A New Model of Competitive, Synchronous Information Dissemination in Social Networks

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Abstract

Information competes with each other as it disseminates over the social networks, and the factors that influence the synchronous spread have been attracting the academic interest. In this paper, a framework of social evolutionary games is used to investigate the evolution process of the information spreading through social networks, which a coevolutionary mechanism is adopted by individuals who aim to improve not only their short-term utility, but also their own long-term reputation affected by the information accepted. Meanwhile the strategy of coordination game is used to describe the behavior of competition in the information diffusion. Several simulations are performed by the proposed model to analyze the factors that influence the synchronous spread of the competitive information. Simulation results indicate that the individual’s reputation plays a certain role in the dissemination of information. And thereafter, we observe how the competitive information dissemination predicted by our model works in a real scenario.

Key Words: Social Network, Information Dissemination, Evolutionary Game, Coordination Game

1. Introduction

Social network is a kind of social structure, which is formed by the connection between the individual or groups in the information network [1]. The free and open characteristics of social network make it become an important platform for the modern communication of social information. The new social network is based on the communication mode of “user-to-user”. Through the interactive behavior, such as publishing, comments, recommendations, forwarding and praise, etc., users can interact frequently and information can be disseminated wide and fast.

In the case of information in the same field spreading in social networks, it will make mutual influence and reflect the characteristic of competition among them [2]. Information with different features, such as posting time, content and the source of the information, causes people to have different degrees of acceptance. This phenomenon is concerned with whether the information can survive in the competition or not. In this paper, we aim to analyze the competition within the synchronous information, which describes a pair of rival information transmitting at the same time in networks. Here the “synchronization” refers to a relatively small period of time, not an exact point in time. Such as the sales promotion of electronic commerce on Sina Weibo or other social network platforms during the holidays. The Internet information in a field often aims for a particular Internet customer, which will disseminate together on the networks within a specific time period inevitably leading to competition. The profit-driven business makes merchants in-

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creasingly focusing on the information spreading process and whether it competing successful or not in a period of time. Therefore, the inherent mechanism of the competition in the process of information dissemination within the social networks is paid more attention. So it is not only necessary to reveal the complex mechanism of the synchronization information competitive diffusion on social networks and its overall evolution trend, but also need to enhance deeper comprehending of the complex relationship and internal competition laws of information dissemination. Thus, the companies can make rational and wise decisions in the fierce market competition according to the characteristics of information dissemination and the factors of the spread and speed of the competitive information diffusion. Therefore, how to study the rules of information dissemination in social networks, analyze the key factors influencing the diffusion, predict the evolution law and ultimately find a way to effectively control the spread of information is the challenge problem. It is necessary to manipulate spreading process to maximize or minimize the outcome of information dissemination. And we should also research for what kind of income the information with can win the competitive dissemination.

The current research of information spreading mainly involves network structure, the group agents and the information disseminated in the network, while the individual factors have not yet been considered. Online evaluation and the third party network media assessment can eliminate the concerns of consumers for product advertising and establish mutual trust.

Aiming at the characteristics of large scale and fast dynamic changing of data in social network, especially considering the personality factors of the networks’ participants, evolutionary game is considered as a suitable method for solving the problem of information dissemination. And the information diffusion and strategy selection can be regarded as the network dynamic behavior [3]. Evolutionary game theory is able to well describe the dynamic characteristics of information communication on social networks and reflect the influence of user’s behavior on the dissemination. In this paper, we use a framework of social evolutionary games (SEG) to analyze the phenomenon of synchronous competitive information dissemination on online social network and adjust the utility function and the updating mechanism of the information dissemination based on the coordination game. Through a model simulation we analyze the variation of the cooperation rate in the process of competition and find that the individual reputation plays an important role in the dissemination. We also verify the model on a real data set of “Let Red Packet Fly” from Sina Weibo and the related discussion is generalized as a evolutionary process of information dissemination.

2. Related Work

The traditional information dissemination model mainly studies from three aspects: the network structure, the population status and the information characteristic. Also many scholars have carried on the research to the influence factor of the information dissemination. Kate et al. found that strong connectivity increases reputation between individuals which plays an important role in reaching a consensus [4]. Scott et al. also believe that the higher density and more connection can reduce the uncertainty and contribute to information dissemination [5].

