Stochastic two-dimensional neural field equation: numerical approximation and applications to working memory

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The main goal of the present work is to investigate the effect of noise in some neural fields, used to simulate working memory processes. The underlying mathematical model is a stochastic integro-differential equation. In order to approximate this equation we apply a numerical scheme which uses the Galerkin method for the space discretization. In this way we obtain a system of stochastic differential equations, which are then approximated in two different ways, using the Euler-Maruyama and the Itô-Taylor methods. We apply this numerical scheme to explain how a population of cortical neurons may encode in its firing pattern simultaneously the nature and time of sequential stimulus events. Numerical examples are presented and their results are discussed.