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On Graduate Students-centered English Teaching Based on PBL in the Big Data Era

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Abstract: As an effective approach to research and to analyse public safety events, safe behaviour simulations are widely adopted in this research area. However, the complexity of safe group behaviors brings a lot of challenges to existing unitary pattern algorithms. To improve the accuracy of describing group safety behaviors in panic, this paper proposes a multi drive force model framework, which analyses stimulation factor and emotion factor in the process of group safety behavior evolutions. And to improve the efficiency of multi-agent based simulation systems, an indexed Multi-agent based algorithm is also put forward in this paper. In the end, the feasibility and efficiency of the proposed framework are verified by some experimental results.

Keywords: Algorithm, Multi-drive force model, Safe behavior, Simulation.

1. INTRODUCTION

Among public security accidents in the development process of urban modernization, sudden crisis may cause disastrous results which have raised a lot of attentions all over the world [1]. For example, in Second Miyun Spring Lantern Festival (Mihong park, Miyun District, Beijing, China) one visitor fell into a river when crossing a bridge at 19:45, Feb. 5th, 2004, which attracted the crowd and caused congestion, trampling 37 people to death and injuring 15 people. On one hand, this accident attracted serious public and governmental concerns about safety and it also attracted much needed research about tackling sudden crisis. Since public and touristic places gather people of different habits, culture and social values, the evolution of people behavior is very complex that it needs efforts from multiple disciplines, such as safety science, psychology, behavioral science, computer science, information theory, control theory, physics, mathematics, and engineering [2]. What is more, in a panic situation people behaviors have more dynamic features than usual [3], such as uncertainty and unpredictability. At the same time sudden crisis is irreproducible and easy to cause great damage to surroundings, which also brings great challenges to academic researches. As a low cost analysis technology, simulations have been widely used in this research area [4]. And scientists have gained a lot of significant researches on this issue.

German theoretical physicist and transportation scientists Helbing D (Helbing) proposed the definition of the force that affects the individual behaviour among the crowd from a mathematical point of view. He published a paper in Nature, and established a particle system based on social force model [5, 6]. According to this social force model, pedestrians are all same when describing interactions among different people, that is to say, all force varying patterns of pedestrians to given individual are same. However, this assumption does not agree with the true situation, for different pedestrians always have different effects on given individual and the desired speed of the pedestrian is always changing.

To improve the description of the force that is imposed on individuals in crowd behaviours, Taku Komura [7] summarized the interactions among individuals in "Crowd simulation" in his report. From the physics point of view, these forces basically reflect the physical and social forces that are exposed to individuals in crowd behaviours. Taku Komura also analysed potential field based methods. Although satisfying rational crowd behaviours well, they lack cognitive and emotional expressions for crowds in panic.

Since the evolution of group behavior can be deemed as a non-equilibrium system within open systems, and can be featured as non-retrospective, random and subjective. Interactive techniques are involved in its mathematical expressions and simulation descriptions, such as cross-border handle, emotional contagion calculation, stimulate response, herd & follow. Unfortunately, the cellular automata and social force model cannot satisfy all these requirements. In this paper, a multi drive force model framework is proposed to analyze stimulation factor and emotion factor in the process of group safety behavior evolutions. And to improve the efficiency of multi-agent based simulation systems, an indexed Multi-agent based algorithm is also introduced.

