CEITEC
Central European Institute of Technology
BRNO | CZECH REPUBLIC

UNIVERSITAS MASARYKIANA BRUNENSIS

BULLETIN VOL. 3
MAFIL Core Facility

MAFIL

Introductory Word

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

The year 2016 has brought several novelties to our laboratory. It was the first year when we were operating within the scope of the infrastructure project CzechBioImaging. For the first time, the internal evaluation of CEITEC laboratories took place which included also our Multimodal and Functional Imaging Laboratory (MAFIL). At the end of the year, the preparation of supporting materials for the evaluation of research infrastructures was started. At the same time, the usage rate of the instrumentation in the laboratory has been slowly increasing. In summer, we upgraded our MR scanners to the most recent software version, which caused some short-term restrictions for the users, but in the future will enable us to obtain up-to-date versions of acquisition sequences from the leading world sites. In October, we had the chance of welcoming prof. Rainer Goebel of Maastricht within the scope of Life Science Seminar Series. Motivated by his lecture and the subsequent discussion with the cooperating researchers, we have decided that in the coming year we will attempt to introduce real-time fMRI as one of our methods, offering an interesting usage in the field of neurofeedback or the brain-computer interface (BCI). Finally, I would like to take this opportunity to wish you all a successful start of 2017 on behalf of the whole laboratory.

Thank you for your hitherto support.
On behalf of CF MAFIL, Michal Mikl,
Head of the Core Facility

News and Events in 2016

As a tradition, this section presents an overview of various events and news relating to our laboratory. The table below provides an overview of visits and excursions that took place in 2016.

01/2016	Excursion for the participants of EPODES course
02/2016	Visit of elementary school children
	Excursion for the participants of CEITEC-IKEM course
04/2016	Excursion for the Academic Senate of MU
	Excursion for foreign visitors of the Faculty of Sports Studies of MU
	FMRI demonstration for the visitors of BUT
	Excursion for the visitors of the Chancellor's Office of MU
05/2016	CEITEC MU open day
08/2016	Visit from the MEYS CR
09/2016	Summer school for young talents
10/2016	Visit of the representatives of the Korean Embassy
	Visit of Rainer Goebel (Maastricht)
11/2016	Visit of the representatives of Israel universities
	Visit of the representatives of universities from Georgia and Kyrgyzstan
	Neuroimaging educational course
	Teaching lecture for the students of the Faculty of Science of MU
12/2016	Visit of prof. Ray Chaudhuri, London

Educational activities

The table below presents an overview of official workshops and courses organised by our laboratory in 2016. Starting from 2016, these activities are also organised under the auspices of the research infrastructure CzechBioImaging.

07/04/2016	Workshop - Innovations in mapping of brain function and structure: benefits and pitfalls
14–16/11/2016	Neuroimaging educational course: Mapping of the brain functions and structure

The spring workshop usually is an event focused on a specific scientific topic and is prepared as a follow-up event of the international fMRI workshop held in Olomouc. In 2017, this workshop will take place at a similar date, on 6 April 2017. The autumn educational course is also a traditional event, but this year it will feature several new aspects. For the first time, the course lasted for three days and our colleagues of the Institute of Scientific Instrumentation of CAS significantly participated in the preparation of the theory blocks, which cooperation for the first time enabled the inclusion of a block focused on animal MR studies. The syllabus newly also included a short block focused on non-invasive brain stimulation in connection with neuroimaging. The workshop was attended by more than 50 participants.

Evaluation of the core facilities

In 2016, the first internal evaluation of all the core facilities within CEITEC took place, bringing valuable feedback for the future development and improvement of our services. This is an internal tool of CEITEC used for the review of the functioning of our laboratories and for the creation of a certain feedback and monitoring of the trends in the functioning of the laboratories. The laboratories were evaluated in terms of different aspects, such as the instrumentation equipment, staffing, economic aspects and user fees, range of the offered services, usage rate, etc. Internal evaluation is one of several evaluation procedures that the core facilities at CEITEC undergo.

In addition, the core facilities are evaluated within the scope of the international scientific evaluation of the CEITEC project (once every 4 years, with the most recent evaluation in 2014), as well as within the scope of evaluation of individual projects of different research infrastructures in which they participate. The core facilities can also obtain a partial feedback from the annual meeting of the International Scientific Advisory Board of CEITEC (ISAB). Probably the most flexible feedback that he core facilities should be getting is the feedback from their users (e.g. at various meetings with users or, in our particular case, at the meetings of the Programme Board).