In recent years, information dissemination on social networks has been deeply explored. Some mature communication models is presented focusing on the topics of the information cascades, viral marketing and product penetration, such as the linear threshold model, the independent cascade model and the study of the concept of exposure curve, while this works are all on the manner of independent dissemination. More attentions focus on the epidemic models, however, all of these works focus on single virus models. Pathak et al. looked at a two-virus SIS model on graphs [6]. Beutel et al. investigated the competition of mutual exclusion of infection. But this model can’t describe the dynamic characteristics well [7]. On the basis of Twitter, Wang et al. has studied the problem of information dissemination, but only from the point of view of data analysis, not consider the possibility of coexistence of information cooperation [8].

From the actor’s perspective, some other works have been studied recently. Iribarren and Moro study the impact of human activity patterns on information diffusion and model human dynamical collective phenomena [9]. Jiang et al. review diffusion in social networks through a
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Users will choose the same behavior or technology from their neighbors to gain the profit. This kind of multi information diffusion competition attracts researchers from the perspective of game theory to study the manner of the competition information. Game-theoretic models are well studied in economic, sociology, ecology etc. and adopted by computer scientists for analyzing network behaviors. Kempe et al. began to pay attention to the sudden and widespread adoption of various strategies in games [13]. But his model still didn’t consider the influence of the individuals on the spread. In work [14,15], Domingos and Richardson et al. posed a fundamental algorithmic problem for such systems while the probability models failed to describe the character of the process of the information dissemination. In recent years, game-theoretic models are well studied in economic, sociology, ecology etc. are adopted by computer scientists for analyzing network behaviors. Kostka et al. [16] used the concept of game theory and location theory examined the dissemination of competing rumors in social network. Zinoviev D et al. [17,18] adopted game theoretic models to understand human aspects of information dissemination taking into account personalities of individuals. The most interesting is in this work [19], Yu et al. proposed a game-theoretic model for competitive information dissemination in social network and tried to understand human impacts on competitive information dissemination, however, the model and the method still needed to be improved.

On the basis of the existing work, we adopt a frame-work for competitive information dissemination based on social evolutionary game. We take individuals’ reputation into consideration, which can affect their strategy choice. Based on SEG model, we can analyze the competitive information propagation and factors.

3. Preliminaries

Before the introduction of the system models and the proposed methods, we first present the introduction to the synchronous information dissemination and its communication process.

3.1 Synchronous Information Dissemination

Online social network applications provide users great opportunities to share their ideas or information with other individuals on the networks and also give channels for the dissemination of products or advertisement. When two similar products or information of relevant areas propagating in social networks, it is a strong chance for them to compete with each other. Individuals prefer which information is determined by his acceptance degree to it and herd mentality [19].

Synchronous information dissemination is caused by individuals’ communication with their neighbors for sharing knowledge or opinion when multiple types of information generating from one certain topic at the same time. This kind of communication, affects individuals’ acceptance and preference, can be regard as a game based on the information interaction considering the reputation factor. The communication process is shown in Figure 1. The black and gray colors respectively represent two kinds of competitive information on networks.

The online social network is described as an directed network, where the circle represents the individual in the
network and the communication channel between individuals can be connected or disconnected by their own will. In initial state, two competitive information begin to spread on the networks and try their best to attract more individuals. The individuals accept or maintain their choices on the information according to their payoff and also considering their neighbors behaviors on them. The transition state describes how two competitive information spread on the networks. The higher value of the information is bound to attract more users. For example, the individuals 3 and 8 receive two competitive information at the same time and they should make their choices according to their own bias. With the evolutionary of the competition, it will finally reach to a stable state of relative equilibrium. Two types of competitive information can coexist in a certain proportion. The strategy selected by an individual will effect on his neighbors’ choice to the information.

3.2 The Evolutionary Game Model

In online social networks, such as Facebook, Sina Weibo, users can follow each other based on their interest. Here we construct the social network model based on this kind of scene and perform social evolutionary games on an unweighted directed graph \( G = (V, E; I, U, R) \) [20], where \( V = \{v_1, v_2, \ldots, v_n\} \) is the set of individuals; \( E = \{e_{ij} \mid i \in V, j \in V, 1 \leq i \leq n, 1 \leq j \leq n\} \) is the set of partnerships between the individuals; \( I \) is the set of interactions performed by the individuals based on their corresponding strategies; \( U \) is the set of utility functions of the individuals; \( R \) is set of reputation functions of the individuals. In the game process, individuals have two alternative strategies cooperate \( C(s = [1,0]^T) \) or defect \( D(s = [0,1]^T) \).

