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Research on Scientific Communication Mechanism of Public Emergencies Based on Information Aging Characteristics

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Abstract: The openness of public emergency information shows that any individual may become the object of the evolution system of false information, and its complexity shows the diversity of information dissemination methods, the variability of individual emotions, and the randomness of public participation and retreat. Firstly, this paper analyzes the characteristics of information aging in the network age, and establishes the theoretical models of acceleration, speed and diffusion intensity of public emergency network diffusion according to the characteristics of public emergency network communication. According to the problems analyzed above, some suggestions are given to improve the scientific communication mechanism of public emergencies in China. With the help of melt media, the mechanism of scientific communication can be innovated, the integration among media can be promoted, the self-organization ability of the system can be enhanced, the "checking" of information can be strengthened, and the feedback adjustment mechanism can be improved, thus providing endogenous power for enhancing the effectiveness of scientific communication.

1. Introduction

As a product of the development and evolution of public emergencies, public opinion refers to the opinions, attitudes and emotions held by the subject to the object, and can also be used as a catalyst to trigger new public emergencies [1]. Many major public emergencies have occurred in China in recent years, which shows that the society expects good and interactive public information exchange. To achieve this goal, it is necessary to build a smooth information dissemination platform, which is also an important content of political civilization.

The aging research of network information is an important part of the research of network information metrology: on the one hand, it is of great significance to the perfection and development of the discipline system of network information metrology; On the other hand, the rapid development of network has brought explosive growth of information, and the study of network information aging can track the process of network information utilization and guide the construction of network information resources [2-3]. Scientific response to public emergencies is the most direct embodiment of rationality. Scientific response includes establishing scientific concepts, adhering to scientific spirit and applying scientific methods, etc. It is in this process that the dissemination of science has not stopped, but has its own uniqueness which is not available in general social conditions. With the rapid growth of network population and the rapid expansion of network information dissemination scale, it is necessary to conduct in-depth discussion and research on the characteristics and diffusion mechanism of network dissemination of public emergencies.

2. Aging of Network Information

Internet is a resource network integrating all kinds of information resources. Because the government, institutions, enterprises and individuals can publish information on the network at any time, the network resources are growing rapidly. Network information has its own characteristics, and its aging is similar to the aging of traditional literature, and there are also obvious differences, mainly in [4]:

2.1 Imperfection

In the aging research of network information, the research objects have the problem of "incompleteness". The reasons are as follows: on the one hand, the openness of the network determines the uncontrolled release of information, and the number and scope of research objects cannot be accurately delineated; On the other hand, the dynamic and non-cumulative nature of network information leads to the lack of time coordinates of research objects, which makes it difficult to systematically trace the historical state of research objects.

2.2 Non-Cumulative

The external form and content of traditional documents are inseparable, and the revision, update and addition of the original information must rely on new carriers. Even if the knowledge on these carriers completely loses its use value, it will not disappear. We call it cumulative, and its most important feature is its perpetual existence. However, the external form and core content of network information can be independent of each other, and its carrier and organization can be kept unchanged, and its content is constantly updated, modified or even deleted, which we call non-accumulative.

2.3 Dynamic Property

Any information is the organic unity of external form and content, its carrier and organization are the external form of information, and its data and knowledge are the core content. Like traditional literature, the determination of half-life and price index is based on the utilization of information; The difference is that because of the dynamic nature of network information, the study of its aging law also increases the study of the life cycle of network information itself.

3. Diffusion Mechanism of Public Emergency Network Communication

3.1 Diffusion Model

The spread and diffusion mechanism of numerous public emergencies shows that in the initial stage of the incident, different public emergencies not only have different initial spreading speeds, but also have different expansion accelerations. The network diffusion process of public emergencies is a bidirectional variable acceleration process [5]. The positive change acceleration process refers to the fact that the online media reported the true nature of public emergencies as soon as possible, and reminded and called on relevant departments and relevant personnel to judge and start the corresponding emergency plan according to the information of public emergencies obtained as soon as possible.

