Emergency Management on Internet Spread of Social Events

Weihui Dai* · Chunshi Wang** · Yuan Zhang***

Abstract

The rapid development and widespread application of Internet has provided a platform for people to participate and discuss social hotspot events. In the meantime, social events may be spread throughout the Internet more quickly and widely than they did ever before, and possibly lead to serious social problems due to opinion violence or seditious rumour. This paper analyzed the Internet spread of social events, and presented a five-stage model to describe the evolution process of that spread. Furthermore, the improved IBF* algorithm was applied to extract a pruned connected graph aiming to find the key nodes and the shortest spread path for the control of that spread. After analyzing the different factors that may cause the netizens' attention, this paper concluded BBS type, the visit quantity and the opinion leader are key factors which affect the Internet spread. Based on those researches, a life-cycle emergency management methodology and the related strategies were proposed for the achievement of healthy spreading environment on Internet.

Keywords : Emergency Management, Social Event, Public Opinion, Internet Spread

1. Introduction

With the rapid development and widespread application, Internet is not only changing the traditional news media in the manner and pattern, but also providing a platform for people to participate and discuss social hotspot events. Social events have been known more quickly and attained more attention than they did ever before. However, the Internet spread of those events usually exerts heavy impacts on social psychology, and possibly lead to serious social problems due to opinion violence or seditious rumour, such as the "9.11" terrorist attack on the United States in 2001, the first occurrence and spread of the SARS epidemic, the China's Wenchuan earthquake in 2008, as well as the global financial crisis in the same year. On the one hand, the timeliness of online media makes up for the time lag produced by traditional media's complex reporting process, which makes people participate in and get to know the events as soon as possible. On the other hand, the wide and fast spread of the Internet is also challenging the control system which fights with the negative effects. It has been the urgent task for the government to conduct emergency management on the internet spread of social events and achieve the spreading environment healthily. In doing so, the Internet spreading mechanism of social events should be firstly disintered, and then after the emergency management system and strategies may be explored with the help of crisis management theory and methodology.

So far, scholars have made a large number of researches on the Internet spreading process and its characteristics, as well as the social impacts by that spread. With the widest Internet and the most users, China relates to this issue more closely and attentively. Chinese reserachers Zhang, J. [2005] analyzed the formation process of Internet opinion. Wei, W. H. [2006] and Wang, L. [2008] illustrated the impacts of Internet opinion from both the positive and negative sides. Hu, X. F. [2006] established the small world network model that realized the regional simulation of Internet opinion. And Li, L. Y. [2008] presented the cellular automata model to analyze the specific factors' effect on Internet spread. Liu, Y. C. [2009] later built an agent-based Internet model, working out the different reactions of individuals that play the different roles in Internet spread of social events. Besides, Guo, G. H. [2004], Bi, H. Y. [2007], etc. [2008], have made significant contributions to some special phenomena on netizens' behavior in social events, such as the opinion leader, group polarization, and network violence, etc.

Based on those researches, this paper aims to explore the whole evolution process of that spread and its influence factors, and provide an effective methodology as well as the related strategies for the emergency management of Internet spread.

