TOPOLOGY SHAPES DYNAMICS OF HIGHER-ORDER NETWORKS

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Higher-order networks capture the many-body interactions present in complex systems, shedding light on the interplay between topology and dynamics. The theory of higher-order topological dynamics combines higher-order interactions with discrete topology and nonlinear dynamics, and has the potential to enhance our understanding of complex systems, such as the brain and the climate, and to advance the development of next-generation AI algorithms. This theoretical framework, which goes beyond traditional node-centric descriptions, encodes the dynamics of a network through topological signals—variables assigned not only to nodes but also to edges, triangles and other higher-order cells. Recent findings show that topological signals lead to the emergence of distinct types of dynamical state and collective phenomena, including topological and Dirac synchronization, pattern formation and triadic percolation. These results offer insights into how topology shapes dynamics, how dynamics learns topology and how topology evolves dynamically.

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