BAYESIAN APPROACH FOR ESTIMATING AMPLITUDE AND LATENCY VARIABILITY IN NEURONAL SPIKE TRAINS

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Abstract

On a trial by trial basis, cortical activity evoked by sensory stimulation is extremely variable. In the case of single unit spike train recordings, both the amplitude and latency of the rate function can vary from trial to trial. Measures which are based on averaging across trials, for example, peri-stimulus histogram (PSTH) and cross-correlogram, are adversely affected by such trial to trial variability. In addition, correlated variations in either amplitude and latency over repeated stimulus presentations can result in peaks in the cross-correlogram . Such peaks, without an understanding of their origin, may then be misconstrued as evidence for spike-spike synchrony. On the other hand, single trial parameters such as amplitude scaling factors and latency shifts are themselves interesting physiological variables, providing information for understanding stages of information processing in the cortex.In this paper, starting from a Bayesian perspective, we propose a comprehensive framework that can serve as a theoretical guideline for modeling and estimating parameters of single trial spike trains recorded in the sensory evoked response paradigm. The firing rate over a trial is modeled by a family of rate profiles with trial invariant waveform and trial dependent amplitude scaling factors and latency shifts. A *Maximum a Posteriori* solution of the model is implemented via an iterative algorithm from which the single trial amplitude scaling factors and latency shifts are estimated. We test the performance of the algorithm on simulated data.