A NEW DIMENSION-REDUCTION METHOD FOR COMPLEX DYNAMICAL NETWORKS

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July 12, 2018

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Dynamical complex networks

Nodes
Activity $x_i(t)$

Edges
Weights $A = \{a_{ij}\}$

Dynamics

$$\dot{x}_i = F(x_i) + \sum_{j=1}^{N} a_{ij} G(x_i, x_j)$$
1-dimensional reduction

Red node activity = Weighted average activity

\[ \langle x \rangle_w = \sum_{i=1}^{N} w_i x_i \]

\( w \) must be the dominant eigenvector of \( A \).

Gao et al. (2016) reduction is found as an approximation.
Star networks

- 2-dimensional

- # of eigenvalues on the spectral radius $\rightarrow$ # of dimensions
Star networks

1-dimensional Structural parameter
Activity

2-dimensional Structural parameter

1-dimensional Structural parameter
Activity
Modular networks | A combined method

Combined method
The combined method predicts accurately the critical edges.
FURTHERMORE

Predicting global state using a low dimensional representation of dynamical complex networks

Available soon

- Many dynamics: SIS, Neural, Lotka-Volterra, Genes
- Critical transition of scale-free networks
- Error estimations

Take home message

- Systematic method
- Based on spectral properties of networks