

BULLETIN

MAFIL Core Facility

Introduction

Dear researchers, colleagues and those interested in the services of our core facility,

We have prepared for you the first issue of an information bulletin CF MAFIL. In this way we would like to bring you news and interesting information regarding the central laboratory, called Core Facility. The bulletin is going to be prepared randomly twice annually. Our aim is to inform both professional and general public about news in the instrumentation and services on offer, to gradually introduce key people of our facility, explain the organizational structure and clarify rules concerning the use

of available equipment and services on offer. We would also like to give you statistics of the use of instruments and occasionally present interesting projects which are being carried out at our facility. We will inform you about educational and specialized events which we are preparing or those which have been completed. We co-organize these events which concern us or our users and may be of interest and useful for you. We are a young, developing "core facility", so we would appreciate any suggestions as to what we can improve or change.

Thank you for all your support so far.

Michal Mikl, Head of MAFIL Core Facility





Introducing MAFIL Core Facility

(Multimodal and Functional Imaging Laboratory)

What do the acronyms CF and MAFIL actually mean?

CF or core facility (in Czech a central laboratory or also a shared laboratory) is one of the ten core facilities of the project CEITEC (Central European Institute of Technology, see www.ceitec.cz). The term shared laboratory expresses the meaning of the laboratory exactly. It is accessible to external users, so it is shared by more users. It is also a set of instruments and technologies which are unique in being in one place and easily accessible. MAFIL is an acronym for the name Multimodal and Functional Imaging Laboratory, in Czech Laboratoř multimodálního a funkčního zobrazování. CF MAFIL is a part of Masaryk University and within the university institute CEITEC it belongs to the research programme Brain and Mind Research and the Neuro Science Centre CEITEC MU. Our main area of interest is the mapping of the human brain and neuroimaging, but with the equipment available we are also able to carry out studies focused on other human body parts.

As to its equipment, CF MAFIL has two main components. The first one is imaging by means of MR scanners. We have two Siemens Prisma whole-body scanners with 3T magnetic induction and related accessories at our disposal. The second component is electrophysiology mainly focusing on electroencephalography (EEG), which is based on a 256-channel MR compatible scalp EEG EGI GES 400 MR. MAFIL has also an instrument for repetitive

transcranial magnetic stimulation (rTMS) and instruments for general electrophysiological (and also for polygraphic) measurements at their disposal. You can find a detailed overview of equipment and instruments including their technical specifications on pages 3 and 4. The laboratory and its equipment was completed in 2014 and at the



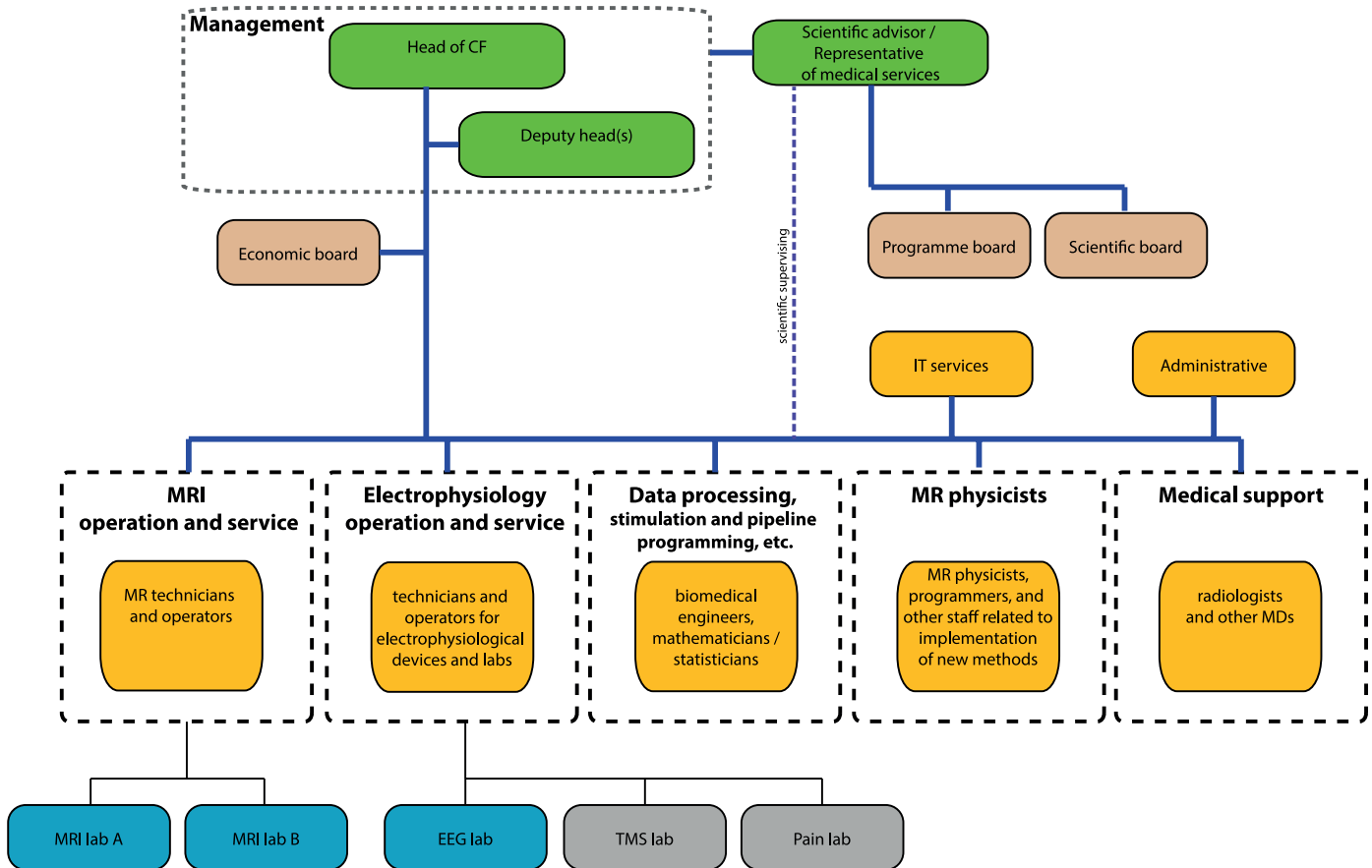
beginning of the following year the MR scanners were installed. The first trial measurement was carried out in March 2015. It was followed by the Grand Opening of CF MAFIL and the first meeting of the Core Facility Scientific and Programme Board in May. In the second half of 2015 the laboratory equipment was extended following the needs of the CF and the projects dealt with.

