Drechsler

According to SAE J3016, the actual producing vehicles attend level 2 of automatization, which include driving functions like Lane Keeping Assistance (LKA) or Adaptive Cruise Control (ACC). The next generation of cars should include level 3-4 of automatization, in which the cars independently drive in specific situations, increasing the manufactures responsibility and complexity of the driving functions. As indicated in the White Paper „Safety First for Automated Driving (SaFAD)“, the implementation of the next levels of automatization includes the consideration of more complex scenarios, for example urban traffic, which include interaction with traffic signals, Vulnerable Road Users (VRU) and conditions that cannot be recognized by the perception algorithms.

To support the challenges on the development of these functions Verification and Validation (V&V) approaches as Driver-in-the-Loop (DiL), Model-in-the-Loop (MiL), Hardware-in-the-Loop (HiL) and Vehicle-in-the-Loop are implemented aiming the verification of the system in a preliminary phase of development. In the SAFIR Project, a Mixed-Reality experimental environment for safety-critical functions in highly automated driving is proposed. In this approach, different road users (Car, Pedestrian, Cyclist) are connected by a common virtual environment permitting the interaction between these entities. This approach permits the evaluation of the automated vehicle in unexpected or more complex situations, in which the vehicle needs to be able to properly react. To the controlling of this vehicle, a Driving Function focused on in-city scenarios needs to be implemented and tested in different degrees of reality, so that the potential of the Mixed-Reality Environment as a testing method can be evaluated. In this way, the present research is focused on the development of an automated driving function able to interact with traffic lights, traffic signals and VRU’s in an urban scenario. The developed driving function will be integrated using the Robot Operating System (ROS) framework with the perception and control modules developed during the first phase of the SAFIR project.

To achieve this objective, the researcher will implement AI-based image processing algorithms to recognize signals and traffic light, as well as implement the decision-making algorithms which permit the vehicle to stop before a traffic light safely and comfortably. The driving function should also include the decision to overtake parked cars or to wait in traffic jams. The implemented function will be tested in an endless scenario, which permits the generation of multiple critic situations in a virtual urban scenario. To permit a more accurate representation of the vehicle dynamics the test will be conducted on the Vehicle-in-the-Loop (ViL) platform developed at the Research Center CARISSMA Institute of Automated Driving. On the ViL the complete test environment is still simulated, although the simplified vehicle model is replaced by a real vehicle, in this way, complex scenarios can be still simulated, however, the influence of the real vehicle dynamics is taken into account.

During the stay in Ingolstadt, the researcher will have multidisciplinary learning in the automated driving area, including the implementation of State-of-Art Artificial Intelligence algorithms, testing of automated driving vehicles in simulation and on proving ground, development with ROS framework and the concepts behind the architecture of automated driving vehicles.

Special Requirements

Basic programming knowledge in Matlab, Python or C++

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11. Advanced LiDAR sensor model for birds view observation of urban intersections

Supervising professor CARISSMA: Prof. Dr.-Ing. Werner Huber/Florian Denk

Research into automated vehicles is one of the big topics in the automotive industry worldwide. Test drives on public roads in America have already resulted in a fatal incident. At THI, the SAVe research project (https://save-in.de/) is therefore aimed at predictive evaluation of automated connected driving functions through virtual testing. A robust detection of the environment is a central component for the safe operation of automated vehicles. In particular, inner-city traffic poses an enormous challenge due to many road users and potential visual obscurations. Birds view observation through LiDAR sensors installed for example at traffic lights poses the potential contribute to solving these issues. However, the actual effect of infrastructure-based support to the environment perception of automated vehicles is highly uncertain. Therefore, modeling the capabilities and limitations of LiDAR birds view sensors is an important building block in virtual testing. This project aims to extend the simulation of environment detection already developed at THI.
The following work is planned for this purpose:

- Reimplementation of the existing LIDAR sensor model in combination with a 3D engine (for example Unity, Blender …) to enable more efficient data generation and enable the simulation of more complex environment effects (for example effects of the static environment at an intersection such as trees, bus stops…)
- Develop a model for the effects of different clothes of pedestrians/cyclists on the detection quality of a LiDAR sensor (for example black clothes tend to pose difficulties to LiDAR sensors)
- Validate the extended LiDAR sensor model through real experiments on the CARISSMA test tracks

Special Requirements

- Programming experience required
- Experience with 3D engines desirable
- Experience and interest in machine learning, statistics or big data methods desirable
- Knowledge in the field of sensor technology desirable

12. Evaluation of 3D Vehicle Radar Test Stimulator

Supervising professor CARISSMA: Prof. Dr.-Ing. Werner Huber/Diogo Wachtel

The automotive radars keeping developing, the new market generation will be the 3D Radar, with which it is possible to measure the distance, angle, height and velocity of the object. In order to validate such radars a Vehicle Radar Test simulator (VRTS) plays an important role. Nevertheless, it is also necessary to validate the equipment, measuring outdoor scenarios and objects to check them in the VRTS. The student should measure various objects under several weather conditions in the real world. Afterwards the same objects measurements should be performed in the VRTS. A report with statistical analysis should be delivered as goal of the project.

Special Requirements

Basic knowledge in Python and Radar waves

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13. Automotive Radar Raw Signal Simulation

Supervising professor CARISSMA: Prof. Dr.-Ing. Werner Huber/Diogo Wachtel

The student will have the opportunity to work with a high frequency simulation tool in order to investigate the effects of radar waves over different weather environments and object dynamics. The work should deliver at the end of the study: Analysis of weather disturbance over RCS and Doppler characteristics; Analysis of Material properties over RCS and Doppler characteristics; Analysis of geometry properties over RCS and Doppler characteristics. The findings should be checked with real measurements.

Special Requirements

Basic knowledge in Simulation and Radar waves

14. AI based Radar Object Classification

Supervising professor CARISSMA: Prof. Dr.-Ing. Werner Huber/Diogo Wachtel

In Autonomous Driving, it is necessary not only to detect an object, but also to identify the objects type. Therefore, a classification is necessary. Usually, the camera has been in this lead, however it is not reliable as radar under adverse weather conditions. Thus, a study to improve the precision of radar classification is necessary. The student will have to develop an AI classification based on Radar signatures over different situations and weather conditions. At the end of the project, the student must deliver a trained classification AI network.

Special Requirements

Basic knowledge in Python and Radar waves

Topics of C-ECOS

15. Development of battery models of lithium-ion-batteries

Supervising professor CARISSMA: Prof. Dr. Hans-Georg Schweiger

Development of battery models of lithium-ion-batteries, design and conduct measurements with lithium-ion cells in the battery lab, multi parameter fitting measurement results to models, verification experiments, and contribution to publication.

Special Requirements

English language skills of C1; Bachelor's/master's degree in electric engineering or similar degree

16. High precision current measurement device for a battery test bench

Supervising professor CARISSMA: Prof. Dr. Hans-Georg Schweiger

Development of high precision current measurement device for a battery testbench. Circuit design, assembly of the circuit, microcontroller software development, integration of the sensor into the Digatron battery tester, test and verification of the complete setup.

Special Requirements

English language skills of C1; Bachelor's/master's degree in electric engineering or similar degree

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