Meeting of the Programme Board and Scientific Board on 12 December 2016

In December, a joint meeting of the members of the Programme Board and Scientific Board took place. The Programme Board of CF MAFIL is equal to the user committee according to the common rules of the core facilities and performs its role. It is composed of experienced researchers using CF MAFIL. The task of the Programme Board is to provide feedback from users implementing their projects at CF MAFIL, provide opinions regarding the development of instrumentation equipment, etc. The Scientific Board consists predominantly of external researchers and should be able to provide a certain comparison with the external environment and an independent view with respect to the discussed topics. The boards were established at the beginning of 2015 and their first meeting was held at the opportunity of the official opening of CF MAFIL in May 2015. Since then, the Programme Board has been meeting twice a year, providing its statements on an ongoing basis with respect to various issues, such as the planning of investments in development projects. At the December meeting, the outputs of the internal evaluation were discussed with the board members and the infrastructure projects CzechBioImaging and EuroBioImaging in which we participate were introduced in detail.

Involvement of CF in the infrastructure projects

This year, our laboratory operates as a part of the research infrastructure CzechBioImaging, which is primarily reflected in economic aspects. Thanks to the involvement in CzechBioImaging infrastructure, we can offer open access to a wide range of users while maintaining very low user fees (the users taking advantage of open access only pay the necessary costs not covered by the research infrastructure subsidy). External users also have the opportunity to take advantage of regular calls where the projects with the best evaluation gain access without any additional fee. In 2016, three projects of external users were supported in this way. At the end of 2016, another round of invitations was announced, to be evaluated in February 2017, with the successful projects being able to commence in March 2017. Detailed information and forms for the access of external users to the CzechBioImaging infrastructure are available at the websites
https://www.czech-bioimaging.cz/application-forms.

CzechBioImaging also supports education courses and workshops focused on the laboratory users. This year, we have organised, in cooperation with another site involved in CzechBioImaging infrastructure, the Institute of Scientific Instruments of CAS, a three-day education course focused on neuroimaging - see detailed information in the section relating to the News and Events. Users can also apply for open access through the European infrastructure EuroBioImaging at the address
https://www.eurobioimaging-interim.eu/

EURO-BIOIMAGING

CZECH BIOIMAGING
Imaging principles of life

Access to the CF's services in 2017

All measurements at CF MAFIL takes place in the form of research projects (studies). A research project is defined as a set of measurements taken with identical measurement protocol relating to the hypothesis of the given research project. Each project is associated with a responsible person (project owner/applicant) and its measurements are usually taken within a pre-defined period of time.

Apart from the structure described above, several testing measurements can be taken prior to the commencement of the actual project, in order to verify the technical feasibility of the tested hypothesis and setting of the parameters. These measurements are taken in a specific regime of co-operation between the lab employees and the researcher.
Formal requirements prior to the commencement of measurements in a research project, as well as the necessary documents are available at www.ceitec.eu/mafil/doc.

Prior to the commencement of each measurement, an informed consent signed by the relevant entity is required (a copy is sufficient). The signed informed consent must be subsequently archived together with the filled safety form of CF MAFIL.

Users book their measurement time through the CEITEC planning board (http://booking.ceitec.cz). Each reservation on the planning board must be assigned to a specific project and newly also to a specific research group; subsequently, it is confirmed by an employee of CF MAFIL.

The measured data are handed over only to the researchers listed in the "CF MAFIL Access Form". All data is anonymised. Personal data of the participants may only be provided to the project owner or a person appointed by the project owner.

Access modes

In 2017, there are several access modes available at CF MAFIL, as listed below. The differences are based on user classification (i.e. internal/external) and source of funding.

