Discriminating between correlated and uncorrelated signals with a small neural circuit

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Humans and animals often show different behavioral responses depending on whether sensory signals co-fluctuate in intensity or are uncorrelated [1-3]. This implies that neural networks in their sensory systems are capable of discriminating between these two types of input. We investigated how synchronous excitatory spikes and inhibitory spikes affect the firing of downstream leaky integrate-and-fire neurons and on this basis, proposed a simple neural network that can perform the above-mentioned discrimination task on a pair of input signal traces modeled as fluctuating currents. In our model, each signal trace on its own and their combinations, correlated and uncorrelated, elicit responses from different sets of neurons in the network, hence enabling these signal conditions to be differentiated with a combinatorial code. The discrimination task is successful for inputs with a considerable range of intensities as long as the neurons are fluctuation-driven, and the mean intensities of the two inputs are not required to be equal. The amount of correlation for which the input is considered to be 'correlated' is controlled by the strength of synaptic connections between neurons, which suggests that learning may be involved in enabling and fine-tuning such discrimination tasks in biological contexts.
Our results are consistent with experimental observations in [1] and offer a hypothesis on how biological neurons may detect and encode information about correlations in inputs or correlations arisen from their own intrinsic activities.

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References:

1. *PLoS One*. 2012; **7(4)**: e36096.
2. *Trends Cogn Sci*. 2004 **Oct;8(10)**:465-71.
3. *Behav Cogn Neurosci Rev*. 2005 **Mar;4(1)**:21-42.

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