The interactive reflection of network communication is determined by many factors, such as the co-operation between public emergencies and network communication. It can be characterized as $F = g(y_1, y_2, \cdots, y_i, t)$. Based on the acceleration principle of Newton's Second Law of Motion, the calculation model of propagation and diffusion acceleration of public emergency network can be described as follows [6]:

$$a = \frac{|F|}{M} = \frac{|g(y_1, y_2, \cdots, y_i, t)|}{fF = (x_1, x_2, \cdots, x_m)} \quad (1)$$

In which, a --Diffusion acceleration of network propagation of public emergencies;

$|F|$ --The size of the diffusion intensity of public emergency network propagation, which changes with the different diffusion time;

$x_1, x_2, \cdots, x_m$ --The degree and level of social stability and economic development formed by the joint action of many factors such as economy, resources, environment, security, culture and policy;

$y_1, y_2, \cdots, y_i$ --The nature, cause, scale, time and space of public emergencies, the stage of network diffusion and communication of public emergencies, the interactive reflection of network communication, and the disastrous cooperation between public emergencies and network communication.

t --Time of occurrence of public emergencies.

It is assumed that the occurrence time of public emergencies is t_0 and the initial diffusion velocity is 0. The diffusion speed model of public emergency network at t_n time can be characterized as:

$$v_{t_n} = \int_0^{t_n} a dt \quad (2)$$

In which, v_{t_n} --The network diffusion speed of public emergencies at time t_n,

a --The diffusion acceleration in the process of public emergencies, and it changes with the change of public emergencies network propagation and diffusion.

According to the diffusion speed model of public emergency network, the diffusion intensity calculation model of domino effect caused by public emergency and the loss of life, resources, property and environment can be characterized as:

$$S_{st_n} = \int_0^{t_n} t_{t_n} dt = \int_0^{t_n} \int_0^{t_n} a dt dt \quad (3)$$

In which S_{st_n} is the intensity of event diffusion at time t_n when public emergencies occur.

3.2 Improved Model Based on Information Aging Characteristics

In the process of information dissemination, in the classic information forwarding model (network SIR model), individuals in the state S (susceptible state) can become the state I (infected state) with a certain probability by being infected, while individuals in the state I may recover to the state R (recovered state) with a certain probability [7].

A user u who has not forwarded the information changes to I after receiving the information and forwarding it with a certain probability. in a directed network, users connected with u along the edge starting from u in the network will receive this information and continue to forward the information with a certain probability. at the same time, the user u changes to R after forwarding the information, which will not affect or be affected by other users. the process is shown in Figure 1.

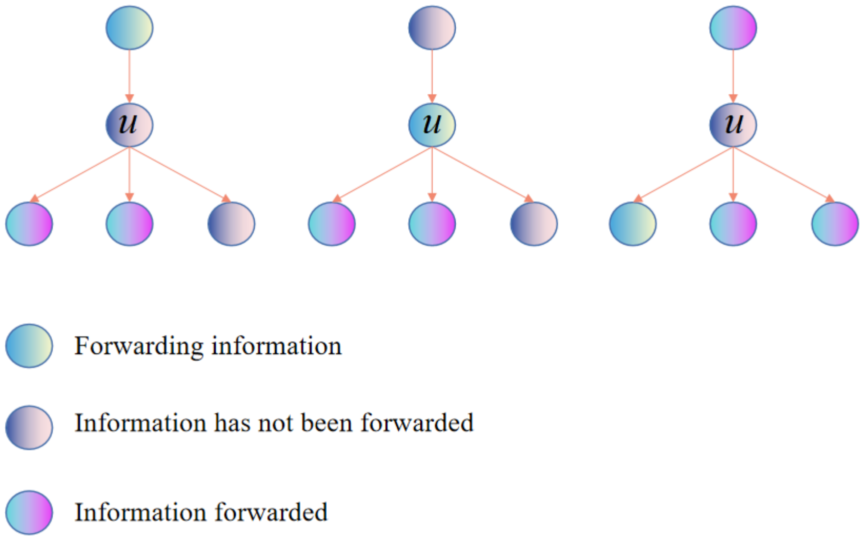


Fig.1 Schematic Diagram of Propagation Model

Therefore, assuming that the propagation probability changes with time, set $I(1)=p(1)\cdot k_{out}=a$ according to the characteristics of information forwarding, namely $I(k)\sim k^{\lambda}$. Where $a>0$ is a constant, then:

$$I(k)=I(k-1)\cdot p(k-1)\cdot EK_{out}=a\cdot k^{\lambda} \quad (4)$$

When $k>1$, we can get the propagation probability:

$$p(k)=(k/(k+1))^{\lambda}EK_{out}^{-1} \quad (5)$$

Then for $R(k)$, when $k>1$:

$$R(k)=a\sum_{x=1}^{ste_{\max}}x^{\lambda}+1\approx\frac{\left((ste_{\max}+1)^{\lambda+1}-1\right)\cdot p(1)\cdot K_{out}}{\lambda+1}+1 \quad (6)$$

In which table $ste_{\max}$ shows the maximum propagation step size. K_{out} represents the average output of nodes in the network.

4. Diffusion Simulation Experiment of Public Emergencies

4.1 Simulation Environment and Parameter Description

In this paper, the simulation mainly attempts to discuss the relationship between the collapse threshold of the public emergency system and the event network propagation, and the influence of the correlation between events on the event diffusion. Therefore, during the simulation experiment, two parameters are mainly involved:

First, about the parameters of network structure, firstly, there is network scale, that is, the total number of network nodes is 500, secondly, the average degree of network, and this paper adopts 3.

Second, the vulnerability parameters of nodes themselves and the propagation parameters between nodes. The vulnerability parameters of nodes are considered to be between 0 and 20, and the intermediate value is set as 10 in simulation;.

In addition, the propagation function parameters between network nodes come from the dynamic model. After referring to other documents and models, the coefficient used in the comparison weight function of node access degree is set to $a = 2, b = 5$, and the propagation influence function is set to $\alpha = 0.5$, propagation damping coefficient $\beta = 0.01$, and time delay parameter T obeys Chi-square distribution with mean value of 1; In addition, $M_{ij} \in [0,1]$ is known, and the observation range of θ is [0,3].

4.2 Collapse of Nodes over Time

When the i node in the network is disturbed, the corresponding state variable of the node is given a small amount greater than zero. With the evolution of time, the network generally has two situations:

In one case, due to low vulnerability and strong self-protection and external intervention, the node state tends to be stable, that is, it eventually returns to zero.

In another case, the diffusion mechanism of node i causes the diffusion of disturbance, and other nodes in the network have a chain reaction disturbance due to some connections with it. If the disturbance is coupled with the public emergency system represented by the node, the system state will exceed a breaking value, and the node will collapse, that is, the outbreak of public emergency. If copied according to this rule, more and more nodes will be unable to keep stable, resulting in the collapse of most nodes in the whole network [8].

One of the purposes of this simulation experiment is to analyze how the difference of network structure affects the diffusion speed and consequences of public emergencies. In order to verify the relationship between network topology and the diffusion of public emergencies, based on the model introduced above, this paper fixed the vulnerability parameters of the network and other parameters in dynamics. In addition to the fixed parameters set above, in this simulation, $M = 0.5$, threshold $\theta = 0.5$, the initial disturbance point was randomly selected by the program, and the initial disturbance value was set to 1. The breakdown of nodes with time is shown in Figure 2.