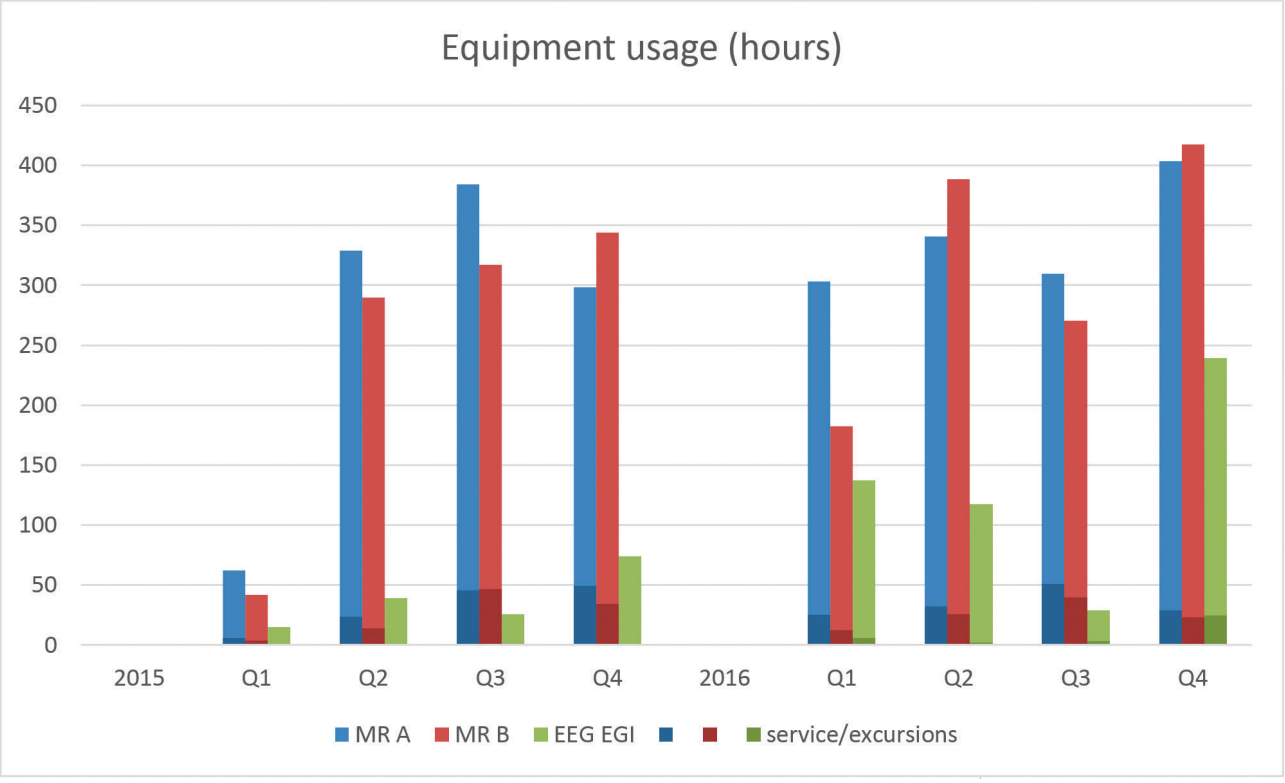
- Direct access / direct payment
- CzBI open access (https://www.czech-bioimaging.cz/application-forms)
- CzBI grant scheme (https://www.czech-bioimaging.cz/czech-bioimaging-call-for-research-projects)
- Cooperation with CF MAFIL
- EUBI open-access (https://www.eurobioimaging-interim.eu/)

Details relating to each of the alternatives are described in the document entitled "Access to services of CF MAFIL in 2017" available at www.ceitec.eu/mafil/doc.

If you need any explanations or if you wish to co-operate with us, please do not hesitate to contact us.

Measurement reports 2016

In 2016, 1,844 measurements were taken in total, for 40 unique projects (apart from testing and fine-tuning measurements for the CF). Thus, the average number of measurements per project was 46.1 and an average time of each reservation (measurement block) was 1.87 hours. The total numbers of measurement hours divided by the devices in the past period are illustrated in the chart below. The data for the calculation were taken from the CEITEC booking system (so-called planning board).