2. Internet Spread of Social Events

2.1 Evolution Model

We applied the methodology of multi-case study to analyze the evolution process of Internet spread of social events. Some of neg-
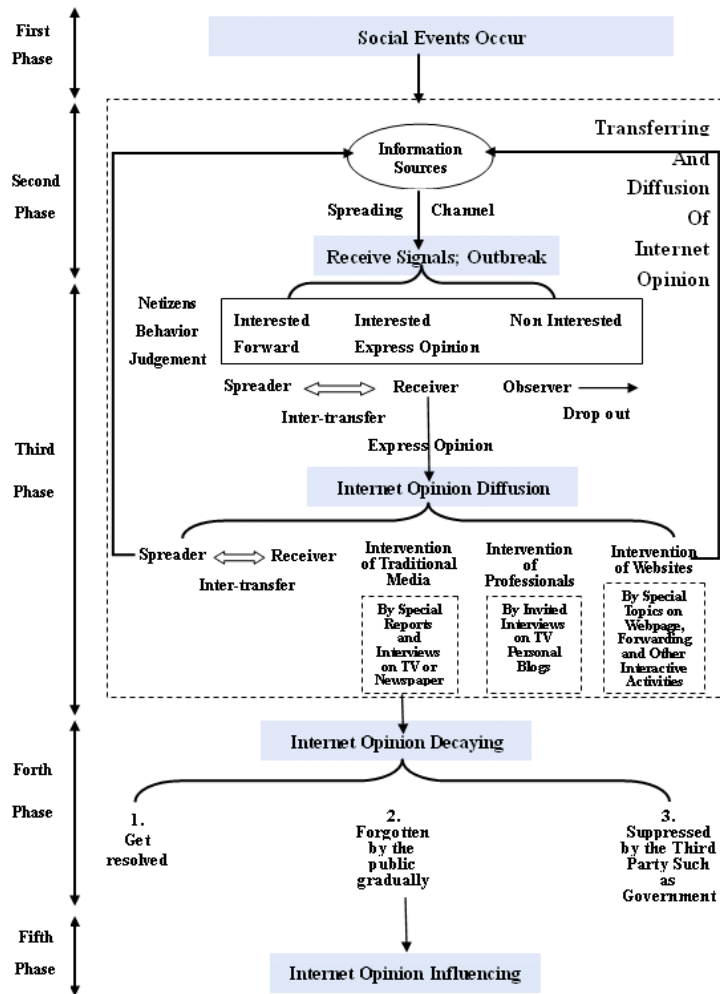
ative social events which took palce in the year of 2005~2009 in China are listed in <Table 1>. Those events may be classified into five categories: moral crisis, illegal administration, cheating scandal, political event, and natural disasters, which account for 47.6%, 28.6%, 9.5%, 9.5%, 4.8% respectively in that period [Sun,

〈Table 1〉 Social Events in China

Date	Social Events	Classification
2005. 11	cat abused by university student	moral crisis
2006. 04	secretary scandal	moral crisis
2006. 04	bronze beard case	moral crisis
2006. 07	Shanxi brickkiln	illegal administration
2007. 01	south china tiger photo	cheating scandal
2007. 11	professor died by policeman's shooting	illegal administration
2007. 12	Jiang Yan and Wang Fei case	moral crisis
2007. 06	super girl angrily kicked policeman	moral crisis
2008. 01	Chen Guanxi photo scandal	moral crisis
2008. 12	price of cigarettes event	illegal administration
2008. 03	3.14 Event in Tibet	political event
2008. 03	mayoress in traffic accident	illegal administration
2008. 04	torch blocked and Carrefour event	political events
2008. 05	5.12 Wenchuan earthquake	natural disasters
2008. 06	college entrance examination fraud	illegal administration
2008. 07	Yangjia assaulted a police officer	illegal administration
2009. 02	Duo Maomao event in prison	illegal administration

2009]. By analyzing those cases, we conclude the basic composition of Internet spread of social events into three parts : the information source, spreading platform, and the participants. The information source can either be the Internet itself or be the traditional channel, but both spread through the network platform. The spreading platform ranges from the major media network, such as portals, network forums, to blogs and various social media networks, etc. The participants of Internet spread are usually the netizens, which can be furtherly divided into controller, opinion leader, follower and observer. They play the different roles in that spread.

The Internet spread of social events is featured to be anonymous, technically versatile, and very fast. It is the major reason that netizens' identification is unknown, which leads to the wide popularization and heavy impacts of the social events on Internet. The technical versatility, consisting of words, pictures, video and other forms, is another feature of the Internet spread that makes public favor of such way of taking in information and expressing opinions. Besides, the Internet spreading scope and influences are used to being magnified in a shortest time because of the technological reason. Last, opinions appear complicated and hard to distinguish on the Internet because its spread lacks a regulated spreading procedure By a deep study of those cases and refering to the corporation crisis life-cycle theory presented by Steven Fink [1986], who divided the corporation crisis into five stages of incubation stage, outbreak stage, diffusion stage, decaying stage, and aftermath stage, we presented the

〈Figure 1〉 The Evolution Model of Internet Spread of Social Events

evolution model of Internet spread of social events as 〈Figure 1〉.