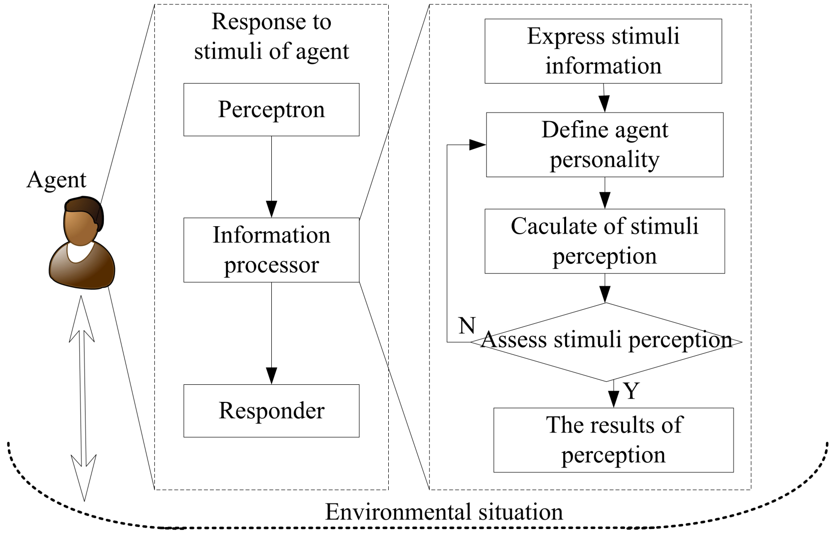


Fig. (1). Stimuli factor driving force calculation process.

2. MULTI-DRIVE FORCE MODEL FRAMEWORK

Generally speaking, group behavior presents itself in a rational and stable pattern, reflects a steady state, and the individual behavior inside is predictable, computable and controllable, despite of that there exist random phenomena. A lot of continuous and discrete models can describe these behaviors completely and successfully. Due to stimulations of abnormal factors, the group behavior shifts to completely non-rational states. Caused by complex influence factors, the evolution of group behaviors takes on a series of non-stable phase transitions.

2.1. Define Stimuli Factor

In the calculation process of group behavior evolutions, instant stimulations are usually ignored in stable states, while their sound definitions are crucial for non-steady states, for the disturbance caused by them can result in dynamic group behavior evolution phenomena.

In the proposed framework, the stimuli perception force coefficient can be calculated by formula (1), this formula is non-dimensional. The force coefficient is named to represent the effective strength from stimuli to individuals. According to the velocity and direction of reactions to stimuli derived from formula (1), agents can perform avoidance actions.

$$F_{(i)} = e^{-k_i d_{(i)}} \tag{1}$$

Where k_i is the coefficient used to describe differences of agents, $d_{(i)}$ is the distance between agents and stimuli source, the value of $d_{(i)}$ can be calculated by Euclidean distance:

$$d_{(i)} = \sqrt{(x-x_i)^2 + (y-y_i)^2} \, .$$

Fig. (**1**). describes the driving force calculation process.

2.2. Infection Calculation

Infection plays an important role in the process of group behaviour evolutions, behaviours of given individual can be affected by those of other individuals. When it comes to simulating infection, there are three basic issues that need to be solved first.

- What is the scope of infection?
- How to calculate the strength difference from different infectors?
- How to calculate the response difference of different infected individuals under the same circumstance?

The calculation process introduced in Fig. (**2**) aims at a sound solution to these issues.

The final result of infection calculation is the transfer velocity and direction of infected individuals to next state. Compared with other calculation methods, this paper introduces perception radius and emotional intensity to deal with the differences among individuals. The calculation of agent perception radius reflects different individual perceptions to density of people of the surrounding environment. In group behaviour evolutions, emotional contagion and infection can cause individual state transitions and affect the results of group behaviour evolutions. And this paper obtains the influence weight of velocity vector by individual emotional intensity by deducing the degree of influence of the given infected individual from different infectors.

The intensity increment of emotional infection PE_{ji} is obtained by Formula (2), where d_{ji} is the Euclidean space distance, and PE_{ji} defines the emotional infection degree from individual j to individual i.

