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**Add HOC?: dendritic nonlinearities shape higher-than-pairwise correlations and improve coding in noisy (spiking) neural populations**[1]
JOEL ZYLBERBERG, ERIC SHEA-BROWN, University of Washington — Recent experiments with relatively large neural populations show significant higher-order correlations (HOC): the data are poorly fit by pair-wise maximum entropy models, but well-fit by higher-order models. We seek to understand how HOC are shaped by the properties of networks and of the neurons therein, and how these HOC affect population coding. In our presentation, we will demonstrate that dendritic non-linearities similar to those observed in physiology experiments are equivalent to beyond-pairwise interactions in a spin-glass-type statistical model: they can either increase, or decrease, the magnitude of the HOC relative to the pair-wise correlations. We will then discuss a population coding model with parameterized pairwise- and higher-order interactions, revealing the conditions under which the beyond-pairwise interactions (dendritic nonlinearities) can increase the mutual information between a given set of stimuli, and the population responses. For jointly Gaussian stimuli, coding performance can be slightly improved by shaping the output HOC via dendritic nonlinearities, if the neural firing rates are low. For skewed stimulus distributions, like the distribution of luminance values in natural images, the performance gains are much larger.

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