Research on Cellular Automata Network Public Opinion Transmission Model Based on Combustion Theory

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Abstract. With the continuous development of social networks and the continuous emergence of public opinion on the Internet, the government's emergency response is facing tremendous pressure. In this paper, cellular automata is used to compare the social relationships between individuals in the network. Combustion propagation models are used to compare the network masses to several types of burning substances according to their propagation characteristics. The influencing factors among individuals are determined. A network public opinion propagation model is established to explore the rationality of its propagation.

1. Introduction

With the continuous development of Internet technology and the continuous enrichment of communication methods, more and more people choose to recognize, communicate and judge events through the website, circle of friends, Weibo and other methods as soon as possible. Network media and online public opinion often have the characteristics of fast response, strong authenticity, and wide range of influences[1-2]. When emergencies occur, especially when large-scale natural disasters and public health incidents occur, netizens often find themselves while expressing the same Internet users under the same incident. As a result, public opinion on the Internet is formed, and even social conflicts are caused.

At present, research on the spread of Internet public opinion mainly focuses on two aspects: one is the infectious disease model, and the other is the multi-attribute model. Because the spread of infectious diseases is similar to the way of information exchange, many scholars use the model of infectious diseases to study Internet public opinion. Goffman and Newill[3] proposed using a dynamic model of infectious diseases to study the spread of information in the population. Zhao, W.D[4] also carried out research on the spread of Weibo information based on SIR model. Li,C.C[5] and other scholars proposed a network rumor burning model to describe the law of network rumor spread. On the other hand, scholars have considered factors such as psychology and age in the Internet public opinion into the propagation model, and scholars such as Deng,Q[6] have considered environmental factors and the influence of individual Internet users into the propagation model.

Based on cellular automata and considering the influence among individuals, this paper uses the combustion propagation model to compare the Internet masses to several types of combustion substances according to their propagation characteristics, establishes a network public opinion propagation model, and discusses the rationality of its propagation.
2. Cellular automaton propagation model of network public opinion based on combustion theory

Neumann first proposed the concept of cellular automata to describe the self-reproduction of individuals [7-8]. A single unit cell in the cell space can be updated in real time according to the state of the adjacent unit cell. The information exchange between network individuals in network public opinion is similar to the propagation mechanism of cellular automata model. Li, C.C. [5] proposed the use of combustion theory in social networks to characterize the interactive relationship between users, so that the spread of Internet public opinion more in line with actual laws. Each unit cell in the cell space represents every user in this social network. The neighboring unit cells appear to have a social relationship with them in the network, that is, the neighboring unit cells will affect each other.

In this paper, users in social networks are compared with various substances in the combustion state according to their state characteristics, and the social relationship between users is established according to the characteristics of cellular automata. After communication between users, the crystal is defined by the combustion mechanism The influence relationship between cells, and the spread and evolution of Internet public opinion.

2.1. Cell space and its domain

This article uses the Moore evolution trajectory, the eight-neighbor rule. The black unit cell in the figure is referred to as the node under study, and the gray unit cell is the adjacent node of the black unit cell. As shown in Figure 1 (a), when the black unit cell to be studied is at the corner position of cell space, the number of adjacent unit cells in its domain is 3, and similarly, in Figure 1 (b) and As can be seen in Figure 1 (c), when the black unit cell is at the edge position and the center position, the number of adjacent unit cells in its area is 5 and 8.

![Figure 1. Cell space and its domain](image)

2.2. Impact relationship

In social networks, the spread of public opinion has many similarities with burning. The four types of substances in the combustion process: smoldering substances (D, Divorced), burning substances (D, Divorced), flame suppressing substances (D, Divorced), stable substances (D, Divorced) and each of the social networks Analog users are analogized and divided into four categories:

Smoldering users (D): Individual Internet users do not receive public opinion information. After contacting the burning users, they will be converted to burning users at the burning rate $\alpha$; after contacting the burners or burners, they will be changed at the burning suppression rate $\beta$ Suppressor; Over time or after contact with the burner, it will change to a stable one with a self-decay rate $\omega$.

Burning users (B): Individual Internet users have been exposed to public opinion information. After contacting the burning users, they will be converted to burning users at the burning rate $\alpha$; after contacting the burners or burners, they will be changed at the burning suppression rate $\beta$ Suppressor; After being contacted, the burner will transform to a stable user with a probability of $\gamma$; as time goes on, it will also change to a stable with a self-decay rate $\omega$.

Suppression of fire users (F): Individual Internet users are exposed to public opinion information, have no willingness to spread, and have a certain ability to spread. Smoldering users or burning users may become stable users after contacting them.
Stable users (S): Individual Internet users are exposed to public opinion information and have no willingness to disseminate, and will not change to other states.

The state transition relationship between network users can be simplified as:

\[
\begin{align*}
D & \xrightarrow{\alpha} B \\
B & \xrightarrow{\eta, \gamma, \omega} S \\
D & \xrightarrow{\beta} F
\end{align*}
\]

Figure 2. The influence relationship

3. Model simulation and analysis
This article conducted simulation experiments based on the above propagation models to study the spread of Internet public opinion in social networks. The experimental scenario is constructed as follows: The spread of online public opinion needs a starting point. It is assumed that at the beginning, except for a few burning users, the rest of the social users on the network are smoldering users. Web users started. So set the cell space to 500 * 500, which is 2.5 * 10^5 users. The unit cells randomly set (350,360) and (100,100) positions represent the burning users. Set the burning rate \( \alpha = 0.3 \) and the flame suppression rate \( \beta = 0.02 \). The \( \omega = 0.001, \eta = 0.001, \gamma = 0.001 \), and the time axis is 0 to 300.

It can be seen from Figure 3 that after the public opinion on the Internet began to spread, the smoldering user group fell from slow to fast, and then gradually slowed down. This is because the number of burning users among network users increased rapidly. When the simulation progressed to about 130s, At the peak, the rate of smoldering population also reached its peak. With the continuous increase of the number of burners, around 170s, the number of stable user groups began to exceed the number of burner users. The simulation results show that the burners can greatly promote the spread of online public opinion, and the increase in the number of burners can effectively curb the development of online public opinion.

4. Summary
Based on the combustion mechanism, this article simulates the public opinion transmission among network users with social relationships on the basis of cellular automata, and conducts simulation
under the set conditions to explore the various types of network users during the online public opinion transmission. The changing trend provides a reference for the government's emergency response in the Internet public opinion.

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