Heterogeneous Bond Percolation on Complex Networks: Application to Epidemiology

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In the past decade, considerable attention has been paid by the physics community to complex networks. Empirical studies on real-world networks (proteins, food chain, social networks, WWW, Internet, etc.) highlighted many important topological properties [1,2] that allowed scientists to build always more complex mathematical models. For instance, physicists have successfully used the bond percolation of such networks to model the propagation of infectious diseases in populations. This in turn can help public health officials to make critical decisions during crisis [3] or to elaborate efficient intervention/prevention plans before any epidemics have even started [4]. Despite these successes, actual models [5] are still based on simplifying assumptions which restrict the categories of diseases that can be accurately described. Efforts have therefore been undertaken to remove some of the limitations to make the approach more realistic. We present a new model of bond percolation of complex networks with an arbitrary degree distribution. Our mathematical formalism adds a structural improvement allowing different types of nodes in the networks and therefore admitting an heterogeneous probability of occupation of edges. This will permit the simulation of propagation of diseases with an heterogeneous transmissibility and will hopefully lead to more precise intervention/prevention scenarios.

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