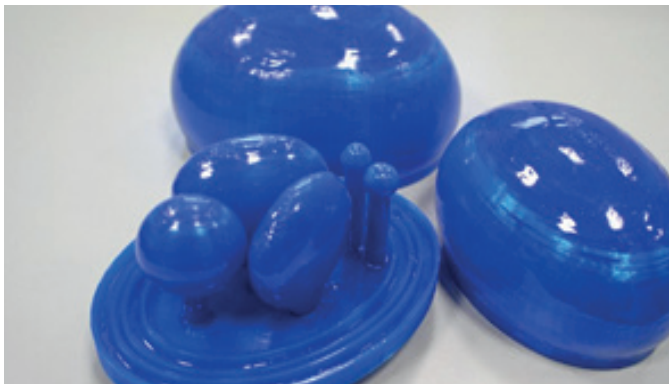


Production of accessories for MR and EEG

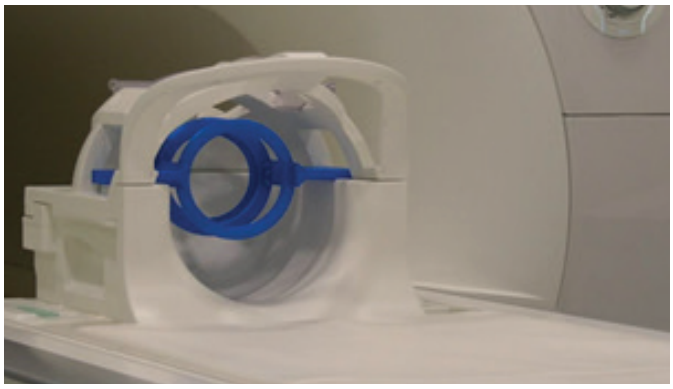
In connection with the implementation of scientific projects and introduction of new methods, there is a constant need in our laboratory of using various tools and accessories. These are often various connection cables, converters of optical and electrical signal, various separation and shielding elements and mechanic tools.

A number of generally applicable accessories for MR and EEG have been constructed, tested and produced, as well as a number of various tools necessary for the implementation of specific studies. E.g.

Phantoms for MR and their accessories



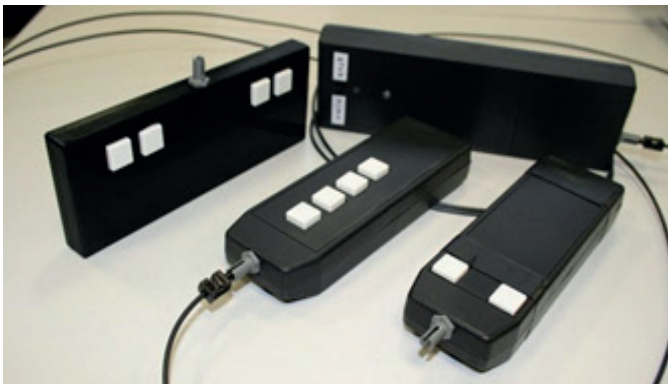
Shepp-Logan phantom - a multicompartment phantom that is used as a model of human head



Adjustable mount for positioning of the cylindrical phantom as needed

MR-compatible set for recording the person's reactions during magnetic resonance measurement.

The set contains an evaluation box and several MR-compatible button modules with different settings customised for different studies. It also includes, for example, a pen recording information on the beginning and interruptions of the writing process. In order to avoid any interference in the shielded area of the MR scanner, the connection between the assessment box and the button modules is ensured by an fiber-optic cable.



Set of MR-compatible buttons used for recording measured person's responses

MR compatible pencil - designed for recording measured person's responses

A set for recording reactions during measurement in a rTMS laboratory

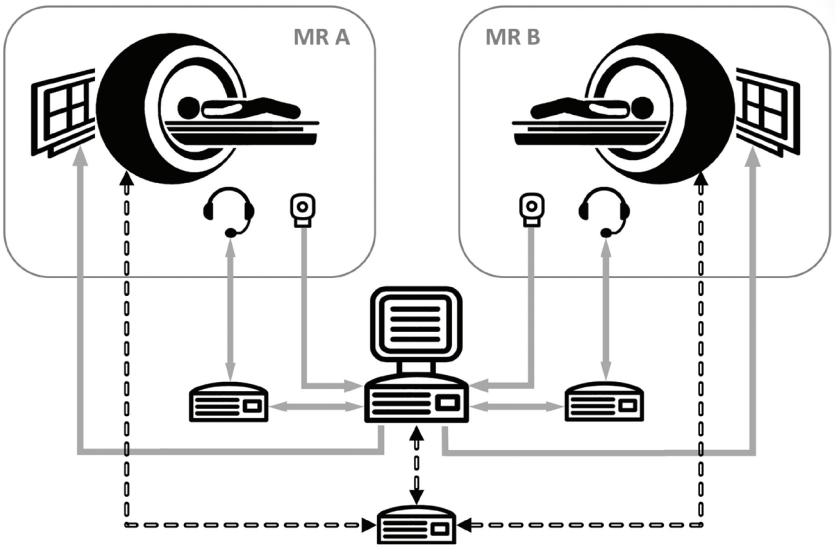
Presentation of selected measurement methods and technical solutions

