Abstract View

ATTENTIONAL MODULATION OF SYNCHRONY IN CORTICAL NETWORKS

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Attention can modulate the synchrony of neurons in extrastriate cortex without changing their mean activity. We investigated using two different model networks how cortical neurons synchronize when a stimulus was attended and how they desynchronize when attention was switched off. Network 1 consisted of interneurons that were coupled by fast GABAergic synapses and electrical gap junctions. The effects of attention were mediated by activation of cholinergic or glutamatergic projections and was modeled as a depolarizing current to part of the network. This resulted in synchronized oscillations in the gamma frequency range (40 Hz) within a 100 ms. The firing rate of the activated neurons increased, but their inhibitory projection decreased the activity of non-activated neurons, keeping the mean activity of the network approximately constant. Synaptic background activity -- noise -- was critical to attentional modulation: Networks of inhibitory neurons did not synchronize when the noise was too strong; for noise that was too weak the networks did not desynchronize when attention was switched off. Hence, there was an optimal noise level for attentional modulation. Network 2 consisted of excitatory and inhibitory neurons at a 4:1 ratio. A parameter range was identified where by modulating the drive to the interneuron network the synchrony of the excitatory neurons could be varied without changing their mean activity. In studying how synchrony was manipulated by neuromodulatory substances we used a novel synchrony measure: The spike times of all neurons in the network were sorted and synchrony was quantified as the standard deviation of the interspike intervals divided by the mean.
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