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Shift of percolation thresholds for epidemic spread between static and dynamic small-world networks

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The aim of the study was to compare the epidemic spread on static and dynamic small-world networks. The network was constructed as a 2-dimensional Watts-Strogatz model (500x500 square lattice with additional shortcuts), and the dynamics involved rewiring shortcuts in every time step of the epidemic spread. The model of the epidemic is SIR with latency time of 3 time steps. The behaviour of the epidemic was checked over the range of shortcut probability per underlying bond 0-0.5. The quantity of interest was percolation threshold for the epidemic spread, for which numerical results were checked against an approximate analytical model. We find a significant lowering of percolation thresholds for the dynamic network in the parameter range given. The result shows that the behaviour of the epidemic on dynamic network is that of a static small world with the number of shortcuts increased by 20.7 +/- 1.4%, while the overall qualitative behaviour stays the same. We derive corrections to the analytical model which account for the effect. For both dynamic and static small-world we observe suppression of the average epidemic size dependence on network size in comparison with finite-size scaling known for regular lattice. We also study the effect of dynamics for several rewiring rates relative to latency time of the disease.

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