In the directed network, an individual \( i \) have two types of neighbors IN-neighbors and OUT-neighbors. If there is an edge \( e_{ij} \) directs from individual \( j \) to \( i \), individual \( j \) will be \( i \)'s IN-neighbor and \( i \) is \( j \)'s OUT-neighbor. \( N_i^I \) indicates the set of \( i \)'s IN-neighbors and \( N_i^O \) is the set of \( i \)'s OUT-neighbors. The set of \( i \)'s IN-neighbors is indicated as \( N_i \). The individual \( i \)'s indegree and outdegree are \( d_i^I \) and \( d_i^O \), respectively. \( d_i \) denotes the individual’s degree which is the sum of his indegree and outdegree.

The utility of individual \( i \) is the cumulative payoffs obtained from the game with his opponents in each round. It is users’ short-term concern, which affects users’ choices when they imitate others’ strategies. The reputation of individual \( i \) is the opinion of his partners on him, which is the results of his partners’ evaluation upon the partners’ behavior history. It is users’ long-term concern, which affects users’ choices when they find new partners.

4. Modeling & Mechanism Analysis

4.1 The Coevolutionary Dynamics

Considering the network effect of social networks, individuals usually not only pursue the benefits of information influence, but also the impact on their reputation for the information dissemination. Coordination game theory can well describe the information competition under the influence of the multiple factors. As of coordination game, we can make following assumptions: 1) the more widely spread of certain information over the social network, the higher the users would accept it; 2) users are less likely to accept alternative information if they have already accepted a similar one. On the one hand, individuals benefit from coordinating their actions on a common goal, benefit will increase if the number of cooperators increases. On the other hand, cost of defecting original strategy would be very high once participants stick to their strategies. Coordination game needs Pareto efficiency strategy to take place, so as to strengthen mutual trust. Both persisting in the same strategy or defecting to adopt a new strategy are both pure strategy Nash equilibrium: payoff-dominant equilibrium and risk-dominant equilibrium [21]. The equilibrium depends on utility and participants’ behavior expectation and perception of risk and benefit, which makes information dissemination uncertain. We assume that the two-person, two strategies coordination game is defined by a 2×2 matrix as \[
\begin{bmatrix}
a & c \\ d & b
\end{bmatrix}
\] [22].

More precisely, we have \( a > d \) and \( b > c \). Individuals can choose strategy A or strategy B. In this matrix, participants both choosing strategy A or strategy B are both pure strategy Nash equilibrium: \( a \) is the payoff-dominant equilibrium and \( b \) is the risk-dominant equilibrium. Utility is one of the factors that affect the coordination game equilibrium and the equilibrium is also dependent on the participants’ behavior expectation and the perception of
risk and benefit, so that make the information transmission uncertain. In our model, each individual is coordinated with all his direct partners, choose cooperation or defection. His utility is the cumulative payoffs obtained from his opponents, formulated as Eq. 1.

$$
u_i = \sum_{j \in N_i} s^T_j M$$  \hspace{1cm} (1)

where $N_i$ is the set of individual $i$’s neighbors. We consider pure coordination game with a 2x2 payoff matrix $M: M = \begin{pmatrix} 1 & 0 \\ 0 & b \end{pmatrix}$. The payoff is the results of the dynamic behavior of the two sides of the game. Individuals active or passive take game behavior with other individuals both can gain income. So the payoff of an individual is from all his neighbors, not only including his In-neighbors also includes his Out-neighbors.

The Nash equilibrium in pure strategies corresponds to the diagonal elements in matrix $M$ when players adopt different strategies, both of their benefits are 0 and the non diagonal elements in $M$ are set to 0, because of this is not the Nash equilibrium state. Individuals are rewarded by 1 when coordinating on a same strategy, and are tempted to defect by $0 \leq b \leq 2$. Participants obtain higher payoff from adopting unanimously strategies as their opponents, named “payoff-dominant equilibrium”. When $1 < b \leq 2$, which is named “risk-dominant equilibrium”, the temptation of defection is even higher.

