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Bayesian Ising approximation for learning dictionaries of multispike timing patterns in premotor neurons[1] DAMIAN HERNANDEZ LAHME, Department of Physics, Emory University, SAMUEL SOBER, Department of Biology, Emory University, ILYA NEMENMAN, Department of Physics and Biology, Emory University — Important questions in computational neuroscience are whether, how much, and how information is encoded in the precise timing of neural action potentials. We recently demonstrated that, in the premotor cortex during vocal control in songbirds, spike timing is far more informative about upcoming behavior than is spike rate (Tang et al, 2014). However, identification of complete dictionaries that relate spike timing patterns with the controled behavior remains an elusive problem. Here we present a computational approach to deciphering such codes for individual neurons in the songbird premotor area RA, an analog of mammalian primary motor cortex. Specifically, we analyze which multispike patterns of neural activity predict features of the upcoming vocalization, and hence are important codewords. We use a recently introduced Bayesian Ising Approximation, which properly accounts for the fact that many codewords overlap and hence are not independent. Our results show which complex, temporally precise multispike combinations are used by individual neurons to control acoustic features of the produced song, and that these code words are different across individual neurons and across different acoustic features.

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