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Research Article

Network Public Opinion Propagation Control Model of Major Emergencies Based on Heat Conduction Theory

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In physics, the process of heat conduction of objects is similar to the process of network public opinion propagation of major emergencies. Based on the theory of heat transfer, this paper analogizes the process of network public opinion information propagation and object heat conduction and analogizes the exchange of network public opinion information between individuals in social networks to the course of object heat transfer. Based on the accumulation of individual energy in social network, the propagation model of network public opinion is established, and the propagation control model of network public opinion in major emergencies is established based on the heat conduction theory. The influence of individual interest, propensity to spread, transmission coefficient of network public opinion information, and the breadth of dissemination on the dissemination of network public opinion in major emergencies are analyzed, respectively. This study provides some inspiration for the disposal and governance of network public opinion, propagation of major emergencies.

1. Introduction

After the occurrence of major emergencies, the network public opinion has a sudden outbreak, wide coverage, strong sensation, high social sensitivity, great attention of public opinion, fast spread on the network, and improper disposal can easily lead to an irremediable situation. How to effectively handle and control the spread of public opinion and smoothly guide the direction of public opinion development, do a good job in online public opinion guidance, and create a public opinion atmosphere conducive to the solution of emergencies which is an urgent need of the current situation and also has great theoretical research and practical value.

In the study of propagation control of network public opinion, some scholars have constructed propagation control models from different perspectives to explore the control and disposal of public opinion propagation. Xia et al. [1] qualitatively analyzed the alienation mechanism of network public opinion information in the big data environment, extended the evolution mechanism model of network public opinion to the control model of information alienation and studied the classification of government control information alienation through numerical simulation on this basis. With the continuous development of information technology, the social network is filled with complicated information all the time, which also makes negative public opinion information breed and spread rapidly, seriously affecting network security and social stability. Gu et al. [2] put forward an optimal control model of public opinion communication considering thinking time delay. Chen and Huang [3] established the SEIQR evolutionary game model to integrate the strategic interaction behavior of online media and local governments into the improved infectious disease model. Wang et al. have established a network public opinion propagation control model based on the relative weight of users [4] for the purpose of studying the reasonable intervention timing of public opinion control, through the research, it is found that the dissemination of public opinion on the internet is closely related to the network status of the initial source of information dissemination. In addition, based on the complex network theory and propagation dynamics, they also built a public opinion propagation model on the double-layer social network [5] and explored the corporate public opinion propagation law and control strategy on the double-layer social network. In order to study the impact of information interaction between platforms on public opinion propagation and public opinion control, Chen [6] took wechat and microblog platforms as examples, used multiagent modeling method, and improved SEIR model to build a multilayer coupling network public opinion propagation and public opinion control model including "wechat layer –microblog layer –control layer". In order to effectively control the spread of public opinion of ICO (initial coin offering), Zuo et al. [7] analyzed the development of ICO projects and the characteristics of public opinion in the social network environment by introducing the impact of external public opinion field on the spread of ICO public opinion, and they proposed a model for the spread and control of ICO public opinion in the small world network. Li et al. [8] used the method of empirical analysis to simulate the four different types of 101 major emergencies based on the social network theory, analyzed the time and space interaction between different network public opinion propagation subjects, and put forward suggestions on public sentiment management and network public opinion emergency risk management by the government and the media for different stages of major emergencies. Lu [9] established an evolutionary game model between online media and local governments based on evolutionary game theory and a public opinion monitoring and guidance model.

However, the current research on the guidance and control of network public opinion involves relatively few technical aspects of the specific implementation of network public opinion propagation control. The construction of network public opinion propagation control model is relatively simple, and the comprehensive framework of network public opinion control mechanism does not fit the actual situation well.

Based on this, under the background of multidisciplinary integration, this study uses the ideas of other disciplines for reference to study the behavior of network public opinion propagation, so as to better describe the process of network public opinion propagation and achieve the purpose of effective control and disposal. In view of the fact that the propagation process of network public opinion derived from major emergencies is the same as the explosive energy diffusion process in physics, the theory of heat transfer is introduced to explore the control of network public opinion propagation. The main contributions of this paper are as follows:

(1) The process of network public opinion information dissemination is compared with the process of object heat conduction, and a control model of network public opinion dissemination based on heat conduction theory is established

(2) The influence of individual interest, propensity to spread, transmission coefficient of network public opinion information, the breadth of dissemination on the communication effect of network public opinion are analyzed, and the communication law of network public opinion information is further explored

In this paper, the principles and methods of physics, mathematics, and other disciplines are used to explore the complex practical problems of communication and management, broaden the research field, and provide new ideas for the research of cross disciplines.

The chapter structure of this paper is as follows. Section 2 mainly discusses the related theory. Section 3 introduces the established propagation control model. Section 4 describes the numerical simulation and result analysis. Section 5 summarizes the research ideas of this paper and proposes future work.

2. The Related Theory

2.1. Concept and Form of Heat Conduction. A phenomenon in which heat is transferred from one end of a system to another, or from this system to another, is called heat transfer. The three heat transfer modes of heat conduction are heat conduction, convection, and radiation. Heat conduction is a heat transfer phenomenon caused by the thermal motion of molecules, atoms, and free electrons in a substance [10]. Heat conduction is a diffusion behavior based on the random thermal motion of the basic microscopic particles that make up a substance. In fact, it is a process in which a large number of molecules in a substance collide with each other to transfer energy from the high-temperature part of the object to the low-temperature part, or from the high-temperature object to the low-temperature object, as shown in Figure 1.

2.2. Temperature Field and Temperature Gradient. The temperature field refers to the general distribution of temperature at each point in the instantaneous object, which can be expressed as spatial coordinates and time coordinates τ function.

$$t = f(x, y, z, \tau). \tag{1}$$

The distribution space of the temperature at each point in an object or system at any time is called the temperature field. A surface consisting of points of the same temperature is called an isothermal surface. Because any point in the space cannot have multiple different temperatures at the same time, isothermal surfaces with different temperatures cannot generally intersect. From any point, it moves along the isothermal surface, since there is generally no temperature change on an isothermal surface, there is no heat transfer. Moving in any direction intersecting the isothermal surface will change the temperature, with the maximum rate of temperature change in the direction perpendicular to the isothermal surface. The temperature difference between two adjacent identical temperature surfaces is defined as Δt, the vertical distance between two identical temperature surfaces is defined as Δn, and the limit of the ratio between them is obtained. This limit value is called the temperature gradient gradt, which is expressed by the mathematical formula:

$$\text{grad } t = \lim_{\Delta n \longrightarrow 0} \left(\frac{\Delta t}{\Delta n} \right) = \frac{\partial t}{\partial n} n = \frac{\partial t}{\partial x} i + \frac{\partial t}{\partial y} j + \frac{\partial t}{\partial z} k. \tag{2}$$

