

BULLETIN VOL. 4

MAFIL Core Facility

Introductory Word

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

At the time of preparation of the current information bulletin, summer presented itself with a very hot weather and everybody is slowly getting ready for the summer holidays. We hope that this magazine, in which we bring news and current topics related to our laboratory, will also contribute to making the hot summer days pleasant and enjoyable. We commenced this year with finalization of materials necessary for the evaluation of the research infrastructure CzechBioImaging, which we are part of, we discussed the acquisition of new sequences, prepared realization of some new projects and dealt with requests for providing more measurement timeslots. Based on



the long-term plans and on our users' requests, we are currently preparing implementation of several investment acquisitions for the expansion of our equipment and for the portfolio expansion of the provided services. In the previous issue, we started with an introduction of interesting technical solutions, particularly the real-time fMRI method, which, in cooperation with our users, we have recently managed to implement. Have a pleasant summer,

On behalf of CF MAFIL, [Michal Míkl](#)



News in infrastructure projects

As we informed in previous issues of the information bulletin, candidates interested in measurement in our laboratory can use an open access to the infrastructure project CzechBioImaging (see <https://www.czech-bioimaging.cz/application-forms>) or the European project EuroBioImaging (see <http://www.eurobioimaging.eu/>), under which our laboratory offers the services of MR imaging as a part of the Brno Node (see <https://www.eurobioimaging-interim.eu/almmdb.html>). Recently, the information about Brno Node has been updated, so that researchers interested in measurement can easily find possibilities offered by EuroBioImaging under Brno Node. This year, our laboratory has had first experiences with providing user applications via EuroBioImaging portal. The length of the formal process (from the project submitting by the researcher until the call for the launch of the project) took approximately 5 weeks. The project is now being prepared for implementation and should be implemented in summer.



Supporting access of new external users

To support access of new academic users through EuroBioImaging, we have decided to reward the researchers approaching our laboratory for the first time with a specific amount of measurement time. It is necessary to successfully submit your project through EuroBioImaging portal (see <https://www.eurobioimaging-interim.eu/apply-for-access.html>). The first 20–25 hours shall be provided with the CF support free of charge to enable users proper setting and testing their research project. The further measurement hours and services shall be subsequently charged at a reduced rate of the user fee, as in case of the standard access through CzechBioImaging open access. This motivational support for new users is valid until 31 December 2017 (request submission date through EuroBioImaging web portal).

Past events of 2017

- In February and March 2017, an applied course of fMRI and structural data processing using Matlab software + SPM12 and GIFT took place. The course was particularly aimed at local users and was divided into 4 two-hour blocks.
- On 4 April 2017, a traditional spring workshop organized by CF MAFIL in cooperation with HuBraM (department of functional brain mapping ČSKN CzMA JEP) and related to the international fMRI workshop in Olomouc took place. This year, the name of Brno workshop was “Experiments in neuroimaging: planning, optimization, analytical and technical issues”.
- On 19 June 2017, a meeting of the CF MAFIL’s Programme Board took place.

