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Cellular Automaton-based Controlling Simulation of Fake Information Diffusion in Public Crisis

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Abstract: In order to clarify the mechanism of public crisis fake information diffusion and its intervention mechanism, this paper has done the research from perspective of complex science and social network theory. First, the background of fake information diffusion in public crisis management was analyzed, then three hypothesis of simulation were concluded. this research will choose interventions to control fake information through Cellular Automaton simulation, and put forward a set of interventions in view of the reality of different situation to help control and reduce the loss of public crisis. This project will further perfect the theory of public crisis information spread and have the very vital significance to improve the government's information evaluation ability and intervention capabilities.

Key words: Cellular automaton, chaos management, fake information, public crisis

INTRODUCTION

Fake information in public crisis tends to be the direct cause of the public emergency and catalyst, to seek the effective management of public crisis of fake information has become an important content of public crisis management (Zhang and Xie, 2006; Zanette, 2001). However, after looking at Elsevier, Spring link PQDD, ISTP, EI Village database, as well as Chinese, in national library of science and technology periodical database, and the national natural science fund project topic during 99-07, the author finds that the research about the problem of false information on the public crisis mainly concentrated in the field of communication studies, political science and sociology ,many scholars both at home and abroad discuss the public crisis fake information problems with the method of qualitative analysis and case analysis and very few people with the method of computer simulation from the perspective of management (Fan, 2007). For example, as a kind of complexity information problems are gradually caused extensive concern of academic (Fan, 2007; Cao *et al*., 2007). Fu *et al*. (2007) defines the connotation of the complexity of the category of fake information and constructs the public crisis information diffusion simulation model based on Cellular Automaton method and simulates the diffusion simulation model based on Cellular Automaton method and simulates the situation of the fake public crisis information diffusion.

RESEARCH HYPOTHESIS

As the information age is coming and global integration trend is accelerating, the production, diffusion and special harmfulness of fake information has more and more influence on the public crisis (Moreno *et al*., 2004), or be the cause of public crisis, or increase the complexity and uncertainty of public crisis, thus greatly increase the difficulty of public crisis management (Duggan and Banwell, 2004). In order to improve the false information interference ability, this paper puts forward the following hypothesis:

- **Hypothesis 1:** management performance of fake information in public crisis can be evaluated from management strategy and execution
- **Hypothesis 2:** Fake information management in public crisis is a process of repeatedly comparing goals, effectively correcting deviations
- **Hypothesis 3:** Every management behavior can effectively correct the deviation in a certain range and achieve management objectives

SIMULATION MODEL OF CONTROLLING

Research method: Cellular Automaton method based on chaos theory is a kind of nonlinear system evolution prediction method (Liu, 2003). Cellular Automaton mainly adopts "bottom-up" modeling ideas (Bottom-Up). As a general modeling method (Seeger, 2002), the prediction

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method of chaotic situation focuses more on the application of chaos theory to explain and analyze the process of the formation and evolution of the complex phenomena, while is widely used in simulation, evaluation and imitation about the complex social economy phenomenon and the public management policy (Hui and Gao, 2002). Compared with traditional methods, Cellular Automaton method can describe the interaction between primitive easily, it can simulate some complex phenomena difficult to be analyzed and expressed and its evolution better, and can vividly and truly reflect the detailed structure and pattern of a large number of individual interaction, can be used to predict, simulate to produce the future prospect of fake information evolution in public crisis, is an effective research method for simulation of fake information management in public crisis.

Model building: According to the Cellular Automaton method, a management simulation model of fake information diffusion in public crisis is as follows:

$$A = (L_d, S, N, F)$$

- **Primitive and space (L_d):** Space refers to the entire space in which fake information in public crisis spread
- **Neighbors (N):** Definition of neighbor is the abstraction about a network in the real world, and neighbor refers to potential recipients of fake information in public crisis and these potential recipients are closed to each other. This article uses the Moore type, namely the primitive makes eight adjacent primitive (3 above, 3 below, each 1around) as its neighbors, as shown in Fig. 1
- **State (S):** There are two kinds of each primitive state with the 0 s and 1 s. The primitive state of 0 shows potential recipients refusing fake information, 1s accepting the fake information
- The decision rules (f): Decision rule is generalization and abstraction for potential recipients behavior and decision in the process of fake information spread in the state of public crisis