$$PE_{(ji)} = (1 - \frac{1}{1+e^{-d_{(ji)}}}) * PE_{(j)} \tag{2}$$

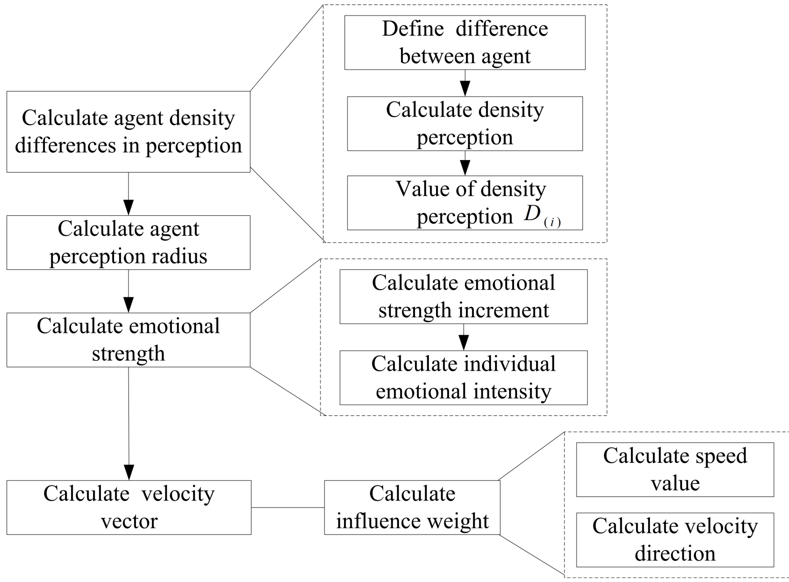


Fig. (2). Calculation process of infection.

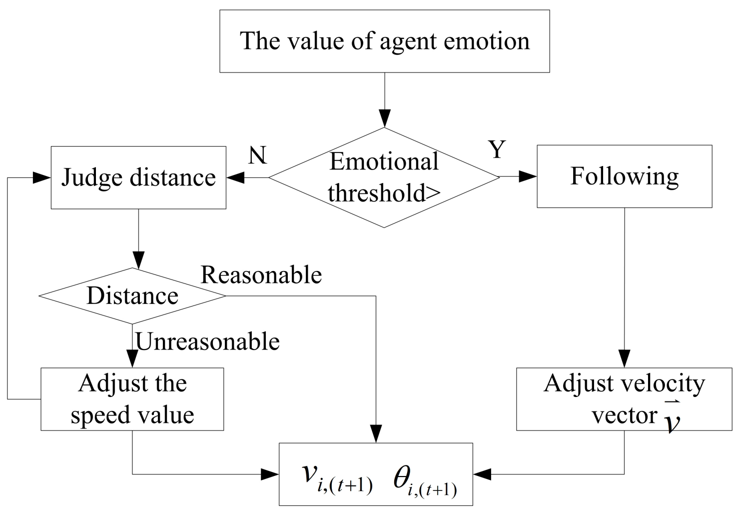


Fig. (3). The calculating processes of individual space perception.

Formula (3) calculates the influence value of given infected individual's velocity vector.

$$w_{(ji)} = \frac{PE_{(ji)}}{\sum_{j=1}^{n} PE_{(ji)}} \tag{3}$$

The velocity v_{t+1} and the direction $\theta_{(t+1)}$ s of individual i from moment t to (t+1) can be calculated by $w_{(ji)}$.

2.3. Individual Space Perception

In group behavior evolutions, according to their expectations individuals continuously change their states with surrounding environments. These behaviors can be usually deemed as a function of time and space. In the space state change, the emotional value of affected individuals accumulates with the spread of aggressive panic. When it reaches a certain threshold, panic arises. Otherwise, individuals will judge whether their space movement from moment t to (t+1) exceeds the max emotional value in given a group to ensure that their space locations always remains within this group. If the result is true, formula (4) is used to adjust their movements.

$$\begin{cases} v'_i = k_i v_i \\ \theta'_i = k_i \theta_i \end{cases} \tag{4}$$

Where k_i is the cognitive difference coefficient of different individuals, $k_i \in [0,1]$.

Individual space perception process is shown in Fig. (**3**).