Excursions and visits at CF in the first half of 2017

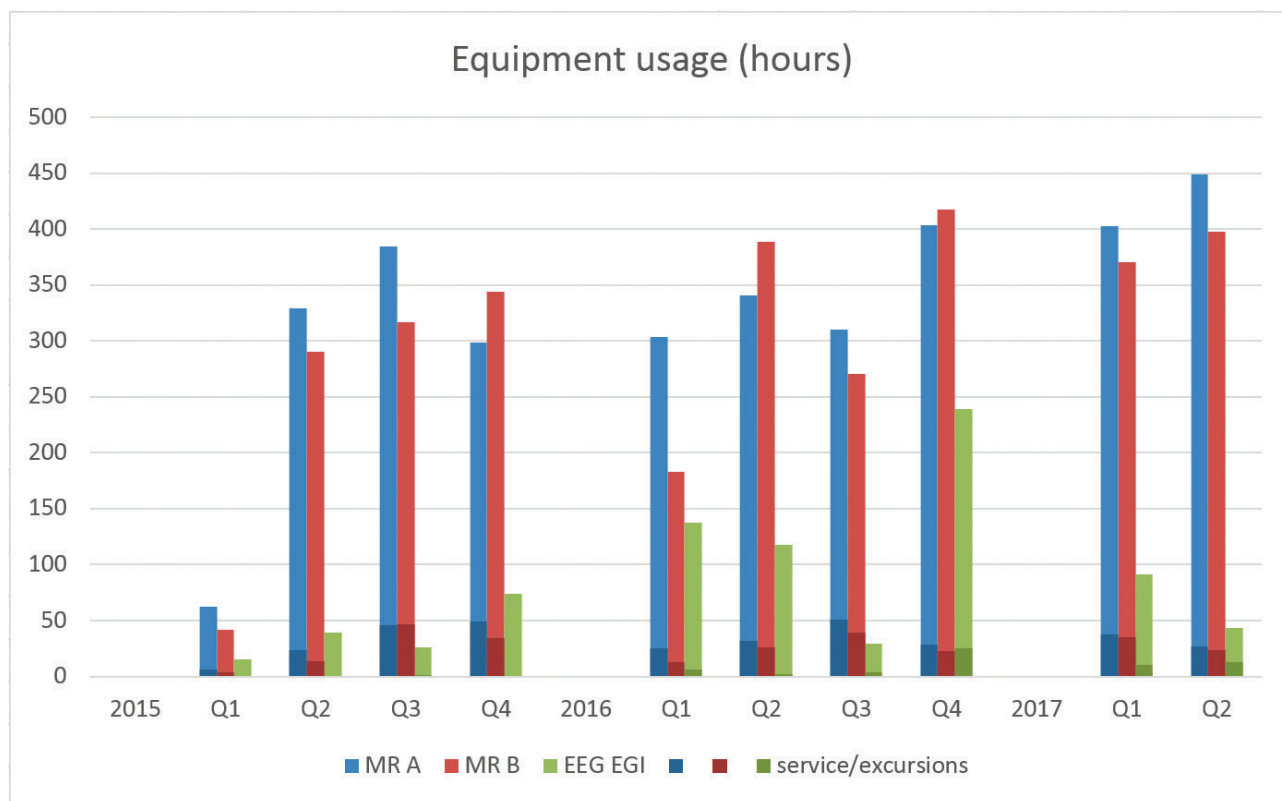
31. 1. 2017	Excursion for elementary school children
3. 2. 2017	Report making for Czech Television
23. 2. 2017	Tour for M. Dettenhofer's guests
2. 3. 2017	Excursion for Respekt magazine (M. Brázdil)
2. 3. 2017	Visit of MU Scientific Board members
3. 3. 2017	Visit of neurologists, Grenoble
22. 3. 2017	Excursion for children of Labyrinth elementary school
3. 4. 2017	Tour for members of Mensa CR
12. 4. 2017	CEITEC MU open day
21. 4. 2017	Visit of students of IOCB
25. 4. 2017	Excursion for students of FEA MU
27. 4. 2017	Business Research Forum
23. 5. 2017	CF Tour for Antje Kepler (EMBL and Euro-Biolmaging)
30. 5. 2017	CF Tour for J. Pejchl (Dresden), representative of advisory board of CzechBiolmaging research infrastructure
29. 6. 2017	Excursion for secondary school students

