

With this writing, I declare my application for the Research Prize Tinnitus & Hearing of the German Tinnitus and Hearing Foundation Charité. For your consideration, I wish to submit a collection of four high-calibre scientific papers on innovative approaches in tinnitus detection and treatment, all compiled during the final phases of my doctoral and start of my postdoctoral research work at the University of Antwerp and the Antwerp University Hospital. These four papers are provided in the attachments to this writing.

The submitted body of work represents a significant advancement in the field of tinnitus research, addressing both the detection and treatment of this complex condition through innovative methodologies and rigorous scientific inquiry. Below, I will provide a short description of these papers and their importance for the field.

The first study ('Dual-site transcranial direct current stimulation to treat tinnitus: a randomized controlled trial', published in *Brain* in 2022) investigates the **efficacy of dual-site sequential high-definition tDCS** targeting the left temporal area and right dorsolateral prefrontal cortex in reducing tinnitus severity. For this large-scale clinical trial, a rigorous protocol was designed based on state-of-the-art literature on tDCS for tinnitus. Importantly, we reported a lack of significant differences between the active and sham groups. The study provides critical insights into the placebo effect and the influence of gender and anxiety on treatment outcomes. This research underscores the necessity of considering individual patient characteristics in clinical trials, paving the way for more personalized treatment approaches.

A second study ('Cortical auditory evoked potentials, brain signal variability and cognition as biomarkers to detect the presence of chronic tinnitus', published in *Hearing Research* in 2022) addresses the urgent **need for reliable biomarkers** in tinnitus diagnosis and research. By analysing cortical auditory evoked potentials (CAEP), brain signal variability, and cognitive performance, the research identifies significant neural and cognitive differences between tinnitus patients and controls. The development of a logistic regression model based on these biomarkers demonstrates a promising 75% accuracy in detecting tinnitus cases, highlighting the potential of these biomarkers in clinical diagnostics and the importance of top-down information processing in tinnitus perception.

The two final studies collectively highlight the potential role of machine learning and **data-driven classification algorithms** in tinnitus research and practice. One of these studies ('Random forest classification to predict response to high-definition tDCS for tinnitus relief: a preliminary feasibility study', published in *Ear & Hearing* in 2022) explores the use of random forest classification to predict individual responses to high-definition tDCS treatment. By analysing baseline audiometric and questionnaire data, the model achieves an impressive 85.71% accuracy in predicting treatment responders, significantly outperforming traditional logistic regression methods. This research highlights the potential of machine learning in personalizing tinnitus treatment, ensuring that patients receive the most effective interventions based on their unique profiles. The final study ('The Rapid Screening for Somatosensory Tinnitus Tool: a data-driven decision tree based on specific diagnostic criteria', also published in *Ear & Hearing* in 2022) focuses on somatosensory tinnitus, a subtype influenced by somatosensory afference from the cervical spine or temporomandibular area. Utilizing data from a large online survey, the research constructs a decision tree model that accurately diagnoses somatosensory tinnitus with an 82.2% accuracy using only four key criteria. This model's simplicity and high accuracy make it a valuable tool for clinical practice, facilitating the identification and treatment of somatosensory tinnitus patients.

Collectively, these studies exemplify excellence and innovation in tinnitus research. They not only advance our **understanding of tinnitus neurophysiology and treatment** but also introduce **practical tools and methodologies** that can be readily implemented in clinical settings. The integration of advanced statistical and machine learning techniques further underscores the pioneering nature of this work, making it highly deserving of recognition and support.

The innovative approaches across these studies are unified by their focus on leveraging advanced technologies and methodologies to address the multifaceted challenges of tinnitus. The use of high-definition tDCS represents a cutting-edge approach to neuromodulation, aiming to modulate cortical activity in specific brain regions associated with tinnitus perception. The exploration of individual variability in treatment response through machine learning further exemplifies the move towards personalized medicine, ensuring that interventions are tailored to the unique characteristics of each patient.

The *Ear & Hearing* study's development of a decision tree for diagnosing somatosensory tinnitus showcases the practical application of data-driven models in clinical settings. By simplifying the diagnostic process to four key criteria, this research makes it feasible for clinicians to accurately identify and treat somatosensory tinnitus patients, thereby improving patient outcomes.

In parallel, the *Hearing Research* study's identification of neural and cognitive biomarkers for tinnitus detection provides a foundational step towards objective diagnosis, which is crucial for developing targeted treatments. The innovative combination of CAEP, brain signal variability, and cognitive performance metrics offers a comprehensive understanding of the neural underpinnings of tinnitus, paving the way for future research and clinical applications.

Together, these studies highlight a cohesive and forward-thinking approach to tinnitus research, integrating neuromodulation, biomarker identification, and machine learning to push the boundaries of what is possible in the detection and treatment of tinnitus. This body of work not only demonstrates scientific excellence but also holds significant potential for transforming clinical practice and improving the quality of life for individuals suffering from tinnitus. Therefore, I hope this application will be considered for this year's Research Prize Tinnitus & Hearing.