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An Improved Synchronization Likelihood Method for Quantifying Neuronal Synchrony

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Abstract

Indirect quantification of the synchronization between two dynamical systems from measured experimental data has gained much attention in recent years, especially in the computational neuroscience community where the exact model of the neuronal dynamics is unknown. In this regard, one of the most promising methods for quantifying the interrelationship between nonlinear non-stationary systems is known as Synchronization Likelihood (SL), which is based on the likelihood of the auto-recurrence of embedding vectors (similar patterns) in multiple dynamical systems. However, synchronization likelihood method uses the Euclidean distance to determine the similarity of two patterns, which is known to be sensitive to outliers. In this study, we propose a discrete synchronization likelihood (DSL) method to overcome this limitation by using the Manhattan distance in the discrete domain ($l1$ norm on discretized signals) to identify the auto-recurrence of embedding vectors. The proposed method was tested using unidirectional and bidirectional identical/non-identical coupled Hénon Maps, a Watts-Strogatz small-world network with nonlinearly coupled nodes based on Kuramoto model and the real world ADHD-200 fMRI benchmark dataset. According to the results, the proposed method shows comparable and in some

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