S1b.3

BRAIN STIMULATION AND NEUROSCIENCE ROBOTICS FOR INDUCTION AND ASSESSMENT OF HALLUCINATIONS

Olaf Blanke. *Swiss Federal Institute of Technology (EPFL), Switzerland*

Abstract
Although hallucinations are essential and frequent symptoms in major psychiatric and neurological diseases, little is known about their brain mechanisms. Moreover, hallucinations are unpredictable and private experiences, making their investigation, quantification, and assessment challenging. A significant shortcoming in hallucination research is the absence of methods able to induce specific and short-lasting hallucinations, which resemble clinical hallucinations, which can be elicited repeatedly and vary across experimental conditions. By integrating results on specific hallucinations from cortical stimulation in epilepsy patients with recent advances in cognitive neuroscience and robotics, we have designed a robotic procedure able to repeatedly induce a specific, clinically relevant hallucination in healthy individuals: presence hallucination (PH). Patients with Parkinson's disease (PD), who frequently experience PH in daily life, were shown to have abnormally elevated sensitivity to the robotic PH procedure, reflecting their abnormal cortical-subcortical networks. In ongoing clinical research, we are combining neuroscience robotics with deep brain stimulation, targeting control of hallucinations and related cognitive dysfunction in PD.
Research Category and Technology and Methods
Basic Research: 1. Deep Brain Stimulation (DBS)

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Abstract key: PL- Plenary talks; S- Regular symposia oral; FS- Fast-Track symposia oral; OS- On-demand symposia oral; P- Posters

S1b.4

STUDYING THE PHYSIOLOGY OF MIND WITH INTRACRANIAL ELECTRICAL STIMULATION

Itzhak Fried. *UCLA, USA*

Abstract
Direct electrical stimulation of the brain has been used as an investigative tool in the study of human mind physiology, and as a therapeutic mean to modulate higher cognitive and affective functions. Unique insights into human experience in states of mind including volition, spontaneous recollection, laughter, and guilt are obtained by electrical stimulation during awake neurosurgical procedures. Systematic modulation of memory during wake and sleep cycles is enabled by closed-loop brain stimulation based on hippocampal-neocortical physiology. The chief strength of brain stimulation lies in the combination of causal inference and self-report of human experience, albeit the lack of anatomic, physiological and functional specificity remains a major challenge.
Research Category and Technology and Methods
Basic Research: 1. Deep Brain Stimulation (DBS)

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Abstract key: PL- Plenary talks; S- Regular symposia oral; FS- Fast-Track symposia oral; OS- On-demand symposia oral; P- Posters

S2a.1

ROBOTIC-GUIDED MULTI-LOCUS TMS FOR AUTOMATED, FAST, AND ACCURATE BRAIN NETWORK STIMULATION

Victor Hugo Souza. *Aalto University School of Science, Finland*

Symposium title: The ConnectToBrain Project: On the way to multi-locus closed-loop brain stimulation
Symposium description: The ConnectToBrain Project is funded by the European Research Council Synergy program. The three project partners (Aalto University Finland, Chieti-Pescara University Italy, Tübingen University Germany) contribute complementary expertise to develop a radically novel approach to stimulate the human brain with TMS. They will develop a helmet-like multi-channel coil (Aalto) to enable multi-site stimulation of distributed brain networks, utilize EEG real-time information on brain network excitability and connectivity (Chieti-Pescara) to read brain states, and use this information for brain-state-dependent and closed-loop stimulation (Tübingen) to highly effectively modify brain networks, eventually for treating network disorders of the human brain. This symposium will provide insights into the most recent advancements three years into the ConnectToBrain Project.
Abstract
Our recently developed 5-coil multi-locus TMS (mTMS) device enabled, for the first time, the operator to electronically control the stimulus location and orientation without manually moving the transducer. However, the increase in the number of coils makes the transducer heavy and inconvenient for manual operation, limiting its applicability in clinical settings. Thus, we developed and validated a robotic-guided control of mTMS transducers. Our system automatically and safely positions the multi-coil transducers and accurately stimulates user-specified cortical targets based on closed-loop automated algorithms, compensating for the subject's head movement. The presentation will provide performance data and applications of this novel technology.
Research Category and Technology and Methods
Translational Research: 7. Responsive (Closed-Loop) Stimulation
Keywords: TMS, Multi-locus TMS, Multi-channel coil, Robotic-guided TMS

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Abstract key: PL- Plenary talks; S- Regular symposia oral; FS- Fast-Track symposia oral; OS- On-demand symposia oral; P- Posters

S2a.2

REPETITIVE TMS DURING SPECIFIC PHASES OF THE DORSOMEDIAL PREFRONTAL THETA OSCILLATION HAS DIFFERENTIAL EFFECTS ON NETWORK EXCITABILITY AND WORKING MEMORY PERFORMANCE

Pedro Caldana Gordon. *Eberhard Karls University Tübingen, Germany*

Abstract
Brain-state-dependent rTMS has been used for phase-specific stimulation of the μ-rhythm in motor cortex, and revealed differential efficacy of plasticity induction depending of the phase stimulated. We extended this method based on real-time analysis of EEG to target prefrontal theta, a rhythm associated with cognitive functions. By applying rTMS to the dorsomedial prefrontal cortex during different phases of the local theta oscillation, we obtained TMS-EEG excitability increase and working memory performance improvement specifically when stimulating the trough of dorsomedial prefrontal theta. This novel method may have potential for therapeutic applications in patients with cognitive disorders.
Research Category and Technology and Methods
Translational Research: 7. Responsive (Closed-Loop) Stimulation
Keywords: EEG-TMS, Brain-state-dependent stimulation, Dorsomedial prefrontal cortex, Working memory

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Abstract key: PL- Plenary talks; S- Regular symposia oral; FS- Fast-Track symposia oral; OS- On-demand symposia oral; P- Posters

S2a.3

EEG BRAIN NETWORKS IDENTIFIED BY HIDDEN MARKOV MODEL AND THEIR RELATION TO TMS-EVOKED MEP AMPLITUDES

Laura Marzetti. *University "G. d'Annunzio" of Chieti-Pescara, Italy*

Abstract
Recent work using time delay embedded hidden Markov model applied to magnetoencephalography resting-state data revealed a distinct set of brain states, with each state engaging a specific set of cortical regions and featuring different functional roles. Here, we apply this approach to EEG-TMS data to the purpose of understanding whether the characteristics of