



CEITEC
MAFIL



BULLETIN

VOL. 8

MAFIL Core Facility

INTRODUCTION

Dear readers,

another of our newsletters is now in your hands. Once again, we will inform you about the events that took place in the past period (i.e. in 2022), the news for 2023, and present some interesting projects and technical solutions.

The current topic for us is financing. The unfavourable economic development, related, among other things, to the war in Ukraine, also means that our facility has to make significant savings, while energy costs and prices of goods are increasing. We must therefore look for other sources of funding in the future, try to maintain our existing activities and also participate in the development of neuroimaging so that we can continue to offer high quality and modern services to our users.

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

The year 2022 was marked by waiting for the government's decision on funding research infrastructures. Although Czech-BioImaging succeeded in the previous international evaluation with the best possible score, the funds allocated by the government for funding infrastructures were not sufficient to cover all the requirements of research infrastructures, even the best-rated ones. Efforts to increase the budget could not be pushed through due to the poor economic situation. This has led to significant cuts. The entire Czech-BioImaging infrastructure received 25% less than requested for 2023 and for 2024-2026 the reduction will be even more significant (to about 60% of the planned budget). We were thus faced with the difficult task of how to appropriately secure funding for in-

dividual laboratories while ensuring the same scope of services. The period from 2024 to 2026 will therefore be very challenging for our laboratory as well.

In the autumn of 2022, a meeting of the representatives of the individual nodes of the EuroBioImaging project (Panel of nodes) together with the EuroBioImaging Infrastructure Committee took place in Turin, Italy. EuroBioImaging already provides users with selected funding options. Unfortunately, so far this has been more in support of targeted topics (e.g. COVID-19 disease research, cancer research) and the necessary access from a country other than the laboratory to perform the measurements.



ONLINE EDUCATIONAL COURSES OR E-LEARNING ON THE MU WEBSITE

The novelty of 2022 was the availability of four electronic educational courses (e-learning) prepared by our laboratory. The courses can be found on the website <https://is.muni.cz/ekurzy>.

The course **MRI for (not only) brain imaging** focuses on a very simplified basic description of magnetic resonance imaging (MRI), the safety of the measurements and a practical demonstration of the measurement process in our laboratory.

The course **Structural Brain Mapping** introduces diffusion-weighted MRI and morphometric methods comparing e.g. grey matter volume.

The course **Principles of Functional Brain Mapping with MRI** explains the principle of the method abbreviated as fMRI, describes the possible applications and how to process fMRI data.

As a practical follow-up, the fourth course, **Processing neuroimaging data using Matlab and SPM12**, explains and illustrates the processing of fMRI data and provides a general introduction to working in SPM12, which is also useful for working with other types of MRI data (e.g. for morphometric methods).

The image shows a screenshot of an online course presentation. The top part is a slide titled "Obecný lineární model – testování hypotéz – T-test". The slide contains a list of bullet points and a mathematical equation for the T-statistic:
$$t = \frac{c' \hat{\beta}}{SE(c' \hat{\beta})} = \frac{c' \hat{\beta}}{\sqrt{\sigma^2 c' (X'X)^{-1} c}}$$
 The presenter is Ing. Martin Gajdoš, Ph.D., as indicated by the text and a silhouette icon on the slide. Below the slide is a video recording of the presenter, Ing. Martin Gajdoš, sitting at a desk with a computer monitor. The monitor displays the same slide content. The video player interface shows a timestamp of 11:52 and a duration of 00:27:04.

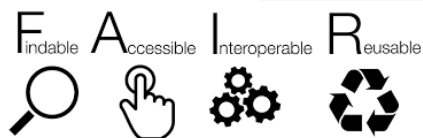
EVENTS OF THE YEAR 2023

HuBraM coffee – first Wednesday of the month from 16:00

New this year are meetings of the HuBraM community (Brain Mapping Section of the Czech Society for Clinical Neurophysiology ČLS JEP), which will offer an informal discussion on various topics in the field of neuroimaging. More information can be found on the website www.hubram.cz

Open data seminar / FAIR data – 22.2.2023, 9:00, CEITEC MU

The seminar, intended primarily for users of the Multimodal and Functional Imaging Laboratory (MAFIL), will present both the general concept of open data and so-called „FAIR“ data, as well as specific requirements and experiences in the field of neuroimaging data. Existing and forthcoming tools to support open data in MAFIL will be presented, as well as principles for handling data so that the requirements of FAIR data are met.



Workshop on Brain Microstates 30.3.2023

The workshop will be focused on presenting the experiences of several laboratories from the Czech Republic in the field of processing EEG microstates. Basic principles, methodological pitfalls, processing of microstates from simultaneous EEG-fMRI recording and possible use of microstates in neuroscience research will be presented.

Educational Neuroimaging Course - Fall 2023

In the fall, we will prepare a traditional educational course on the basics and principles of neuroimaging and functional brain mapping. The exact date will be specified during the year.