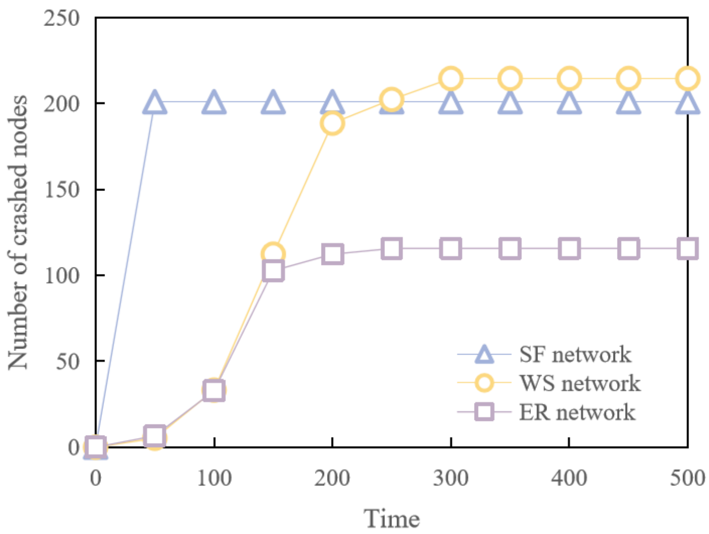
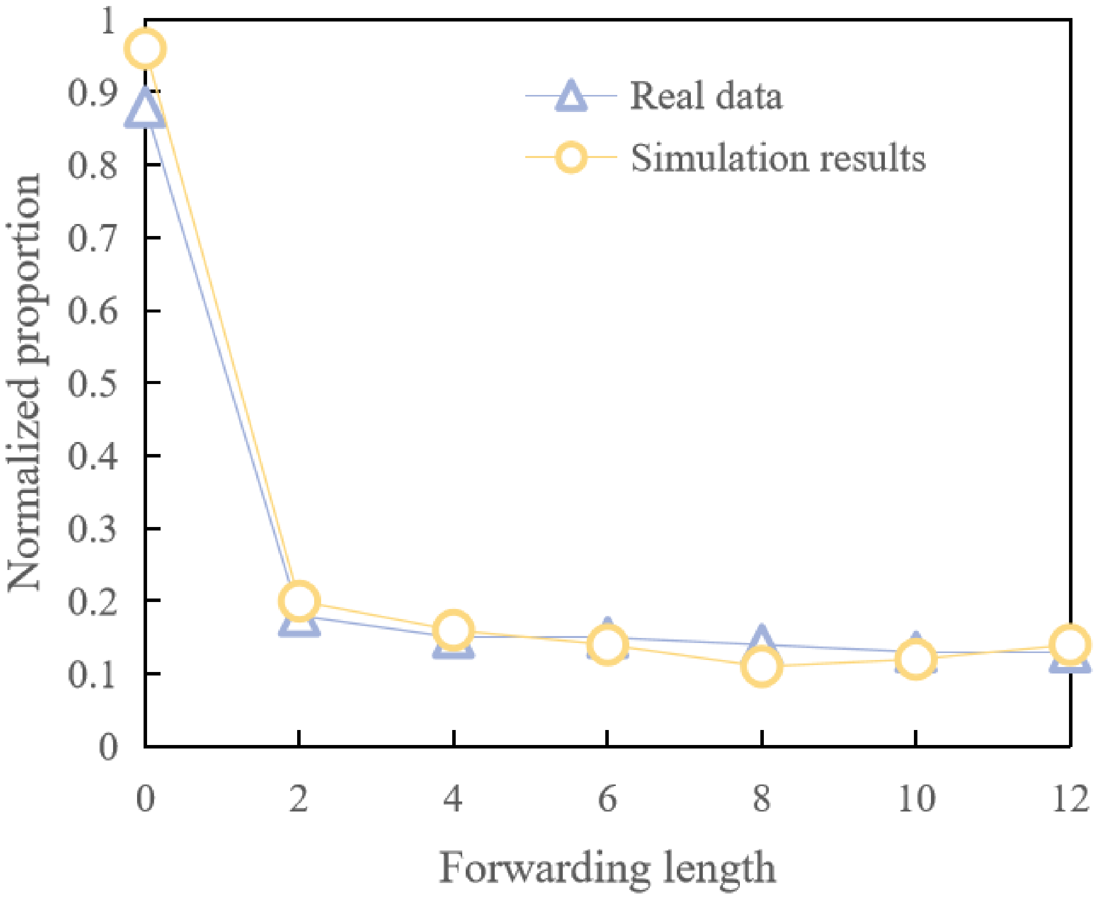


