Université Claude Bernard Lyon 1

MASTER OF NEUROSCIENCES
University Claude Bernard Lyon 1
M2 FCN
M2 Fundamental and Clinical Neurosciences

LABEX CORTEX
UNIVERSITÉ DE LYON

NeuroConferences organized by the Master 2 FCN of UCB Lyon 1 – with the support of Labex Cortex
2024

Updates on Neuromodulation techniques	Organizers: **Marine MONDINO (CRNL), Marion RICHARD (CRNL) & Jérôme SALLET (SBRI)** marine.mondino@ch-le-vinatier.fr marion.richard@univ-lyon1.fr jerome.sallet@inserm.fr

Several neuromodulation methods are currently being used in humans to modify brain activity in physiological contexts to better understand brain function, or in pathological contexts to alleviate symptoms. However, the exact way in which these methods modify neuronal activity at the cellular level is still not clearly characterized. This Neuroconference theme will present five different neuromodulation techniques (FUS, TMS, tTIS, tACS and tDCS), some of their applications and current knowledge of their underlying mechanisms, highlighting the advantages and limitations of each technique.

	Thu Oct 10	**Focus on FUS (Focus UltraSound) neurostimulation**		
		14.00-14.30	**Dr Jérôme SALLET (Stem Cell and Brain Research Institute, Lyon)** Introduction and history of neuromodulation methods	Amphi Neurocampus CRNL (CH Le Vinatier, Bat. 462, 95 bd Pinel, Bron)l
		14.30-15.30	**Dr Jérôme SALLET (Stem Cell and Brain Research Institute, Lyon)** Title: Testing causality in brain networks using transcranial ultrasound neurostimulation	
		15.45-16.45	**Dr W. Apoutou N'DJIN (Laboratory of Therapeutic Applications of Ultrasound, Lyon)** Title: Biophysical mechanisms underlying UltraSound Neurostimulation	
		17.00-17.30	Discussion	
	Fri Oct 11	**Therapeutic applications of Neurostimulation: neurological and psychiatric diseases**		
		14.00-15.00	**Dr Adam WILLIAMSON (International Clinical Research Center, Brno, Czech Republic & Karolinska Institutet, Sweden)** Title: Clinical Results of Non-invasive Deep Brain Stimulation in Epilepsy and Parkinson's patients using Temporal Interference ONLINE speaker	Amphi Neurocampus CRNL (CH Le Vinatier, Bat. 462, 95 bd Pinel, Bron)
		15.15-16.15	**Dr Jérôme BRUNELIN (Centre de Recherche en Neurosciences de Lyon, Lyon)** Title: Investigating and treating schizophrenia with noninvasive brain stimulation (TMS/tDCS/tACS/tRNS)	
		16.30-17.00	Discussion	