SAVE THE DATE

Workshop on Brain Microstates

Thursday, 30 March 2023
from 9:00

CEITEC MU, University Campus
Brno, Building E35, Room 145

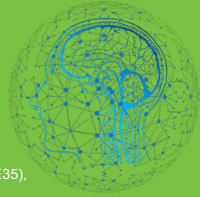


Laboratoř multimodálního a funkčního zobrazování zve na seminář

FAIR data / Open data pro uživatele CF MAFIL

Termín: 22. 2. 2023
od 9:00

Místo: Univerzitní Kampus
Bohunice
Budova CEITEC MU (E35),
místnost 145



Program:

- FAIR data, praktická implementace a proč to děláme – požadavky projektových výzev (*Michal Růžička*)
- Iniciativa EOSC a národní implementace (*Jiří Marek*)
- MAFIL a FAIR/Open data - stav a vize (*Michal Miki*)
- Praktické představení nástrojů a postupů pro práci s daty (*Tomáš Slaviček*)
- Diskuse s uživateli



A LOOK BACK AT 2022

In **2022**, 1,721 measurements with a total duration of 2,988 hours were carried out on **the core instruments of the MAFIL laboratory** for 48 unique projects. These numbers correspond approximately to the values of 2021 (-2%), but also to the „pre-pandemic“ period, so the situation has stabilized after the pandemic has subsided.

The traditional Neuroimaging training course took place in **November 2022**. Following the COVID years (2020 online only, 2021 hybrid form), it was held in a traditional face-to-face format although with limited online participation. The course was attended by 25 people from both CEITEC MU researchers and externs.



For the first time, we participated in the event called **Night of Scientists**. The theme for 2022 was **All the Senses**. Visitors could test their reaction time, their sense of smell with special tests or compete for prizes at our station - **Senses in Mind!** Many also took part in guided tours of the CF MAFIL laboratories.

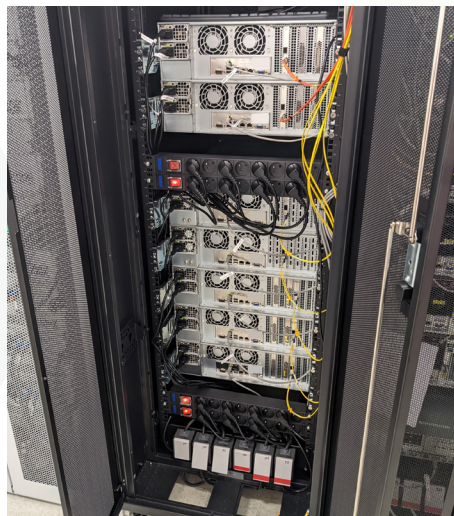


MAFIL Open Day 25.10.2022. This open day was specifically designed for those potentially interested in using the shared Multimodal and Functional Imaging Laboratory, for potential volunteers for research studies, and for university students interested in neuroscience, imaging, etc.

INTERESTING TECHNICAL SOLUTIONS

CF MAFIL computing infrastructure

With the implementation of new measurement techniques (e.g., MultiBand, MultiEcho, MREG, and others), the volume of neuroscience data is constantly increasing. Processing large datasets (up to hundreds of GB) or implementing advanced processing methods often exceeds the capabilities of conventional IT devices, so we are developing the “computing infrastructure” in the MAFIL lab. In addition to considerable time savings, it offers the possibility of “online” collaboration of several people over the processed data, facilitating the collaboration of researchers with data experts from the MAFIL lab. Currently, MAFIL has 7 data servers and 5 computing servers, with the last expansion taking place at the end of 2022.



Thanks to the CEPH (ceph.com) platform, the data servers provide a total of 450TB of storage with high redundancy and data throughput. The AMD EPYC architecture in sum of 416 processor cores are used for computation, enabling massive parallelization to reduce computation time. To increase flexibility and scalability, the infrastructure uses a virtualization system (mainly DOCKER), which allows to dynamically regulate the allocated HW resources and increases the reliability of the entire solution (e.g. a crash of one node will not affect other running nodes on the same machine). In addition to flexibility and reliability, one of the pillars of the infrastructure is also security, which is why every user has access, apart from their own folder (so-called HOME), only to

the data of pre-approved projects, and all data stored in the infrastructure is anonymized or pseudonymized.

The user base consists of about 40 users, of which about half are active users using the infrastructure for demanding calculations, and the other half are users accessing the data stored there. In the Debian oper-

ating system, each user has a variety of software packages for processing neuroscience data (e.g., SPM12, FSL, FreeSurfer, ANTs, and many others), as well as MATLAB and Python3 programming environments for creating or modifying their own scripts for data processing.

INTRODUCING INTERESTING PROJECTS IN CF

Esport as a New Phenomenon in Kinanthropological Research

Electronic sport (esport) is a term used to describe casual or organized video game play in a way that provides professional or personal development for the player. Esports are beginning to receive increased attention from researchers. One topic of interest and debate is the comparison of esports with traditional sports. In particular, they focus on whether esports can be classified as a „sport“ and whether its players can be treated as traditional „athletes“. Esport fits well into sociological and philosophical definitions of sport (e.g., it involves play, competition and skill). The total prize pools of esport competitions are projected to reach more than \$413 million by 2022. The growth in viewership and prize pools has led to the development of professional players/teams competing in regular professional esports leagues.