Future Events

- **On 27 September 2017 (Tuesday) from 14:00: CF MAFIL and medical imaging of CzechBiolmaging research infrastructure open day.** This open day will be prepared particularly for potential partners interested in using CF MAFIL, for study participants and for university students interested in neuroscience, imaging methods etc. Visitors can ask directly in the laboratories about all subjects of interest, have a look at our laboratories, find out more about CzechBiolmaging research infrastructure functioning in the medical imaging field and do some networking for any possible future cooperation.
- **From 14 November 2017 to 16 November 2017 a traditional autumn educational workshop focused on neuroimaging will take place.** The workshop is designed in particular for PhD and Master students and postdocs familiarizing themselves with the neuroimaging methods. This year, one of the guests will be Jelena Zinnati from Vienna Preclinical Imaging Facility. She will introduce some specifics of animal MR imaging. The workshop will be realized with support of RIAT-CZ project and CzechBiolmaging infrastructure and is also registered under educational activities of the European EuroBiolmaging infrastructure.

Measurement reports

Below you can find a graphical overview of the total number of realized measurements in 2017 and its comparison to the previous years.



Since the start of 2017, measurements for 37 projects have been realized or commenced, from which 29 are supported by the CzechBioImaging infrastructure project. There are 25 projects which started last year and are still running and 12 projects which are newly launched in 2017. Of the total amount of 37 projects, there are 7 projects realized for external users.

On all of the monitored devices of CF MAFIL laboratory, the measurements in the total length of 2120 hours were realized, with an average length of one measurement of 1.71 hours. In comparison to the first half of 2016, the total number of measurements in 2017 on both MR devices increased by more than a quarter.

New sequences

In spring 2017, we tested the original version of multi-band sequences from the device manufacturer (Siemens), called SMS (simultaneous multi slice) and from June these sequences are fully installed on both of our devices. This will enable us to realize long-term studies with functional and diffusion MR measurements. As the name implies, sequences performs simultaneous measurement of several slices/layers, therefore will enable a significant acceleration of whole volume acquisition. SMS sequences are also a prerequisite for the use of the given type of acceleration within the sequences modified by other worksites. Together with these sequences, we will further use MB-EPI sequences from CMRR worksite, Minneapolis, USA, which enables other specific possibilities for the researchers.

Furthermore, we have extended the possibility of measurement of susceptibly weighed images (SWI) and MR spectroscopy to the second scanner. This will improve flexibility for scheduling the studies on the MR devices.

Another sequence which we are currently testing comes also from the CMRR worksite. It is a multiband (simultaneous measurement of multiple slices) of pseudo-continuous ASL with the possibility of perfusion measurement with various time delays (so called multi-delay).

Presentation of selected projects

CoBeN – Novel Network-Based Approaches for Studying Cognitive Dysfunction in Behavioural Neurology

This is a project supported by the European union from Horizon 2020 program. The aim is to search for new possibilities of early detection and more accurate diagnostics of neurodegenerative illnesses such as Alzheimer's or Parkinson's diseases and to verify the efficiency of individualized therapy methods. The project is realized in cooperation with our colleagues from Hungary (Szeged university) and USA (Arizona University). In CF MAFIL MR measurements including detailed structural images, several fMRI tasks (focused on reading, writing and speaking), resting fMRI measurement and diffusion measurement will take place. The project setup phase (preparation and testing of fMRI tasks and measurement protocols) took place during spring and the collection of "real" data will start in summer. The project is interesting also because both devices will be used for the measurements to divide the whole protocol into two individual visits and to ensure effective data collection.

Changes in brain structure and its function in relation to the therapeutic impact of "Hear differently" program

This study took place in May 2017 and its aim was to monitor the impact of the innovative program "Hear differently" on the development of musical creativity and brain functions of healthy young individuals. This study is unique in both Czech and international environment because of its focus on dynamic impact of a short-term innovative program aimed at creativity stimulation, with the use of not only typical psychological testing, but also functional magnetic resonance imaging.

