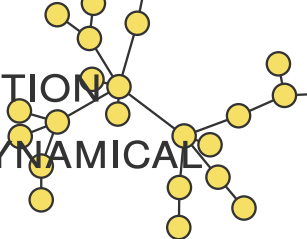# A New Dimension-reduction Method for Complex Dynamical Networks

SIAM

Edward Laurence

July 12, 2018

Département de physique, de génie physique, et d'optique
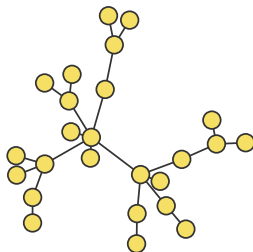Université Laval, Québec, Canada

Sentinelle Nord

UNIVERSITÉ LAVAL

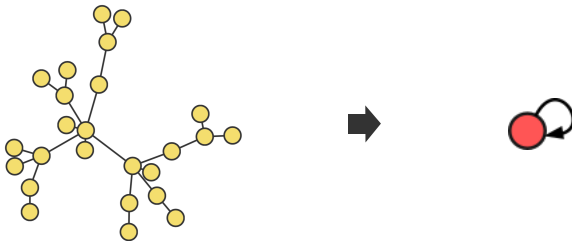*Dynamical complex networks*

Nodes
Activity $x_i(t)$

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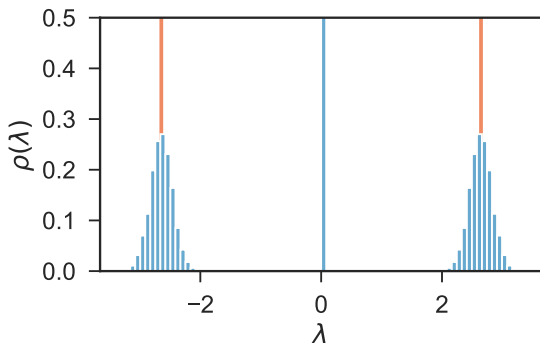
Dynamics

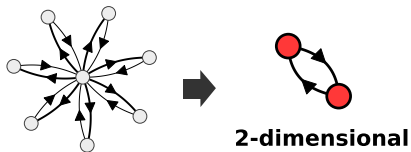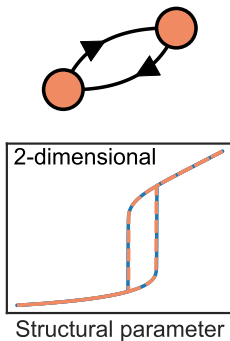$$\dot{x}_i = \boxed{F(x_i)} + \sum_{j=1}^{N} a_{ij} G(x_i, x_j)$$

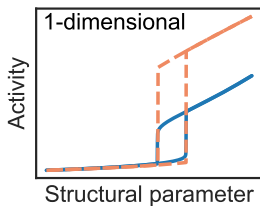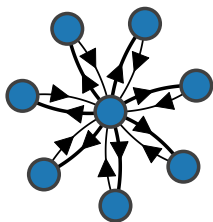Red node activity = Weighted average activity
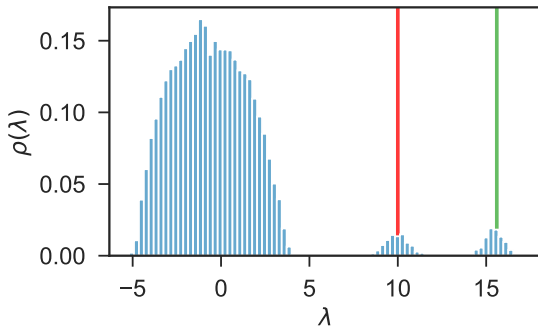
$$\langle x \rangle_w = \sum_{i=1}^{N} w_i x_i$$

w must be the **dominant eigenvector** of A.

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

2-dimensional

1-dimensional

Activity

Structural parameter

2-dimensional

Structural parameter

Combined method

Observed | Gao et al. | 1-dimensional | Combined

Globally critical   Locally critical   Uncritical
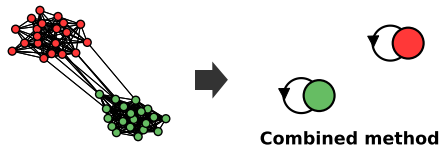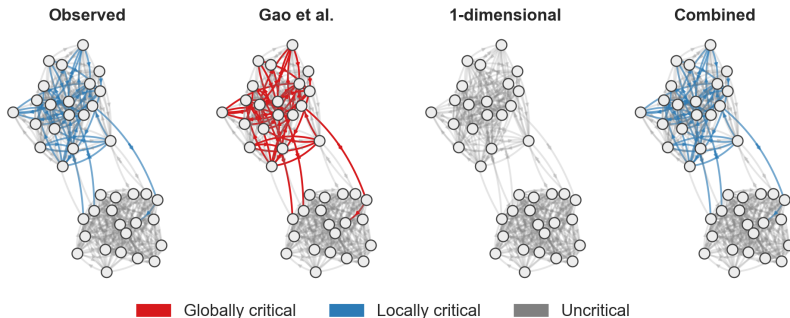
The combined method predicts accurately the critical edges.

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

- ○ Many dynamics : SIS, Neuronal, Lotka-Volterra, Gene
- ○ Critical transition of scale-free networks
- ○ Error estimations

Take home message

- ○ Systematic method
- ○ Based on spectral properties of networks

Louis J. Dubé

Patrick Desrosiers

Nicolas Doyon

dynamica.phy.ulaval.ca

edwardlaurence.me