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CF MAFIL Organization Structure Scheme



Laboratory Equipment

Two whole-body human 3T MR scanners

- **Siemens Prisma 3T, whole-body MR scanner for imaging and spectroscopy with 60 cm bore-size, powerful gradient system (max. amplitude 80 T/m with slew-rate 200 T/m/s). RF excitation use two independent channels (TimTX TrueShape technique)**
 - available coils: head/neck (64 channels), head/neck (20 channels), spine (32 channels), body (18 channels), small and large flexible (4 channels)
 - possible triggering with ECG, breathing belt, and pulse oximeter
 - possible simultaneous recording of polygraphic signals (EOG, ECG, EEG, breathing, movement, EMG,...)
 - MR scanner A is prepared for multinuclear measurements (equipped with 1H/31P head volume coil) and equipped with Tx/Rx CP Head Coil
 - several sequences developed or modified in prestigious foreign institutions are available (e.g. from CMRR, University of Minnesota, University of Maastricht)
- **Equipment for functional studies**
 - software E-Prime for stimulation, MATLAB, etc.
 - MR compatible audio-visual stimulation for delivering of auditory and/or visual stimuli
 - other equipment for recording of subject's response (buttons, keyboard, etc.)

Electrophysiological systems for measurement in EEG lab or MR

- 256 channel MR compatible EEG system**

EGI GES 400 MR system with amplifier EGI Net Amps 400, 256 channels for EEG recording, including software for correction of artefacts caused by MR and for data analysis. Several types and sizes of EEG caps are available – MR compatible EEG caps for fast application, EEG caps for long-term measurements outside of MR, and rTMS compatible low-profile caps.

- 30 channels MR compatible EEG/ExG system**

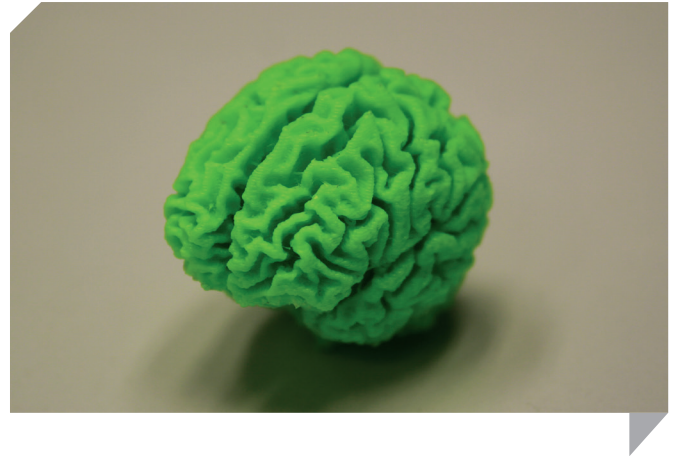
BrainProducts BrainAmpl MR / BrainAmp ExG MR, 30 EEG channels, 1 EOG channel, ExG module. ExG module enables to record other physiological signals (ECG, EMG, skin conductance, respiratory signal, movement, general bipolar electrophysiological measurements). Software for correction of artefacts caused by MR and for data analysis.

