Group 2-3

Ionic Current Model of Retinal Cells

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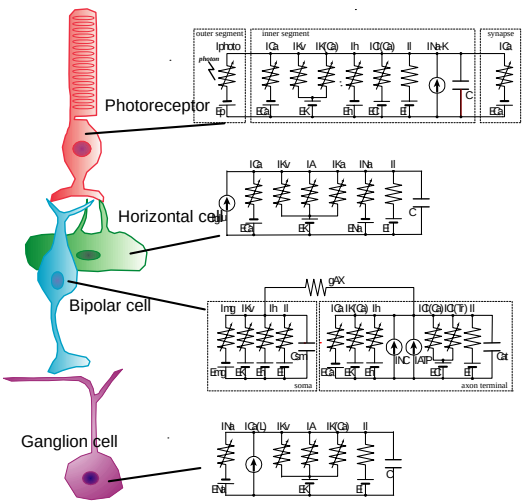
Summary

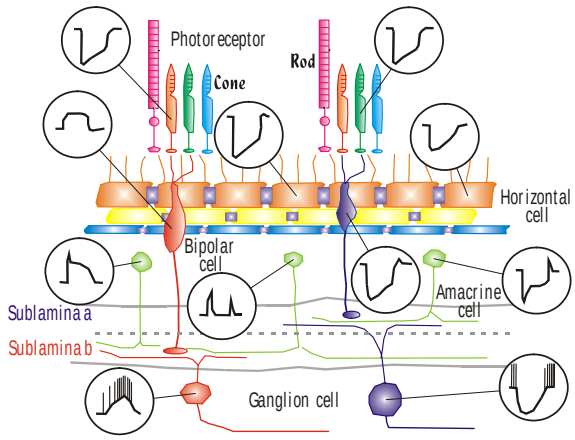
Mathematical descriptions of the membrane ionic currents in the retinal neurons, photoreceptors, horizontal cells, bipolar cells and ganglion cells are realized. Electrical properties of each neuron is described by a parallel conductance circuit. The voltage- and time-dependent characteristics of ionic conductance are modeled by Hodgkin-Huxley types of equations. For ganglion cells, a stochastic model of spike generation is developed based on discrete stochastic ion channels. The developed models are capable of accurately reproducing the voltage- and current clamp responses of retinal neurons. Any electrical response including light response which depends on the dynamic balance of different ionic currents is quantitatively analyed by the model. Therefore, working hypotheses on how the retina processes visual information are understood at the cellular and subcellular level. These models can be used to summarize what we know and what we need to find out on the retina. Simulation scripts in SATELLITE languages are downloadable from *Visiome Platform* (http://platform.visiome.org/).

Ionic Current Model



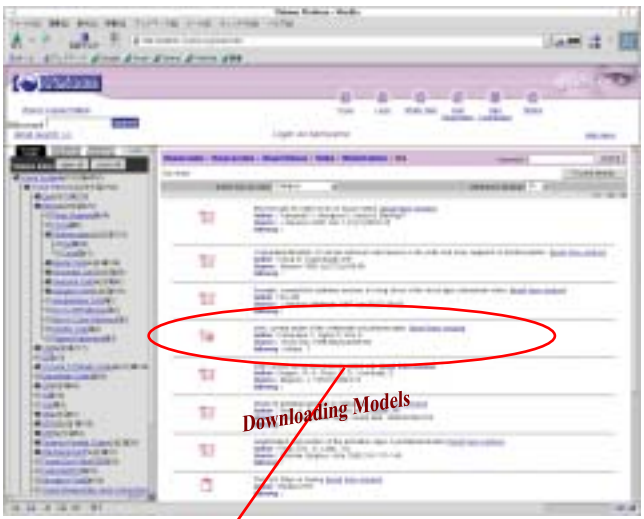
Cellular physiology has uncovered a multitude of cellular and subcellular facts, such as phototransduction mechanisms, ion channel characteristics of retinal neurons. Membrane ionic currents of retinal cells have been studied in a quantitative fashion using the voltage-clamp techniques. Those data provide information concerning the functional role of the ionic currents in generating and shaping the light response of the retinal neurons. However, the detailed experimental data alone are not enough to understand how the retinal neurons work. A combination of experimental work and mathematical modeling is necessary to clarify the complicated retinal functions.

The Vertebrate Retina



The vertebrate retina has been thought to be a window to the brain because of its accessibility and suitability for the neuroscientific investigation. It is thought to be still the only part of the vertebrate brain where we can reasonably explain what it is for and how it works. Therefore, the retina is an ideal model of neural network system and neural information processing system.

Downloading and Running Models



Running Models

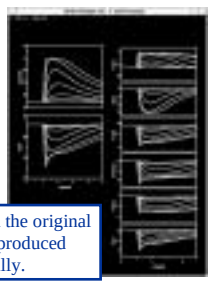
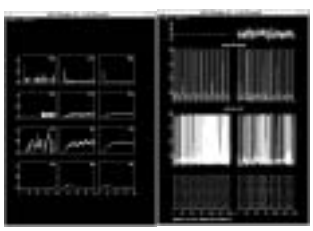


Figure 5 in the original paper is reproduced automatically.



Readme

Model Scripts

Original Paper