3. INDEXED MULTI-AGENT BASED ALGORITHM

An indexed multi-agent based algorithm is proposed in this paper to improve the efficiency of this algorithm. This algorithm builds unified multi-agent classes based on the

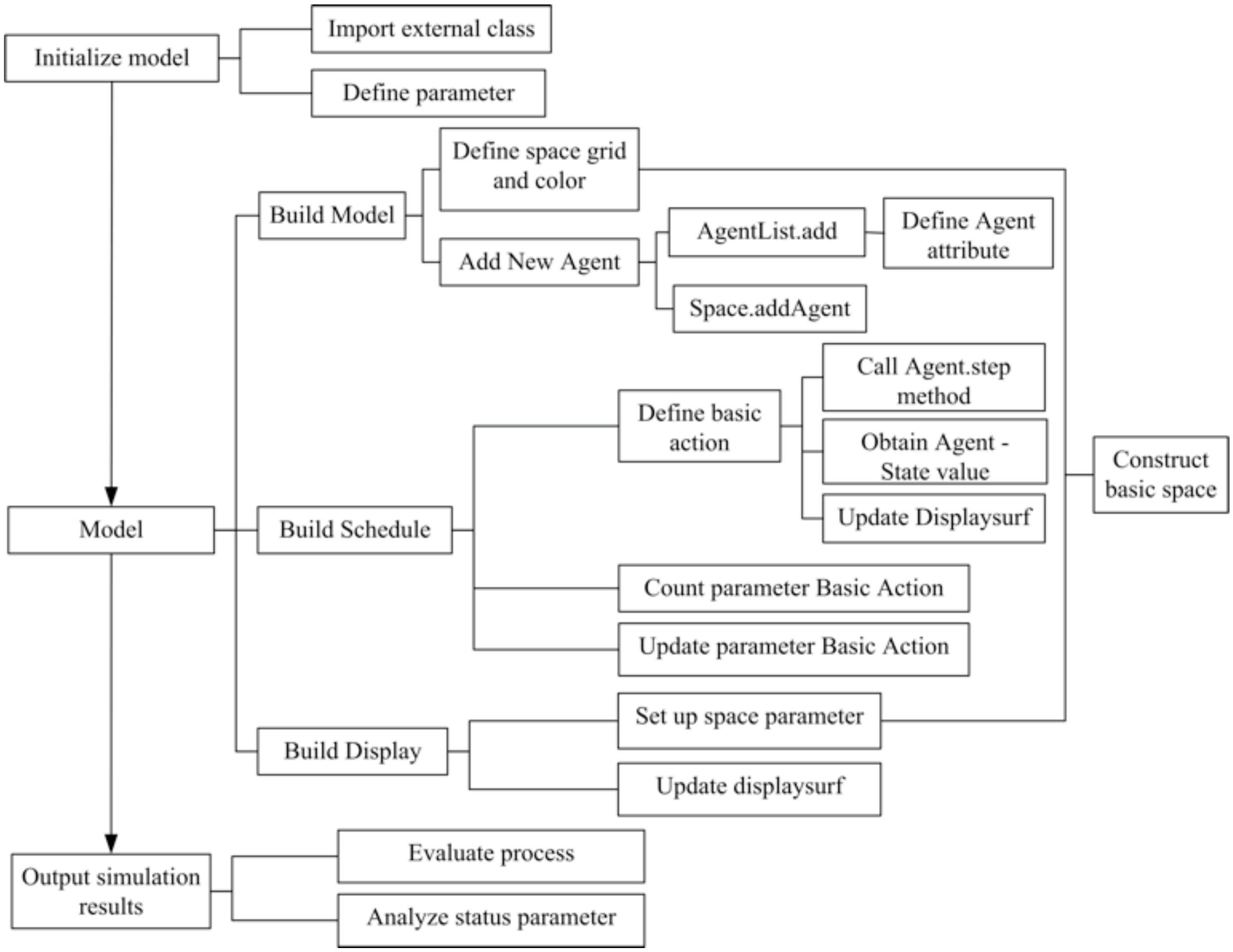


Fig. (4). Process of simulation modeling.

multi-agent list in order to achieve the unified definition of multi-agent class attribute, and the multi-agent list is used to index agent attribute values. Then the traversal algorithm of different multi-agent attribute value can be realized. The algorithm realization process is as follows:

for each agent in do

locating Agent.get(i)

end

for each agent in (i=0;i<AgentList.Size;i++) do

for each agent in (j=0;j< numAgents;j++) do

recorder x_i, y_i

calculating D_{ij}

if ($D_{ij} \le JD_i$)

