Chair of Imaging and Computer Vision

RWTH AACHEN UNIVERSITY

Master/- Bachelor Thesis

Design and Characterization of a Constant-Current Gradient Amplifier for Low-Field MRI

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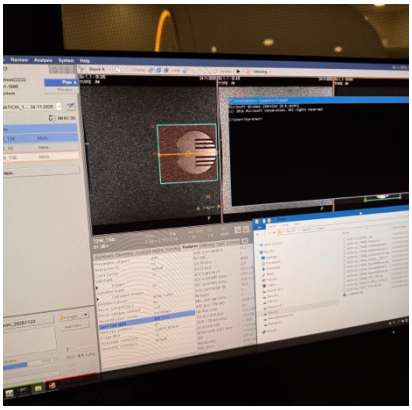
Keywords

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. In such systems, gradient coils are used to generate controlled spatial variations of the magnetic field, enabling slice selection and spatial encoding during image acquisition. Since the generated gradient strength is directly proportional to the coil current, accurate and stable current control is essential for image quality, geometric accuracy, and reproducible sequence execution.

Tasks

The aim of this work is to design and evaluate a proof-of-concept constant-current gradient amplifier for a low-field MRI system. Gradient coils in MRI require precisely controlled current waveforms to generate spatially linear magnetic-field gradients for image encoding. In this thesis, the electrical requirements of a low-field MRI gradient channel shall be analyzed, including coil inductance, resistance, current range, voltage demand, slew-rate limitations, thermal behavior, and safety constraints. Based on these requirements, a suitable amplifier topology shall be selected and implemented as a prototype or detailed circuit design. The work can further include simulation and experimental characterization of the current-control behavior and achievable gradient slew rate.

Your Profile

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

- Electrical Engineering | Power Electronics
- Embedded Firmware | PCB Design

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.