n is a unit vector in the normal direction of the isotherm

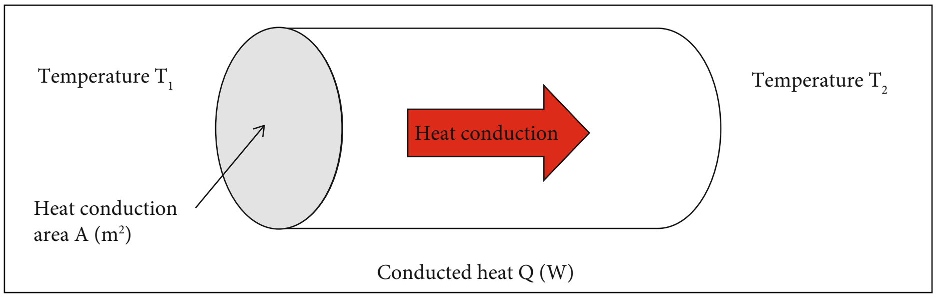


Figure 1: Schematic diagram of heat conduction.

at the position of point P, and i, j, and k are unit vectors on the three coordinate axes, respectively. The temperature gradient is a vector, and the positive direction indicates the direction in which the temperature increases, as shown in Figure 2 below.

In the heat conduction theory, the local heat flux of an object is expressed as:

$$q = -\lambda \text{ grad } t = -\lambda \left(\frac{\partial t}{\partial x} i, \frac{\partial t}{\partial y} j, \frac{\partial t}{\partial z} k \right). \tag{3}$$

The above equation is Fourier's law, also known as the heat conduction rate equation. The heat flux transferred by conduction in a body is proportional to the temperature gradient, where λ is called the thermal conductivity of the object. The local heat flux q represents the heat passing through the unit cross-sectional area of the object in the unit time. The local heat flux q is affected by the corresponding x, y, and z directions in the rectangular coordinate system.

2.3. Unsteady Heat Conduction. Unsteady heat conduction means that in the process of heat conduction, if the temperature changes with time, it is considered to be unsteady heat conduction. The distribution of temperature field in an object under unsteady heat conduction changes with time, and the heat flux on each section is different in the direction perpendicular to the heat flux. According to the characteristic that the temperature in the object changes greatly with the change of time, the unsteady heat conduction process can be divided into two types: transient heat conduction and periodic unsteady heat conduction. Solving the unsteady heat conduction problem can be reduced to solving the definite solution problem which is composed of the heat conduction differential equation, including the unsteady term and the corresponding single extreme value condition. The integrated parameter analysis method can be selected for analysis and solution.

As shown in Figure 3, an object of arbitrary shape, volume V, surface area A, density p, specific heat capacity c, and thermal conductivity λ is constant and has no internal heat source. When the initial temperature is t_0, it is suddenly put into a fluid with constant temperature t_f for cooling, and the surface heat transfer coefficient h between the object and the fluid is constant.

Heat balance equation:

$$hA\left(t - t_f\right) = -\rho c V \frac{dt}{d\tau}. \tag{4}$$

Excess temperature $\theta = (t - t_f)$, then

$$\begin{cases} \rho c V \dfrac{dt}{d\tau} = -hA\theta \\ \theta(0) = (\mathrm{t}_0 - \mathrm{t}_\mathrm{f}) = \theta_0 \end{cases}. \tag{5}$$

$$\int_{\theta_0}^{\theta} \frac{d\theta}{\theta} = -\int_0^{\tau} \frac{hA}{\rho c V} d\tau. \tag{6}$$

Separation of variables:

$$\ln \frac{\theta}{\theta_0} = -\frac{hA}{\rho c V}\tau. \tag{7}$$

⊠数:

$$\frac{\theta}{\theta_0} = \frac{t - t_f}{t_0 - t_f} = e^{-(hA/\rho c V)\tau}. \tag{8}$$

$$\frac{hA}{\rho c V}\tau = \frac{h(V/A)}{\lambda} \frac{\lambda \tau}{\rho c (V/A)^2} = Bi_v Fo_v. \tag{9}$$

$$\frac{\theta}{\theta_0} = e^{-Bi_v Fo_v}. \tag{10}$$

Here, the angle code V refers to the feature size, which is expressed by the ratio V/A, $\mathrm{Fo} = a\tau/l^2$, B_i is called the characteristic number. The (instantaneous) heat flux exchanged between the object and the fluid at any time can be obtained from the temperature distribution.

$$\Phi = -\rho c V \frac{d\theta}{d\tau} = hA\theta_0 e^{-(\mathrm{h}A/\rho c V)\tau}. \tag{11}$$

And from the start time of the unsteady process $\tau = 0$ to a specified time τ,, the total amount of heat exchanged between a fluid and an object during this time interval is:

$$Q_{0\sim\tau} = \int_0^{\tau} \Phi \mathrm{d}\tau = \theta_0 \rho c V \left(1 - e^{-(\mathrm{h}A/\rho c V)\tau}\right). \tag{12}$$

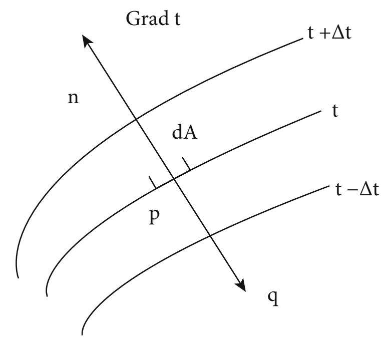


Figure 2: Isotherms versus temperature gradients.

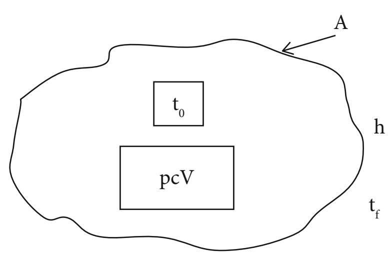


Figure 3: Illustration of heat transfer.

2.4. Application Status of Heat Conduction Theory. Heat transfer is a science that studies the basic law of heat transfer. Heat transfer is a very common phenomenon that can be encountered in daily life, and the theoretical knowledge of heat transfer is also widely used in reality. The research and application of heat transfer are flourishing in the fields of traditional industry [11, 12], chemical textile industry [13–17], geotechnical engineering [18–21], algorithm improvement [22–26], and biomedicine [27–30], and many cross branch disciplines have emerged.

