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## Nonlinear brain dynamics in neural field model and harmonic generation responses to the external stimuli

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### Abstract

The most important nonlinear feature in the EEG response to external stimuli is the harmonic generation and entrainment which is due to the interaction between stimuli and ongoing brain oscillations. In this paper, we study the nonlinear brain dynamics and harmonic generation responses to the periodic external stimuli by employing continuum neural field model. A compact dynamical model of brain activity is first introduced, and the governing equations for the evolution of potential are obtained. Then, using the perturbation method and multiple time scales, we show brain response oscillations in harmonic drive frequency consistent with the recorded scalp EEGs from awake human subjects. Finally, to confirm the experimentally observed results of interaction between photic driving and brain dynamics, we have numerically simulated the full neural field model equations, and have shown harmonic frequency generation over a range of external frequencies.

**Keywords:** neural field model, cortex-thalamus system, photic driving, harmonic generation

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