in the brain from MR-measurements of the current-induced magnetic field B_z.
Aim: We test the performance of a standard reconstruction algorithm ("projected current density algorithm", PCD, Jeong et al. 2014) for human brain data. We compare it with current flow simulations using personalized head models.
Methods:
1. We generated ground-truth data for the TES current flow and *Bz*-field using a detailed head model and SimNIBS (www.simnibs.org). We applied the PCD algorithm to the B_z -field and quantified the reconstruction performance by comparison with the ground-truth current flow. We additionally compared the PCD results with simulations using a simple head model ("3c" with scalp, bone and a homogeneous intracranial compartment).
2. We reconstructed the current flow from in-vivo MRCDI data (Göksu et al, 2018) with the PCD algorithm. We also used head models of different complexities ("3c" and "4c": scalp, skull, CSF & brain) and optimized their conductivities to minimize the root-mean-square difference between the measured and simulated B_z.
Results:
1. For simulated B_z data, the PCD algorithm only coarsely reconstructed the true current flow. Even the simple head model performed better.
2. For measured B_z data, current flows obtained with personalized head models and fitted conductivities explained the measurements better than the current flow reconstructed with the PCD algorithm. This was already the case for the simple head model (3c). The more detailed model (4c) resulted in further statistically significant improvements. However, for all models, the unexplained variance stayed above the noise floor, indicating remaining differences to unknown true current flow.
Conclusions: The PCD algorithm has low accuracy for MRCDI data of the brain. However, MRCDI is useful for evaluations and improvements of current flow simulations with anatomically detailed personalized head models.
Keywords: magnetic resonance current density imaging, personalized electric field calculation, dose control, transcranial electrical stimulation

P1.011

INDUCTION OF HUMAN MOTOR CORTEX PLASTICITY BY THETA BURST TRANSCRANIAL ULTRASOUND STIMULATION

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Abstract
Transcranial ultrasound stimulation (TUS) is a novel, non-invasive neuromodulation method that is beginning to be applied in human subjects. We hypothesize that long-term potentiation (LTP)-like plasticity can be induced in the human motor cortex by repetitive TUS. Three repetitive TUS protocols, theta burst patterned TUS (tbTUS), regularly patterned TUS (rTUS) and sham TUS, were delivered to motor cortex in 15 healthy subjects in separate sessions in random order. The tbTUS and rTUS had same total sonication duration and total time of stimulation. Motor evoked potentials (MEPs) evoked by single and paired-pulse TMS were recorded before and at 5 min, 30 min and 60 min after TUS. Short interval intracortical inhibition (SICI) and intracortical facilitation (ICF) were measured with paired-pulse TMS. The effects of motor cortex tbTUS on movement performance in a visuo-motor task and the effects of ipsilateral occipital cortex tbTUS on motor cortex excitability were also assessed. MEP amplitudes significantly increased at 5 min (43.4%) and 30 min (27.5%) and returned to baseline level at 60 min after tbTUS. SICI was significantly attenuated and ICF was significantly enhanced after tbTUS. The movement time on a visuo-motor task was significantly shortened after tbTUS. In contrast, rTUS, sham TUS and occipital tbTUS had no effect on the MEP amplitudes elicited by both single and paired-pulse TMS. The tbTUS protocol is capable of inducing LTP-like plasticity in human for at least 30 min. The plasticity occurred at the cortical level and involved both inhibitory and excitatory cortical circuits. This LTP-like plasticity was specific to tbTUS and could not be due to sensory confounds associated with TUS. tbTUS is a novel paradigm to induce cortical plasticity in human and has the potential to be developed for neuromodulation treatment for neurological and psychiatric disorders, and to advance neuroscience research.
Keywords: Transcranial Ultrasound Stimulation, Motor Cortex , Plasticity, motor-evoked potential

