Abstract View

FAST-EMERGENT OSCILLATIONS IN A MUTUALLY INHIBITORY NETWORK

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We study a network of mutually all-to-all inhibiting Hodgkin-Huxley model neurons each of which is driven by an independent Poisson train (rate, lambda) of subthreshold excitatory alpha function inputs. The inhibitory synaptic conductance (with decay time constant of Tsyn) from each presynaptic neuron incorporates a synaptic time delay, Tdelay. In the absence of inhibitory coupling, cells fire irregularly and asynchronously with a ‘‘spontaneous’’ rate of 52 Hz (when lambda=300 Hz) due to temporal summation of subthreshold synaptic inputs. When coupled, the network shows an emergent synchrony with a population firing rate (213 Hz) that is substantially enhanced (by a factor of 4) compared to the spontaneous rate of isolated cells. The cells show strong cross correlations and they skip cycles of the population rhythm but still fire faster (74 Hz) than when isolated. The resultant interspike interval histogram of each cell has multiple peaks at multiples of the network oscillation period. The network’s frequency and individual cell frequency decrease as Tdelay or Tsyn increase. If Tsyn is above a critical value (1.6 ms), the individual cell’s firing rate falls below its spontaneous rate, while the network population rate still exceeds the spontaneous rate. *This work supported in part by NIH/NIMH Grant MH62595-01*.

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