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Rumor Spreading Modelwith noise interferencein Complex Social Networks

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Abstract: In this paper, a modified susceptible-infected-removed (SIR) model has been proposed to explore rumor diffusion on complex social networks. We take variation of connectivity into consideration and assume the variation as noise. On the basis of related literature on virus networks, the noise is described as standard Brownian motion while stochastic differential equations (SDE) have been derived to characterize dynamics of rumor diffusion both on homogeneous networks and heterogenous networks. Then, theoretical analysis on homogeneous networks has been demonstrated to investigate the solution of SDE model and the steady state of rumor diffusion. Simulations both on Barabási-Albert (BA) network and Watts-Strogatz (WS) network display that the addition of noise accelerates rumor diffusion and expands diffusion size, meanwhile, the spreading speed on BA network is much faster than on WS network under the same noise intensity. In addition, there exists a rumor diffusion threshold in statistical average meaning on homogeneous network which is absent on heterogenous network. Finally, we find a positive correlation between peak value of infected individuals and noise intensity while a negative correlation between rumor lifecycle and noise intensity overall.

Key words: rumor spreading model, complex social networks, stochastic differential equations, noise

1. Introduction

Since the similarity between rumor propagation on social networks and virus diffusion on biological networks, epidemic models have been widely applied and improved to explore the rumor dynamics on social networks. Daley and Kendall [1] established D-K model on the basis of classical epidemic model and analyzed the difference between disease diffusion and rumor dissemination. Since then, susceptible-infected-susceptible (SIS) models [2] and susceptible-infected-removed (SIR) models [3] in terms of degree based mean-field theory and percolation theory have been the mostly investigated to describe the spreading of diseases and rumors on complex networks. Several remarkable results of SIS and SIR models have been explored. Moreno and Pastorsatorras et al. [4] analyzed the epidemic threshold of a SIR model which has a biological implication: the amount of susceptible individuals infected by an infected individual before infected individual's recovering which is also defined as basic reproduction number. The value of threshold, below which the