Fig.2 Node Collapse on Different Network Structures

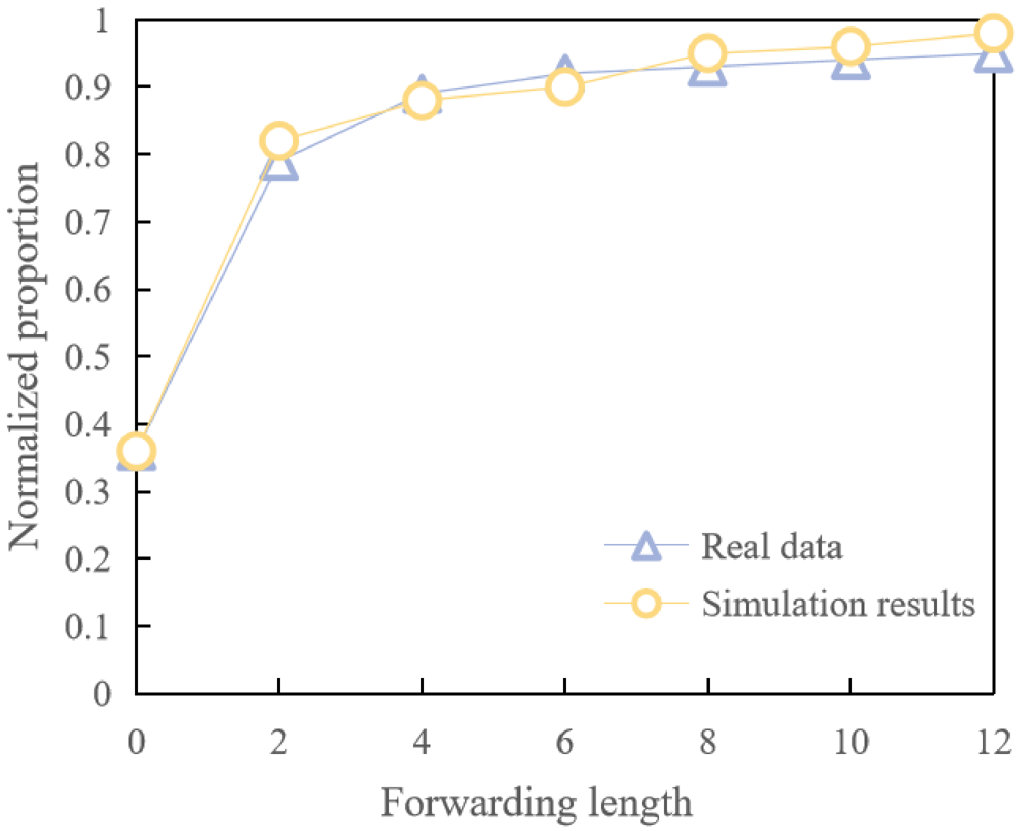
It can be seen from Figure 2 that the number of node crashes does not change smoothly with the increase of time, that is to say, in complex networks, the diffusion of events is nonlinear, and the diffusion speed varies greatly in each diffusion stage. Reflected in the diffusion process of public emergencies in reality, it shows that when a minor event first appeared, it did not suddenly appear explosively from the occurrence of minor events to the large-scale diffusion, but gradually spread after the minor event brewed and triggered the events that might be related.

4.3 Improved Model Analysis

According to the improved SIR model proposed in the previous section, this section simulates the process of information dissemination with Weibo forwarding network as the carrier of information dissemination, and further uses this model to analyze the distribution of node influence. The simulation results are shown in Figure 3.



(a) The proportion of nodes with I status changes with the forwarding length



(b) The proportion of nodes with R status changes with the forwarding length

Fig.3 Comparison between Simulation Results of Improved Sir Model and Real Data

It can be found from Figure 3 that the simulation algorithm can fit the real data well, which shows that the simulation algorithm reflects the real information forwarding law to a certain extent. In the whole propagation process, users who have already forwarded information and users who are forwarding information increase rapidly at the initial moment, but with the increase of forwarding length, their growth rate decreases rapidly.

5. Conclusion

The synchronous behavior in the information dissemination of public emergencies is influenced by many factors such as nature, society, culture and politics, and its evolution process is characterized by multiple frames, self-organization, imbalance and randomness. The aging research of network information is an important part of the research of network information metrology: on the one hand, it is of great significance to the perfection and development of the discipline system of network information metrology; On the other hand, the rapid development of network has brought explosive growth of information. Therefore, it is necessary to establish an emergency response mechanism for public emergency network communication, strengthen the cooperation between the Internet and traditional media, make full use of the interactive function of the network, and carry out emergency strategies for public emergency network communication guided by public opinion.

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