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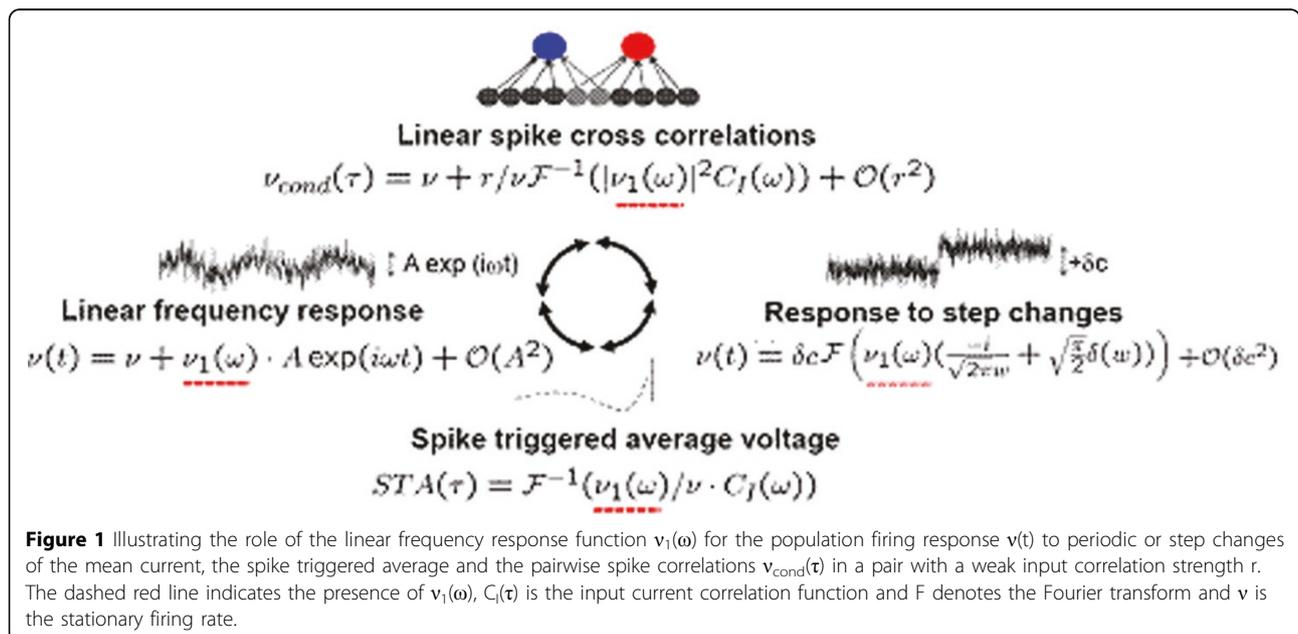
Representation of dynamical stimuli in threshold neuron models

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A vital function of the mammalian cortex is the processing of dynamical stimuli. These stimuli are encoded in cortical neurons as modifications of the input current, which can be brief, prolonged or periodic, all depending on the type of the sensory stimulus, e.g. [1,2]. While experimental findings can increasingly link sensory stimulation to specific input current modulations, the representation of current stimuli by populations of cortical neurons currently lacks a comprehensive theoretical understanding. In particular, few theories can

analytically describe the numerous phenomena related to the processing of dynamical current stimuli, such as pairwise spike correlations and spike triggered average currents (Fig. 1). Even in the simplest integrate and fire model, the complexity of the coupled differential equations allows for tractable analytical results only in specific limiting cases [3,4]. Here, we show how a modified threshold model framework can accurately describe many important features of cortical neurons and provide set of tractable analytical expressions for all quantities of



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interest shown in Fig.1, such as spike triggered average current, pairwise spike correlations [4,5] and response to dynamical input changes [3,4]. Using this novel model framework, we study how populations of cortical neurons represent dynamical stimuli encoded in the input current and place many important, yet disparate, observations into a common conceptual scheme.

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References

1. Buzsáki G, Draguhn A: **Neuronal Oscillations in Cortical Networks.** *Science* 2004, **304**:1926-1929.
2. Volgushev M, Pernberg J, Eysel UT: **γ -frequency fluctuations of the membrane potential and response selectivity in visual cortical neurons.** *Eur J Neurosci* 2003, **17**(9):1768-1776.
3. Brunel N, Chance F, Fourcaud N, Abbott LF: **Effects of synaptic noise and filtering on the frequency response of spiking neurons.** *Phys Rev Lett* 2001, **86**:2186-2189.
4. Ostojic S, Brunel N, Hakim V: **How connectivity, background activity, and synaptic properties shape the cross-correlation between spike trains.** *J Neurosci* 2009, **29**(33):10234-10253.
5. Tchumatchenko T, Malyshev A, Volgushev M, Wolf F: **Correlations and synchrony in threshold neuron models.** *Phys Rev Lett* 2010, **104**(5):058102.

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