



CEITEC  
MAFIL



# BULLETIN

## VOL. 9

MAFIL Core Facility

### INTRODUCTION

Dear readers,

we have again prepared an overview of information from our laboratory. In 2023, we did not purchase any new devices or major expansions, and from this perspective it was a quieter period. However, we have devoted our efforts to many other areas, such as preparing a project for equipment renewal in the coming years, evaluations within

the Czech-BioImaging research infrastructure, coping with the reduction of infrastructure subsidies and the present inflation (price increases for services and materials). At the same time, we have been preparing a number of new projects, completing measurements for ongoing projects, and continuing educational and data management activities. You can read more about our ongoing activities and plans for 2024 in the individual chapters of our newsletter.

On behalf of the MAFIL  
laboratory  
Michal Mikl



CEITEC

Central European Institute of Technology  
BRNO | CZECH REPUBLIC

Information Bulletin of MAFIL

# NEWS IN THE CZECH-BIOIMAGING AND EURO-BIOIMAGING INFRASTRUCTURES

Regular readers and users of our laboratory know that we are part of the national Czech-BioImaging infrastructure and the European Euro-BioImaging infrastructure. Through these infrastructures we offer open access to all researchers. And the national Czech-BioImaging infrastructure is also our main source of funding, both in terms of day-to-day operations and the acquisition of new instruments. The year 2023 was the first year of the new financial framework (2023-2026), where we had to deal with a slight reduction in operating funds and, at the same time, the expectation of a further reduction in 2024. Besides, we were preparing a project for the acquisition of new instruments (mainly as a renewal of older equipment) for the years 2024 to 2026. At the end of 2023, the project evaluation was published and we are pleased that the Czech-BioImaging infrastructure project was recommended for funding. However, we still have to wait a while for the official approval of the project, and therefore for information on

whether we will receive the requested amount of support. A major investment planned for the beginning of 2025 is the upgrade of one MR scanner.

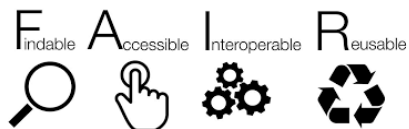
In 2023, an internal evaluation of the laboratories involved in the Czech-BioImaging infrastructure was also carried out by an international advisory board. We are pleased that MAFIL received an „A“ rating. It means that our services are comparable internationally with similar facilities. We thank our users for the fact that they can transform the collected data into high quality scientific outputs in the form of publications in prestigious journals.

As part of the events organized by the Euro-BioImaging infrastructure, we participated in a workshop organized in collaboration with the EBRAINS infrastructure called „Multiscale Imaging in the Neurosciences“ and presented the possibilities of neuroscience research with human participants.



## A LOOK BACK AT 2023

22.3.2023 **Open data/FAIR data** seminar took place



30.3.2023 the **Brain Microstates** workshop was held

6.10.2023 we participated in the **Night of Scientists** with the theme We Do(n't) Know What You Think

7.-8.11.2023 the traditional **Educational Neuroimaging Course** took place

22.11.2023 training course on **Data processing in SPM12 and Matlab software** was held



## EVENTS OF THE YEAR 2024

**Seminar FAIR data** 14.2.2024, Brno

**CF MAFIL Open day** 12.3.2024, Brno

**Neuroscience workshop** 21. - 22.3. 2024, Brno + Olomouc

**Euro-Biolmaging Conference** 18.-19.4.2024, Turin

**Czech-Biolmaging Conference** 1.-2.10.2024, Hustopeče

**The European Society for Magnetic Resonance in Medicine and Biology (ESMRMB)** 2.-5.10.2024, Barcelona

**Educational workshop MAFIL** November 2024, Brno (date to be specified)

**37th Czech and Slovak Neurological Congress** 27.-29.11.2024, Ostrava

**70th Joint Congress of the Czech and Slovak Society of Clinical Neurophysiology** - 2024 in Olomouc (date to be specified)

## INTRODUCING INTERESTING PROJECTS IN CF

### Reading and speech processing in adults with developmental dyslexia

The aim of this project was to assess brain activation and eye movements during word and pseudowords reading, and object naming in individuals with and without developmental dyslexia. During functional magnetic resonance imaging (fMRI), the study participant was required to alternate

between the activity of reading/naming pictures and then only passively watching the words/pictures and listening to an audio recording of their naming.