The asynchronous update mechanism is applied [23]: at each time span $t$, a randomly selected individual updates his strategy with probability $1/(1 + W)$, otherwise adjusts his partnership. $W$ is the ratio between the time scale of strategy updating $\tau_s$ and the time scale of partnership adjustment $\tau_p$, $W = \tau_s/\tau_p$ [23,24]. The frequency of partnership adjusting increases with $W$. At each evolutionary time step, each agent’s reputation $R_i (t)$ is renewed as Eq. 2.

$$
\begin{align*}
R_i (t) &= \sigma R_i (t - 1) + \Delta R_i (t) \\
\Delta R_i (t) &= \sin \left( \frac{\pi n^C_i}{2d_i} \right)
\end{align*}
$$  \hspace{1cm} (2)

where $\Delta R_i (t)$ is the increment of reputation for the individual $i$ at time $t$, $\sigma$ is the memory decaying rate of reputation and $n^C_i$ is the number of C-strategy neighbors of individual $i$ and $\sin()$ function is used to compute the rise rate of reputation.

4.1.1 Strategy Updating

When the individual $i$ is determined to update his strategy, he should choose an individual $j$ from his partners as Eq. 3 and then imitate $j$’s strategy. The imitation process can be expressed by Fermi update rule (Eq. 4) [23,25].

$$j = \arg \max_{i \in N_i} \{ u_i > u_j \}$$  \hspace{1cm} (3)

$$W(s_i \leftarrow s_j) = \frac{1}{1 + \exp[\beta(u_j - u_i)]]}$$  \hspace{1cm} (4)

where $s_i$ and $s_j$ are strategies adapted by agents $i$ and $j$ respectively, $u_i$ and $u_j$ are utilities of individual $i$ and $j$. $\beta$ represents the extent of imitation noise.

4.1.2 Partnership Adjusting

The individuals’ information spread distance is limited in their nearest and the next-nearest neighbors due to the limit of network structure and their myopia. When individual $i$ is randomly selected to update his partners, he will disconnect the lowest reputation individual $j$ (as Eq. 5) with a probability $p_i$ in his direct partners. Meanwhile individual $i$ also searches individual $k$ (as Eq. 6) with probability $p_i$ as his new partner based on the maximum reputation rule from his direct partners and the partners’ partners, otherwise he randomly select individual $k'$ with probability $1 - p_i$ from his IN-neighbors and the next-nearest OUT-neighbors.

$$j = \arg \min_{i \in N_i} \{ R_i (t) > R_j (t) \}$$  \hspace{1cm} (5)

$$k = \arg \max_{k' \in \{ V \cup \{ k \} \}} \{ R_i (t) > R_{k'} (t) \}$$  \hspace{1cm} (6)

In our model, users do not have to establish social relationships with all of their direct neighbor nodes. A part of the direct neighbor node has been established social relations, and the other part of the node is just neighbors with no information exchange. So users have to adjust their relationship structure from cutting off the already established social relations between the neighbor with the lowest reputation, choose their partner from the neighbors with no social relationship.
4.2 Simulation Results

We built a random regular network with each individual’s degree $d_i = 4$, and the total number of individuals is $N = 10^3$. Initially, all individuals randomly choose to cooperate or defect with equivalent probability, which means adhere to the competitive information A or adopt the competitive information B. The cooperators $f_c$ are calculated as the average value over the following $10^3$ MC time steps by 20 independent running. The small fluctuation of $f_c$ means the coevolution is evolving into a relative stable state, otherwise runs $2 \times 10^5$ Monte Carlo (MC) time steps. The imitation noise is $\beta = 0.01$, the probability of disconnection is $p_s = 0.01$. The memory decaying rate of reputation is 1. The income of the original information is set at 1. $b$ is denoted as the income of information which relative later added into the competition. The range of $b$ is from 0 to 2 and the interval is 0.04.

The average cooperation rate $f_c$ describes the evolution of cooperation and the higher $f_c$ means information A is dominant in the dissemination, the lower $f_c$ means information B is more popular. $f_c$ describes the frequency of the partnership strategy adjusting. The sampling interval of $pr$ and $W$ is 0.1 and the range is from 0 to 1.

When $W$ remains constant and the value of $b$ and $pr$ change at the same time, the fraction of cooperators is shown in Figure 2. In temperature chart, the changing of temperature color indicates the changing of $f_c$. $f_c$ describes the evolution of cooperation, the percentage of original information in networks. The higher temperature (bright) means more cooperation behaviors between users, the lower temperature (dark) means more defection behaviors. $W = 0.8$ means the participants in the network communicate with each other relatively frequently.