P1.012

A PHYSICAL NEURAL MASS MODELING FRAMEWORK FOR LAMINAR CORTICAL CIRCUITS IN BRAIN STIMULATION

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Abstract
Brain function emerges from the interactions of multi-scale networks that may be modeled using neural mass models (NMM) – effective or lumped models of large numbers of neurons. While biologically inspired, NMMs cannot directly reproduce physical measurements without further structure.
Here we present a framework that adds a physical layer for the simulation of the effects of electric fields and the measurement of electrophysiological signals, and in particular, from multicontact laminar electrodes. We then propose a specific architecture capable of representing fast (gamma, 50–250 Hz) and slow (alpha/beta, 4–22 Hz) oscillations and contrast it with multicontact recordings of the prefrontal cortex in the macaque monkey. Since the analysis of local field potential (LFP) data in electric potential space (V) is susceptible to reference location and volume conduction, the model also produces laminar power profiles of bipolar LFP (biLFP) and current source density (CSD).
To select the best model, we search and rank the space of locations of synapses into pyramidal cells using a loss function that evaluates the correlations between bipolar voltage measurements at different cortical depths. The selected solution reproduces the main features of the observed electrophysiology fields while predicting specific synapse locations that set fast activity generation in the top layers and slow activity generation across all depths. Moreover, we used the model to simulate the neural entraining effects of tACS using the lambda-E coupling model, which are characterized by a frequency-amplitude Arnold tongue with two frequency peaks.
In closing, we discuss how this physico-physiological modeling framework can help decipher the circuitry of oscillatory generation in the brain, shed some light in the relationship between different types of electrophysiology measurements, and provide a grounded approach for the generation of EEG/MEG from NMM brain networks to personalize brain models for the design optimal brain stimulation protocols.
Keywords: Neural Mass Model, Oscillations, Cortical Layers, tACS

P1.013

NEUROPHYSIOLOGICAL MODULATIONS IN THE (PRE)MOTOR-MOTOR NETWORK AND THE ROLE OF GABA+ LEVELS UNDERLYING AGE-RELATED REACTION TIME SLOWING

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Abstract
Although it is argued that age-related slowing of reaction time (RT) might be related to changes in the neurochemical and -physiological properties of the GABAergic system, the role of GABA levels within the primary sensorimotor cortices (SM1) in mediating interhemispheric interactions

(IHi) during the processing phase of a fast motor response, as well as how both properties influence RT, are currently not fully understood.
In this study, data were collected from 25 young [22.1 ± 4.4 years (mean ± SD)] and 28 older [(67.3 ± 4.2 years (mean ± SD)] healthy adults. We adopted a bimodal approach combining edited magnetic resonance spectroscopy (MRS) and dual-site transcranial magnetic stimulation (dsTMS) for probing GABA+ levels in bilateral SM1 and task-related neurophysiological modulations in corticospinal excitability (CSE), and primary motor cortex (M1)-M1 and dorsal premotor cortex (PMd)-M1 IHi, respectively. Whereas GABA+ levels were assessed during rest, TMS metrics were collected in the preparatory and premotor period of a choice RT task.
Our findings revealed that older as compared to younger adults exhibited a reduced bilateral CSE suppression. Furthermore, irrespective of the direction of the IHi, a reduced magnitude of long latency M1-M1 and PMd-M1 disinhibition during the preparatory period was observed in older adults as compared to their younger counterparts. Importantly, in older adults, the GABA+ levels in bilateral SM1 were related to individual differences in RT. In contrast, in young adults, this relationship was absent. Furthermore, there were no associations between neither task-related neurophysiological modulations and SM1 GABA+ levels.
In conclusion, this work contributes to a comprehensive understanding of how age-related changes in neurochemical and neurophysiological processes may underlie increases in RT.
Keywords: Aging, TMS, MRS

P1.014

TRANSCRANIAL DIRECT CURRENT STIMULATION MIGHT DECREASE LOWER LEG GLUCOSE UPTAKE AND ASYMMETRIES IN PEOPLE WITH MULTIPLE SCLEROSIS

