Interpreting the Mechanisms and Meaning of Human MEG/EEG signals with the Human Neocortical Neurosolver (HNN) Neural Modeling Software

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Abstract

Electro- and magneto-encephalography (EEG/MEG) are the leading methods to non-invasively record human neural dynamics with millisecond temporal resolution. However, it can be extremely difficult to infer the underlying cellular and circuit level origins of these macro-scale signals without simultaneous invasive recordings. This limits the translation of E/MEG into novel principles of information processing, or into new treatment modalities for neural pathologies. To address this need, we developed the Human Neocortical Neurosolver (HNN: https://hnn.brown/edu), a user-friendly neural modeling tool designed to help researchers and clinicians interpret human imaging data. A unique feature of HNN's model is that it accounts for the biophysics generating the primary electric currents underlying EEG/MEG with enough detail to connect to cell and circuit level phenomena that can be studied with invasive techniques in animal models. HNN is being constructed with workflows of use to study some of the most commonly measured E/MEG signals including event related potentials, and low frequency brain rhythms. I will give an overview of the theory behind the development of this mathematical neural modeling tool and demonstrate its use in uncovering the mechanisms and meaning of human brain dynamics in health and disease.