The application of heat conduction theory in the study of network public opinion is rare, and some scholars have explored it in this field. In the link prediction theory, the introduction of material diffusion and heat conduction theory in classical physics provides a new opportunity for the research of link prediction algorithm based on network structure. Zhang et al. [31] first introduced the heat conduction theory into the link prediction process. Later, researchers Pan [32] applied it to the link prediction of the network public opinion propagation model on this basis, Liu [33] established a heat conduction equation for rumor propagation evolution based on the classical heat conduction theory in physics and Fourier heat conduction equation, Xie et al. [34] proposed the principle of heat conduction, the definitions of microblog heat and heat conductivity, and the propagation model of microblog heat in microblog public opinion (MPOPTM) is constructed, according to which the heat and heat conductivity of microblog are calculated, Zhang et al. [35] put forward the intertextual characteristics of the generation, diffusion and polarization process of self-Media network public opinion, and construct the energy logic model of the intertextual evolution of self-Media network public opinion. The process of energy accumulation and polarization of self-Media network public opinion dissemination is deeply studied.

3. Establish Propagation Control Model

In heat transfer, the transfer of heat from one part of a system to another due to temperature differences is called heat conduction. The essence of heat conduction is a process in which a large number of molecules in a substance collide with each other to transfer energy from a higher temperature part to a lower temperature part, or from a higher temperature object to a lower temperature object.

Specific to the network public opinion of major emergencies, the individual disseminates the network public opinion information of major emergencies and is also a carrier of network public opinion information of major emergencies. In the social network, the dissemination of network public opinion information can be seen as a process of collision between individuals, because of the differences in their own conditions, individuals have different interest in network public opinion information, which makes the dissemination and diffusion of network public opinion in the social network.

In heat conduction, the propagation rate is determined by the distribution of the temperature field in the system. The temperature field in the spatial rectangular coordinate system can be expressed as $t = f(x, y, z, \tau)$. It is affected by the three directions of x, y, and z. In the spread and diffusion of network public opinion, the speed of transmission is affected by the distribution of the propensity of individuals in social networks to spread. The influence of coordinate axis x is analogized to the influence of user characteristics in social networks on the propagation of network public opinion in major emergencies, the influence of coordinate axis y is analogized to the influence of the media on the propagation of network public opinion in major emergencies, and the influence of coordinate axis z is analogized to the influence of the government on the propagation of network public opinion in major emergencies.

Human factors in major emergencies are the key factors for the cause and development of the whole incident, which can be reflected in the following aspects: (a) some of these outbursts come from blind spots in people's perception; (b) premeditated individuals or organizations, after careful planning and implementation, have caused damage to society in order to achieve their economic benefits and political goals. Therefore, it is very important to study the individual characteristics in the process of event network public opinion propagation for correctly guiding the trend of network public opinion. The energy balance relation in the heat conduction equation of the object is quoted:

$$hA\left(t - t_f\right) = -\rho c V \frac{dt}{d\tau}. \quad (13)$$

$$\Phi = -\rho c V \frac{d\theta}{d\tau}. \quad (14)$$

The energy expression of network public opinion propagation in social network is as follows:

$$Y \cdot R\left(\alpha - \alpha_f\right) = -Fe\frac{d\alpha}{d\tau}. \quad (15)$$

$$\Psi = -Fe\frac{d\beta}{d\tau}. \quad (16)$$

$$\beta = \alpha - \alpha_f. \quad (17)$$

Table 1 below is a description of the parameters in the heat conduction network public opinion propagation model.

Then

$$\begin{cases} -Fe\dfrac{d\alpha}{d\tau} = \mathrm{Y}\cdot\mathrm{R}\cdot\beta \\ \beta(0) = \left(\alpha_0 - \alpha_f\right) = \beta_0 \end{cases}. \quad (18)$$

$$\int_{\beta_0}^{\beta}\frac{d\beta}{\beta} = -\int_0^{\tau}\frac{\mathrm{Y}\cdot R}{Fe}d\tau. \quad (19)$$

To separate variables:

$$\ln\frac{\beta}{\beta_0} = -\frac{\mathrm{Y}\cdot R}{Fe}\tau. \quad (20)$$

Score:

$$\frac{\beta}{\beta_0} = \frac{\alpha - \alpha_f}{\alpha_0 - \alpha_f} = e^{-(\mathrm{Y}\cdot R/Fe)\tau}. \quad (21)$$

$$\beta = \beta_0 \cdot e^{-(\mathrm{Y}\cdot R/Fe)\tau}. \quad (22)$$

Then the (instantaneous) heat Ψ exchanged between individuals at any time:

$$\Psi = -Fe\frac{d\beta}{d\tau} = \mathrm{Y}\cdot\mathrm{R}\cdot\beta. \quad (23)$$

$$\Psi = \mathrm{Y}\cdot\mathrm{R}\cdot\beta_0\cdot e^{-(\mathrm{Y}\cdot R/Fe)\tau}. \quad (24)$$

The energy received by the individual in the social network is a cumulative process, and the total energy $Q_{0\sim\tau}$ transmitted by a single individual during the time interval from time $\tau = 0$ to any time τ:

$$Q_{0\sim\tau} = \beta_0 \cdot Fe\left(1 - e^{-(\mathrm{Y}\cdot R/Fe)\tau}\right). \quad (25)$$

Assuming that at the initial moment, there is only one propagator i in the social network, and the propagator exchanges energy with other individuals in the social network, that is, information transfer, then the heat transfer energy received by the neighbor individual j of the individual i is:

$$Q_{(0\sim\tau)ij} = \beta_{0\mathrm{ij}} \cdot Fe_i\left(1 - e^{-\left(\mathrm{Y}_{ij}\cdot R_i/Fe_i\right)\tau}\right). \quad (26)$$

When the individual j receives the heat conduction energy $Q_{(0\sim\tau)j} \geq Q_{\Delta}$, the individual j becomes the disseminator of the network public opinion information in the system, where Q_{Δ} represents the individual energy threshold. The influence of the whole social network by the network public opinion information is the sum of the influence of each individual node in the social network by the network public opinion information, that is, the energy sum of each individual in the whole social network. However, the influence of network public opinion information is not unchanged, with the passage of time and the emergence of new hot network public opinion events, the attention of individuals in the social network to the network public opinion information is gradually decreasing, and the influence of individuals by the network public opinion information is also gradually decreasing. Therefore, this paper defines the influence of the entire social network by the network public opinion information (Q_T) as:

$$Q_T = \frac{\sum Q_{(0\sim\tau)ij}}{\ln\left(\tau + 1\right)}. \quad (27)$$

(1) *The influence of individual interest* (α) *on network public opinion information.* (α_i) refers to the interest of individual i in the social network in the network public opinion information. Different individuals have different interests in network public opinion information because of their different environments. Individual's interest in network public opinion is positively correlated with individual's activity, that is, the greater the individual's activity, the greater the individual's interest degree (α_i)in network public opinion information, at the same time, the individual's interest in network public opinion information (α_i) is related to the degree of ambiguity of network public opinion information. The more fuzzy the network public opinion information, the more it can stimulate the public's interest, and the greater the individual's interest in the network public opinion information

$$\alpha_i = \varepsilon \cdot C_i \cdot \ln\left(I + 1\right). \quad (28)$$

$$\alpha_j = \varepsilon \cdot C_j \cdot \ln\left(I + 1\right). \quad (29)$$

$$\beta_{0\mathrm{ij}} = \varepsilon \cdot \left(C_i - C_j\right) \cdot \ln\left(I + 1\right). \quad (30)$$

where C represents the activity of an individual, I represents the ambiguity of network public opinion information, and ε is the adjustment coefficient. Considering that when an individual has not contacted the network public opinion information, his interest in the network public opinion

Table 1: Parameters in the heat conduction network public opinion propagation model.

