

**brainbox**  
initiative

# Fundamentals & Applications of TUS Workshop

**Programme**

10 - 12 October, 2023

# Welcome

Across three days, the Brainbox Initiative host a comprehensive workshop on transcranial-focused ultrasound (TUS) techniques. This workshop brings together world-leading academic and technical experts in the field from the Verhagen Lab, Donders Institute and UCL Biomedical Ultrasound Group to provide attendees with a solid understanding of designing, setting up, carrying out, and analysing their own TUS studies.

# Programme Outline

## Topics Covered

- **TUS Overview/Introduction:** Explore the fundamental principles and physiology of transcranial ultrasound neuromodulation.
- **Neurophysiology and Biomechanisms:** Gain insights into the intricate relationship between neurophysiology and biomechanics in the context of TUS.
- **TUS Safety:** Understand the safety considerations associated with transcranial-focused ultrasound in humans.
- **Protocols & Effects:** Examine different protocols for transcranial ultrasound stimulation and their effects on brain activity and neuromodulation.
- **Safety Screening:** Gain an understanding of safety screening procedures and protocols to ensure the well-being of participants during TUS experiments.
- **Confounds & Experimental Design:** Learn about potential confounds in TUS studies and gain insights into experimental design strategies to mitigate them.
- **Multimodal Design:** Gain insights into the value of multimodal experimental design, including the combination of TUS with imaging methods and transcranial magnetic stimulation (TMS).
- **Plasticity & State Dependency:** Deepen your understanding of plasticity in the context of transcranial ultrasound stimulation, as well as the state dependency of TUS effects.
- **Physical mechanisms of TUS:** Gain a foundational understanding of the physics underlying ultrasound neuromodulation.
- **Transducers, Measurements, & Simulations:** Learn about core considerations for the hardware and software required for quality TUS research, including transducer properties and functionality, acoustic field measurements, and simulations.

## Hands-on Sessions:

- **Visualising Ultrasound (Water Tank):** get a first glance at the functionality and capabilities of the NeuroFUS ultrasound neuromodulation system.
- **TPO Experimental Control:** Explore the principles of experimental control and learn how to implement TUS experiments with precise timing and accurate control.
- **Neuronavigation:** Get hands-on experience of running TUS sessions in combination with NIBS navigation.
- **TUS Coupling and Positioning:** Engage in hands-on activities to understand the principles and techniques involved in coupling TUS, including various brain imaging and stimulation methods.
- **Experimental Planning & Simulation:** Learn how to effectively plan and simulate TUS experiments, optimizing parameters for optimal results while adhering to safety guidelines.
- **TUS Experiment Setup & Execution:** Gain hands-on experience with running ultrasound neuromodulation experiments from start to finish.
- **Bring Your Own Experiment:** Participants have the opportunity to bring their own TUS experiment ideas and receive guidance on experimental design, confound mitigation, stimulation protocols, safety considerations, transducer design, technical aspects, and more.

# Speakers

## Benjamin Kop

Ben, a Ph.D. student from the esteemed Donders Institute, brings a wealth of knowledge and expertise to the field of Focused Ultrasound (FUS) neuromodulation. With a solid background in Psychology and a research master's degree in Cognitive Neuroscience, Benjamin's passion for the brain, neuromodulation, and the motor system is evident in his work. As a member of the Brainbox Initiative workshop, Benjamin's research focuses on applying Transcranial Ultrasound Stimulation (TUS) to the motor system, exploring its potential in understanding and modulating cortical excitability. We are thrilled to partner with Benjamin Kop, as his expertise and dedication will undoubtedly enrich the workshop and provide attendees with valuable insights into FUS neuromodulation.



## Sjoerd Meijer

Sjoerd, an ambitious Ph.D. student, is dedicated to investigating circuit-level neuroimaging and neuromodulation in the context of anxiety. With a strong foundation in Cognitive Neuroscience and a deep understanding of the complexities of the brain, Sjoerd's research explores how brain stimulation techniques can alleviate anxiety in humans. By utilizing state-of-the-art methods, such as Transcranial Ultrasonic Stimulation (TUS) and dual-site transcranial alternating current stimulation (tACS), Sjoerd aims to uncover the potential anxiolytic effects of neuromodulation on emotional behaviour. We are delighted to have Sjoerd Meijer as part of our workshop, as his expertise in FUS neuromodulation and his commitment to understanding anxiety disorders will greatly benefit workshop participants.



# Speakers

## **Soha Farboud**

Soha, a passionate Ph.D. student, brings a unique perspective to the workshop through her research in the field of cognitive neuromodulation. Working under the guidance of renowned researchers, Hanneke den Ouden and Lennart Verhagen, Soha's expertise lies in the development of an online TUS protocol which she will then use to explore the role of the striatum in motivational decision-making. By employing non-invasive techniques, such as Transcranial Ultrasound Stimulation (TUS), Soha investigates the complex interplay between motivations, decision-making processes, and the striatum. Her innovative approach and dedication to advancing our understanding of cognitive neuromodulation make her an invaluable addition to the workshop. We are thrilled to partner with Soha Farboud, as her expertise and research contributions will significantly enhance the learning experience for all workshop participants.



## **Dr Elly Martin**

Elly is a distinguished researcher and UKRI Future Leaders Fellow in the Department of Medical Physics and Biomedical Engineering at UCL. Her research focuses on the measurement and simulation of ultrasound fields, ultrasonic device design, and characterisation. She is currently developing an ultrasonic rewarming technique for cryopreserved biological cells and tissues, aiming to achieve uniform and rapid warming. Elly's work involves quantitative comparisons between hydrophone measurements and acoustic field simulations, particularly in transcranial ultrasound therapies. She actively contributes to standards development as a member of the British Standards Institute and the IEC Ultrasonics Technical Committee. Additionally, she is involved in the International Transcranial Ultrasonic Stimulation Safety and Standards consortium. Elly's expertise and dedication greatly contribute to the advancement of ultrasound technology in medical applications.