If ($Emotion_i > Emotion \;\&\; Emotion_j < Emotion$)

$Emotion_j = Emotion_j + k_{j1}$

else if ($Emotion_i < Emotion \;\&\; Emotion_j > Emotion$)

$Emotion_i = Emotion_i + k_{i1}$

end if

end if

end

end

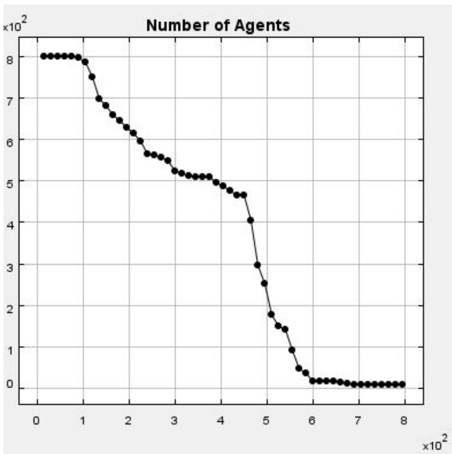
4. SIMULATION

In this paper, multi-agent is introduced to reduce the scale of model definition, and the basic process of establishing group behaviour simulation model can be described as Fig. (**4**).

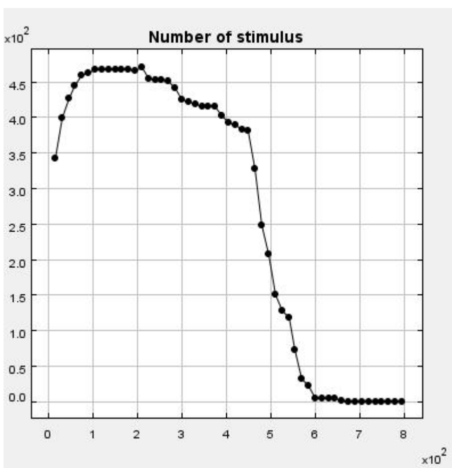
The simulation model construction of group behaviour has three steps: modelling initialization, modelling and simulation result output. Modelling initialization defines relative parameters and introduces external classes. As the kernel part of this process, modelling has three parts: establishing model, process creation and display. Establishing model mainly consists of the space grid definition and adding new agents in space grid. Establishing process creation defines all kinds of behaviours. Establishing display shows predefined variations of given simulation and some special parameters. Simulation result output gives final results of given simulations.

5. CASE STUDIES

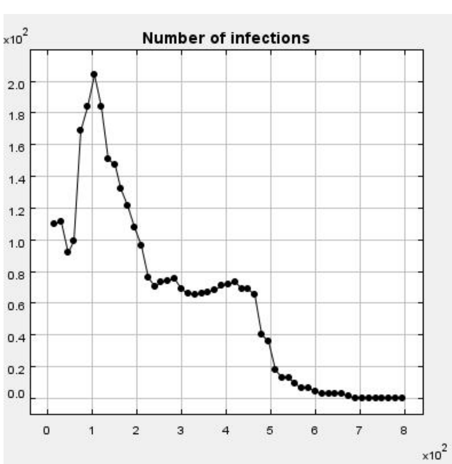
This demonstration is built on the basic model of group behaviour evolutions and the proposed indexed multi-agent based algorithm. The basic simulation parameters are assigned as: simulation space is 300×150, the number of agent is 800, four exits is diagonal distribution, there is only one stimuli source in the simulation space, and the location of agent is randomly distribution. Based on the above definition, the simulation result of group behaviour is shown in Fig. (**5**).



