Evans, J. D.; **Kember, G. C.**

Analytical solutions to the multicylinder somatic shunt cable model for passive neurones with differing dendritic electrical parameters. (English) Zbl 0807.92005

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Summary: The multicylinder somatic shunt cable model for passive neurones with differing time constants in each cylinder is considered. The solution to the model with general inputs is developed, and the parametric dependence of the voltage response is investigated. The method of analysis is straightforward and follows that laid out by the authors and *G. C. Kember* in Biophys. J. 63, 350-365 (1992) and in Math. Biosci. 125, No. 1, 1-50 (1995):

(i) The dimensional problem is stated with general boundary and initial conditions. (ii) The model is fully non-dimensionalised, and a dimensionless parameter family which uniquely governs the behaviour of the dimensionless voltage response is obtained. (iii) The fundamental unit impulse problem is solved, and the solutions to problems involving general inputs are written in terms of the unit impulse solution. (iv) The large and small time behaviour of the unit impulse solution is examined. (v) The parametric dependence of the unit impulse upon the dimensionless parameter family is explored for two limits of practical interest.

A simple expression for the principle relationship between the dimensionless parameter family is derived and provides insight into the interaction between soma and cylinders. A well-posed method for the solution of the dimensional inverse problem is presented.

MSC:

92C20 Neural biology
78A70 Biological applications of optics and electromagnetic theory

Keywords:

multicylinder somatic shunt cable model; passive neurones; differing time constants; voltage response; dimensionless parameter family; unit impulse problem; dimensional inverse problem; Green's function

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