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Diffusive persistence on disordered lattices and random networks

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To better understand the temporal characteristics and the lifetime of fluctuations in stochastic processes in networks, we investigated diffusive persistence in various graphs. Global diffusive persistence is defined as the fraction of nodes for which the diffusive field at a site (or node) has not changed sign up to time t (or, in general, that the node remained active or inactive in discrete models). Here we investigate disordered and random networks and show that the behavior of the persistence depends on the topology of the network. In two-dimensional (2D) disordered networks, we find that above the percolation threshold diffusive persistence scales similarly as in the original 2D regular lattice, according to a power law $P(t, L) \sim t^{-\theta}$ with an exponent $\theta \simeq 0.186$, in the limit of large linear system size L. At the percolation threshold, however, the scaling exponent changes to $\theta \simeq 0.141$, as the result of the interplay of diffusive persistence and the underlying structural transition in the disordered lattice at the percolation threshold. Moreover, studying finite-size effects for 2D lattices at and above the percolation threshold, we find that at the percolation threshold, the long-time asymptotic value obeys a power law $P(t, L) \sim L^{-z\theta}$ with $z \simeq 2.86$ instead of the value of $z = 2$ normally associated with finite-size effects on 2D regular lattices. In contrast, we observe that in random networks without a local regular structure, such as Erdős-Rényi networks, no simple power-law scaling behavior exists above the percolation threshold.

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