As the model shows, the whole Internet spreading process of social events can be divided into five stages : the incubation stage, the outbreak stage, the diffusion stage, the decaying stage, and the aftermath stage. The spreading scale and influences are different among each stage. In the first stage of incubation, the event occurs and affects only the related persons because it has not been spread around. In the second stage of outbreak, the information concerning the event is published on the Internet and gets some netizens' attention. In the next stage of diffusion, the information about the event gets forwarded and commented in large number of times, accelerating the spread of opinions. In the forth stage of decaying, the event comes to the end and the opinions decrease to the least. In the final stage of aftermath, some long-term

social effects still exist, for example, the Internet popular phrases, the new regulations, etc.

2.2 Spread Path

The Internet spread of social events is usually realized by the communication among a group of connected nodes, which may be mathematically modelled as a random graph in Euclid space. It's very important to find the key nodes and the shortest spread path for the control of that spread process. In order to solve this problem, we use the improved IBF*(Intersect–Bellman–Ford) algorithm as following [Wu, 2009] :
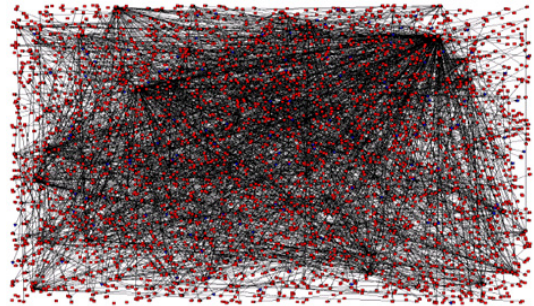
```
vertex sourceAgent
procedure IBF*(list vertices, list edges)
    for each vertex v in vertices :
        if v is sourceAgent then v.distance : = 0
        else v.distance : = infinity
        v.predecessor : = null

    repeat
      change : = false;
      for each edge uv in edges :
        u : = uv.source; v : = uv.destination
        if v.distance > u.distance + uv.weight :
            v.distance : = u.distance + uv.weight
            v.predecessor : = u
      for each edge uv in edges(reverse order) :
        u := uv.source;v : = uv.destination
        if v.distance > u.distance + uv.weight :
            v.distance : = u.distance + uv.weight;
            v.predecessor : = u; change : = true
    until not change
```

<Figure 2> is the original connected graph in our experiment. After searching the key nodes and the shortest path by this algorithm, the original graph can be pruned as the <Figure 3>, which illustrates the possible fast spread path of social events [Wu, 2009].

⟨Figure 2⟩ The Original Connected Graph

⟨Figure 3⟩ The Pruned Connected Graph

2.3 Influence Factors

As it has been pointed out in the evolution model of the Internet spread, the prevention of information spread should be started from the period of opinion outbreak. In order to take the Internet spread into control, we use the Tobit model, which was presented by the American economist James Tobin in 1985, to calculate the extent of different key factors of the social events that may cause the netizens' attention. In Tobit model, the explaining variables are ob-

servable while the explained variables are able to be observed in a restricted range. With this model, we firstly selected some variables and quantitative measuring method, and collected the sample data from major websites and forums, calculating their involvement values. After that, we found out the relevant factors of netizens' involvement level, using a group of influencing variables to make regression, and figured out the major influence factors of Internet spread. The model variables we selected can be listed as <Table 2>.