Parameter	Description
Y	Transmission coefficient of network public opinion information
R	Breadth of network public opinion dissemination
α	Individual interest in network public opinion information
α_f	Audience temperature
Fe	Propensity to spread

information is zero, the above formula can be written as:

$$\beta_{0ij} = \varepsilon \cdot C_i \cdot \ln (I + 1). \quad (31)$$

(2) *The influence of the propensity to spread (Fe)*. The propensity to spread of different individuals to the network public opinion information is influenced by the education level、the environment and the network public opinion information, compared with the individuals who have not received higher education, the educated individuals will not be easily attracted by the network public opinion information before they have determined the authenticity of the network public opinion information, and have a lower propensity to spread the network public opinion information, at the same time, the propensity to spread of individuals to network public opinion information is affected by the importance of network public opinion information.

According to the sensitivity, severity, urgency, scope of influence, and other factors, the network public opinion information can be expressed as blue warning information, yellow warning information, orange warning information, and red warning information from low to high, they correspond to the four levels of importance: general importance, relatively important, important, and very important.

Therefore, the propensity to spread (Fe_i) of individual i is expressed as a function of education level (E_i), the importance of network public opinion information m and environmental factors

$$Fe_i = \frac{m \times k}{E_i}. \quad (32)$$

where E_i represents the education level of individual i. k represents the environment of the social network, in general, take $\mathrm{k} = 1$, when an unexpected event occurs in the social network, $\mathrm{k} > 1$. m indicates the importance of the network public opinion information, and m is assigned according to its level:

$$\mathrm{m} = \begin{cases} 2.5 \text{ General importance} \\ 5 \text{ Relatively important} \\ 7.5 \text{ Important} \\ 10 \text{ Very important} \end{cases}. \quad (33)$$

(3) *The influence of transmission coefficient (Y_{ij}) of network public opinion information.* Y_{ij} represents the transmission coefficient of network public opinion information between individual i and individual j in the social network. The transmission coefficient Y_{ij} is affected by government and official media reports. After the occurrence of major emergencies, it is accompanied by the dissemination of network public opinion information. The propagation process is shown in Figure 4

In the initial stage of network public opinion, there is only a small range of public dissemination, forwarding, and reporting, and the information transmission coefficient (Y_{ij}) between individuals in the social network is only affected by the individual itself. When the influence of the network public opinion events is further expanded, the government and official media will issue a statement on the event, and the degree of reporting and response speed of the government, official media, and other relevant departments to the event play an important role in the dissemination of network public opinion information. Timely, official reports will make individuals in the social network transmit information more quickly and frequently, that is, the transmission coefficient (Y_{ij}) of network public opinion information between individuals i and j is larger.

$$\mathrm{Y}_{ij} = \begin{cases} \mathrm{h}_{ij}, \tau \le \tau_0 \\ \mathrm{h}_{ij} + \mathrm{G} \cdot e^{-(1/M)}, \tau > \tau_0 \end{cases}. \quad (34)$$

where h is the information transmission coefficient (self information transmission coefficient) of individual i and individual j without external environment interference, G is the utility of the government, M is the guidance strength

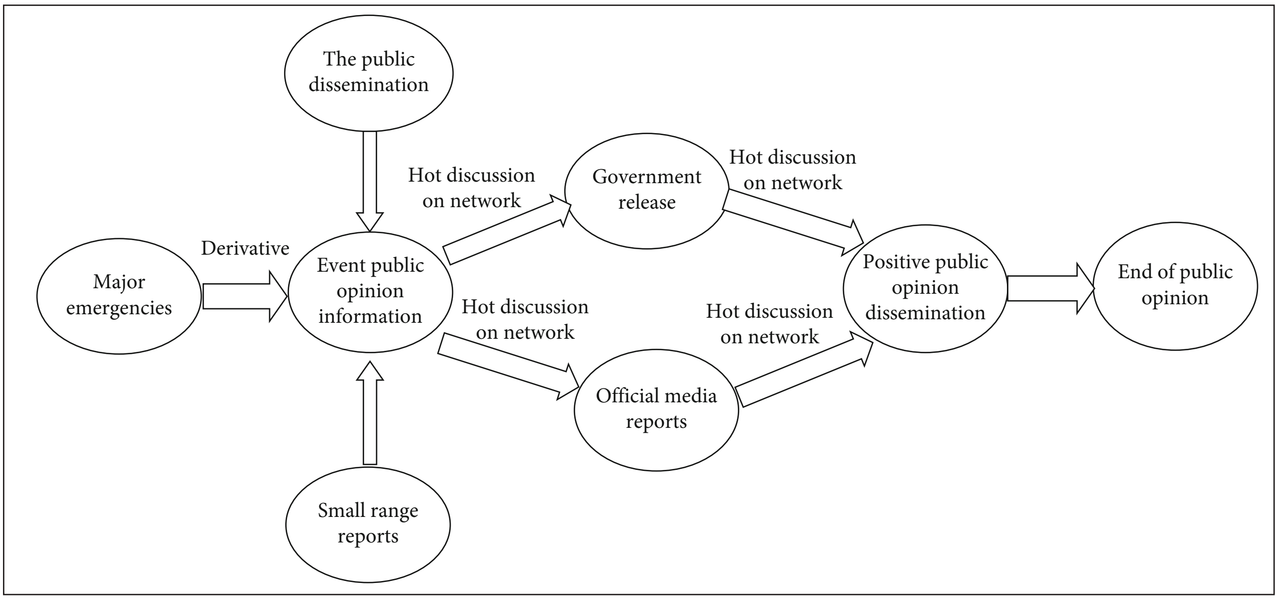


FIGURE 4: Network public opinion dissemination process of major emergencies.

of the official media, τ_0 is the reaction time of the government and the media

When $\tau \le \tau_0$, the information transmission coefficient (Y_{ij})of network public opinion is only related to its own information transmission coefficient h;

When $\tau > \tau_0$, the information transmission coefficient of network public opinion is affected by the coupling of itself, the government and the media.

