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Poster presentation

Broadband coding with dynamic synapses

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Short-term synaptic plasticity (STP) comprises facilitation and depression processes. Although STP can alter the mean value and spectral statistics of the effective input to a neuron from presynaptic spike trains, its functional roles are not clear. In a steady state condition, synaptic depression is generally considered to provide low-pass filtering of inputs, with facilitation providing high-pass filtering. Here, we consider the general case of a model neuron receiving inputs from a population of independent Poissonian spike trains, and show using both analytical results and simulations that dynamic synapses can add or remove (depending on synaptic parameters) spectral power at low frequencies. The implications of these findings are demonstrated when a band-limited-noise rate modulation of the Poissonian spike trains is considered. Information transmission, as measured by the spectral coherence between the rate modulation and synaptic input, does not depend on frequency. This effect is also observed for the coherence between the rate modulation and the membrane voltage of the postsynaptic neuron. In contrast to the prevalent view, in terms of information transmission, synaptic dynamics provide no low- or high-pass filtering of the input under steady-state conditions. Despite the lack of dependence on frequency, there is a balance between facilitation and depression that optimizes total information transmission and this balance can be modulated by a parameter associated with some forms of long-term plasticity.