Song Discrimination Using a Biologically Plausible Circuit That Implements a Spike Distance Metric.

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Recent work has shown that spike trains from individual sensory neurons can be used to discriminate between and classify stimuli [1]. Multiple groups have developed spike (dis)similarity metrics to quantify the differences between spike trains. Using a nearest neighbor approach the spike similarity metrics can be used to classify the stimuli into groups used to evoke the spike trains. The nearest prototype spike train to the tested spike train can then be used to identify the stimulus. However, how biological circuits might perform such computations remains unclear. Elucidating this question would facilitate the experimental search for such circuits in biological systems, as well as the design of artificial circuits that can perform such computations.

Here we present a biologically plausible model for discrimination inspired by a spike distance metric [2] using a network of integrate and fire model neurons. We then apply this model to the birdsong system in the context of song discrimination and recognition. We show that the model circuit is effective at recognizing individual songs, based on experimental input data from the field L region (homologous to primary auditory cortex). We also compare the performance and robustness of this model to two alternative models of song discrimination: a model based on coincidence detection and a model based on firing rate.

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References