(4) The influence of the breadth of network public opinion dissemination (R_i). R_i represents the breadth of dissemination of the possible propagation of network public opinion information of individual i in the social network. The diffusion degree of individual i for network public opinion information depends on the number of neighbor nodes of individual i. Nb_i is the number of neighbor nodes of individual i, that is, how many neighbor nodes can receive the network public opinion information spread by individual i.

$$R_i = \begin{cases} \omega, \mathrm{Nb}_i = 0 \\ 1 - e^{-\mathrm{Nb}_i}, \mathrm{Nb}_i \neq 0 \end{cases}. \tag{35}$$

where the range of R_i is $R_i \in (0, 1)$,there is a positive correlation between Nb_i and R_i, indicating that the greater the number of neighbor nodes of individual i node, the wider the spread of network public opinion information. ω is a default minimal real number, for example $\omega = 10^{-6}$, use ω to represent the value of R_i when $\mathrm{Nb}_i = 0$.

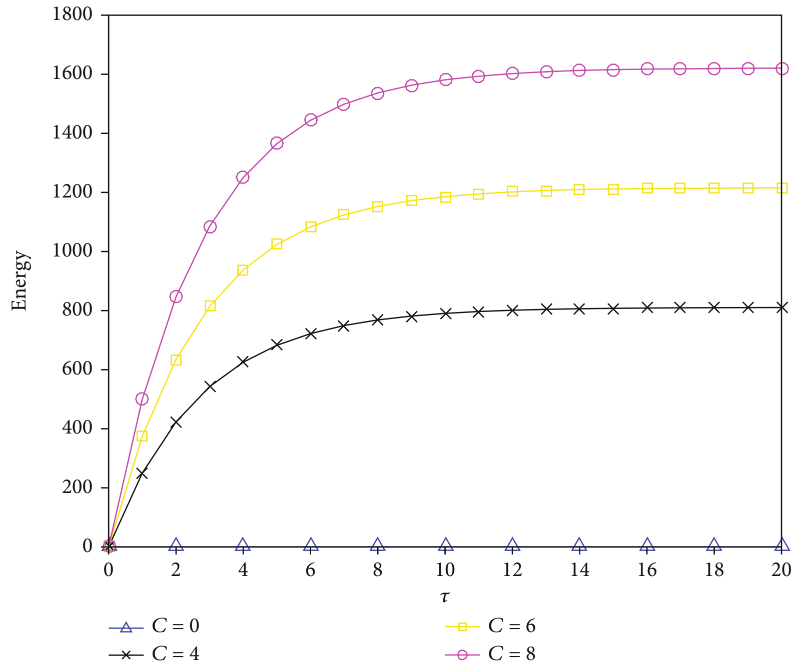
4. Numerical Simulation and Result Analysis

This section uses MATLAB platform to simulate the dissemination process of network public opinion of major emergencies and carries out simulation experiments. Firstly, it analyzes the propagator's propagation track. Secondly, it analyzes the influence of each factor on the propagator's access to energy. Finally, the influence of various factors on the total energy in the social system is simulated and analyzed. Through the simulation experiment, find out the key factors that affect the network public opinion communication of major emergencies, so as to realize the regulation and governance of the network public opinion information of major emergencies and correctly guide the trend of public opinion.

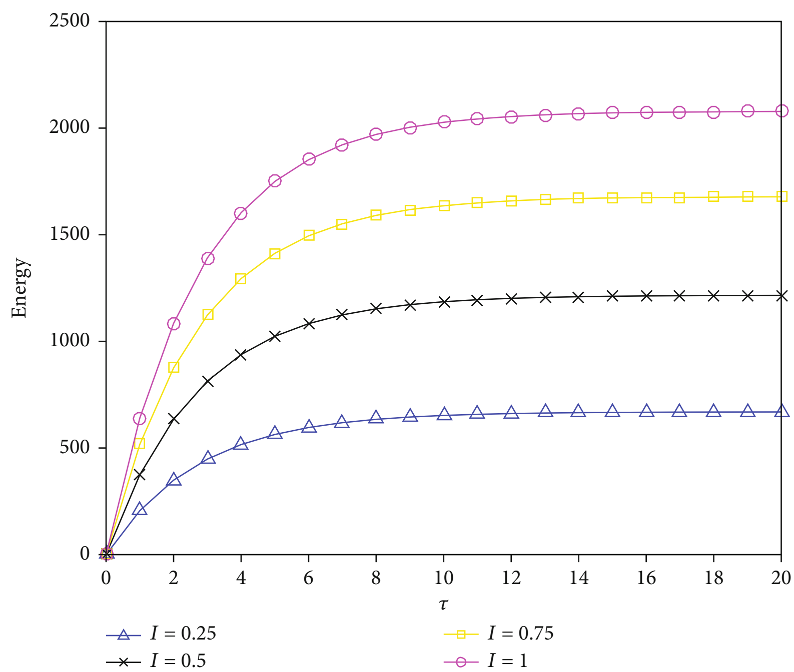
(1) *The influence of individual's interest in network public opinion information (α_i) on the propagation of network public opinion in major emergencies*. The individual's interest in network public opinion information (α_i) is affected by individual activity C and the fuzzy degree of network public opinion information I. Figure 5 simulation analysis of C and I parameters, respectively

Figure 5(a) describes the influence of the different individual activity C on individual energy in the dissemination process of network public opinion information. It can be seen from the figure that when the individual activity $C = 0$, the individual's energy value is always zero, that is, the individual does not transmit network public opinion information with neighbor individuals. When the individual activity C becomes larger, the energy peak becomes larger and the time to reach the energy peak is longer. It shows that with the increase of individual activity C, the greater the individual's attention to network public opinion, the longer the time affected by network public opinion.

Figure 5(b) describes the influence of the fuzzy degree I of different network public opinion information on individual energy in the dissemination process of network public opinion information. It can be seen from the figure that



(a) Influence of individual activity C on energy.



(b) Influence of fuzzy degree of network public opinion information I on energy.

FIGURE 5: The influence of individual's interest in network public opinion information (α_i) on energy.

when the information fuzzy degree I = 0.25, $\tau = 9$, the peak of personal energy is Energy = 523. When the information fuzzy degree I = 1, $\tau = 11$, the peak of personal energy is Energy = 2023. That is, the more fuzzy the network public opinion information, the greater the individual energy peak in the social network, and the longer the time to reach the energy peak. It shows that the more ambiguous the network public opinion information is, the less comprehensive the authenticity disclosure of the event is. The more concerned individuals are about public opinion, the longer the network public opinion lasts and the greater the impact of network public opinion.

