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Parameter Extraction of Hodgkin-Huxley Type Circuit Model of Neuron using Advanced Algorithm

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Abstract : Hodgkin and Huxleys' conductance based model of biological neuron can accurately reproduce the waveform of the membrane voltage as well as the spike timing in response to injected currents. Based on this model, a simple electronic circuit is proposed as an analog of postsynaptic membrane of neuron. The simulated sodium and potassium conductances and the electronic action potential of this circuit are compared with Hodgkin-Huxley(HH) model. For finding the good model parameter set to membrane voltage recordings, we have first tested three algorithms, namely Genetic Algorithm(GA), Particle Swarm optimization(PSO) and Firefly algorithm(FA) on originally recorded action potential of squid giant axon by Hodgkin and Huxley and found that FA is more efficient method for parameter sof the action potential generated by our proposed electronic circuit model. Parameter values are compared with voltage clamped experimental data of Hodgkin and Huxley and found that this analog circuit could be very useful for simulating different types of action potential.

Keywords: Hodgkin-Huxley (HH) model; Firefly Algorithm; Particle Swarm Optimization; Genetic Algorithm.

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