- ExG MR compatible system**

BrainProducts BrainAmp ExG MR, ExG module enables to record other physiological signals (ECG, EMG, skin conductance, respiratory signal, movement, general bipolar electrophysiological measurements). Software for correction of artefacts caused by MR and for data analysis.

- Shielded EEG lab**

This lab is prepared for measurement of high-quality electrophysiological data inside RF shielded cabin fully equipped for audio-visual stimulation and recording of interactions of measured subject during experiment. E-prime software is used for programming of stimulation. Hardware configuration of lab is prepared for simultaneous recording with EEG and ExG systems



CF MAFIL provides services related to usage of equipment installed in our labs but moreover other services related to processing of measured data are offered. General overview of MR and electrophysiological techniques is below.

MR techniques	Electrophysiological techniques
anatomical imaging with variety of contrasts (T1-, T2-weighted, separation of fat/water, magnetization transfer)	high-density EEG (256 channels) with possible usage for simultaneous recordings in MR scanner
BOLD effect imaging (functional imaging) including multiband acquisition	standard EEG (30 channels) with possible usage for simultaneous recordings in MR scanner
imaging of diffusion of water molecules (diffusion weighted images, diffusion tensor, kurtosis) including multiband acquisition	recording of electrocardiography (ECG), breathing, movement (accelerometer), skin conductance and general polygraphic signals with unipolar or bipolar electrodes (for instance EMG) – all with possibility of simultaneous measurement in MR scanner
spectroscopic measurements (single-voxel spectroscopy and spectroscopic imaging) + SemiLaser and FastMap for MRS (CMRR, Minneapolis)	*rTMS (repetitive transcranial magnetic stimulation)
perfusion imaging	
*imaging of muscle dynamics (heart)	
*MR mammography	

* Nowadays, CF MAFIL can provide only basic access to equipment without full expertise

The laboratory technicians are able to ensure the production of various MR compatible tools to their users by means of their own 3D printer, they are also able to provide consultations for the preparation of fMRI experiments, optimization of measurement protocols, programming stimulation for fMRI and processing the data measured in the field of neuroimaging. We also participate in educational and training activities

(in November 2015 a two-day educational workshop was held focused on neuroimaging and electrophysiological measurements). The aim of the laboratory is testing and consequent applications of the latest technologies and procedures, that's why CF MAFIL is in close cooperation with the Institute of Scientific Instruments at the Czech Academy of Sciences.

Visits and Excursions in 2015

The MAFIL laboratory is one of the most frequently visited laboratories in CEITEC. In 2015 the laboratory has participated in a number of tours and educational excursions for both professional and general public. The overview is given in the following table..

