Effects of bursting interactions for spreading dynamics in intermittent contact networks

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Complex networks have long been used as underlying substrates for spreading processes since the nodes can represent the agents and the links the interactions between them. Although static networks have been a useful approach, the temporal aspect of the interactions should be considered for more accurate modeling. An individual with a given number of acquaintances is not in contact with all of them simultaneously. So we propose an intermittent contact network approach by considering a simple way to incorporate time into the interactions. We start building a network structure for an initial condition in which some nodes (or links) are active and the remaining are inactive. The states of each node (link) alternate between active and inactive following independent random processes with inter-event times obeying a given probability distribution. If this distribution is exponential, these events follow Poisson processes [1]. However, the inter-event time distribution can be chosen in a more extended case, characterizing a general renewal process. Considering a power-law inter-event time distribution, bursts of activity can be observed. Many physical and biological systems exhibit bursty dynamics [2], and understanding how it influences the spreading dynamics is a rich topic of investigation. To simulate the epidemic process we use the SIS model, in which a node in the network can be susceptible and become infected upon contact with another infected node with a given infection rate. Also, it can heal and return to the susceptible state. Despite the simplicity, this model is known to undergo a phase transition between an inactive and an endemic (active) regime as we vary the infection rate [3]. We observe that the spreading dynamics depend on the inter-event time distribution, for example, the epidemic threshold changes according to the average inter-event times. We investigate the role of intermittency in square lattices and how it affects the critical exponents of the system. Our current research includes the analysis of phase transition in this process. For instance, we seek to understand the interdependence of the critical behavior and the power-law exponent in the inter-event time distribution. In our forthcoming studies, we expect to simulate epidemic spreading on intermittent complex networks and incorporate spatial heterogeneity into our analysis.

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