Readings in Neuroinformatics

Slaven Cvijetic

A QUANTITATIVE DESCRIPTION OF MEMBRANE CURRENT AND ITS APPLICATION TO CONDUCTION AND EXCITATION IN NERVE, BY A. L. HODGKIN AND A. F. HUXLEY, J. Physiol. (I952) I I7, 500-544

Abstract

We have developed a physical framework which is useful to faithfully predict the changes in a giant squid axon upon electrical stimulation for the first time to our knowledge. The membrane was modelled as an electric circuit to simulate the characteristic properties of resistance, membrane potential, electric current and conductance. We have derived a number of mathematical equations and provide their numerical procedures to model membrane action potentials with high numerical accuracy. The theory describes the changes over time of the permeability of sodium and potassium ions respectively. Our modelling takes into account the form of the axon, duration and amplitude of the spike, conduction velocity, impedance changes and ionic exchange amongst others to simulate the data from an actual action potential in an isolated squid axon. The model also accounts qualitatively for many phenomena of excitation such as accommodation. We propose that the basic framework of the model can also be used for other excitable tissues to model their behaviour upon excitation.