Control/Tracking Number: 2008-S-101199-SfN
Activity: Scientific Abstract
Current Date/Time: 5/9/2008 3:28:03 PM

Heuristics for revealing the event structure of neuronal spike trains

AUTHOR BLOCK: *J. V. TOUPS[1], J.-M. FELLOUS[2], T. J. SEJNOWSKI[3,4], P. H. TIESINGA[1];
[1]Dept Physics/Astronomy, UNC Chapel Hill, Chapel Hill, NC; [2]Psychology Dept. and Program in Applied Mathematics, Univ. of Arizona, Tucson, AZ; [3]CNL, Salk Institute, Howard Hughes Med. Inst., La Jolla, CA; [4]Div. of Biol. Sci., UCSD, La Jolla, CA

Abstract: Neurons in sensory systems must convey information about the temporal structure of stimuli. In vitro, single neurons respond precisely and reliably to the repeated injection of the same fluctuating current on multiple trials, producing regions of elevated firing rate, which are termed events. Further analysis reveals spike patterns, which are trial-to-trial correlations between spike times (Fellous et al, J. Neurosci 2004). Finding events in data with realistic spiking statistics is challenging because events may overlap. Overlapping events typically belong to different spike patterns. Therefore, we developed a method to find spiking events that uses information about which pattern a trial belongs to. First, to find patterns we constructed a pair-wise distance matrix with the element on the ith row and jth column being the Victor-Purpura (VP) distance between the spike trains obtained on the ith and jth trial (Victor & Purpura, J. Neurophys. 1996). Fuzzy-c-means (FCM) was applied to the columns of the distance matrix, each treated as a vector, in order to group trials expressing the same pattern. The temporal resolution of the VP distance is controlled by a parameter q and FCM takes the number n of clusters (patterns) to look for as a parameter. We found that the q-value, which distinguished optimally between different patterns, corresponded to the q value at which the entropy of the distribution of pair-wise distances was maximal. The n value for which the derivative over n of the so-called gap statistic (Tibshirani et al, J. Royal Stat. Soc. 2001) had a maximum often corresponded to the number of patterns present in the data. Second, spikes across all trials belonging to a pattern were collected into an aggregate spike train. An event consisted of a group of spikes in the aggregate spike train whose interspike intervals were less than a given threshold, tISI (Tiesinga et al, Neural Comp. 2002). Third, because the same event could be part of multiple patterns, events were merged across patterns. Events were merged when their spike times could not be reliably distinguished because the receiver operating characteristic (ROC) was less than a given threshold, tROC.
The complete procedure is thus characterized by four parameters: q, n, tISI and tROC for which heuristics have been developed. This procedure was tested using artificial data as well as responses recorded in vitro in response to fluctuating current waveforms.
:

Theme and Topic (Complete): D.04.g. Neural coding ; G.07. Data Analysis and Statistics
Keywords (Complete): spike timing ; precision ; noise ; synchrony ; biophysical model
Presentation Preference (Complete): Poster Only
Support (Complete):
Support: Yes
Grant/Other Support: : NIH Grant MH68481

Linking Group (Complete): None selected
Special Requests (Complete):
Religious Conflict?: No Religious Conflict
Additional Conflict?: No

Status: Finalized