

PO.10.Measures of spike train synchrony: Defining a minimum time scale for ISI and SPIKE-distances

Over the years many different methods have been developed in order to quantify spike train similarities. For example, Victor-Purpura [1] and Van Rossum [2] metrics describe spike train (dis)similarity based on user given time scales. The main drawback of these measures is the fixed time scale, since it sets a boundary between rate and time coding for the whole recording. This means that the result obtained depends on the user input and they do not perform well if the spike trains contain more than one time scale.

These drawbacks have been eliminated in time scale independent ISI [3] and SPIKE [4] distances by Kreuz et al., since these methods always adapt to the local firing rate. However, while the methods identify correctly the relative firing rate differences, they have no concept of actual time scales. Especially in the presence of bursts this may lead to situations, where the time scale independence identifies small deviations from perfect synchrony as highly dissimilar.

Here we propose an extension to the existing ISI- and SPIKE-distance measures that is based on using a minimum relevant time scale (MRTS). This new version starts to gradually ignore differences in ISI that are smaller than the MRTS. The MRTS can be a parameter, but we also introduce a method for estimating it directly from the data. We perform a pairwise analysis on a library of stereotypical spike trains to show that the correction addresses the shortcomings of the original measures without introducing any side effects.

In summary, our new extension allows for a more accurate estimation of similarity with certain types of data. Especially in the presence of bursts the new version has the advantage of being able to disregard the differences that are too small for the time scales of the underlying system.

- [1] Victor JD and Purpura KP. Journal of Neurophysiology 76(2):1310 (1996)
- [2] van Rossum M. Neural Computation 13(4):751 (2001)
- [3] Kreuz T, Haas JS, Morelli A, Abarbanel HDI, Politi A. J Neurosci Methods 165, 151 (2007)
- [4] Kreuz T, Chicharro D, Houghton C, Andrzejak RG, Mormann F. J Neurophysiol 109, 1457 (2013)

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