Computational Modeling of the Human Head and Optimization of Stimulus Patterns for Noninvasive Neuromodulation

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New methods of altering brain plasticity include transcranial Direct Current Stimulation (tDCS), where current is applied to the brain through head surface electrodes. Electrical Geodesics, Inc. (EGI) has developed the Geodesic Transcranial Electrical Neuromodulation (GTEN) system, to apply flexible patterns of source and sink currents with 256 electrodes. Given the target brain site, the goal is to optimize the application of currents with the complex geometry and conductivity of human head tissues. CIBC is developing tools for modeling and current pattern optimization that inspire and guide commercial implementations by EGI.

Segmentation, structure identification for creating high resolution computational head models

Subject-specific head models allow tDCS simulations and electrical current estimation in the human head

HD Stimulus Pattern Optimization is needed for precise and directional targeting in the brain

Focal target

Complex target

In progress: Practical need: reduce number of current sources required while maintaining targeting optimization.

Computational models and simulations are validated using experimental data and alternative methodologies

The GTEN Planning Module provides eEIT validation of the paths of the injected current through head tissues.

The success of decreasing cortical excitability with GTEN can be tested by probing the target cortex with TMS to elicit a motor twitch, such as in the thumb.

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