

# Study of Simulation Technology for Myocardial Ion Channel on Pharmacological Effects

Jihong Liu\*, Yue Cui, Yitian Tao and Henggui Zhang

College of Information Science and Engineering  
Northeastern University No.3-11, Wenhua Road, Heping District,  
Shenyang, Liaoning Province, China, 110819

Cardiac modeling is an exploratory problem in the field of biomedical engineering, which is involved intensive theories, complex research fields and difficult technologies. Computational models of the myocyte have become important tools for understanding the biophysical basis of the action potential, for relating changes in gene/protein expression and effects of gene mutations to alterations of AP and calcium transient morphology, and for investigating mechanisms of arrhythmia. As the action potential equation is formed by the ion channel current, it is closely related to the ion concentration inside and outside the cell, the channel conditions, neurotransmitter, and the influence of drugs. Therefore, the models could build an exact link between the cellular electrophysiology and the clinical pathology. With the development of computer technology, various types of cardiac cell electrophysiology models have been described in different programming languages, and widely used into packaged commercial software. Propagation of electrical excitation in cardiac tissue can be described by the non-linear cable equation, a reaction-diffusion-type partial differential equation. Families of cardiac cell models have been developed to describe the voltage- and time-dependent current that reconstruct the action potential. These models can be applied hierarchically, with cell models for AP properties.

We simulated the electrophysiological effects on the action potential of the main myocardial ion channel according to the action of class III antiarrhythmic drugs by reducing the conductances of specific membrane currents. We discuss the display method of the action potential of the purkinje fiber, endocardial, midmyocardial and epicardial cells under both the normal condition and the effect of the medicine. The action potential duration, diastolic interval and maximal voltage change rate are calculated, as well. This work could be used to study the effects of class III antiarrhythmic drugs on transmural propagation and to develop a simulation tools for developing the new drugs for arrhythmia.