	Tue Oct 15	**Mechanisms underlying neuromodulation effects (1/2)**		
		9.00-10.00	**Dr Andrea ANTAL (Non-Invasive Brain Stimulation Laboratory, Dept. of Neurology, Goettingen University)** Title: Neurophysiological, cellular and molecular mechanisms of action of tACS and tRNS. ONLINE speaker	Amphi Neurocampus CRNL (CH Le Vinatier, Bat. 462, 95 bd Pinel, Bron)l
		10.15-11.15	**Dr Dezso NEMETH (Centre de Recherche en Neurosciences de Lyon, Lyon)** Title: Modulating learning and memory processes by non-invasive brain stimulation (tACS/tDCS/TMS)	
		11.30-12.30	**Pr Vincent VAN WAES (LINC, Université de Bourgogne Franche Comté)** Title: Interest of animal models in deciphering the biological effects of neurostimulation techniques ONLINE speaker	
		12.30-13.00	Discussion	
	Wed Oct 16	**Mechanisms underlying neuromodulation effects (2/2)**		
		9.00-10.00	**Dr Nir GROSSMAN (Imperial College, London, UK)** Title: Non-invasive temporal interference deep brain stimulation ONLINE speaker	Amphi Neurocampus CRNL (CH Le Vinatier, Bat. 462, 95 bd Pinel, Bron)
		10.15-11.15	**Dr Marine MONDINO (Centre de Recherche en Neurosciences de Lyon, Lyon)** Title: Mechanisms of action of tDCS	
		11.30-12.30	**Dr Marine VERNET (Centre de Recherche en Neurosciences de Lyon, Lyon)** Title: Exploring cortical connectivity, oscillations and plasticity underlying cognition through the TMS-EEG combination.	
		Focus on TMS (Transcranial Magnetic Stimulation)		Amphi Neurocampus CRNL (CH Le Vinatier, Bat. 462, 95 bd Pinel, Bron)
		14.00-15.00	**Dr Cécilia NEIGE (Centre de Recherche en Neurosciences de Lyon, Lyon)** Title: Investigating corticospinal excitability and brain networks with TMS	
		15.15-16.15	**Dr Estelle RAFFIN (Ecole Polytechnique Fédérale de Lausanne, Suisse)** Title: Coupling EEG with TMS to investigate the neural effects of NIBS ONLINE speaker	
		16.30-17.00	Discussion	

ABSTRACTS

Dr Adam WILLIAMSON (International Clinical Research Center, Brno, Czech Republic & Karolinska Institutet, Sweden)

Title: Clinical Results of Non-invasive Deep Brain Stimulation in Epilepsy and Parkinson's patients using Temporal Interference

Temporal Interference Stimulation (TIS) is an innovative non-invasive brain stimulation technique which enables targeted modulation of deep brain structures by applying high-frequency electrical fields. In this study, we present clinical results from two patient cohorts: those with medication-refractory mesiotemporal epilepsy (MTLE) and those with Parkinson's disease (PD).

In the epilepsy cohort, TIS targeted the hippocampus in 13 patients implanted with stereoelectroencephalography (sEEG) depth electrodes. TIS at an envelope frequency of 130 Hz significantly reduced interictal epileptiform discharges (IEDs) and high-frequency oscillations (HFOs), including fast ripples, suggesting its potential as a non-invasive alternative for neuromodulation in epilepsy.

In the Parkinson's cohort, TIS targeted the subthalamic nucleus (STN) in 7 patients. The results demonstrated a significant reduction in pathological beta oscillations, similar to those achieved by conventional deep brain stimulation (DBS), indicating that TIS can effectively modulate motor symptoms in PD patients without the need for invasive surgery.

These findings highlight TIS as a promising tool for non-invasive deep brain stimulation, offering potential therapeutic benefits for patients with epilepsy and Parkinson's disease, particularly for those who are not candidates for traditional surgical interventions. Further research is warranted to explore long-term outcomes and refine stimulation parameters for individualized treatment.

Dr Nir GROSSMAN (Imperial College, London, UK)

Title: Non-invasive temporal interference deep brain stimulation

Electrical brain stimulation is a key technique in research and clinical neuroscience studies and is also in increasingly widespread use from a therapeutic standpoint. However, to date, all methods of electrical stimulation of the brain either require surgery to implant an electrode at a defined site or involve the application of non-focal electric fields to large fractions of the brain. We recently discovered a strategy for sculpting electrical fields to enable focused yet noninvasive neural stimulation at depth using temporal interference (TI) of kHz electric fields with a difference frequency within the range of neural activity. We reported the TI brain stimulation concept and its validation in rodents in 2017 Grossman et al, Cell 2017) and in humans in 2023 (Violante et al., Nature Neuroscience, 2023). The TI stimulation was awarded the Neuromodulation Prize by Science (Grossman, Science 2018). In this presentation, I will introduce the concept of non-invasive TI brain stimulation, its systematic validations in animal models and humans, insights into the mechanism of TI neural stimulation, and ongoing translation into therapy for Alzheimer's disease.