A team of researchers from the Faculty of Sports Studies approached us with the practical part of their research project to investigate some of the psychological factors that can determine success in esports. The participants are members of professional esport teams and regular computer game players. While playing the game in

our laboratory, their EEG is scanned and their eye movements are monitored. In cooperation with the RECE-TOX centre, further physiological data is simultaneously collected using the experimental measuring device ENTRANT. The results should help to understand the differences in coping with esports-related stress situations between professional and amateur players. Professional esports players' abilities to cope with stressful situations are comparable to the psychological characteristics of traditional athletes.

Neurobiological impact of extreme war stress: a study of Ukrainian war survivors

This study examines the effects of extreme stress among civilians affected by the war in Ukraine between February and April 2022 who fled to the Czech Republic. The traumatic experience of war and experiencing severe stress leads to an impact on the psyche and mind. The aim of this study was to investigate the effects of currently experienced stress on brain structures and functions as well as mental health. During a functional MRI scan, where brain activity was monitored, study participants were presented with two visual tasks - mathematical examples and war-themed images (e.g. images of destroyed/bombed cities, soldiers, people fleeing war, etc.). Psychological testing examined post-

traumatic stress symptoms, posttraumatic growth, resilience, and current emotional experience.

Prostate cancer screening using magnetic resonance imaging

Carcinoma of the prostate is the most common oncological disease in men and its occurrence is approximately as frequent as breast cancer in women. However, unlike them, prevention is very complicated for men. One currently recommended and available method is palpation combined with blood sampling, which is then used to determine the PSA level in the blood. Blood PSA levels may be elevated in men with prostate cancer, benign prostate enlargement or prostate infection.

Every patient who is part of the project will have a blood test at the Masaryk Cancer Institute and an MRI scan in our laboratory. The results from these modalities are then compared. The use of MRI for prostate cancer prevention is a novelty. Doctors will evaluate in two years whether and how successful the project will be depending on how many patients have been detected by this method. So far, half of the volunteers have been measured, and the cancer detection rate has been 6%, whether by PSA blood levels, MRI scans or a combination of these modalities. Thus, in the future, this prostate screening could be widespread.

SELECTED PUBLICATIONS

In 2022, we have 20 publications based on the use of our laboratory. An overview of all publications can be found on our website: <http://mafil.ceitec.cz>

Here we look at just a few selected publications.

Zatloukalova, E., Mikl, M., Shaw, D. J., Marecek, R., Sakalosova, L., Kuratko-va, M., Mitterova, K., Sklenarova, B., & Brazdil, M. (2022). **Insights into déjà vu: Associations between the frequency of experience and amplitudes of low-frequency oscillations in resting-state functional magnetic resonance imaging.** *European Journal of Neuroscience*, 55(2), 426–437. <https://doi.org/10.1111/ejn.15570>

One of the media-interesting topics of Brno neuroscientists is „deja vu“. This publication further expands the knowledge about this phenomenon, this time using a method for monitoring brain activity using the ALFF method, which focuses on the intensity of signal fluctuations in functional magnetic resonance data.

Valošek, J., Bednařík, P., Keřkovský, M., Hluštík, P., Bednařík, J., & Svátková, A. (2022). **Quantitative MR Markers in Non-Myelopathic Spinal Cord Compression: A Narrative Review.** *Journal of Clinical Medicine*, 11(9), 2301. <https://doi.org/10.3390/jcm11092301>

The publication is an example of the fact that not only the brain is the subject of research by our users, but also, for example, changes in the spinal cord caused by spinal compression. This topic was the subject of a project that we presented to you in earlier issues of the bulletin.

Pupíková, M., Šimko, P., Lamoš, M., Gajdoš, M., & Rektorová, I. (2022). **Inter-individual differences in baseline dynamic functional connectivity are linked to cognitive aftereffects of tDCS.** *Scientific Reports*, 12(1), 20754. <https://doi.org/10.1038/s41598-022-25016-5>

One of the methods used in our laboratory is non-invasive brain stimulation, which is mainly the focus of the Applied Neuroscience research group. This publication investigates the effect of direct current stimulation on brain activity measured by fMRI, focusing on dynamic changes in brain connectivity.

LET'S END WITH A RIDDLE

Last year, one project implemented in our laboratory focused on which part of the body atypical for neuroscience?

B	A	L	E	T	D	K	P	R	H
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K	Ř	A	T	O	N	D	O	H	S
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O	S	R	K	Á	E	O	A	Ň	R
T	I	A	K	Č	R	F	L	T	P
T	J	C	A	R	Y	B	K	A	O
D	C	E	R	U	Š	K	A	T	A

ALOBAL BALET BANKROT BRÁNA ČAJNÍK DCERUŠKA DIMENZE FRČKA
HODNOTA JISKŘIČKA KONVICE LÍHEŇ MATRACE MOZOL OKAMŽIK
OTAZNÍK PROSPĚCH RYBKA





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