STOCHASTIC DIFFERENTIAL EQUATIONS FOR NEURONAL BEHAVIOR*

S.K. Christensen and G. Kallianpur

University of North Carolina at Chapel Hill

The paper extends some results of Kallianpur and Wolpert on stochastic differential equation models for the behavior of spatially extended neurons. The results are employed to provide a rigorous treatment of a model recently considered by Wan and Tuckwell.

1. Introduction and statement of results.

We have recently extended the work of Kallianpur and Wolpert (1984) modeling the behavior of neurons by means of stochastic differential equations on the dual of a nuclear space. The extensions cover nuclear spaces of a more general structure and apply to models described in terms of more general differential operators. In this article we state some of the results we have obtained and show that they provide a general theoretical framework for the investigation of the behavior of spatially extended neurons. In particular, we illustrate our approach and its application by giving a rigorous treatment of the model recently proposed by Wan and Tuckwell (1980). Most of the details of the proof will be omitted for lack of space and will be published elsewhere. For the same reason we shall have to forego a description of the neurophysiological context which is, however, available in Kallianpur and Wolpert (1984) and the references cited there.

Our principal aim is the study of the random field $\xi(t,x)$ which represents the difference between the voltage potential at time t at the

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