Colloquium: Medical Imaging

3. – 7. February 2025
Showroom (DHEG136E) | Sandgasse 36, Erdgeschoß

It is a pleasure to invite you to the colloquium for our Professorship in Medical Imaging at Graz University of Technology. The public part will be a short educational presentation at Bachelor's level 3rd year in Biomedical Engineering on topic "Introduction to quantitative MRI", a scientific talk (titles below), and a discussion with the audience.

Mahler Simon

3. February 2025 | 11:00 | Showroom (DHEG136E) | Sandgasse 36, Erdgeschoß

Title: "Non-Invasive Blood Flow Monitoring: Laser Speckle Imaging Device for Cardiovascular and Cerebrovascular Diseases Applications"

Abstract: Magnetic resonant imaging (MRI) provides high spatial-resolution imaging of the brain. While functional MRI offers comprehensive assessments of cerebral blood flow, its temporal resolution is limited to at most a few images per second, leaving a gap in real-time blood dynamics monitoring. Optical imaging techniques, such as laser speckle imaging, offer a non-invasive, cost-effective, and scalable approach to monitoring cerebral blood flow with high-temporal resolution, although a low spatial resolution. These features make laser speckle imaging suitable for developing biomedical devices for screening cardiovascular and cerebrovascular diseases. In this talk, I will present our recent advancements in designing laser speckle imaging devices for non-invasive blood flow monitoring at multiple head locations simultaneously. I will demonstrate how this device can prove helpful for addressing critical challenges in cerebrovascular diseases including as stroke, brain injury, and other neurological disorders. I also discuss strategies for transitioning the device from a research setting to clinical practice.

Özen Ali

3. February 2025 | 16:30 | Showroom (DHEG136E) | Sandgasse 36, Erdgeschoß

Title: "The Future of MRI: Faster, Higher, Stronger – Safe"

Abstract: In this talk, I will provide a brief introduction to the selected technologies and methods that I have developed for magnetic resonance imaging (MRI). With the ultimate goal of realizing the full diagnostic potential of MRI, both hardware and pulse sequences that enable faster imaging at higher bandwidth with stronger MR signal will be discussed. An outlook for future developments, and an overview of the clinical and social implications of this research will also be provided. The following specific topics will be included:

- Light Coils: MRI with fully optical signal and power transmission
- Intraoral coils for advanced dental MRI
- Ultra-fast silent encoding using oscillating gradients
- Ultra-high bandwidth, multi-contrast, multi-resolution sequences
- Mitigation of RF-induced heating during MR-guided intravascular interventions

Roeloffs Volkert

4. February 2025 | 11:00 | Showroom (DHEG136E) | Sandgasse 36, Erdgeschoß

Title: “Quantitative MRI: Towards Robust and Fast Multi-Parameter Mapping in 3D”
Abstract: Current MR image interpretation is almost exclusively qualitative. The long-standing goal in the MR community to make quantitative imaging useful in the clinical routine has still not been achieved. The two main obstacles are long acquisition times and the lack of robustness. In this talk, I will demonstrate how model-based reconstruction techniques along with new pulse sequences can help to overcome these obstacles. In particular, I will show what role frequency-modulated steady-state free precession sequences could play in paving the way towards fast multi-parameter mapping in 3D.

Lipp Ilona

4. February 2025 | 16:30 | Showroom (DHEG136E) | Sandgasse 36, Erdgeschoß

Title: “From Metrics to Meaning: Towards qMRI-based Profiling of Brain Microstructure and Pathology”
Abstract: Quantitative MRI (qMRI) offers powerful methods for characterizing the microstructural properties of brain tissue. To translate this potential into standard practice for the diagnosis and management of neurological conditions, we need qMRI-derived metrics that are both interpretable and clinically valuable. In this talk, you will learn about my research vision for advancing qMRI as a tool for precise tissue profiling and bridging the gap between histopathology and symptomatology. Based on multiple sclerosis as a model system, I will highlight how in vivo qMRI can reveal microstructural damage and functional alterations, emphasizing the role of myelin, a complex lipid-rich structure essential for signal conduction and axonal health. Clarifying the biological meaning of in vivo findings requires a more direct link between qMRI metrics and underlying tissue architecture. I argue that postmortem imaging is a tool to address this challenge, and I will present my work which combines whole-brain, high-field postmortem qMRI with histology and lipidomics to validate MRI markers against the tissue’s biological features. In my future research, I will build on these tools to develop a biologically specific qMRI framework capable of linking microstructural imaging with clinical applications for improved diagnosis, prognosis, and tailored treatment strategies.

Dillinger Hannes

5. February 2025 | 11:00 | Showroom (DHEG136E) | Sandgasse 36, Erdgeschoß

Title: “Towards Faithful Flow Magnetic Resonance Imaging”
Abstract: This talk covers the magnetic resonance imaging method of flow MRI which has emerged as a powerful tool for visualization and quantification of (blood) flow dynamics; both in research and clinical settings. The technique is widely applied in cardiovascular diagnostics or industrial flow studies as it allows for non-invasive, non-radiating insights into complex flow patterns. Despite its potential, there are still difficulties in guaranteeing the accuracy and reproducibility of MR flow imaging, especially when sequence and system characteristics are present. This talk examines the underlying theoretical framework and current initiatives to overcome these hurdles by means of methodological improvements, such as enhanced sequence design or calibration techniques. The goal of this effort is to develop flow MRI towards better fidelity and broadening its applicability by bridging theory with innovative practical applications to make precise diagnostics more accessible for all.

Santini Francesco

5. February 2025 | 16:30 | Showroom (DHEG136E) | Sandgasse 36, Erdgeschoß

Title: “Spins and Twitches: Reproducible MR Imaging of the Skeletal Muscle”

Abstract: Investigating neuromuscular diseases requires detecting subtle changes in muscle composition and functionality, which is challenging in a scenario where the investigated diseases are rare in occurrence. For this reason, enabling cooperation among institutions and aiming for multicentric studies is of paramount importance. To achieve this goal, reproducible, quantitative methods need to be developed and disseminated. My research, as leader of the Basel Muscle MRI (BAMM) group, has focused on developing and investigating quantitative biomarkers of muscle health and translating them into the clinical reality, both for the analysis of tissue composition, and for the evaluation of muscle functionality. This talk will present the advances in acquisition methods and postprocessing pipelines that we have been developing over the last years, alongside the clinical results already achieved.

Glang Felix

6. February 2025 | 16:30 | Showroom (DHEG136E) | Sandgasse 36, Erdgeschoß

Title: “Novel Approaches to MRI Acceleration and Quantification: From Hardware to Sequence to Post-Processing”

Abstract: Magnetic resonance imaging (MRI) is a highly successful medical imaging technology. Despite its advantages, its main limitations are long acquisition times and the challenge of accurately quantifying tissue properties of interest. In my presentation, I will present my research on novel methods to accelerate MRI acquisitions and extract more meaningful information from the data, focusing on the synergies between hardware, acquisition, and post-processing.
At the hardware level, I will introduce custom-built reconfigurable radiofrequency (RF) coils that allow for time-varying receiver sensitivity profiles. This novel temporal degree of freedom has the potential to improve image quality while reducing scan times. On the acquisition side, I will present MRzero, a supervised learning framework for automated MRI sequence design, and highlight some application examples of this new paradigm. In addition, addressing both acquisition and post-processing, I will discuss Chemical Exchange Saturation Transfer (CEST) MRI, a molecular imaging technique with promising applications, such as cancer imaging. I will show how machine learning-based methods can enable robust and rapid extraction of quantitative information from CEST data, potentially enhancing the clinical applicability of CEST MRI.