Research plan: According to the proposition and assumptions above, in this article influence from fake information management strategies and management executive ability in public crisis on the spread of fake information is discussed. In terms of control simulation, in this article fake information management in public crisis is divided into (A) simple, complete management, (B) to coordinate and direct management, TWO types. Use (a) a whole line, (b) one ring (including central point) in public crisis to correspond to said 2 types above of management strategy work area.

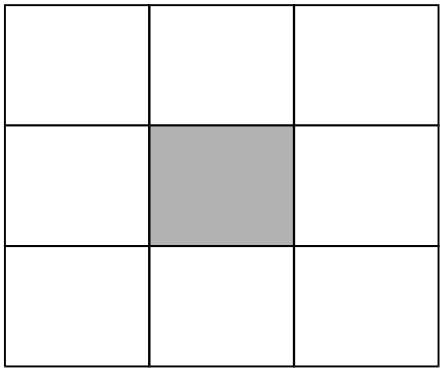

Fig. 1: Type MOORE neighbors

Table 1: Simulation scheme of fake information management in public crisis

	(A) simple and complete	(B) coordinate and direct
(I) Defensive management	AI	BI
(II) Discrete management	AII	BII
(III) Sustainable management	AIII	BIII

To measure the simulation executive ability, the codes of execution frequency are used as ① ② ③, respective of (I) defensive management, (II) discreteness management and (III) sustainability management.

In conclusion, there are a total of 6 kinds of controlling simulation solution AI, AII, AIII,BI, BII, BIII, as shown in Table 1.

RESULTS AND ANALYSIS

The results of the study: In order to take for general and observation, acceptance probability P of the false information was set to 0.3. Simulation clock is set to 25 K, simulation interface is set to 100 x 100, potential recipient of fake information is defined as (0, 0)-(100,100) the positive integer point coordinates in two-dimensional space. Convenient for drawing, in this article the evolution of the drawing map following (Fig. 3-10) undertakes unity agreement: (1) Primitive tag are moved towards the positive axis 10 units when drawing again, namely point actually at (I, j) in the picture marked at (I+10, j+1), I, j for the abscissa and ordinate respectively; (2) plot (i+10, j+10, 's',' Marker Edge Color', 'b', 'Line Width', 0.05,' Marker Face Color', 'k', 'Marker Size', 5; (3) plot i+10, j+10, 'r*', 'Marker Size', 5 the I, j says abscissa and ordinate of the action area. Through many simulation tests, the most typical evolution distribution and quantity variation are taken and the results of simulation experiment are summarized as follows:

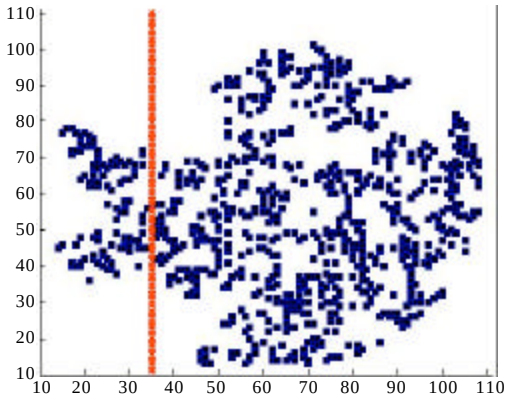

Fig. 2: The evolution of distribution in AII

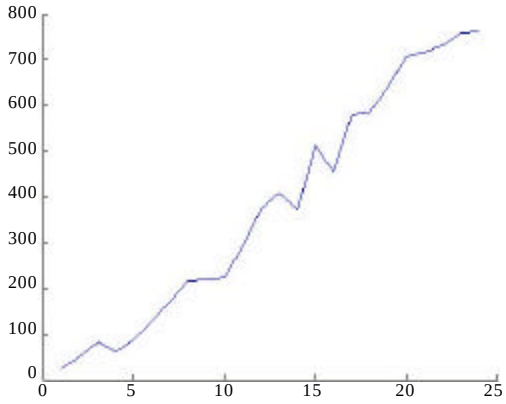

Fig. 5: Changes of number of recipients in AI

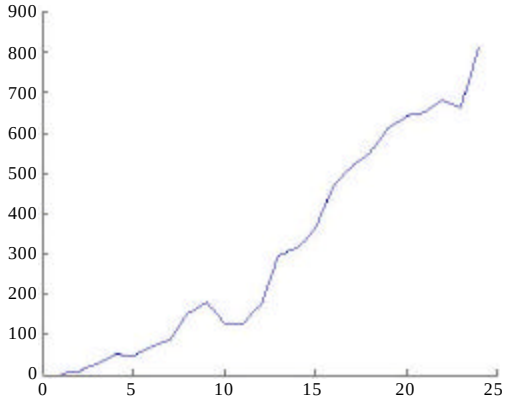

Fig. 3: changes of number of recipients in AII

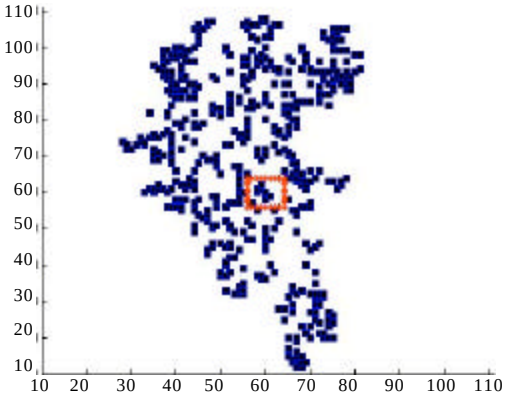

Fig. 6: Evolution of distribution in BII

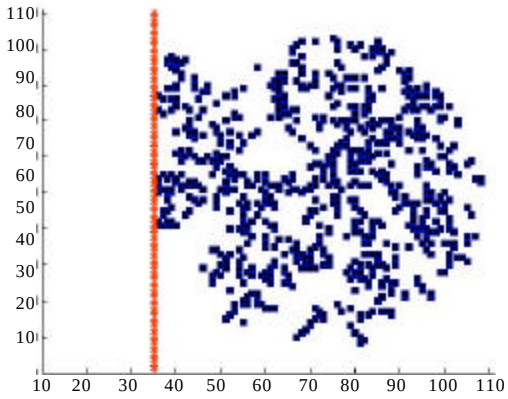

Fig. 4: Evolution of distribution in AIII

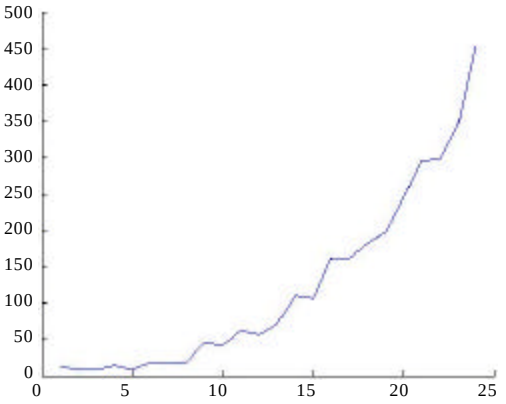

Fig. 7: Changes of number of recipients in BII

In the scheme A, take fake information management function area in public crisis for the 25th line the entire line. The simulation experiment results show that: AII scheme can delay the spread of fake information, as shown in Fig. 2.The spread speed from the center to the function area lags significantly behind in other direction,

but it is difficult to effectively block fake information spread in public crisis in quantity, as shown in Fig. 3. As shown in Fig. 4, all the parts on the left side of the25th line of is blank, and the diffusion in the other direction is not affected, fake information diffusion in public crisis is sheared by function area. In terms of the number change, in BIII situation number change curve of fake information receiver in public crisis at K = 10 and K = 15 has an obvious fluctuations, but overall curve still maintains rapid growth trend, the ultimate recipient number is less than 700, less than the number of fake information receiver in AII situation. Comparing the evolution distribution of the fake information in public crisis and quantity change in two schemes (situation), we can know it can be more effective to prevent the fake information in public crisis spreading the outside of function area for AIII schemes than AII, and it can be more effective to reduce the number of fake information recipient in public crisis for BIII schemes, this fully shows that the administrative executive ability is important for fake information spread in public crisis.

