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Title: Personalized smart transcranial electrical stimulation techniques

In this project we focus on the elucidation of the fundamental aspects of multi-electrode transcranial smart alternating current stimulation (tACS) techniques in order to develop non-invasive approaches for different neuropsychiatric brain disorders. Very recently, temporarily interfering electrical fields (TIEF) has been proposed. This latter technique can become a novel disruptive brain modulation technique because it has the intrinsic characteristics to focus a stimulation dose in deep brain regions.

A first goal of the project is **to create a computational framework** allowing you to predict the distribution of the induced electrical fields within the brain, starting from the neuromodulation settings. These generally consist of the location of electrodes, and the parameters of the stimulation waveform (amplitude, pulse width, frequency or multi-frequency, duration, pulse repetition frequency…).

Simulation software: Simulations of the in-situ electric field due to neuromodulation will be performed either with the finite-element method (FEM) or the finite-difference time-domain method (FDTD). These brain models are often obtained from MRI scans, and have associated with them the electric constitutive parameters. In this project, we will do these simulations with the commercial software package **Sim4Life,** which already includes discretized brain models of people of varying age and gender. Furthermore, we will design and assemble fully controllable TIEF like systems with complex wave stimulation formats and apply it to **phantom structures** equipped with intrusive sensors allowing us to experimentally verify the simulations.

The next goal of the project is to understand the **mechanistic effects** of the distributed stimulation field on healthy and pathological network functioning. Different approaches can be followed: a first option would be a bottom-up approach starting from electrophysiological models of neuronal firing. An alternative approach could be the study of the interaction of the electrical fields on a local cluster of neurons. Computational simulations can be experimentally verified in mice or rodents.

The research project will be conducted within an ongoing collaboration between the Electronics department and the Faculty of Medical Sciences and Pharmacy within the Centre for neurosciences (www.c4n.be) at VUB. There are ample opportunities for creating an interdisciplinary and intersectoral research project.

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Research Group: http://etrovub.be/ (website update in Sept 2020), https://c4n.be/

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