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**Improving the Network Structure can lead to Functional Failures**

TIAGO PEREIRA, Imperial College London, PHILIPP PADE, Humboldt University — In many real-world networks the ability to synchronize is a key property for their performance. Examples include power-grid, sensor, and neuron networks as well as consensus formation. Recent work on undirected networks with diffusive interaction revealed that improvements in the network connectivity such as making the network more connected and homogeneous enhances synchronization. However, real-world networks have directed and weighted connections. In such directed networks, understanding the impact of structural changes on the network performance remains a major challenge. Here, we show that improving the structure of a directed network can lead to a failure in the network function. For instance, introducing new links to reduce the minimum distance between nodes can lead to instabilities in the synchronized motion. This counter-intuitive effect only occurs in directed networks. Our results allow to identify the dynamical importance of a link and thereby have a major impact on the design and control of directed networks.

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