With these variables, we set the model quotation as following :

$$y_i = \begin{cases} \beta^T X_i + \epsilon_i, \ \beta^T X_i + \varepsilon_i > 0 \\ 0, \ \beta^T X_i + \varepsilon_i \leq 0 \end{cases} \quad (1)$$

$$y_i = \beta_0 + \beta_1 1 BBS + \beta_2 News + \beta_3 Visit + \quad (2)$$
$$\beta_4 Newsword + \beta_5 Opileader + \beta_6 Stage + \varepsilon_i$$

In the quotation, β_0 refers to the intercept, β_1

<Table 2> Model Variables

Variables Name	Definition
BBS Type	1. hot forums 2. potal sites 3. major media network version
News Type	1. fact 2. commentary 3. Inquiry 4. joking
Visit Quantity	number of post clicks
News Word Quantity	number of post characters
Opinion Leader	1 for existing, 0 for none
Stage of Evolution Process	1. incubation stage 2. outbreak stage 3. diffusion stage 4. decaying stage 5. aftermath influencing stage

refers to the coefficient to be estimated, ε_1 refers to the differential, y_i refers to the replying number of the ith post.

With the software of Stata 9.0, we calculated the relevant coefficients of the influencing factors. The results are showed in <Table 3> [Sun, 2009; Wan, 2009].

According to the results, all the absolute values of the coefficients in the table are below 0.6, meaning that the explaining variables are in small relevance. Further with the State 9.0 and Tobit regression method, we made regression analysis of all 1896 sample data. <Table 4> shows the regression results.

According to the results, the factors that pass the T-test are the BBS type, the visit quantity and the opinion leader. For the BBS type factor, the result shows that the netizens' involvement extent is relevant to the website type. The netizens are more likely to participate in the forums that are closer to the public forum. For the visit quantity factor, its coefficient is close to 0, indicating that the post click numbers have no relationship with the reply numbers. This is because the fact that the overload of Internet information let the netizens pay more attention

<Table 3> The relevant coefficients of variables

	BBS	News	Visit	News word	Opinion leader	Stage
BBS	1					
News	-0.0885	1				
Visit	-0.1706	-0.1107	1			
News word	0.0005	-0.1091	0.1841	1		
Opinion leader	-0.391	0.0505	0.0207	-0.0799	1	
Stage	0.0173	-0.1039	-0.1114	-0.2512	-0.0741	1

⟨Table 4⟩ Tobit regression results

Tobit regression					Number of obs	1896
					LR chi2(6)	40.72
					Prob > 0 Chi2	0
Log likelihood	−239.61507				Pseudo R2	0.0783
reply	Coef.	Std. Err.	t	P > t	[95% Conf.	Interval]
BBS	−7.506056	2.13949	−3.51	0.001	−11.75922	−3.252891
News	−1.83664	1.173084	−1.57	0.121	−4.168654	0.4953736
Visit	0.0001976	0.0000454	4.35	0.000	0.0001073	0.0002878
News word	−0.13193	0.303517	−0.43	0.665	−0.7353	0.471445
Opinion leader	8.508498	3.097694	2.75	0.007	2.350486	14.66651
Stage	2.379038	1.410971	1.69	0.095	−0.42588	5.183955
/sigma	10.91701	1.01422			8.900804	12.93321
Obs.			93	left-censored observations at reply<=0		
summary :			1803	uncensored observations		

to the quality of the information. The numbers of post click do not affect the netizens' involvement level, either. For the opinion leader factor, the result proves that the opinion leader effect is obvious in promoting the Internet spread.

Besides, factors of the news type, of the news word quantity and of the spreading stage do not pass the T-test, indicating that these factors do not have much contribution to the Internet spread of social events.

2.4 Psychological Impacts

The Internet spread of social events and their consequent opinions have exerted great impacts on the public psychology. As it was pointed out by the Canadian biologist Hans Selye in the stress model, people respond to the emergency in three phases : awareness, resistance, and tiredness. The psychological effects of the neti-

zens that are exerted by the Internet spread of social events can also be separated into four stages in accordance with the five stages in the evolution model.

In the incubation stage of Internet spread, netizens have an aware response. Since the emergency is still to be proved, curiosity takes place of the expressive comments. In the outbreak stage, the published information is proved and starts to be quoted and the comments are made in a great number. Netizens start to have corresponding psychological response such as panic, angry, etc. The phenomenon of group polarization and network violence become the products of this phase. In the opinion decaying stage, social attention on the emergency begins to decline and netizens start to be tired of the opinions as well. In the last aftermath stage, comments and conclusions are made by netizens as the emergency comes to an end. Netizens'

response level also gets adjusted to the normal level.

