Closed-loop neurostimulation for the treatment of schizophrenia

Michel DUPREZ, Inia - Strasbourg **Axel HUTT**, Inria - Strasbourg
Thomas WAHL, Inria - Strasbourg

Mental disorders are among the top most demanding challenges in world-wide health. A large number of mental disorders exhibit pathological rhythms, which serve as the disorders characteristic biomarkers. Neurostimulation techniques have been developed to target these pathological rhythms and provide therapeutic interventions. However, current neurostimulation protocols often rely on open-loop approaches, where the stimulation parameters are predefined and independent of the patient's real-time brain state. In our work [1], we propose a novel fully adaptive closed-loop neurostimulation setup that dynamically adjusts the power spectral density (PSD) of brain activities based on a user-defined PSD. Our approach utilizes a non-parametric brain model estimated from observed data and considers conduction delays in the feedback loop between brain activity measurement and stimulation. We specifically focus on pathological alpha and gamma rhythms associated with psychosis and demonstrate the effectiveness of our method through numerical simulations of neural population and cortico-thalamic loop models. Our findings highlight the potential of closed-loop neurostimulation in improving the treatment of mental disorders by precisely modulating brain activity patterns.

[1] T. Wahl, J. Riedinger, M. Duprez, A. Hutt. *Delayed closed-loop neurostimulation for the treatment of pathological brain rhythms in mental disorders : a computational study.* Frontiers in Neuroscience, 2023. doi :10.3389/fnins.2023.1183670.

Contact : michel.duprez@inria.fr