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Analytic relationship of synchronizability and computational properties to network structure and motifs

The manner in which the underlying structure of networked systems drives their emergent dynamics is one of the most important open issues in complex systems science. We use a linear model (approximating the weakly-coupled non-linear regime) to provide direct analytic insights into the ability of various network structures to synchronize, as well as to store information. Synchronization and information storage are two of the most important and general dynamical properties of complex systems, and are observed and utilised in robotics, neural and other biological networks. Our insights relate in particular the prevalence of various motif (sub-network) structures to the synchronizability and information storage properties of complex networks, revealing for example the direct relationship between the clustering coefficient and information storage capability. In general our results suggest explanations for the importance of these motifs in biological networks, as well as how artificial networks could be guided towards exhibiting various desired dynamical properties.