To make it short, the Internet provides a dynamic platform for the public to express their opinions actively, and increases the possibility that the public may be misguided. Reversely, the large-scale Internet spread and opinions influence the development of the social events as well, for example, to make it more difficult to control, and to increase the rumors, etc.

3. The Emergency Management of Internet Spread

3.1 Life-cycle Emergency Management

Since the Internet spread has both the positive and negative impacts on the society, it is essential to build a effective emergency management mechanism. As is talked about above, the process of the Internet spread of social events can be concluded into an evolution model, which contains five phases. In this section we will present a life cycle emergency management strategy for the achievement of healthy spreading environment on Internet [Wan, 2009; Wu, 2009].

To treat the Internet spread as a special emergency, its management can be divided into the same five phases. In the first incubation stage, monitoring and warning of the Internet information about the social events is the major task for the management department. In the second outbreak stage, it should be put in the primary place to publish and to get the feedback of the event's information. In the stage of the opinion diffusion, to collect information and analyze the emergency caution constitutes the main responsibility of the management. The related department of government should be involved in controlling and guiding the opinion directions. In the following opinion decaying stage, social events that caused Internet spread of opinions should have been treated, and mass media starts to make conclusion and review of the whole process. In the last aftermath stage, the effects of emergency management are evaluated, and thereof the governmental regulations are usually revised and improved.

Summarily, the measures that should be taken in each stage are demonstrated in <Table 5>.

Before the emergency happens, the Internet spread is in the stage of opinion incubation. In this stage, three methods can be taken to make warning and monitoring of the Internet spread. The first method is the analysis of concentration extent, such as opinion analysis, website analysis and topic data seeking, etc. The second method is to use the web-based monitoring model to predict the public attitude. It uses web data mining technique to take out the related data and evaluate the public attitude. A model can be built to finally work out the concrete quantity of public attention, as well as the positive attention quantity and the negative attention quantity. The third method is to monitor the popular website to discover the clues with the techniques of RSS Feed, etc.

When the emergency occurs, the Internet spread will usually experience three stages : outbreak, diffusion, and decay.

⟨Table 5⟩ The Life-cycle Emergency Management of Internet Spread

Social Events	Evolution Process of Internet Spread	Measures
Beforehand	Incubation Stage	Warning and Monitoring; Analyzing and Predicting
In the Progress	Outbreak Stage	Publishing and getting feedback of Internet spreading information
	Diffusion Stage	Analyzing the caution of Internet spread; Making some opinion guidance via mass media
	Decaying Stage	Processing the emergency; Reviewing the process of the Internet spread
Aftermath	Aftermath Influence Stage	Evaluating the emergency processing effects; Improving the management methodology and strategies

In the outbreak stage, the authorized Internet media should make the first-time reaction and publication to let the public know the real facts which may avoid the rumor information, since it is usually in the first 24 hours that the information is changed most severely and the public possess the biggest desire of knowing the real situation. In the meantime, the feedback information about the psychological response, suggestions and demands of the public should be collected effectively from some hot websites and forums.

In the diffusion stage, there are two tasks to be conducted. First, the Internet news should be collected to analyze the caution of Internet spreading outbreak. Secondly, governmental guidance should be put into effect to avoid some side effects such as the Internet violence.

From the technical perspective, an Internet intelligence information system may be designed to detect the information publishing sources and collect the related information automatically. Furtherly, the related information can be analyzed intelligently. For example, the

demanding information can be subscribed and there are functions to recognize and track the hot topics, analyze the opinion inclination and predict the developing trends.

To realize those functions, some major techniques are usually in demand :

1. The Internet intelligence information acquisition and extraction technique. The Internet intelligence used to be collected from the news, forums, blogs, etc, which are mostly embed in the dynamic webpages.