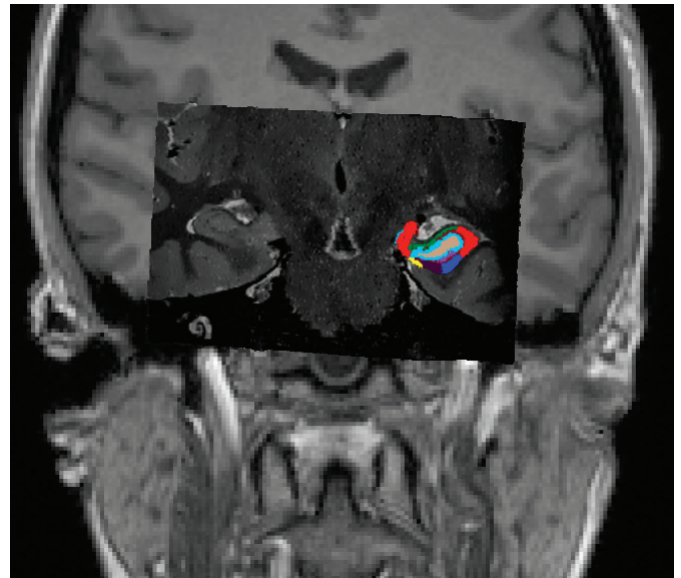
Longitudinal empirical studies using this training program and systematic evaluation of the participants show that participation in the study leads to changes in perception and assessment of different sound stimulations and to its creative use as a musical material. This study was therefore based on an assumption, that behavioural effects are caused by hidden plastic changes in anatomy and/or physiological area of the brain engaged in the music perception, musical creativity and creativity itself.

The measurements were taken always at two visits, the second taking place after approximately one week after the first one. They were always scheduled before and after participating in a several-days long training program. The measurement itself consisted of functional magnetic resonance (task focused on perception of musical sounds as well as resting measurement), diffusion and detailed anatomical images. The project was uncommon by its request for subjects being measured in the shortest time possible to ensure a comparable time elapsed after the completed training program.

Neuroanatomical and neurochemical correlates of physiological déjà vu phenomenon

This is a study with measurements already commenced in June 2017. The study is a follow-up to the previous research of the scientific team, which proved a significantly lower volume of particular brain structures (especially hippocampal formations on inner part of temporal lobes) of healthy individuals who have experienced a feeling of already seen/experienced (déjà vu). The study aims to fundamentally determine the level of anatomical differences in the brain (hippocampus in particular) among individuals who have experienced (or have not experienced) the feeling of already seen, to specify functional neuronal circuits involved in genesis of this phenomenon and above all, determine whether distribution of excitatory and inhibitory neurotransmitters (Glx, Glx/Cr ratio) in hippocampus supports hypothesis of higher brain irritation among individuals with the personal experience of déjà vu.

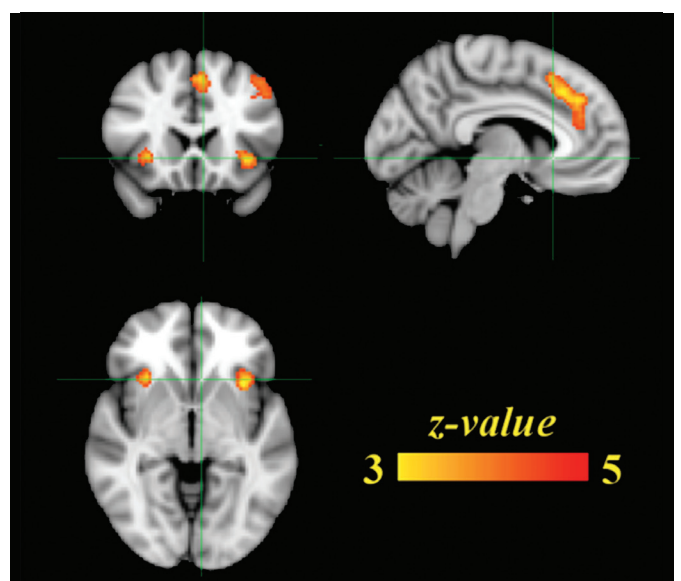
In the research, we use excellent features of Prisma device, as for example detailed image of hippocampal structures using ZOOMit method (0.4×0.4×1 mm), spectroscopic measurements using SemiLASER method brought from CMRR, Minneapolis worksite and functional MRI with the use of so called multi-band sequences with 2×2×2 mm resolution and acquisition period of 0.72 seconds, with simultaneous recording of physiological signals to suppress physiological artefacts in the data.



