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Preferential Information Dynamics Model for Online Social Networks

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Abstract: In recent years, online social networks have become an important site for companies to promote their latest products. Consequently, evaluating how many clients are affected by preferential information distributed in online social networks has become essential. In this paper, a novel dynamic model called the follower super forwarder client (FSFC) model is proposed to address the spreading behavior of preferential information in online social networks. The mean field theory is adopted to describe the formulas of the FSFC model and the key parameters of the model are derived from the past forwarding data of the preferential information. The edge between a large-degree node to a small-degree node has a greater weight. In addition, two kinds of infection probabilities are adopted for large-degree node forwarders and small-degree node forwarders. To evaluate the performance of the FSFC model, preferential data published on the Sina microblog (www.weibo.com) for the Vivo smartphone, Alibaba's Tmall shopping site, and the Xiaomi phone were selected as real cases. Simulation results indicate that the relative errors of the output of the FSFC model compared with the actual data are 0.0068% (Vivo smartphone), 0.0085% (Tmall), and 0.032% (Xiaomi phone), respectively. The results verify that the FSFC model is a feasible model for describing the spreading behavior of preferential information in online social networks.
Keywords: dynamic model; scale-free network; preferential information spread model

1. Introduction

Humans live in a world replete with complex networks [1]. The spreading dynamics of these complex networks are attracting increasing interest from researchers as regards their communication mechanism, dynamic behavior in society and nature, and the feasibility of deriving control methods for them [2][3][4].

Two classical models, namely, susceptible infected susceptible (SIS) and susceptible infected recovered (SIR), have been proposed for the spreading dynamics (or network propagation dynamics) based on the mean field theory [5][6][7][8]. Both models were originally used to explain the spreading of diseases [9][10]. Recently, a new model based on SIS and SIR has been developed to describe the spreading dynamics of complex networks (Table 1). The classical SIS and SIR models have been improved either by modifying the rules of dissemination or the infection rates. For instance, Li *et al.* [11] proposed a SIR rumor model that incorporates independent spreaders. In their new model, at every time step, any ignorant node can become an independent spreader with a certain probability. Li *et al.* [12] proposed a susceptible infected beneficial model based on scale-free networks. They assume that susceptible individuals are infected by an infected individual or a beneficial individual with various probabilities and incorporate immigration and emigration into the spreading rules. Kang *et al.* [13] presented an SIS model with delay for scale-free networks in which the function of infected vectors is considered. Chu *et al.* [14] considered the effect of weighted network and nonlinear infection rate on epidemic infection and stated that the infection rate is related to the degree of the node.

Table 1. Summary of related work involving improvement of the classical SIS and SIR models

Classification	Model	Highlights
Dissemination rules modification	SIR [11]	At every time step, any ignorant node can become an independent spreader with a certain probability.
	SIRS [15]	Recovered nodes are considered in a proposed SIRS-based epidemic model with a feedback mechanism on heterogeneous networks.
	SIS [16]	The effects of the linear combination of multiple propagation media on propagation are considered.
	SIQRS [17]	A new quarantine individual (Q) is incorporated into the SIR model.
	New SIQRS [18]	Nonlinear infectivity is incorporated in a new SIQRS model.