Numerical solution of the neural field equation in the presence of random disturbance

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This paper aims at presenting an efficient and accurate numerical method for treating both deterministic- and stochastic-type *neural field equations* (NFEs) in the presence of external stimuli input (or without it) [1]. The devised numerical integration means belongs to the class of Galerkin-type spectral approximations grounded mathematically in [2, Proposition 2.1.10]. The particular effort is focused on an efficient practical implementation of the novel technique because of the partial integro-differential fashion of the NFEs, which are to be integrated, numerically. Our method is implemented in MATLAB. Its practical performance and efficiency is investigated on three variants of a particular NFE model with external stimuli inputs. We study both the deterministic case of the mentioned model and its stochastic counterpart to observe important differences in the solution behavior. First, we observe only stable one-bump solutions in the deterministic neural field scenario, which, in general, will be preserved in our stochastic NFE scenario if the level of random disturbance is sufficiently small. Second, if the area of the external stimuli is large enough and exceeds the size of the bump, considerably, the stochastic neural field solution's behavior may change dramatically and expose also two- and three-bump patterns. In addition, we show that strong random disturbances, which may occur in neural fields, fully alter the behavior of the deterministic NFE solution and allow multi-bump (and even periodic-type) solutions to appear in all variants of the stochastic NFE model studied in this paper.

References

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