Figure 6 describes the influence of the fuzzy degree of different network public opinion information I on the number of disseminators in the process of network public opinion information dissemination. It can be seen that when the fuzzy degree of the network public opinion information is $I = 0.25$, the number of final disseminators in the social

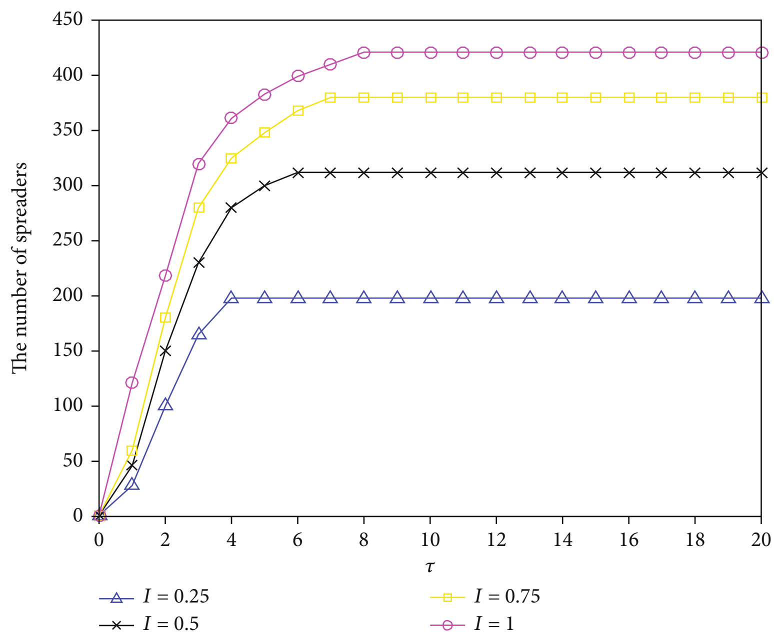


FIGURE 6: Influence of fuzzy degree in network public opinion information I on the number of network public opinion disseminators.

system is higher. With the increase of the fuzzy degree of network public opinion, the number of disseminators in the system also increases. This shows that when the network public opinion information spreads in the social network, the more fragmented and fuzzy the network public opinion information, the more people pay attention to it, and the easier it is to be spread by individuals. This requires the government and the media to release official information in a timely manner, refute rumors about the spread of false information, and guide the trend of network public opinion.

(2) The influence of propensity to spread Fe_i on the network public opinion dissemination of major emergencies.

Figure 7 describes the influence of different education levels E_i received by individual i in the social network under the action of anarchy and media on the energy received by neighbor individuals in the process of network public opinion information dissemination. It can be seen from the figure that as the education level E received by users increases, the time for individual energy to reach the peak becomes faster and faster, and the peak value of individual energy becomes smaller. It can be seen that with the improvement of individual education, individuals are less affected by network public opinion events, the duration of individual influence by network public opinion events is shorter, and individuals' ability to identify network public opinion events is enhanced. Considering the principle of diminishing marginal utility, with the improvement of individual education, the degree of change of individuals affected by network public opinion events becomes smaller. It shows that when the individual's education level is relatively low, improving the individual's education level can greatly reduce the impact of unproven network public opinion information on individuals.

Figure 8 describes the impact of different education levels E_i received by individual i in the social network on the number of disseminators in the network public opinion information dissemination process system under the action of anarchy and media. It can be seen from the figure that when the government and the media do not release official information, the higher the level of energy education received by individuals in the social network, the fewer disseminators of network public opinion information in the system. This shows that when the government and the media do not release the real news, the individuals with higher education have a certain ability to judge the network public opinion information and will not blindly transmit the network public opinion information before they get the official information.

Figure 9 describes the influence of the importance degree m of network public opinion information on individual energy in the process of network public opinion dissemination. It can be seen from the figure that when the importance degree of network public opinion information m = 2.5, that is, when the network public opinion information is generally important, the $\tau = 3$, the individual energy reaches the peak: Energy = 513. When the importance degree of network public opinion information is m = 10, that is, when the network public opinion information is very important, the $\tau = 20$, the individual energy reaches the peak: Energy = 2313. It shows that the more important the network public opinion information is, the longer the impact of the network public opinion information lasts, the greater the peak value of individual energy, and the greater the impact of the network public opinion events on individuals.

Figure 10 describes the influence of the importance degree in network public opinion information m on the number of disseminators in the system during the dissemination of network public opinion information. It can be seen from the figure that the more important the network public opinion information is, the more people will spread the

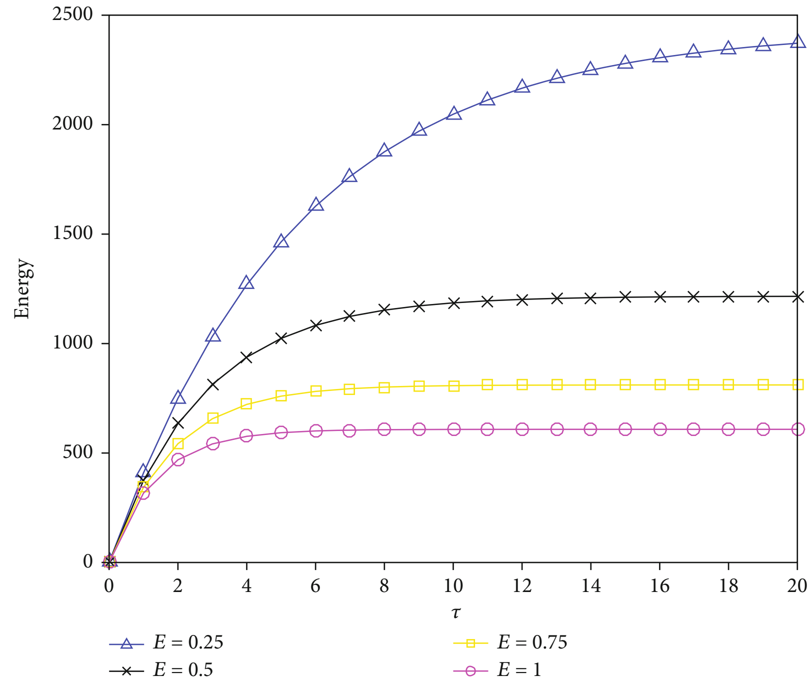


Figure 7: Influence of education level E_i on energy.