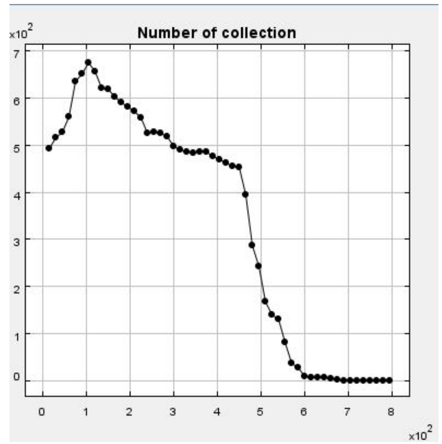
(*a*) Total population



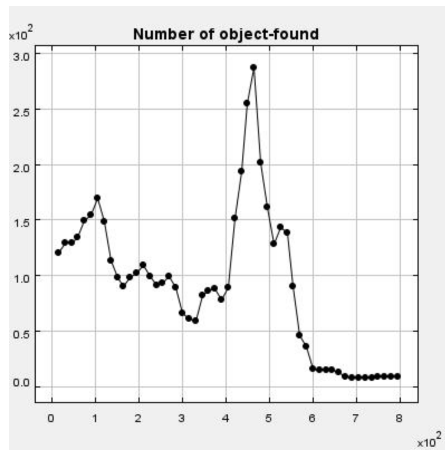
(*b*) Number to be stimulated



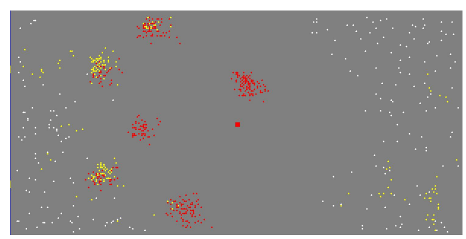
(*c*) Number to be infected



(*d*) Number of congestion



(*e*) Number of finding target

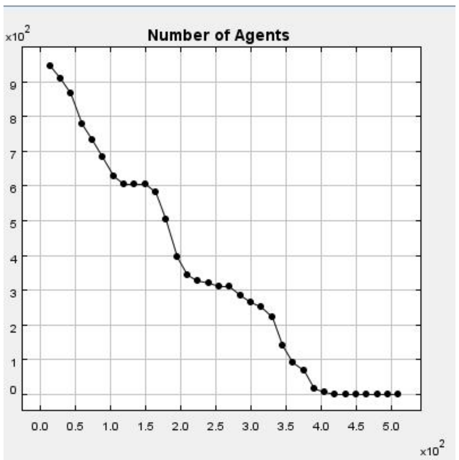


(*f*) Chart of simulation evolution

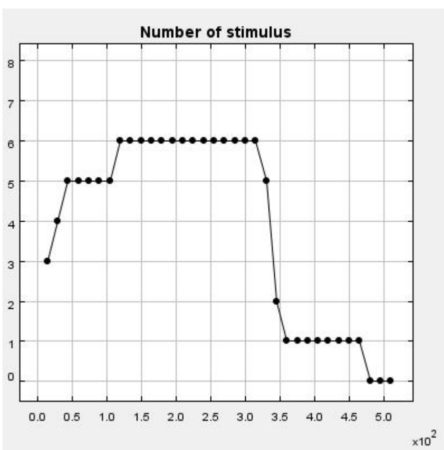
Fig. (5). Simulation result.

The feasibility of the proposed algorithm can be demonstrated by the number synchronous variation of population, stimulated agent, infected agent, congested agent and finding target, and they all converge to Zero at 6 minute. In Fig. (**5a**), the number of agents is initialled as 800. Two obvious inflections can be observed at 1 and 4.5 minute. Fig. (**5b**) describes the number variation of stimulated agent. The initial value is 35 and reaches its maximum 45 at 2 minutes. Fig. (**5c**) reflects the number variation of agents that are infected by the movements of stimulated agents. It reaches its maximum 22 at 1 minute. Fig. (**5d**) describes number variation of agents that are congested due to group behaviours stimulated by given stimuli. It reaches its maximum 68 at 1 minute and decreases with efficient escape until 0 at 6 minute. Fig. (**5e**) describes number variation of finding agent of target. It reaches its maximum 27 at 4.7 minute and decreases to 0 at 6 minute, which implies all agents have escaped from the simulation space.

