Chair of Imaging and Computer Vision

RWTH AACHEN UNIVERSITY

Master/- Bachelor Thesis

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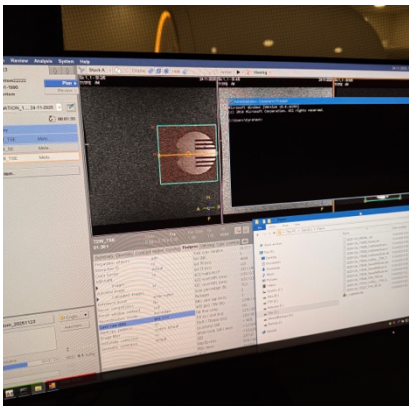
Investigating Digital Models: Physics-Based Digital Modeling of a Low-Field MRI System for Simulation and Parameter Analysis

Keywords
Low-Field MRI | **Software** | **Hardware** | **Simulation**

Background
Magnetic resonance imaging (MRI) is an imaging technique that uses magnetic fields and radio waves to create detailed images of the inside of the body. Low-field MRI systems work with a weaker magnetic field. In the DeLoRI project, together with the Fraunhofer MEVIS Institute, we are developing a low-field MRI device to support cancer diagnostics. Low-field MRI systems based on permanent magnets offer a cost-effective and accessible alternative to conventional high-field MRI. Their performance is strongly influenced by magnetic-field inhomogeneity, temperature-dependent drift, gradient behavior, RF coil properties, and system timing. A digital model can help describe, visualize, and predict these effects during scanner development and operation.



Tasks
The aim of this work is to develop a proof-of-concept digital model for a low-field MRI system. Existing sensor hardware shall be integrated into a time-series data storage system to enable structured acquisition, synchronization, and long-term analysis of scanner-related measurement data. Based on the collected data, suitable analysis methods shall be implemented and applied to extract relevant system metrics, such as magnetic-field drift, temperature dependencies, sensor correlations, and operational stability. A further focus is the use of sensor-fusion approaches to combine heterogeneous sensor information and derive a more robust description of the system state.

Your Profile
For the successful implementation of the project, you should have an interest in one or more of the following subject areas:

- Python | Databases | Time Series
- Embedded Firmware | Electrical Engineering

Our Offer
We offer a collaborative culture in a dynamic team of students, PhD candidates, and postdocs that values new ideas and lively discussion. A workstation can be provided in our student office, together with modern IT infrastructure that includes around 2000 CPU cores and 100 GPUs. You will also have access to a workshop and rapid prototyping facilities, to support fast iteration from design to hardware.