When partners adjust $pr$, at a low level and $b < 1.2$, the cooperation emerges to a high level. While $b > 1.2$, the cooperators are hard to survive. The individuals are no longer pay attention to the reputation, when the temptation is high enough, they will choose to change their strategies, otherwise they will continue to accept the original information. The cooperation level decreases with $b$ increasing and increases with $p_s$ increasing. The more temptation of new information has, it’s easier to attract participants to adopt it, while once individuals pay more attention to their reputation, it’s more cautious for them to change their mind. There exists a high area of cooperation when $p_s$ at a high level. Although $f_c$ decreases with the increase of $b$, the fluctuation of $f_c$ is not obvious. Therefore, individuals pay more attention to their reputation, it is more difficult to change their original information choice.

In Figure 3, $p_s = 0.2$ means the participants consider less reputation when making a strategic decisions. When $W$ is close to 0 temptation to defect $b < 1.2$, there is a cooperation high survival area. There also exists a dead area of cooperation when temptation to defect $b > 1.2$. When $W$ is at a low level, the change of $b$ value has a great effect on $f_c$ and the $f_c$ deceases with the increase of $b$. In other words, when participants do not often communicate with other participants, with the increasing of temptation of the competitive information B, the participants gradually accept the information B instead of taking information A. So cooperation or defection will rest with the temptation in the case of less communication. When $W$ is relatively high, temptation of defection is hard to effect $f_c$, the cooperation is maintained at a high level. Therefore, the higher the frequency of communication between individuals they more insist on their ori-
There is an interesting phenomenon in the above charts. Because coordination games reach the payoff-dominant equilibrium when $b < 1$ and achieve the risk-dominant equilibrium when $b > 1$. So $b = 1$ can be regarded as a critical point: each participant has 50% probability choose to stick to the information they have already taken or switch to a new one. But as shown in the charts, when $b$ nearly reaches to 1.2, which means the benefit of the competitive information B is 1.2 times more attractive than that of information A, the participants begin to switch to choose the new information, that is to say, the critical point has a certain extension.

In Figure 2, when participant are in the face of information choice, not only consider the utilities of two kinds of information, but also consider the impact of different information on their own reputation. Although the utility of new information is greater than the original information, but still can’t make up for the loss of changing information on the participant’s reputation, then they will continue to adhere to the original information.

Figure 3 shows that the partnership adjusting frequency make a certain impact on participants’ information choice. When considering their reputation, less communication means reputation has little effect on the competition, i.e. participants are more likely to change their own information. So we get an important conclusion here: The more attention to the reputation and the higher frequency of communication causes much trouble for participants to change their choices.

5. Model Validation in Real Scenario

5.1 Dataset Description

We select the most influential online social application Sina Weibo as the experiment platform to validate the above model. We obtain the Sina microblog user’s information by accessing to the Weibo data center and its API. Considering the feasibility of the experiment, we pay attention to the “Let Red Packet Fly” activity participated widely by Weibo users during 2015 Spring Festival in China. We choose two representative companies of the electrical industry: Micoe and Midea, and the discussion of two companies spreading on the microblog can be regarded as two types of competitive information diffusing on social networks at the same time. The topics about Micoe are as the competitive information A among the users and those about Midea is the information B taken part in the competition. The number of red packet distributed by the two companies and hot degree of two companies are used to describe the attraction for the users and propagation impact of the relevant information respectively. We considered the focal effect among users: the crowd’s attention tends to focus on the information resources which they have interest in common and users prefer to share the red packet of the same company. This feature is well consistent with the coordination game strategy.

5.2 Results Analysis

In this section, we analyze the dissemination process and characteristics of topics about Micoe and Midea and also discuss the evolution of their related competitive information on Sina Weibo, comparing with the simulation results in the section 4.2.

5.2.1 Analysis of Hot Degree

We collected the relevant data about the hot degree of Micoe and Midea during from Feb. 02 to Feb. 28 in the year of 2015. The variation tendency of the two mentioned keywords is described according to statistics of the original and forwarding blogs of Micoe and Midea. The hot degree of keywords reflects how popular the company is among the users and the spread range of the relevant information can be indicated by the average cooperation rate $f_c$. $f_c$ shows the percentage of the hot degree of the relevant information of Micoe.

In Figure 4, we can find that the hot degree of two competitive companies both present a certain fluctuation
trend. The hot degree of the two companies alternately holds the upper hand and get to a peak in a specific time period. Both companies have taken effective marketing tools and distributed lots of red packets in “Let Red Packet Fly” activity to increase users’ interest. In some special day, for example the China festival eve, Micoe and Midea attracted the attention of a large number of users and trigger strong forwarding and discussing of the related topics on microblog. What is noteworthy is that comparing with the hot degree of Midea within a certain range of fluctuation, the trend on the hot degree of Micoe is more intense and appears three distinct peaks. In this time period, through a certain network promotion, the topic about the Micoe spread quickly on the microblog and become the focus of discussion among microblog users.

