brainbox initiative

Fundamentals & Applications of TUS Workshop

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Programme

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Welcome!

Ultrasound is best known for imaging unborn babies. In this instance, short pulses of ultrasound waves travel through the body and their echoes are used to form images, with a very limited amount of energy remaining in the body. Conversely, in therapeutic uses, when ultrasonic waves are focused on a small region inside the body, they interact with the tissue at this point, by depositing energy as heat or acting on the tissue by mechanical forces. When low-amplitude pulses are used to exert mechanical forces, the tissue function can be altered for a short period of time. By focusing ultrasound through the skull, this effect can be used to change the ways our brain behaves, in a safe, transient, and reversible way. This has great therapeutic potential for treating disorders of the brain, like neurological disorders (Parkinson's disease) but also psychiatric disorders (addiction, depression etc.). The technique is called Transcranial Ultrasound Stimulation (TUS).

The field of TUS brings together engineers, physicists, neuroscientists, and medical practitioners who are all interested in developing and using novel brain stimulation techniques. This field is only at the very beginning of its growth and much work is still needed to understand the effective application of TUS to modulate brain functions and to establish consensus on safety, ways to conduct experiments and standardization, in order to accelerate the technique towards clinical translation.

Programme Outline

Across three days, we will be joined by world-leading academic and technical experts in transcranial-focused ultrasound (tFUS/TUS) techniques for a series of interactive sessions designed especially to give a solid understanding of the physical and biomechanics bases, challenges and potentials; TUS study development and applications; and how to design, prepare, carry out, and analyse TUS studies in a safe and replicable way.

Over the course of three days, we will explore topics such as:

- The basic principles and physiology of transcranial ultrasound neuromodulation;
- An introduction to the basic principles and physiology of TUS;
- The pros and cons of using TUS and ways to counteract these limitations;
- An in-depth look at the safety and efficiency considerations for TUS studies;
- Practical demonstrations of different kinds of TUS protocols, including online & offline-TUS;
- Considerations for TUS study design, supplemented with group discussions;
- Interactive, practical demonstrations of TUS techniques, measurements, and simulation of acoustic fields;
- and much more.

DAY 1

08:30	Registration & Coffee
09:00	Welcome & Introductions
09:15	Lecture: *Basic Principles of TUS Physics*
10:15	Break & Q&A
10:30	Demonstration: TUS Measurement in Hydrophone Tanks
11:15	Demonstration: Ensuring Consistency of the TUS Output / Equipment
12:00	Lunch
13:30	Lecture: *Planning for Ultrasound Neuromodulation: Dealing with the Skull & Acoustic Simulations*
14:30	Break
14:45	Interactive Exercise: Planning your TUS Target & Trajectory: Acoustic Simulations
16:30	Interactive Exercise: Planning your TUS Target & Trajectory: Neuronavigation
18:00	Dinner at the Barbican Kitchen

DAY 2

08:45	**Welcome & Coffee**
09:00	**Lecture: *TUS Safety, Effects and Mechanisms.***
10:15	**Break**
10:30	**Demonstration: Running an offline TUS Study: TUS Coupling & Targeting with Neuronavigation Systems**
13:00	**Lunch**
14:00	**Lecture: *Acute Effects with TUS***
15:00	**Break**
15:15	**Demonstration: Accounting for TUS Auditory Confounds & Double-Blind**
17:00	**Drinks**

DAY 3

08:45	**Welcome & Coffee**
09:00	**Lecture: Offline TUS**
09:45	**Lecture: *Standardised Reporting***
10:00	**Break**
10:15	**Lecture: *Multimodal TUS***
11:00	**Demonstration: Multimodal Online TUS-TMS**
11:30	**Demonstration: Breakout Groups**
13:00	**Lunch & Discussion**
14:15	**Recap & Workshop Adjournment**

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