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Measuring spike train synchrony and reliability

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Estimating the degree of synchrony or reliability between two or more spike trains is a frequent task in both experimental and computational neuroscience. In recent years, many different methods have been proposed that typically compare the timing of spikes on a certain time scale to be fixed beforehand. In this study [1], we propose the ISI-distance, a simple complementary approach that extracts information from the interspike intervals by evaluating the ratio of the instantaneous frequencies. The method is parameter free, time scale independent and easy to visualize as illustrated by an application to real neuronal spike trains obtained in vitro from rat slices (cf. [2]). We compare the method with six existing approaches (two spike train metrics [3,4], a correlation measure [2,5], a similarity measure [6], and event synchronization [7]) using spike trains extracted from a simulated Hindemarsh-Rose network [8]. In this comparison the ISI-distance performs as well as the best time-scale-optimized measure based on spike timing, without requiring an externally determined time scale for interaction or comparison.

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