Abstract View

A binless correlation measure reduces the variability of memory reactivation estimates.

P.B. Kruskal[1,2]; J.J. Stanis[5]; B.L. McNaughton[4]; P.J. Thomas[1,3*]

1. Mathematics, 2. Psychology, 3. Neuroscience, Oberlin College, Oberlin, OH, USA 4. Neural Systems, Memory & Aging, U. Arizona, Tucson, AZ, USA 5. Beckman Inst., U. Ill. Urbana-Champaign, Urbana, IL, USA

Standard methods for estimating the amount of correlation between spike trains are based on coincidence of spikes within fixed time bins. Such estimates are discontinuous functions of the spike times. Consequently, small variations in spike times can shift spikes from "coincident" to "noncoincident" bins, contributing to increased variability in estimates of correlation.

Measurements of reactivation of neural activity during sleep, quantified by the explained variance (EV) (McNaughton 1998) of one set of correlations relative to another set, typically show large standard deviations across different animals, experimental sessions and choices of binning interval. This variability could reflect several sources, including intrinsic variability of spike pattern generation *in vivo*, statistical variability due to sample size, and variability due to binning "noise".

We compare the variability of bin-based estimates of explained variance with those based on a binless method for estimating correlations between spike trains (Fellous et al 2004). Our binless measure smoothes each spike with a finite precision and determines the correlation as an inner product on a function space. Viewed as a function of effective bin width, the binless measure matches the average value of the standard measure, but with substantially reduced variation about the mean. In data sets containing 10 or fewer cells (45 or fewer pairwise correlation comparisons) the binless measure typically reduced the variance of the EV estimate by 50% when compared with the standard method.

This reduction in variability should provide a better measure of the true explained variance, allowing for statistical significance to be established with smaller data sets than currently required.

References

McNaughton 1998, Neurobiology of Learning and Memory 70, 252-267.
Fellous, Tiesinga, Thomas and Sejnowski 2004. J. Neurosci. 24 (12), 2989-3001.

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