5.2.2 Analysis of Utility
We collect the search volume of the Midea and Micoe keywords and the number of red packet distributed by the two company during “Let Red Packet Fly” activity in February as the utilities of two competitive information reflecting the attraction to users. The utility of Midea information is set as standard 1 and the utility of Micoe information is set as a variable $b$ fluctuating according to standard 1.

Figure 5 describes the variation of two companies’ utilities. In the early of February, the utility of Midea is more dominant and users are likely to search its related information. Subsequently, the utility of Micoe has exceeded the utility of Midea, users on networks began to extensive search the information of Micoe and the effect of distributing red packets of Micoe on users began to appear. During the Spring Festival, the microblog search volume of Micoe got certain advantages, but Midea successfully increased users’ interest and the search volume. The number of red packets distributed by two companies affected the users’ initiative of forwarding the related topics to a large extent.

5.2.3 Analysis of Evolution Process
We draw the fluctuation trend of $f_i$ with the change of utility $b$ and find that the real data evolution trend match the evolution characteristics with low level of $p_r$ in Figure 2. We selected the parameter values of $b$ and $f_i$ in simulation with $p_r = 0.3$ and $W = 0.8$ then compared the simulation curve with the actual evolutionary curve in Figure 6.

Other companies distributed the red packets in the sales activity to attract the users and also some uncertainty factors in actual situation make some differences between two curves. When $b < 1$ and $f_i > 0.5$, it shows that users are not willing to recommend Midea on their own initiative if the red packets of the company is not enough to attract them. While they choose to insist on discussing the related topic of Micoe and share its red packets. $f_i$ decreases with the increase of $b$, which means users began to abandon the original information and instead to choose another information in the competition. Well marketing of Midea attracts public attention and users begin to actively search for its related information. Because of the more and the larger amount red packets the company distributed, the more probability the users give up the attention of Micoe they once interested in and turn to promote the topics of Midea.

$f_i$ curve in the real scenario and the simulation case are both obviously falling at $b = 1.2$. This phenomenon well verifies the impact of reputation factor on the dis-

![Figure 5. Fluctuation of utility $b$.](image_url)

![Figure 6. Comparative analysis of evolution process.](image_url)
semination of competitive information. In a word, the attraction of information must be high enough to draw the public attention, which can make up for the loss of reputation caused by changing the information or strategy. Only in this way can the information take advantage in the information competition and attracts more users.

6. Conclusions

In this paper, we introduce a framework of social evolutionary game (SEG) and adopt the coordination game strategy to model and simulate the synchronous competitive information dissemination on social networks. Participants in a SEG care about the short-term utility and long-term reputation, which are not only the basis of strategy updating and partnership adjusting, but also an important factor to influence the diffusion of competitive information. Coordination game used in this paper can describe the communication and competition well, and imitate users’ behavior that unwilling to change the strategy they have already taken on social networks. Simulation results show that users won’t accept the other competitive information, when they attach importance to their reputation and exchange their information with neighbors frequently, meanwhile the competitive information has less influence compare to the information already taken by users. Only if the impact is enough to attract them to defect the original information, users should change their strategy. In order to validate how our model works in the real scenario, we collect related topics about two electronic companies from Sina Weibo for investigating two competitive information synchronous diffusion. We can find it is well fit for the actual variation trend of competitive evolution in the real scenario with the trend in the simulation case, which illustrate the validity of our model. Our research involves computer science, sociology and other disciplines, it can reveal the complex interaction between the relationship structure, groups and information of social networks. The findings also provide a new understanding and theoretical support for the evolution mechanism in social networks. And it is an important guiding for the rational utilization of network information, correct guidance of network users’ information behavior and the effective management of online information. It also provides a reference for the promotion of new products, advertising competition and other information dissemination behavior on social networks. In the further research work, we will continue to improve the model in multi-participant game and analyze the factor more accurate.

Acknowledgements

This work is supported by National Natural Science Foundation of China (No. 61370132, 61572469, 61303244, 61402442, 61402022), Beijing Natural Science Foundation (No. 4152034).

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*Manuscript Received: Mar. 2, 2016
Accepted: Sep. 5, 2016*