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Robust Nonlinear Neural Codes[1] QIANLI YANG, Rice Univ, XAQ PITKOW, Rice Univ, Baylor College of Medicine — Most interesting natural sensory stimuli are encoded in the brain in a form that can only be decoded nonlinearly. But despite being a core function of the brain, nonlinear population codes are rarely studied and poorly understood. Interestingly, the few existing models of nonlinear codes are inconsistent with known architectural features of the brain. In particular, these codes have information content that scales with the size of the cortical population, even if that violates the data processing inequality by exceeding the amount of information entering the sensory system. Here we provide a valid theory of nonlinear population codes by generalizing recent work on information-limiting correlations in linear population codes. Although these generalized, nonlinear information-limiting correlations bound the performance of any decoder, they also make decoding more robust to suboptimal computation, allowing many suboptimal decoders to achieve nearly the same efficiency as an optimal decoder. Although these correlations are extremely difficult to measure directly, particularly for nonlinear codes, we provide a simple, practical test by which one can use choice-related activity in small populations of neurons to determine whether decoding is suboptimal or optimal and limited by correlated noise. We conclude by describing an example computation in the vestibular system where this theory applies.

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Qianli Yang
Rice Univ

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