

Designing temporal networks that synchronize under resource constraints

June 24 2021



Designing temporal networks that synchronize better than optimal static networks. a Evolution of the nonzero Laplacian eigenvalues described in Eq. (5), which are split into two degenerate groups. b Temporal network constructed from the Laplacian eigenvalues in a. The weight of each edge is represented by its thickness. In addition, edges whose weight is larger than 1n1n are colored orange, whereas those with weight less than 1n1n are colored cyan. For this network diagram, we set n = 11 and m = 5, and the corresponding weighted adjacency matrix is given by Eq. (9). Visually, we can see that different parts of the network are being strengthened in an alternating fashion. From: Designing temporal networks that synchronize under resource constraints

Synchronization is critical for the function of many distributed systems—whether it's computers or power grids or neuronal populations—but doing it using the least amount of energy and resources possible can be a daunting task.

In a paper published in Nature Communications in June 2021, incoming



SFI Postdoctoral Fellow Yuanzhao Zhang and former SFI external faculty member Steve Strogatz report using temporal network models to show that allowing connection patterns to change over time makes it possible to synchronize a system more efficiently.

"This was a fun project started by accident," says Zhang. "I was researching circadian clocks and came across an interesting paper about the <u>energy cost</u> of synchronizing them. It piqued my curiosity, so I wanted to figure out the best way to synchronize a generic networked system using the least amount of resources."

The researchers' temporal network design is "open loop," so it's versatile and expected to work for a wide range of systems.

More information: Yuanzhao Zhang et al, Designing temporal networks that synchronize under resource constraints, *Nature Communications* (2021). DOI: 10.1038/s41467-021-23446-9

Provided by Santa Fe Institute

Citation: Designing temporal networks that synchronize under resource constraints (2021, June 24) retrieved 4 May 2024 from <u>https://techxplore.com/news/2021-06-temporal-networks-synchronize-resource-constraints.html</u>

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