



# Fundamentals & Applications of Transcranial Ultrasound Stimulation

Cardiff, UK

**Preliminary Programme**

29 April - 1 May

# Welcome

Across three days, the Brainbox Initiative along with the academic experts from the university of Plymouth hosts a comprehensive workshop on transcranial-focused ultrasound (TUS) techniques. This workshop brings together world-leading academic and technical experts in the field from the University of Plymouth and Brainbox to provide attendees with a solid understanding of designing, setting up, carrying out, and analysing their own TUS studies.

## **Location**

Cardiff

## **Speakers & Organisers**

Prof. Elsa Fouragnan, University of Plymouth

Prof Kim Butts-Pauly, Stanford University

Dr. Miriam Klein-Flugge, University of Oxford

Dr. Miruna Rascu, University of Oxford

Dr. Elly Martin, University College London

Dan Phillips, Brainbox

# Programme Outline

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 to 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 standardisation, in order to accelerate the technique towards clinical translation.

Brainbox Initiative hosts a three-day workshop introducing TUS to researchers and clinicians interested in using this new NIBS technology and to offer an introduction to TUS development and application. In this workshop, you will be equipped with the necessary knowledge to run reproducible, replicable and well-designed TUS studies.

## **Workshop Objectives:**

Over three days, the Brainbox Initiative will be joined by world-leading academic and technical experts in TUS to deliver a series of interactive sessions designed to give attendees a solid understanding of:

- The fundamental principles and physiology of TUS;
- The advantages and limitations of TUS, with strategies to mitigate challenges;
- Safety and efficacy considerations for TUS studies;
- Practical demonstrations of TUS protocols, including online and offline TUS;
- Key considerations for TUS study design, supplemented with group discussions;
- Hands-on demonstrations of TUS techniques, measurements, and acoustic field simulations;
- And much more.

Our workshop programmes are developed in collaboration with leading neuroscientists worldwide. This event will be led by Professor Elsa Fouragnan and members of her lab.

**DAY  
1**

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

**DAY  
2**

- 08:45**      **Coffee & Welcome**
- 09:00**      **Lecture: *TUS Safety, Effects and Mechanisms***
- 10:15**      **Break**
- 10:30**      **Demonstration & Interactive Exercise:  
Running an Offline TUS Study, TUS Coupling & Targeting with  
Neuronavigation Systems**
- 13:00**      **Lunch**
- 14:00**      **Lecture: *Confounds & Control***
- 14:30**      **Demonstration: Accounting for TUS Auditory Confounds &  
Double-Blind**
- 15:30**      **Break & Questions**
- 16:00**      **Lecture: *Acute/online Effects with TUS***

**DAY  
3**

<b>08:45</b>	<b>Coffee &amp; Welcome</b>
<b>09:00</b>	<b>Lecture: <i>Offline TUS</i></b>
<b>09:45</b>	<b>Lecture: <i>Standardised Reporting</i></b>
<b>10:00</b>	<b>Break</b>
<b>10:15</b>	<b>Lecture: <i>Clinical Applications</i></b>
<b>11:00</b>	<b>Lecture: <i>Multimodal Challenges</i></b>
	<b>Demonstration: Multimodal Online TUS-EEG</b>
<b>11:30</b>	<b>Demonstration: Breakout Groups</b>
	<b>Targeting Practice, Comparing Results, Project Discussion</b>
<b>13:00</b>	<b>Lunch &amp; Discussion</b>
<b>14:15</b>	<b>Recap &amp; Workshop Adjournment</b>

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