Study of social interactions using hyper scanning fMRI and “Pattern game” protocol

This is one of the studies representing research in social neurosciences area. The research in social neuroscience has been so far to a large extent focused only on measurement of brain activities of a single individual processing and responding to social stimuli presented in a quite artificial and experimental environment. However, social behaviour is not a one-way process – we do not respond only to our social environment – we interact with it. Thus, research of processes related to coadaptation necessarily requires activity measurement of both brains during the interaction. In this particular study, we examine the process of cooperation and competition during real-time interaction. In the examined game, one of the players should build a given pattern (“Builder”) and his partner has to help him (“Helper”) or impede building the pattern. The modelling brain activities of the builder in reaction to the movements of the helper show the involvement of areas associated with rewarding process (for example putamen).

In addition, the analysis of psychophysiological interactions between the builder and the helper (iPPI) shows that neural brain signals of the helpers predict neural responses in frontal cingulum (ACC) and insula (AI) of the builders.



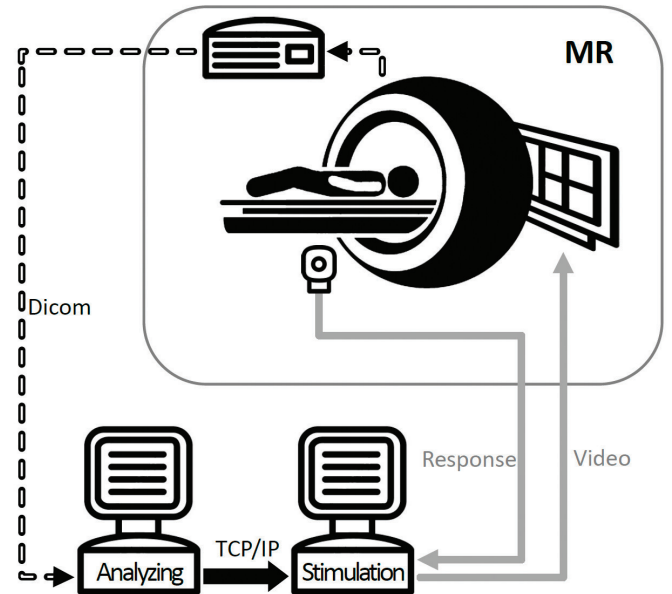


Specific services and technical solutions

Real-time fMRI

One of the novelties of the MR measuring techniques offered by our laboratory is real-time fMRI. It is an immediate evaluation of the measured data which enables tracking changes of brain activities with a minimal delay (the usual delay is $<1s$). Used together with a convenient type of stimulation, this approach is called "neurofeedback" – the measured person inside the MR scanner can see their brain activity on the screen and can learn to control it (for example, emotional response to a stressing stimulus). This approach also reveals new possibilities for brain studies as well as for various psychiatric illnesses therapies.

The essential principle of neurofeedback is pictured in the following scheme. Measured MR data is redirected to the analysis computer which evaluates changes of activities in predefined brain areas and sends this information to the computer controlling audio-visual stimulation. At the end, this information is presented to the measured person (for instance in the form of a colourful scale indicating activity), which closes the feedback loop.



MAFIL SUDOKU

We would like to reward our readers with a Sudoku puzzle which is related to MAFIL laboratory. The decipherment system is the same as with the typical Sudoku, only here the numbers are replaced by letters.

			H	C	A		R	
Y		C	N	P				
S				N		Y	E	
		P		R		C		
	E	N		A				S
				S	P	H		A
	S		R	H	E			

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