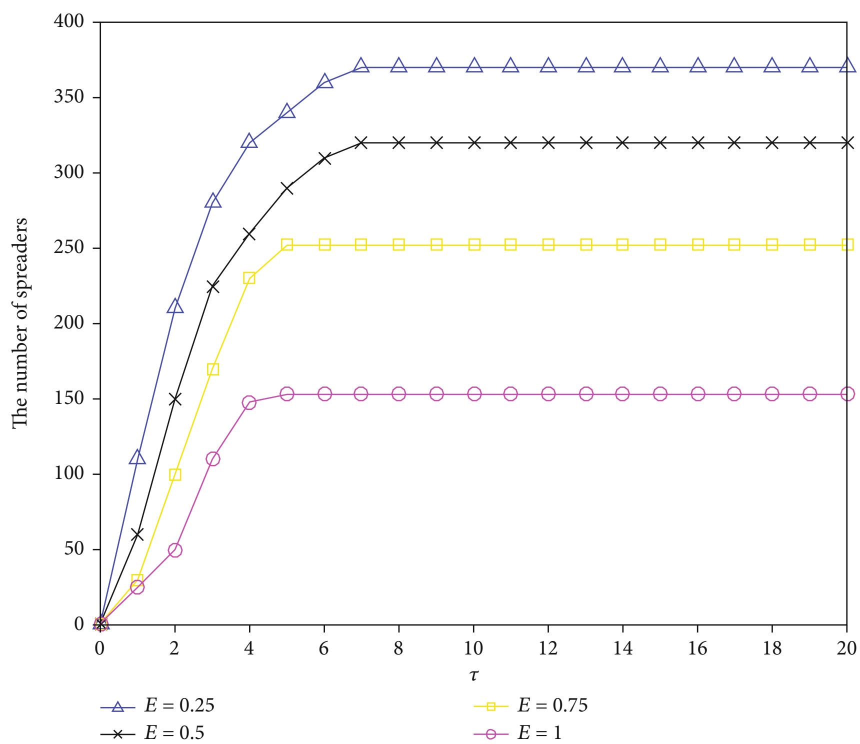


Figure 8: Influence of education level E_i on the number of network public opinion disseminators.

network public opinion in the system, and the longer it takes to reach the peak. It can be seen that the occurrence of major emergencies has a significant impact on the lives of social groups. When the network public opinion information of major emergencies is more important, people pay more attention to it and more people spread it. This requires the government and the media to respond quickly to network public opinion, release official information in time, and actively guide the development trend of network public opinion.

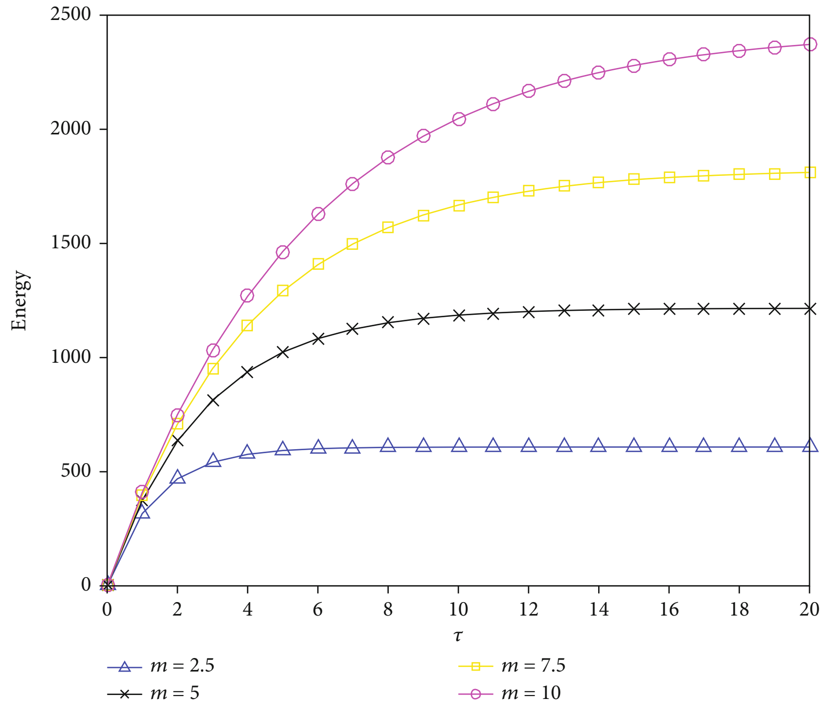


FIGURE 9: Influence of importance degree in network public opinion information m on energy.

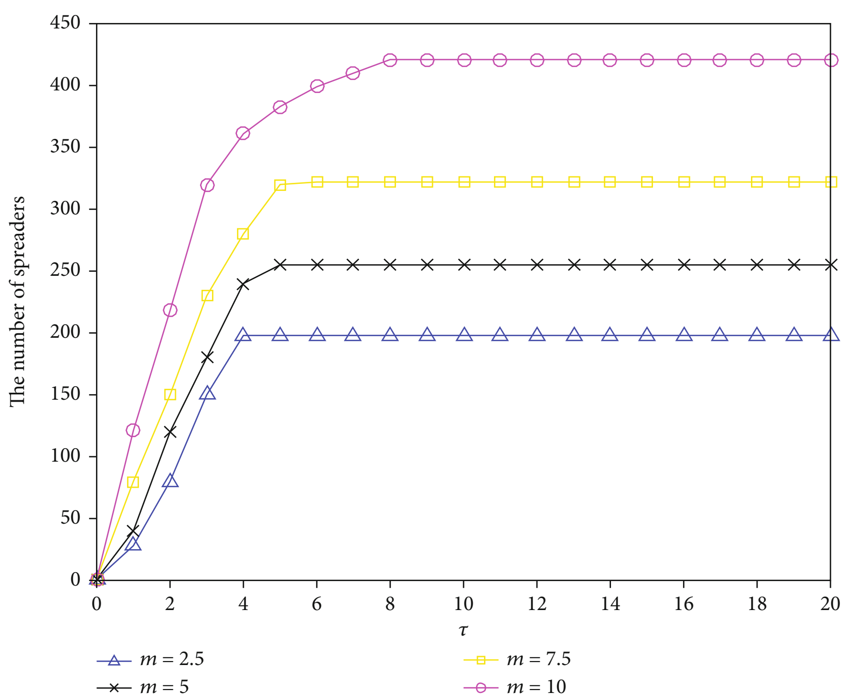
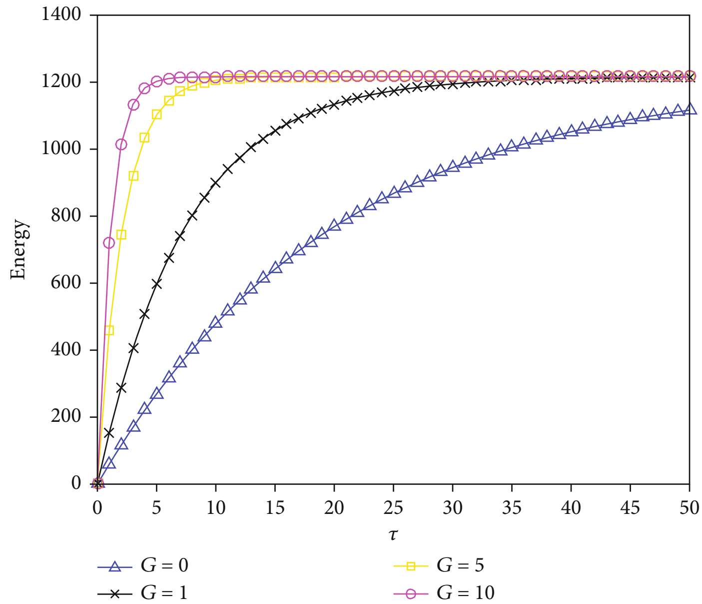


