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CAN I COMBINE SCIENCE AND BUSINESS IN A SINGLE JOB?

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For the **»Positioning and Networks«** department in **Nürnberg**, the Fraunhofer Institute for Integrated Circuits IIS is currently seeking a

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Master Thesis Student

for the topic: Analysis of the use of Gaussian Process Regression for positioning with UWB Channel Impulse Responses

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The group **»Hybrid Positioning and Information Fusion«** of the Fraunhofer IIS department **»Positioning and Networks«** conducts research and measurement services using local and global positioning systems. A key competence of the work group is the analysis and fusion of information from different sensor systems (e.g., image, IMU, UWB, GNSS and RSSI) to determine position, orientation and movement of objects. Typical fields of application are sport, pedestrian and tool tracking systems.

What is this about?

Traditionally, Radio-Frequency (RF) based positioning relies on distance- or angle-of-arrival based signaling to obtain position estimates via lateration method. However, in environments with complex propagation conditions like industrial environments, such simple models are easily violated. Diffraction, absorption, reflection and scattering lead to NLOS propagation channels which heavily deteriorate the results of these classical methods. Therefore, recently positioning based on channel impulse responses (CIRs) using ultra-wideband (UWB) signaling has been proposed. CIRs contain a variety of spatial information on the specific channel conditions between receiver and transmitter. To compress the information contained in CIRs into a compact form, feature extraction algorithms have been proposed, ranging from model-based to deep learning approaches. The suitability of these features for positioning is not easily evaluated. Therefore, in this thesis, a statistical representation of the spatial behavior using marginalized Gaussian Process Regression (GPR) is to be conducted. The information content of the trained GPs and the potential of using them for positioning is to be evaluated by including the GPs into tracking filters like Kalman or Particle filters.

The goals of this thesis can be roughly divided as follows:

- Literature Study on UWB technology, UWB CIRs for positioning, GPR, GPR marginalization (~4 weeks)
- Design and implementation of a pipeline for the efficient training and marginalization of GPRs with GPUs using tools like GPytorch, GPflow and GPy (~6 weeks)
- Developing a method for Inclusion of the trained GPs into tracking filters (~4 weeks)
- Application of the developed methods on an available recorded dataset and analysis of the potential use of the trained GPs for positioning (~4 weeks)
- Writing the thesis (~6 weeks)

The documentation should contain a detailed description of all developed and used algorithms as well as a profound result evaluation and discussion. The implemented code has to be documented and provided. An extended research on literature, existing patents and related work in the corresponding areas has to be performed.

Your profile: You …

- are currently enrolled in a Master's degree program in Computer Science / Electrical Engineering or a related field and looking for a thesis topic
- are fluent in Python
- ideally have experiences with Data Analysis and Machine Learning frameworks (Tensorflow, Keras, PyTorch, sklearn, Pandas, seaborn)
- ideally have knowledge on RF channel models, positioning and statistical signal processing

What you can expect from us

- An **open and cooperative** working environment
- Collaboration in **interesting and innovative projects**
- Many opportunities to gain **practical experience and attend seminars**
- Flexibility concerning your working hours

If you have any questions about this opening, please contact sebastian.kram@iis.fraunhofer.de

The thesis will be assigned and carried out in accordance with the rules of your university. For this reason, please discuss the thesis with a professor who can advise you over the course of the project.

Interested?
Please apply for this position using the following link: https://recruiting.fraunhofer.de/Vacancies/52944/Description/2

Applications are possible **in German and English**. Please include a cover letter, your CV and your latest transcripts of records (as PDF) and quote ID number **52944-LV**. Address your application to Nina Wörlein.

Please let us know how you learned about this job opportunity.

Additional information is available on our website: www.iis.fraunhofer.de/en

Interested?