Catching ghosts with a coarse net: use and abuse of spatial sampling data in detecting synchronization

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Abstract

Synchronization of population dynamics in different habitats is a frequently observed phenomenon. A common mathematical tool to reveal synchronization is the (cross)correlation coefficient between time courses of values of the population size of a given species where the population size is evaluated from spatial sampling data. The corresponding sampling net or grid is often coarse, i.e. it does not resolve all details of the spatial configuration, and the evaluation errori.e. the difference between the true value of the population size and its estimated valuecan be considerable.We show that this estimation error can make the value of the correlation coefficient very inaccurate or even irrelevant. We consider several population models to show that the value of the correlation coefficient calculated on a coarse sampling grid rarely exceeds 0.5, even if the true value is close to 1, so that the synchronization is effectively lost. We also observe ghost synchronization when the correlation coefficient calculated on a coarse sampling grid is close to 1 but in reality the dynamics are not correlated. Finally, we suggest a simple test to check the sampling grid coarseness and hence to distinguish between the true and artifactual values of the correlation coefficient.

Keywords: sparse data, sampling, coarse grid, data analysis, correlation coefficient, ghost synchronization

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