In B scheme, layer 4 neighbors outside the center is taken for action area, namely the encirclement made up by line 46, row 54, and column 46 and 54. The simulation experiment results show that BII scheme has obvious influence on fake information spread in public crisis, which mainly manifests in the following two aspects: (1) Compared with the free diffusion scene, in public crisis fake information spread speed in each direction from the center to the surrounding no longer has convergence, diffusion speed in some direction is high, and some is low, as shown in Fig. 6. (2) in terms of quantity changes, change curve of the receiver number is coarser, jagged peak appears for many times, as shown in Fig. 7 In BIII situation, fake information in public crisis is strictly controlled within the function areas, namely fake information in public crisis cannot penetrate the area, as shown in Fig. 8, and the number of fake information recipient changes irregularly and randomly, as shown in Fig. 9. It suggests that BIII management scheme can effectively control and limit the spread direction of fake information in public crisis. Comparing the effect of BIII scheme with BII, we can know both schemes at the beginning of diffusion have certain influence on fake information spread in public crisis, thus in the early the gap in terms of the number change is not obvious, but due to differences of the late management executive ability ,ultimate evolution results are different, the former continue to spread out so that the number of receiver finally reaches 450, while the latter is strictly limited in function area and the largest number of recipients is only 15.

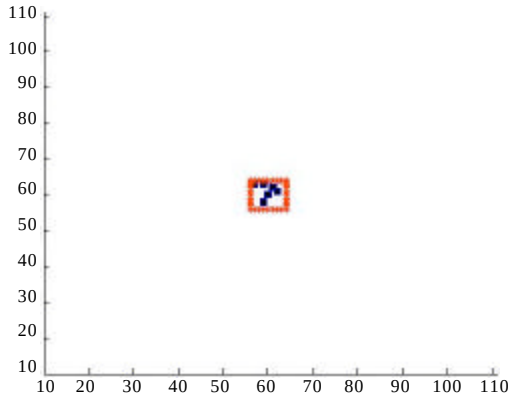

Fig. 8: Evolution of distribution in BIII

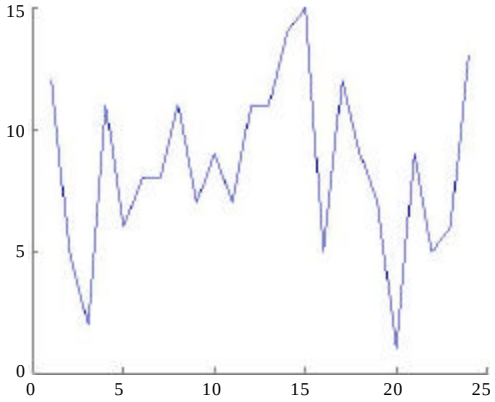

Fig. 9: Changes of number of recipients in BIII

This fully shows that information management in public crisis must be paid constant attention, especially executive ability of the fake information in public crisis must not be lax; if fake information in public crisis takes information isolation measures, strong management executive ability must be equipped with to effectively prevent and eliminate the proliferation and spread of fake information.

CONCLUSION

It can conclude that from the simulation results, (1) with the same situation in other aspects, coordinated management is more effective than simple management. In coordinated management mode the fake information diffusion direction and quantity can be effectively controlled and simple even if complete management can only prevent the fake information diffusion in a certain direction. (2) Among various kinds of schemes, the sustainable management effect is superior to the discrete

management. This suggests that in the process of fake information management in public crisis, fake information management executive ability and execution of various management strategies must be strengthened, the consistency and the continuity of management countermeasures and measures in each stage should be paid enough attention to.

However, in more complex evolution situation, how to combine management strategy with management executive ability more effectively to control the diffusion and spread of fake information in public crisis remains to be further in-depth studied.

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