Noise down, neuron signals up

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Biomedical engineer Muhammet Uzuntarla from Bulent Ecevit University, Turkey, and his colleagues present a biologically accurate model of the underlying noise which is present in the nervous system. The article is about to be published in *European Physical Journal B*. This work has implications for explaining how noise, modulated by unreliable synaptic transmission, induces a delay in the response of neurons to external stimuli as part of the neurons coding mechanism.

Neurons communicate by means of electrical pulses, called spikes, exchanged via synapses. The time it takes for brain cells to first respond to an external stimulus with an electric signal —commonly referred to as fist-spike latency—is of particular interest for scientists. It is thought to carry much more neural information than subsequent serial spike signals.

The authors analysed the presence of noise in the nervous system detected through changes in first-spike latency. The noise is due to the synaptic bombardment of each neuron by a large number of incoming excitatory and inhibitory spike inputs. Previous attempts at noise modeling used a generic bell-shaped signal, referred to as a Gaussian approximation. Now, Uzuntarla and his colleagues have devised a noise model that is closer to the biological reality.

They showed there is a relation between the noise and delays in spike signal transmission. The latter is caused by unreliable synapses that do not always transmit the signal, because their chemical-based signalling does not always work. Yet, the authors also demonstrated that synaptic unreliability can be controlled.

To do so, they identified two factors that could be tuned influencing the noise, namely the incoming excitatory and inhibitory input signalling regime and the coupling strength between inhibitory and excitatory synapses. Ultimately, the authors concluded, modulating these factors could help neurons encode information more accurately.

More information: M. Uzuntarla et al. (2012). Controlling the First-Spike Latency Response of a Single Neuron via Unreliable Synaptic Transmission, *European Physical Journal B*; DOI 10.1140/epjb/e2012-30282-0

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