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## Spatial sound processing in children and young adults with autism spectrum disorder

This project investigates how children and young adults with autism spectrum disorder (ASD) process auditory stimuli. The so-called core symptoms of ASD include difficulties in social communication and interaction, in which hearing plays a significant role. Many studies have confirmed that people with ASD are more sensitive to auditory stimuli, so this study aims to investigate how auditory stimuli are processed and integrated in higher brain centres. Participants in this study underwent functional MRI of the brain as well as EEG to record brain activity dependent on auditory stimulus processing.



## Novel individualized brain stimulation network-based approaches to improve cognition in healthy seniors and patients with MCI

In a collaborative multicenter study between CEITEC MU and the Swiss Federal Institute of Technology Lausanne, measurements were conducted in the autumn to investigate the influence of non-invasive brain stimulation methods, including transcranial magnetic stimulation, and temporal interference current stimulation, on the working memory of seniors. This novel approach allows for the targeting of deep brain structures, a capability not previously available. The study involved 21 seniors who completed a total of 4 visits. During the initial visit, cognitive functions and brain structure were assessed using MRI, facilitating precise targeting of brain areas. Subsequently, participants underwent three different stimulation settings in random order, including a placebo stimulation, while resting fMRI was used to monitor brain function before and after stimulation. The effects of a single stimulation session were expected to last approximately 70 minutes. The impact of stimulation on working memory remains under analysis, with ongoing participation from CF MAFIL.

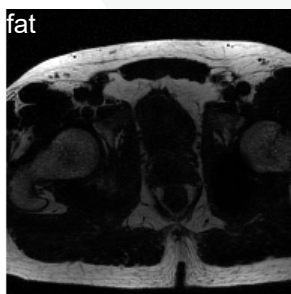
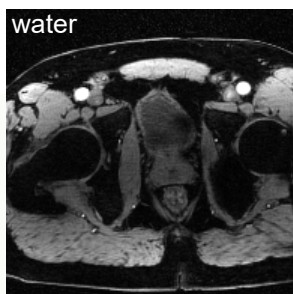
## INTERESTING TECHNICAL SOLUTIONS

### Rosette Trajectory Pulse Sequence

The Rosette Trajectory Pulse Sequence was developed at the MAFIL Core Facility as part of the Magnetic Resonance (MR) Perfusion Imaging project focused on diagnosis and therapy monitoring in oncology, funded by the Czech Science Foundation under grant no. GA 22 10953S. The primary objective was to effectively integrate two commonly used perfusion imaging approaches: dynamic contrast-enhanced (DCE) and dynamic susceptibility-contrast (DSC) MRI. In the initial stage, a 3D golden angle (GA) radial stack-of-stars (SOS) pulse sequence was developed and implemented on our 3T scanners. Following successful tests of the GA radial SOS pulse sequence with both phantoms and healthy volunteers, we decided, in pursuit of more efficient data acquisition, to extend the option to include rosette trajectory data sampling. Rosette MRI, in general, possesses many attractive features, including ro-

bustness to motion, self-inhomogeneity correction, as B0 maps can be calculated from the measured data itself, and off-resonance behavior, leading to signal loss rather than blurring. However, rosette trajectories, like all non-Cartesian techniques, are susceptible to gradient imperfections and delays, which can subsequently degrade image quality. To overcome this challenge, we developed a simple, easy-to-use calibration method for reliably correcting gradient delays. This method is fully integrated into the rosette MRI experiment, eliminating the need for additional measurements.

In the current stage, the initial rosette pulse sequence acquisition was tested with phantoms and volunteers within the PROSTAPILOT study. The examples of rosette images from the volunteer study are shown below, demonstrating the water/fat separation capabilities of rosette MRI. It's important to note that all three images were obtained from a single measurement, and water-fat separation was performed purely during image reconstruction.







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