Dual fMRI (hyperscanning)

One of the unique possibilities of CF MAFIL is the possibility of the so-called dual fMRI also known as hyperscanning. This is a functional imaging method (fMRI = functional magnetic resonance imaging) where two participants undergo the examination simultaneously - each in one MR scanner - performing a task based on mutual interaction. Thus, it is necessary to have two MR scanners available, equipped for fMRI imaging and if possible identical, which is a unique case at CF MAFIL in the Czech Republic, and quite a unique situation worldwide in fact too. Besides, it is necessary to resolve a number of specific hardware and software issues. E.g.

- trigger cables for the interconnection of the stimulation computer with both MR scanners and also with the HDEEG, EEG, pulse generator, etc., including the need of easy changes of the connection configuration for the purpose of independent use of each scanner or for dual fMRI;
- debugging of the simultaneous triggering of both scanners from the simulation PC by means of a generator;
- sound transfer between both MR scanners, elimination of interference and recording for hyperscanning, including the search of an optimal device for sound transfer in the protocols using hyperscanning (headphones, earplugs);
- transfer of audio-visual stimuli from one stimulation computer to two scanners (i.e. two independent imaging devices and sound systems) with the need to transfer both independent stimuli to each participant individua-lly, as well as common stimuli to both participants at the same time.

In our CF, we have managed to successfully resolve all the necessary requirements and at the mo-ment we have been implementing 4 different studies (including the completed ones) using dual fMRI, with other studies being prepared. This type of measurement is used in particular in the field of social neuroscience, neuroeconomic studies and other similar fields.



Presentation of selected projects

1. Pilot 1H proton MR spectroscopy dataset for the cervical spinal cord (SPE-C)

Within the scope of the SPE-C project, measurements are taken of the spectrum of cervical spinal cord metabolites with the use of 1H proton magnetic-resonance spectroscopy. The measured data is used for the evaluation of parameters characterising biochemical composition and metabolic processes in the cervical spinal cord. Detailed examination of biochemical processes in this anatomic area can improve the diagnostic results of future examinations, including the determination of biomarkers of some neurologic diseases, such as cervical spinal stenosis or multiple sclerosis. If this project is successful, spectroscopic measurements of the cervical spinal cord metabolites will be included in the clinical research of the diagnostics of neurologic diseases.

2. Individual differences in the differentiation between the representation of the self and of others

This is a joint project of CEITEC MU and the Institute of Psychology of CAS, the investigator of which on behalf of CEITEC MU is Daniel J. Shaw, Ph.D. The project is financed by the Grant Agency of the Czech Republic and is being implemented in the period of 2015 - 2017. The aim is to identify psychological factors leading to individual differences in behavioral and neurophysiological indexes of differentiation of the self and the others and, consequently, to better understanding of the influence of these factors on differentiation and their role in personality disorders. Repeated examination is planned of the groups of respondents defined on the basis of behavioral mapping of social cognition aspects in the first year of the project implementation. The second and third examination of respondents is carried out with the use of the scalp EEG and MRI. The revelation of factors associated with poor capability of differentiation could in the future enable identification of their role in various clinical populations.

3. Neurologic and psychological markers of stress / resistance in the survivors of the holocaust and their descendants

The study "Neurologic and psychological markers of stress / resistance in the survivors of the holocaust and their descendants - three-generation study" is a research project aimed at investigating the psychological, neurobiological and genetic factors of strong stress in the survivors of the Shoah (holocaust) and finding an association between them Another goal is to reveal mechanisms of trans-generation transfers of biomarkers by which chronic stress affects the lives of the second and third generations compared to control subjects of corresponding age, gender and education.

4. Cognitive and affective aspects of agency (EMOAGENT)

EMOAGENT is an internal project of Behavioural and Social Neuroscience research group CEITEC MU and CF MAFIL, principal investigator is professor Milan Brázdil. The aim of the project is to explore an effect of interoception on predictive coding processing of errors in Sense of Agency. Project involves multiple studies. Data of 30 healthy volunteers for the first study are in the process of collection at the moment. This study examines an effect of interoceptive manipulation of the experience of Sense of Agency. Several methods are used, including simultaneous fMRI and ExG recording.

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