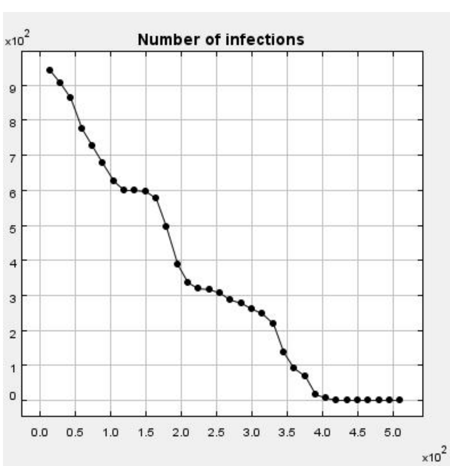
Re-set simulation environment as simulation space is 100 × 50 and agent number is 1000. The simulation results can be shown in Fig. (**6**).



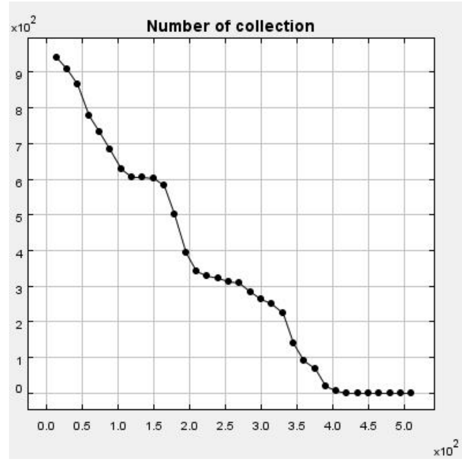
(*a*) Total population



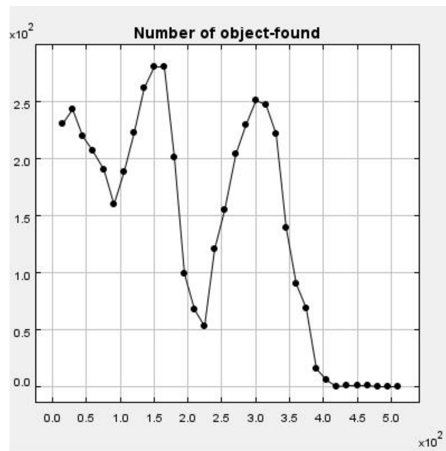
(*b*) Number to be stimulated



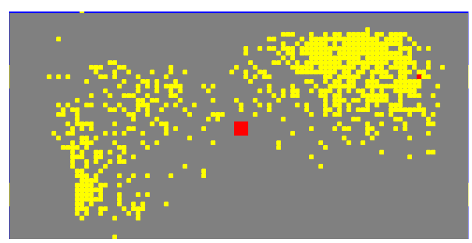
(*c*) Number to be infected



(*d*) Number of congestion



(*e*) Number of finding target



(*f*) Chart of simulation evolution

Fig. (6). Simulation result after parameters reset.

From Fig. (**6**) it can be observed that in the condition of small space and large group, the number variation trends of population, infected agents and congested agents are tending to be synchronized, which is compatible with common intuition.

CONCLUSION

Due to the serious impact on social and economic lives, group behaviour, especially that of sudden crisis in public and touristic places, have attracted a lot of attention from both academic and management aspects. However, the complexity of group safe behaviours brings a lot of challenges to existing unitary pattern algorithms. To improve the accuracy of describing group safety behaviours, this paper proposes a multi drive force model framework, which analyses stimulation factor and emotional factors in the process of group safety behaviour evolutions. And to improve the efficiency of multi-agent based simulation systems, an indexed Multi-agent based algorithm is also put forward in this paper. The experiment results also demonstrate the feasibility and efficiency of the proposed framework and algorithm.

Compared with other researches, the proposed multi-drive force model framework has following advantages:

- the proposed framework take stimuli, infection, follow-up and goal factors into consideration, which effectively improves the description of group behaviour evolution processes that are affected by many factors, especially the group behaviour evolution in panic;
- The indexed Multi-agent based algorithm can obviously improve the efficiency of agent based group simulations.

But there are still a lot of challenges in group behaviour researches, for example the evolution of group safety behaviour is not retrospective, behaviour changes are non-conforming and there exist a lot of randomness in group safety behaviour evolutions. These researches will be reported in separate papers.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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