Abstract
Transcranial focused ultrasound (tFUS) is an emerging technology and has been regarded as the next generation of neuromodulation tools. tFUS is noninvasive and offers high precision targeting and stimulation of any brain region, including deep brain structures. Combined tFUS with MRI, such as MR-acoustic radiation force imaging (MR-ARFI) and functional MRI (fMRI), adds capabilities of real-time feedback on the FUS beam location and functional monitoring of FUS in action. In addition, advanced MRI contrasts provide tFUS safety assessment. In this presentation, I will review our progress on developing these methods for human applications and discuss how they are applied to modulate brain function in nonhuman primates. I will show data acquired at 7T and 3T MRI scanners and present results showing that tFUS exerts bidirectional (excitatory and inhibitory) modulation of brain BOLD fMRI signals at both somatosensory cortex and thalamus nucleus and their functional networks in a state-dependent manner. We are currently testing the hypothesis that varying intensities of tFUS selectively activate different types of neurons, resulting in bidirectional modulatory effects.
Research Category and Technology and Methods
Translational Research: 13. Other Brain Stimulation Technology
Keywords: Transcranial focused ultrasound, MRI guidance, BOLD, Somatosensory and pain system

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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

S1a.4

SEEING THE SOUND: NOVEL OPTICAL AND ULTRASONIC METHODS FOR NEUROMODULATION

Xiang Wu, Nicholas Rommelfanger, Guosong Hong. *Stanford University, Stanford, CA, USA*

Abstract
Today's optical neuromodulation methods enable causal manipulation of neural activity with light to dissect complex circuit connections underlying certain behaviors. In these optical neuromodulation approaches, visible light with wavelengths between 430 nm and 640 nm is commonly used, thus limiting penetration depth in vivo and resulting in an invasive fiber-tethered interface that damages the endogenous neural tissue and constrains the animal's free behavior. In this talk, I will present two recent methods to address this challenge via novel optical and ultrasonic brain interfaces: sono-optogenetics and infrared optogenetics. In sono-optogenetics, we demonstrate that mechanoluminescent nanoparticles can act as a systemic light source to convert focused ultrasound into localized light emission for noninvasive optogenetic neuromodulation in live mice. In infrared optogenetics, we demonstrate 1064-nm near-infrared-II light can enable tether-free and implant-free neuromodulation throughout the entire brain in freely behaving mice. I will conclude my talk by presenting an outlook on how these approaches may advance neuroscience research in live animals and even humans.
Research Category and Technology and Methods
Basic Research: 13. Other Brain Stimulation Technology
Keywords: Sono-optogenetics, TRP channels, mechanoluminescence, infrared

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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.1

NEUROMODULATION OF MEMORY NETWORK IN PATIENTS WITH ALZHEIMER'S DISEASE

Andres Lozano. *University of Toronto, Canada*

Symposium title: Strengths and weaknesses of intracranial electrical stimulation in localizing functions and treating dysfunctions in the human brain
Symposium description: Some of the most distinguished leaders in the field will present an overview of how the human brain can be studied with intracranial direct cortical stimulation and how neuropsychiatric disorders can be treated with this approach. They will discuss promises and weaknesses of this approach and suggest future directions.
Abstract
Alzheimer's disease (AD) is characterized by a profound disruption of cortical networks subserving memory and cognitive function. In an ongoing clinical trial, deep brain stimulation (DBS) of the fornix is being examined to modulate these networks to improve their function. In addition, emerging evidence from animal models and patients suggests that electrical stimulation of these circuits can restore metabolic function, improve cognition, and have reparative and regenerative effects. An update on the state of DBS approaches to treat circuit dysfunction in AD will be presented, along with a discussion of lessons learned.
Research Category and Technology and Methods
Clinical Research: 1. Deep Brain Stimulation (DBS)
Keywords: DBS, Intracranial, Direct Cortical Stimulation

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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.2

NEUROMODULATION OF EMOTION NETWORKS IN PATIENTS WITH DEPRESSION: LESSONS LEARNED

Helen Mayberg. *Icahn School of Medicine at Mount Sinai, USA*

Abstract
It is now almost 20 years since the first case of subcallosal cingulate deep brain stimulation (SCC DBS) for treatment-resistant depression (TRD). Ongoing research using small experimental cohorts has continued to progress, with the implementation of refined techniques for surgical targeting and emerging clues as to which patients are most likely to benefit. Close clinical monitoring and systematic long-term follow-up have provided additional perspectives on the time course, trajectory, and long-term sustainability of DBS-mediated effects. Acute and chronic monitoring using next-generation stim/sense DBS systems has further characterized this chronology at the neural level, demonstrating distinct early and late physiological changes that suggest network plasticity and remodeling maintain the observed long-term clinical effects. Physiological measures are now combined with computer vision, and machine learning approaches to detect more subtle changes in core depression features relevant to DBS optimization. Together these experimental approaches provide a unique opportunity to link first-person experiences to changes in brain state toward a more comprehensive understanding of illness and recovery.
Research Category and Technology and Methods
Clinical 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