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Abstract
Asymmetrical lower limb strength is an early symptom and significant contributor to the progressive decline in walking ability in people with multiple sclerosis (PwMS). Transcranial direct current stimulation (tDCS) may be an effective technique to increase neural drive to the more-affected lower limb muscles and induce symmetrical muscle activation. Six PwMS (3 females, age range: 27–57) underwent two sessions of tDCS (3 mA and Sham, randomized) over their more-affected motor cortex followed by 20 minutes of treadmill walking at a self-selected speed. They were injected with the glucose analog [^{18}F]fluorodeoxyglucose (FDG) two minutes into the treadmill walk and underwent whole-body positron emission tomography (PET) imaging immediately after walking. Volumes of interest (VOIs) of the leg muscles were drawn manually and standardized uptake values (SUVs, normalized to the liver) were extracted. Asymmetry indices (AIs) were then calculated [((less affected side − more affected side)/(0.5)(less affected side + more affected side))*100] and considered asymmetric at AI $\geq$ 10%. During Sham, five subjects had asymmetrical FDG uptake in at least one muscle group (AIs: 22.68 ± 11.26). After tDCS, four of these showed symmetrical FDG uptake in previously asymmetrical muscle groups (AIs: 3.72 ± 3.88). Interestingly, the two subjects without changes in symmetry status were physically active while the other four subjects were not. Additionally, after tDCS, SUVs significantly decreased in the plantar flexors (more-affected − Sham: 0.72 ± 0.35, tDCS: 0.54 ± 0.13, $p < 0.01$; less-affected − Sham: 0.73 ± 0.39, tDCS: 0.59 ± 0.23, $p = 0.01$) and dorsiflexors (more-affected − Sham: 1.01 ± 0.71, tDCS: 0.82 ± 0.36, $p = 0.02$; less-affected − Sham: 1.11 ± 0.81, tDCS: 0.81 ± 0.38, $p < 0.01$) after tDCS. These results indicate that tDCS might increase neural drive to the lower limb muscles of PwMS, resulting in more efficient muscle activation strategies and decreased energy demands.
Keywords: multiple sclerosis, tDCS, PET/FDG, asymmetries

P1.015

MALADJUSTMENT OF PRESSURE SETTINGS OF A CODMAN-HAKIM PROGRAMMABLE SHUNT VALVE BY ELECTROMAGNETIC DOOR LOCKS – A CASE REPORT

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Abstract
Objective: Maladjustments and failures of programmable ventriculoperitoneal shunts have been reported in cases in which patients have encountered powerful electromagnetic fields, e.g., MRI.
Through a case, this study shows easy maladjustment of a Codman-Hakim programmable valve also by small magnetic fields from everyday life.
Methods: Pressure settings of a patient's valve changed randomly, presumably by walking through electromagnetically controlled doors of a hospital ward.
With a test dummy, changes in pressure settings were tracked.
Results: Both - pressure settings of the patient's Codman-Hakim programmable valve as well as pressure settings of a new valve - were unwantedly modified simply by walking through standard doors in a hospital ward.
Conclusions: Thus already weak magnetic fields (< 200 mT) might cause changes in the pressure settings of programmable shunt valves and therefore lead to maladjustment. Patients should be informed and pay attention to using everyday life's devices, like rod magnets or mobile phones.
Keywords: Normal-pressure hydrocephalus, Codman-Hakim programmable shunt valve, maladjustment, magnetic fields

P1.016

MODULATION OF MEMORY PERFORMANCE AND BRAIN ACTIVITY BY NON-INVASIVE AURICULAR TRANSCUTANEOUS VAGUS NERVE STIMULATION IN A MOUSE MODEL OF INTELLECTUAL DISABILITY DISORDER

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Abstract
Auricular transcutaneous vagus nerve stimulation (atVNS) is an evolving non-invasive neuromodulation technology which takes advantage of the intrinsic plasticity of the nervous system, opening a wide range of therapeutic applications, from anti-epileptic to pro-cognitive. However, its effectiveness in preclinical models has not been yet fully elucidated. We studied the efficacy of atVNS on modulating memory performance and brain connectivity in the *Fmr1* knockout (*Fmr1*KO) mouse, a model of fragile X syndrome (FXS), a rare neurodevelopmental disorder featuring intellectual disability. We acutely stimulated the auricular branch of the vagus nerve of *Fmr1*KO and wild-type (WT) mice, using an atVNS device under low level of isoflurane anesthesia. Following an electrostimulation procedure that already showed memory enhancing properties in *Fmr1*KO and WT mice (Brain Stimulation 13:494, 2020), we obtained brain samples for bilateral c-Fos quantification and further connectivity analysis between basal (no manipulation), non-stimulated (anesthetized) and atVNS