Mori, Yoichiro; **Peskin, Charles S.**

A numerical method for cellular electrophysiology based on the electrodiffusion equations with internal boundary conditions at membranes. (English) Zbl 1182.92024

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Summary: We present a numerical method for solving the system of equations of a model of cellular electrical activity that takes into account both geometrical effects and ionic concentration dynamics. A challenge in constructing a numerical scheme for this model is that its equations are stiff: there is a time scale associated with "diffusion" of the membrane potential that is much faster than the time scale associated with the physical diffusion of ions. We use an implicit discretization in time and a finite volume discretization in space. We present convergence studies of the numerical method for cylindrical and two-dimensional geometries for several cases of physiological interest.

MSC:

92C37	Cell biology
92C05	Biophysics
65M08	Finite volume methods for initial value and initial-boundary value problems involving PDEs
65M12	Stability and convergence of numerical methods for initial value and initial-boundary value problems involving PDEs
78A70	Biological applications of optics and electromagnetic theory
35Q92	PDEs in connection with biology, chemistry and other natural sciences
92C30	Physiology (general)

Keywords:

three-dimensional cellular electrophysiology; electrodiffusion; ephaptic transmission; finite volume method

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