Multivariate dependence in complex systems

By

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Abstract

This paper reviews the state-of-the-art and proposes new approaches for the quantification of multivariate dependence in time and space. Traditional measures like linear correlation in time or space and squared coherence in the frequency domain are investigated, followed by more recently developed measures based on mutual information. The latter can be sensitive to data-size, noise and periodicity, even though they theoretically improve over traditional measures by capturing nonlinear dependence. The development of time-lagged and spatially-lagged dependence measures that rely on mutual information and resemble auto- and cross-correlation functions in time and space are proposed. Recently developed approaches for quantifying the dependence among extreme and unusual values within a single time series and among multiple variables are utilized and extended to propose measures that resemble auto- and cross-correlation functions for extremal dependence in time and space. The significance and multidisciplinary impact of these developments are emphasized, using simulated and real data.

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