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Ca^{2+} Dynamics and Propagating Waves in Neural Networks with Excitatory and Inhibitory Neurons. VLADIMIR E. BONDARENKO, University at Buffalo, SUNY — Dynamics of neural spikes, intracellular Ca^{2+}, and Ca^{2+} in intracellular stores was investigated both in isolated Chay's neurons and in the neurons coupled in networks. Three types of neural networks were studied: a purely excitatory neural network, with only excitatory (AMPA) synapses; a purely inhibitory neural network with only inhibitory (GABA) synapses; and a hybrid neural network, with both AMPA and GABA synapses. In the hybrid neural network, the ratio of excitatory to inhibitory neurons was 4:1. For each case, we considered two types of connections, "all-with-all" and 20 connections per neuron. Each neural network contained 100 neurons with randomly distributed connection strengths. In the neural networks with "all-with-all" connections and AMPA/GABA synapses an increase in average synaptic strength yielded bursting activity with increased/decreased number of spikes per burst. The neural bursts and Ca^{2+} transients were synchronous at relatively large connection strengths despite random connection strengths. Simulations of the neural networks with 20 connections per neuron and with only AMPA synapses showed synchronous oscillations, while the neural networks with GABA or hybrid synapses generated propagating waves of membrane potential and Ca^{2+} transients.

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