Title: SLUMBER: A Framework for Home-Based Sleep Experiments Offering Dynamic Delivery of Auditory Stimuli

Abstract:
During sleep, the brain remains sensitive to auditory stimuli, allowing sound and music to influence sleep physiology, cognitive processes, and dream experiences [1, 2]. While laboratory polysomnography provides high experimental control for studying these interactions, it requires overnight supervision from the researcher, and the artificial nature of the sleep lab may influence sleep behaviour. Recent advancements in wearable technology have made high-quality sleep measurement feasible within the home environment [3], providing compact devices that participants can self-apply without direct researcher assistance. What remains missing is the infrastructure required to design, deploy, and manage home-based sleep experiments.

SLUMBER (Sleep Logging and Unsupervised Monitoring through BioElectrical Recordings) is an open-source framework to facilitate home-based sleep experiments using wearable devices. The framework supports physiological signal acquisition, real-time feature extraction, and stimulus triggering, meaning auditory stimuli may be scheduled or administered dynamically, based on a participant's current or previous sleep state. To support unsupervised data collection, *SLUMBER* also provides interactive, participant-guided procedures including automated delivery of instructions, device calibration, and behavioural tasks or surveys. Its modular and flexible design allows researchers to configure existing functionality and tailor the system to different study protocols and experimental paradigms.

This workshop will provide an overview of the framework, followed by a series of case studies demonstrating different ways *SLUMBER* has already been adapted to current research. These include playback of musical stimuli during sleep based on previously-expressed preferences, automated lucid dream induction with auditory cueing, real-time sound modulation driven by EEG activity, and even artistic applications such as the *Somnosphere* installation (also present at ConfMusSleep). Participants will then engage directly with the framework through live demonstrations and hands-on examples, in which they are able to design a basic study using *SLUMBER*. These examples and guided discussions illustrate diverse applications of the framework, and inspire attendees to design their own home-based sleep experiments. By the end of the session, participants will gain practical insights and a deeper understanding of how *SLUMBER* supports flexible and ecologically valid research.

[*SLUMBER* is intended to be accessible to all researchers, meaning only familiarity with basic Python syntax is required. A laptop will be needed to take part in the hands-on components of the workshop.]

Bibliography:

[1] Coenen, A. (2024). Sensory gating and gaining in sleep: the balance between the protection of sleep and the safeness of life (a review). Journal of Sleep Research, 33(5), e14152. https://doi.org/10.1111/jsr.14152

[2] Salvesen, L., Capriglia, E., Dresler, M., & Bernardi, G. (2024). Influencing dreams through sensory stimulation: a systematic review. *Sleep Medicine Reviews*, *74*, 101908. https://doi.org/10.1016/j.smrv.2024.101908

[3] Jafarzadeh Esfahani, M., Sikder, N., Ter Horst, R., Daraie, A. H., Appel, K., Weber, F. D., ... & Dresler, M. (2024). Citizen neuroscience: wearable technology and open software to study the human brain in its natural habitat. *European journal of neuroscience*, *59*(5), 948-965. https://doi.org/10.1111/ejn.16227