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A Mathematical Study of a Model of Three Dimensional Electrophysiology

ABSTRACT:

We study a three-dimensional model of cellular electrical activity, which is written as a pseudodifferential equation on a closed surface Γ in R^3 coupled with a system of ordinary differential equations on Γ . We prove global existence/uniqueness for this system for a large class of nonlinearities including the FitzHugh-Nagumo and the Hodgkin-Huxley kinetics. One of the main difficulties is the absence of a maximum principle, which we overcome in part by introducing the notion quasipositivity. We also discuss asymptotic smoothing and the dependence of the solution on the size of the domain. This is joint work with Hiroshi Matano of the University of Tokyo.