Fraunhofer SCS
Job-Titel:
Master Thesis Student for the Topic: Pen Trajectory Reconstruction

Job-Beschreibung
FOR THE »POSITIONING AND NETWORKS« DIVISION IN NÜRNBERG, THE FRAUNHOFER INSTITUTE FOR INTEGRATED CIRCUITS IIS IS CURRENTLY SEEKING A

MASTER THESIS STUDENT FOR THE TOPIC: PEN TRAJECTORY RECONSTRUCTION FROM FUSION OF 2 IMUS USING DEEP LEARNING AIDED BAYESIAN FILTERING

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. IMU, RSSI and radio based location) to determine position, orientation and movement of objects. Typical field of application are sport, pedestrian and tool tracking systems.

What is this about?
The Master Thesis is offered as part of the “Schreibtrainer” project that aims to develop a handwriting recognition system where the system learns to recognize and advice children with their handwriting. One goal of the project is to reconstruct the pen tip trajectory as accurately as possible using the inertial information from two different Inertial Measurement Units (IMUs) housed inside the pen. The reconstructed trajectory is then used to identify letters and words in the later stages of the pipeline of the project. STABILO INTERNATIONAL GmbH, one of the partners in the project, developed the pen used in this research.

Your responsibilities
The aim of the master thesis is to research the optimal fusion algorithm to best reconstruct the pen tip trajectory. You will study different Bayesian filtering and fusion algorithms including Kalman Filter and its variants. You will also investigate deep learning based approaches to optimizing Kalman filters such as learning the process and measurement noise models of the filter. One part of the thesis will also address the tracking of sensor bias in the state vector of the filter. In this part, sequence learning approaches like Recurrent Neural Networks will be investigated to predict future bias.

The goals of this thesis can be roughly divided as follows:
- Literature study and understanding the theoretical basics of Kalman Filter and its variants. (3 weeks)
- Understanding the signal model of the IMU and its error sources and the state of the art pipeline to reconstruct positions from accelerometer and gyroscope signals. (4 weeks)
- Implement Kalman Filter (and its variants) in python. (6 weeks)
- Implement and test deep learning approaches to optimize Kalman Filter noise models and study RNN approaches for bias prediction (6 weeks)
- Test the algorithm on real world data and tweak the algorithm for better performance. (5 weeks)

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.

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 ramiz.siddiqui@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/51964/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 **51964**. 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](http://www.iis.fraunhofer.de/en)

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### Anforderungsprofil

**What we expect from you**

- You are studying for a master’s degree in computer science, electrical engineering or a related field
- You have good knowledge in Python
- You have knowledge in Bayesian filters (Particle filters and Kalman Filters)
- You have knowledge in Deep Learning (especially Time Series Models: Recurrent Neural Networks)

### Kontakt

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Firmenname: Fraunhofer SCS  
Ansprechpartner: Frau Nina Wörlein  
Jetzt bewerben: [https://recruiting.fraunhofer.de/Vacancies/51964/Description/2](https://recruiting.fraunhofer.de/Vacancies/51964/Description/2)

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