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Relationship between structural and functional networks in complex systems with delay TONI PEREZ, Lehigh University, VICTOR EGUILUZ, IFISC, JAVIER BORGE-HOLTHOEFER, ALEX ARENAS, Universitat Rovira i Virgili — Functional networks of complex systems are usually obtained from the analysis of the temporal activity of their components, and are often used to infer their unknown underlying connectivity. Here we investigate on this challenge from a fundamental physical perspective, analyzing the functional network resulting from the simplest dynamical system with delay presenting a synchronous dynamics on a given topology. We have found the conditions for the emergence of locked dynamical states and the equations relating topology and function in a system of diffusively delay-coupled elements in complex networks. We solve exactly the resulting equations in motifs (directed structures of three nodes), and in directed networks. The mean-field solution for directed uncorrelated networks shows that the clusterization of the activity is dominated by the in-degree of the nodes, and that the locking frequency decreases with increasing average degree. We find that the exponent of a power law degree distribution of the structural topology, γ, is related to the exponent of the associated functional network as $\alpha = (2-\gamma)^{-1}$, for $\gamma < 2$.

Toni Perez
Lehigh University

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