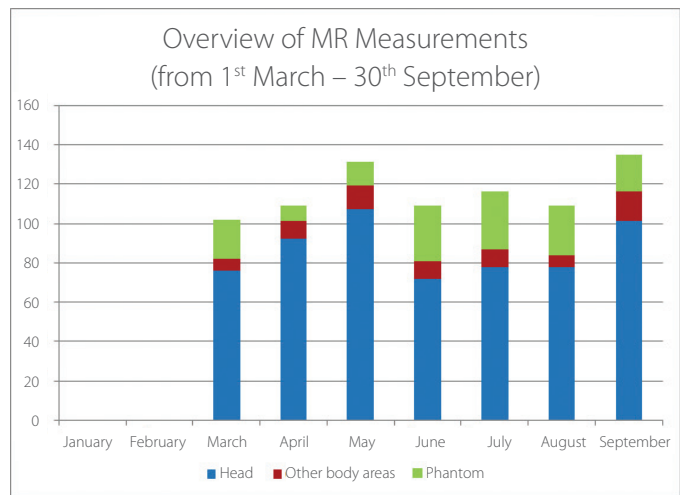
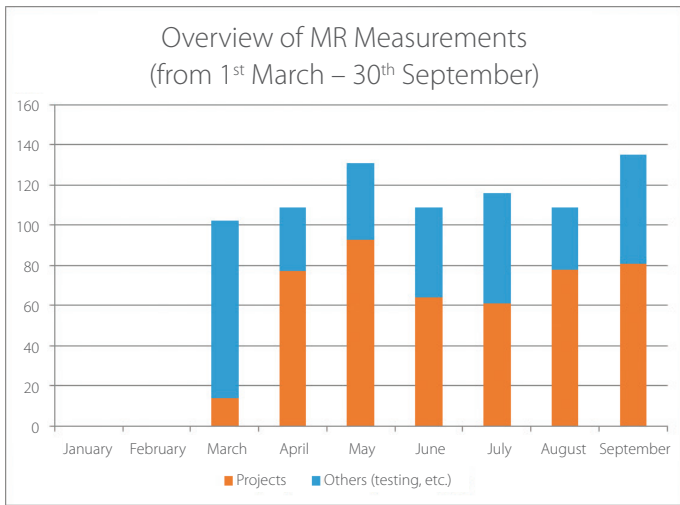
10. 3. 2015	prof. Drago
24. 3. 2015	University of South Bohemia
28. 4. 2015	CSF, Vienna
30. 4. 2015	Business research forum
5. 5. 2015	Grand Opening ceremony of CF MAFIL + Open Day
15. 5. 2015	University of Twente – excursion for students
11. 6. 2015	Biocev
1. 7. 2015	Robert-Jan Smits (DG research, EC)
1. 9. 2015	International School of Prague – excursion for students
7. 9. 2015	a visit by an ISAB member
24. 9. 2015	Peter Hore, Univesity of Oxford
29. 9. 2015	excursion for the participants of ECCN
9. 10. 2015	excursion for the participants of a dementia course
14. 10. 2015	dr. Henzinger (guest of prof. Koča)
16. 10. 2015	a visit by the MU Rectorate
16. 10. 2015	Slovak Centre of Scientific and Technical Information
20. 10. 2015	filming a report for Macedonian television
26. 10. 2015	prof. Goldberg, Izrael
26. 10. 2015	educational course for the students of FEEC BUT
10. 11. 2015	Open Day CEITEC
19. 11. 2015	University of Wroclaw





Statistics of Measurements for 2015

The MR scanners were installed in February 2015



During the above stated period there were 811 measurements in total carried out on MR scanners for 15 different projects for both users and within testing and odlaďování optimization of the services of CF MAFIL. There were 100 electrophysiologic measurements in total carried out for 9 different studies in 2015. Our laboratory has participated in the international project APGEM, we have received 8 requests for measurements from external users, 6 of which were requests for access within the project CEITEC – open access. A number of other studies were started in October and November and their completion is planned for 2016. The final statistics for this year will be published in the next issue of the bulletin.





Access to the Equipment and Services of MAFIL CF

There are several access options to use CF MAFIL. In 2015 the access of internal users was supported with the funds from RDI OP allocated for the running of core facilities. External users could use services in two modes: **1)** through the project CEITEC – open access project, funded by the Ministry of Education, Youth and Sports of the Czech Republic under the activity „Projects of major infrastructures for research, development and innovations“ or **2)** by settling the costs for services from own resources (e.g. research grants). Taking into consideration the requirement for CF MAFIL to start quickly, the procedures and requirements for the administration of access gradually developed based on the experience with the implementation of projects and based on solving various administrative and organizational situations. Before starting cooperation with CF MAFIL it is necessary to fulfil the requirements stemming from these issues:

- **technical feasibility and a clear definition of required services and equipment**
- **settlement of costs**
- **administration requirements**
- **safety issues**
- **insurance**
- **ethics + rules for handling measured and personal data**

Before the start of the measurement itself, it is necessary to check that the necessary equipment, operators, settings (e.g. specific pulse sequences with MR and setting of the parameters of the measurement protocol) and other accessories and software (e.g. equipment for stimulation and recording the response of a measured person) for the given project are available. With the first contact there is normally a discussion over the possibilities of the CF and the needs of the project. The final technical feasibility has to be approved by the CF Head or the administrator of the given instrument / laboratory. To ensure maximum reproducibility of each measurement in the project, there is a detailed description made for each study including the equipment used, the setting of instruments and the measurement procedure. To solve other issues given above, we have prepared a document to fill in for the necessary information and an overview of necessary requirements for each project. The completion of an informed consent document by each person undertaking measurement in CF MAFIL is a vital condition from the point of ethics as well as insurance and safety. In the next issues of the bulletin we are going to make the readers more familiar with each requirement in more detail.



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<http://www.ceitec.cz/ceitec-mu/laborator-multimodalniho-a-funkcniho-zobrazovani/z10>



<https://www.facebook.com/CFMAFIL/>