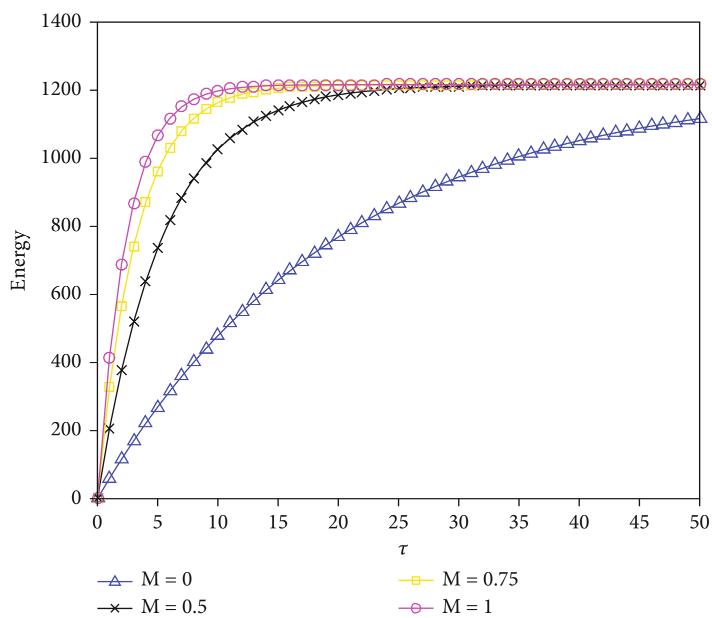
FIGURE 10: Influence of importance degree in network public opinion information m on the number of network public opinion disseminators.

(3) The influence of the role of government and the media on the network public opinion dissemination of major emergencies

Figures 11(a) and 11(b), respectively, describe the influence of the government utility G and the official media guidance M on individual energy in the dissemination of



(a) The influence of government utility G on individual energy in network public opinion dissemination.



(b) The influence of official media guidance M on individual energy in network public opinion dissemination.

Figure 11: Influence of government utility G and media guidance M on individual energy.

network public opinion. It can be seen from the figure that under the guidance of the government and official media, the individual energy threshold becomes larger. It shows that individuals in the social network pay more attention to the development of network public opinion due to the positive reports of network public opinion information by the government and official media. At the same time, with the increasing attention of the government and the official media, the shorter the time for individuals in the social network to reach the energy threshold, and the shorter the duration of network public opinion. It shows that when the government and the official media pay attention to the development of events and timely and positively guide the trend of network public opinion events, the duration of events will become shorter.

(4) The influence of breadth of dissemination in network public opinion R on the network public opinion dissemination of major emergencies

The breadth of dissemination of network public opinion R is determined by the number of neighbor individuals of individuals in the social network. Figure 12 describes the influence of the number of neighbor individuals Nb on the individual energy in the process of network public opinion propagation. It can be seen from the figure that when the

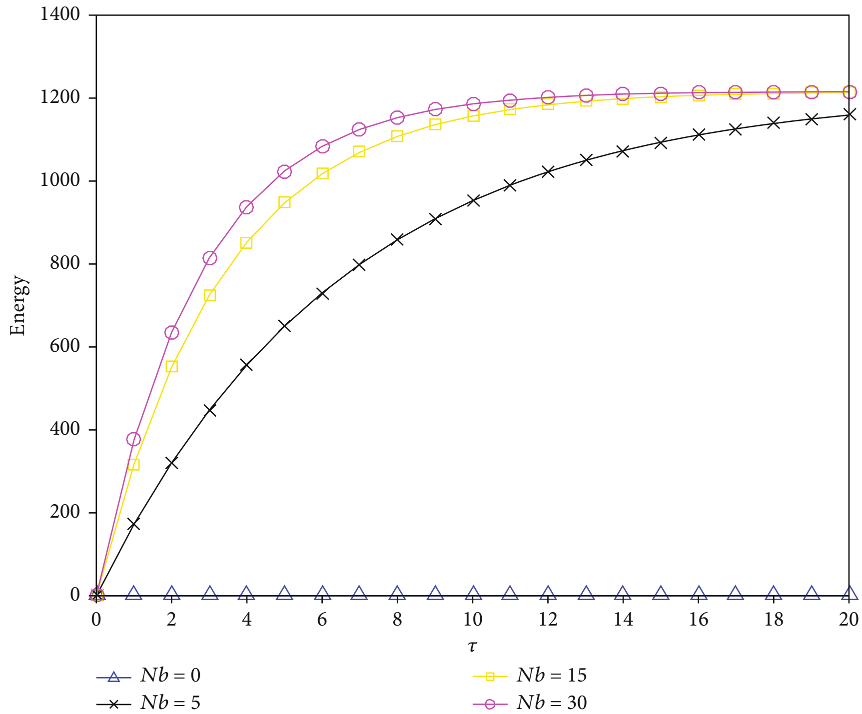


Figure 12: Influence of the number of neighbor individuals Nb on individual energy.

number of neighbor individuals Nb = 0, the energy value of the individual is always zero, that is, the individual has not exchanged energy and has not transmitted and exchanged network public opinion information with the neighbor individuals. When the number of neighbor individuals Nb becomes larger, the time for individual energy to reach the peak is shortened and the peak becomes larger. The results show that in the social network, with the increase of the number of individual neighbors, individuals can gather energy more quickly and obtain network public opinion information.

5. Conclusion

This paper explores the propagation control of network public opinion in major emergencies.

Firstly, the exchange of network public opinion information between individuals in the social network is analogized to the process of object heat transfer, and the process of network public opinion dissemination is explored by the accumulation of individual energy in the social network. Based on the heat conduction theory, the propagation control model of network public opinion in major emergencies is established. The research analyzes the influence of individual interest, propensity to spread, transmission coefficient, and breadth of dissemination of network public opinion information on the propagation process of network public opinion in major emergencies.

Secondly, the energy model is numerically simulated by MATLAB software and the experimental results are analyzed. Through various influence factors in the spread of network public opinion analysis and simulation experiment, further explore the internal mechanism of network public opinion information transmission, explores the law of its spread, found the key factors that influence the spread of major unexpected things network public opinion, and to effectively guide the direction of the development of network public opinion provided the powerful basis.

In this study, the principles of physics are used to explain the propagation control of network public opinion in major emergencies. Under the background of multidisciplinary integration, the principles and methods of other disciplines are used to explore the phenomenon of this discipline, which is an attempt to broaden the research ideas.

However, this study only considers the influence of individual interest, propensity to spread, information transmission coefficient, and breadth of dissemination of network public opinion on the propagation process of network public opinion in major emergencies, and more factors will be added in the follow-up study, so as to make the propagation process of public opinion in major emergencies more detailed and to achieve more accurate prevention and control research.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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