

Temporal Interference (TI) Stimulation with neuroConn DC-STIMULATOR Technology

A new type of transcranial Electric Stimulation (tES) has been described in the study by N. Grossman, et al. (2017) [1]: **Temporal Interference (TI) Stimulation**. The aim of this new stimulation is to non-invasively stimulate deep brain areas.



The stimulation consists of two high kilo-hertz frequency sine signals whose difference frequency is comparatively small, for example: 2 kHz and 2.01 kHz, to drive neural activity (in this case 10 Hz). The two input signals are thus injected to the head surface. Once they are added together, there is a generated amplitude modulated sinusoidal waveform at the slower differential frequency. The focal stimulation is obtained at the site where the multiple electric fields interfere; and neural stimulation occurs where the amplitude of the electric field envelope, at the difference frequency, is of great magnitude [1].

TI stimulation generated low frequencies have been shown to effectively drive neural activity in anesthetized living mice [1]. Neurons followed the low-frequency envelope of the interfering electric fields (10 Hz) but not the high-frequency carrier (2 kHz). Preliminary finite element modeling stimulation of TI fields in human anatomical models show that the locus of TI stimulation is comparable in size with large subcortical structures (e. g. the hippocampus) but cannot be localized to very small deep brain structures (e. g. the subthalamic nucleus) [2, 3].

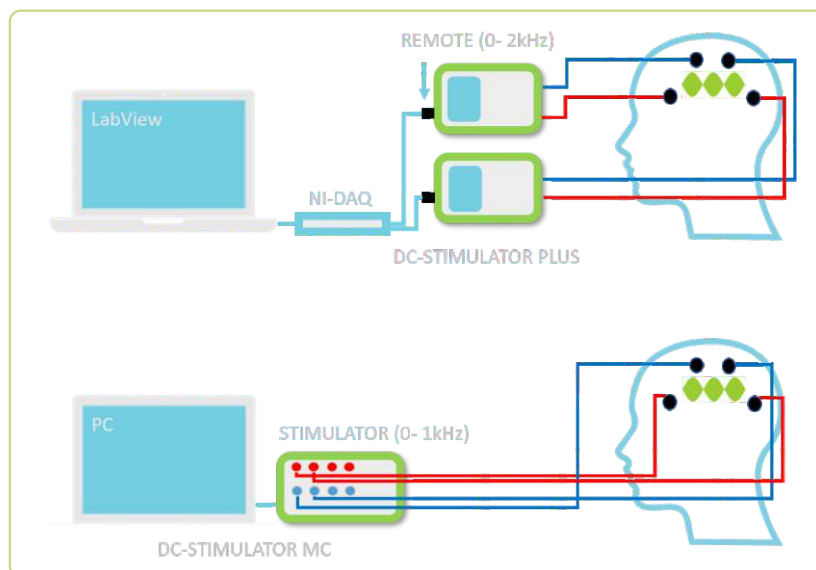
However, further work refining the invention is required to optimize it for human use and future trials should aim at understanding TI stimulation outcomes in specific disease states. Regions that are deep but not too small as a fraction of total volume (e. g. those in stroke, OCD, epilepsy, depression, and spinal cord injury) may be attractive initial indications [2].

neuroConn offers two modalities to achieve TI stimulation:

- using two DC-STIMULATOR PLUS with a modified REMOTE circuit board (frequency resolution up to 2 kHz) [4]
- using the DC-STIMULATOR MC (frequency resolution up to 1 kHz)

In the neuroConn TI systems, the electrical reference points ("ground") of both stimulation channels are galvanically isolated.

neuroConn modalities for TI stimulation with DC-STIMULATOR PLUS and DC-STIMULATOR MC



Literature:

- [1] Grossman N et al., Noninvasive Deep Brain Stimulation via Temporally Interfering Electric Fields. *Cell*. (2017)
- [2] Grossman N et al., Translating Temporal Interference Brain Stimulation to Treat Neurological and Psychiatric Conditions. *JAMA Neurol*. (2018)
- [3] Fernandez-Corazza M et al., Temporal interference transcranial electrical stimulation in humans: actual doses and streerability. Poster at NYC Neuro-modulation Conference and NANS summer series (2018)
- [4] Hunold A et al., Simulating the superposition of transcranial electric stimulation targeting the visual cortex. Poster at BIOMAG (2018)