2. The Internet topic discovery and tracking technique. Since the topics that the netizens discussed about are countless, covering almost every aspects of the society, so the discovery and tracking technique should be applied to find out the hot and sensitive topics as well as their developing trends.

3. The Internet opinion inclination analysis technique. This technique is actually to abstract the author's emotion direction according to the document contents. By this technique, the Internet spreaders' emotion, attitude and intention will get reflected.

4. The multi-document abstract technique. Since most news and posts on the Internet contain lots of information garbage, the webpage contents need to be screened to keep the meaningful information for further processing.

In this stage, the concrete measures of governmental guidance may be considered as :

1. To create a diversified atmosphere to let the public have a place to express different ideas and release their dissatisfaction, while managing the major stream of opinions.

2. To cultivate the opinion leaders by adding expert column, consultation, scholar forums, etc to let the reliable and real voices occupy the market. This may strengthen the effect of opinion control.

3. To set some related special topics, which have great influence on the Internet opinion guidance, and help the mass media perform its social responsibility.

In the decaying stage, the emergency has usually been processed, with the involvement of legal department and administrative department, etc. Besides, the Internet opinions are got controlled, reviewed by the mass media. Government publishes the processing result to remove the rumor.

Lastly, after the emergency comes into the end, the Internet spread also goes into the aftermath influence stage. In this stage, the effects of processing and the results should to be evaluated to improve the management methodology and strategies of Internet spread. Evaluation basis may be established in a graded management system, which is built according to the length of the Internet spread outbreak period

and the involved range. In such graded management system, several evaluation aspects can be taken into account, such as followings :

1. The harm extent of the Internet spread, including the harm to the individuals and government.

2. The control and its satisfaction degree of the Internet spread, and the improvement of the related systems and regulations.

3. The coordination of the governmental and social media resources in the management of Internet spread. In the management of Internet spread of social events, the construction of netizens' self-discipline plays an important role. The netizens' civilization forms the basis of healthy spreading environment on Internet. Besides, the promotion of the real name system on the Internet in some countries has proved to be helpful in reducing the illegal and harmful events concerning the Internet spread. Additionally, the supervision of the government should be promoted to ensure the mutual justice of netizens and Internet managers.

3.2 Psychological Intervention Strategy

As we have analyzed in the third section, the Internet spread of social events may exert a series of psychological effect on the public, leading to the phenomenon of Internet violence, group polarization, etc. In order to lessen such harmful psychological impacts, it is necessary to make some social psychological intervention. Here we pointed out some specific measures to be taken for psychological intervention :

1. The information about the social event

should be in clarity to the public.

2. The government expresses its attitude and comforts the public at the moment the emergency occurs.

3. The communication among the government, media and public should be strengthened, and the psychological tutoring should be set to reduce the public stress.

For the groups that hold the polarized opinions, the measures to be taken can be summarized as the following :

1. To guide the main stream of the Internet opinions.

2. To hold various kinds of grand discussion meeting that is open to the public to receive and share the suggestions from different views.

3. To prohibit the extreme opinions and create a hospitable environment of Internet spread.

4. To encourage the active and hospitable way of expressing opinions on the Internet.

5. To persuade and tutor the netizens who hold the extreme opinions as soon as possible to prevent Internet violence.

For the people who exert the Internet violence, correct psychological tutor such as the education of morality and regulation should be conducted at the first time, and law sanctions might also be taken when it is necessary.

For the victims of the Internet violence, the psychological service should be provided to help them recover from the harm and retain their confidence as soon as possible.

4. Conclusion

This paper researched the evolution process of Internet spread of social events and presented a five-stage model to describe that process. Furthermore, the improved IBF* algorithm was applied to extract a pruned connected graph aiming to find the key nodes and the shortest spread path for the control of that spread. In order to explore the influence factors which affect the Internet spread, we use the Tobit model to calculate the extent of different factors that may cause the netizens' attention. Research results have shown that BBS type, the visit quantity and the opinion leader are key factors. Based on those researches, a life-cycle emergency management methodology and the related strategies were proposed for the achievement of healthy spreading environment on Internet.

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