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A unifying kinetic model for voltage-gated ionic channels**Balbi Pietro**

Clinical Scientific Institutes Maugeri Spa, Italy

Modeling ionic channels represents a fundamental step to develop realistic neural models. Until recently, the voltage-gated ion-channels have been mainly modeled according to the formalism introduced by the seminal works of Hodgkin and Huxley (HH). However, following the continuing achievements in the biophysical and molecular comprehension of these pore-forming transmembrane proteins, the HH formalism turned out to carry limitations and inconsistencies in reproducing the ion-channels electrophysiological behavior. On the contrary, Markov-type kinetic models have been increasingly proven to successfully replicate both the electrophysiological and biophysical features of different ion-channels. However, order to model even the finest non-conducting molecular transition, such kinetic models are often equipped with a considerable number of states and related transitions, which make them computationally heavy and not suitable to be implemented in multi-compartmental conductance-based biologically inspired neuron models and large networks of those. We recently developed a kinetic model for the human Voltage-Gated Sodium Channels (VGSCs), which is detailed, global i.e. it accounts for all sodium channel isoforms, from $Na_v1.1$ to $Na_v1.9$ and computationally efficient (i.e. with a minimal set of states and transitions). The kinetic model was proven to be the simplest and most parsimonious way for a detailed phenomenological description of the human VGSCs electrophysiological behavior. Owing to the structural homology and phylogenetic relationship between sodium and other (mainly potassium and calcium) voltage-gated channels, the developed model is here extended to reproduce the electrophysiological behavior of different potassium and calcium channels. The proposed model can accurately mimic also the electrophysiological behavior of various potassium and calcium channels. This unifying simplified kinetic model can then efficiently replace the HH formalism in neural cells and neural networks simulations. In addition, the unifying model sheds light on common biophysical mechanisms among different voltage-gated ionic channels.

Biography

Balbi Pietro is a Neurologist and Clinical Neurophysiologist with research interest in Computational Neuroscience. He is currently focused on the development of biologically inspired models of neurons and neural networks. He is also involved as Practicing Physician in neurorehabilitation of patients affected by neurological diseases and neurological complications of systemic diseases in clinical neurophysiology, by means of a wide experience in investigating both the peripheral and the central nervous system in diagnosis and treatment of neurological disease with concern on hereditary neurodegenerative diseases and rare diseases.

pietro.balbi@icsmaugeri.it

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