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EDITORIAL

Editorial

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This first special issue of Cognitive Neurodynamics, devoted to "Brain Waves", disseminates some contributions to a minisymposium on brain waves, held at the Waves 2007: The 8th International Conference on Mathematical and Numerical Aspects of Waves hosted by the University of Reading in July 2007.

Since their discovery by the German physician Hans Berger in 1929, brain waves in the human electroencephalogram (EEG), in the magnetoencephalogram (MEG), and even in functional magnetic resonance imaging (fMRI) have become increasingly important for clinical research and for investigations into the nature of cognition. Event-related brain potentials (ERP) and event-related magnetic fields (ERF) are important online measures for tracking cortical and subcortical activity associated with normal and impaired cognitive processes, e.g. in memory, attention, or language.

Research in these areas is concerned with the nature of the cortical activity, the nature of the neural generators of the activity and in theoretical models of wave-like phenomena in the human brain. These points give rise to three questions addressed in this special issue:

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1. The inverse problem. What are the neural generators of macroscopically observable brain waves?
2. Neural field theories. Which physiological properties of the neural tissue, regarded as a continuous, excitable medium, give rise to wave-like solutions of appropriate field equations?
3. Modeling experimental data. How can experimentally observed brain waves be modeled by continuous neural fields or discrete neural networks?

The first two contributions are concerned with cognition-related brain potentials and their modeling. Beim Graben et al. offer a possibility to relating language processing brain dynamics to transient waves in an abstract feature space. Fründ et al. use a particular neural network model to simulate brain waves related to the anticipation of natural stimuli.

The inverse problem is addressed by Galka et al. who estimate the parameters of a discretized linear brain wave equation using a spatio-temporal Kalman filter. Their approach is closely related to Kiebel et al.'s dynamical causal modeling approach, where the parameters of a neural mass model are assessed by Bayesian methods.

A neural network model for the resting state of the brain is provided by Ghosh et al. By contrast, Zachariou et al. present a conductance-based neural network model to describe the impact of cannabinoids on sensory gating in the hippocampus.

Two papers are directly devoted to neural field theories: Wennekers describe how neural field equations can be discretized for localized solutions, in order to obtain plausible neural mass models. On the other hand, Wright and Bourke relate fast neural field dynamics to synaptic plasticity and to Hebbian learning for explaining the self-organization of visual cortex.