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Super-linear Precision in Simple Neural Population Codes DAVID SCHWAB, Northwestern University, ILA FIETE, University of Texas, Austin — A widely used tool for quantifying the precision with which a population of noisy sensory neurons encodes the value of an external stimulus is the Fisher Information (FI). Maximizing the FI is also a commonly used objective for constructing optimal neural codes. The primary utility and importance of the FI arises because it gives, through the Cramer-Rao bound, the smallest mean-squared error achievable by any unbiased stimulus estimator. However, it is well-known that when neural firing is sparse, optimizing the FI can result in codes that perform very poorly when considering the resulting mean-squared error, a measure with direct biological relevance. Here we construct optimal population codes by minimizing mean-squared error directly and study the scaling properties of the resulting network, focusing on the optimal tuning curve width. We then extend our results to continuous attractor networks that maintain short-term memory of external stimuli in their dynamics. Here we find similar scaling properties in the structure of the interactions that minimize diffusive information loss.

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