Research on Passenger 3D View Focus of Attention at Airport Terminal Based on Massmotion

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Abstract. With the development of computer technology, it is possible to simulate pedestrian 3D view focus of attention which affects passengers’ behaviour a lot. The position of passenger 3D view focus of attention is one of the factors that designers should take into consideration. Therefore, there is a necessity to simulate the passenger 3D view focus of attention of the airport terminal. This paper modeled Chaoshan international airport terminal in Jieyang city in Massmotion to simulate passenger 3D vision time on walls. In the vision time map simulated by Massmotion, pedestrian view focus of attention was shown in it. Finally, we proposed a method about simulating the view focus of attention which provides guidance for terminal space design.

1. Introduction
The three-dimensional view focus of attention of passengers in the airport terminal affects passenger behaviour a lot. The position of three-dimensional view focus of attention on the objects of the airport terminal can help designers arranging the information desk, the ads, the lounge, and so on. Although passenger view focus changes during their walking, it has been possible to simulate it with the development of the computer. In order to improve the guidance systems for the elderly and handicapped people, Martin Brunnhuber simulated the visibility of the guiding systems in his research [1]. Michael Voit analyzed the visual focus of attention during dynamic meeting scenarios by collecting data of meetings [2]. L. Bazzani defined Subjective View Frustum to simulate the view focus of attention [3].

This paper illustrated the pedestrian view focus of attention simulation on the walls at the airport terminal. The research consisted of four parts: In the first part, we demonstrated the method about simulating the three-dimensional view focus of attention of passengers in the Massmotion software. The second part illustrated how to model Chaoshan international airport as the case on Massmotion. The third part analyzed the results of the simulation. Finally, we concluded that the pedestrian view focus of attention simulated by Massmotion is of great help for designers.

2. Research method
Massmotion is an agent-based pedestrian flow simulation software. It is widely used in evacuation, pedestrian congestion, process analysis and some other fields [4]. Massmotion has been applied in many actual projects such as the new terminal at JFK International Airport in New York, Toronto union station and so on. In Massmotion, pedestrians are simplified as agents which can be set to different attributes such as size, speed, and destination. The agents can act based on the surrounding environment.
Pedestrian trajectory, pedestrian density, pedestrian view focus of attention, evacuation time can be obtained by the simulation in Massmotion, which can help designers arrange the space of the airport terminal.

Based on the view cone model proposed by Morrow [5], it can be fulfilled to simulate the view focus of attention of agents in Massmotion. People's view focus of attention on a surface when walking can be pictured in the vision time map by coloring the surfaces according to the view time on them.

This paper applied the vision time map to the analysis of pedestrian view focus of attention at the airport terminal.

3. Model establishment

3.1. Case study
The research object selected in this paper was Chaoshan international airport terminal which is located in Jieyang city, Guangdong province. As showed in figure 1 the area we researched was the domestic hall which was mainly composed of the rest waiting area, commercial area, and service inquiry area.

![Figure 1. The research area of Chaoshan international airport terminal.](image)

3.2. Simulation model
The simulation model was established by three steps: the three-dimensional model establishment, agent behavior setting, and agent characteristic setting.

3.2.1. Step 1: the establishment of the three-dimensional model
Many types of files are supported to import to Massmotion software. In this paper, we modeled Chaoshan international airport terminal in Sketch Up 2017 software and imported it to Massmotion 9.0. Figure 2 showed the simulation model.

3.2.2. Step 2: agents behavior setting
Agents behavior can be set by many types of activities such as journey, evacuation, reference time, and so on. We chose the journey to simulate the behaviours of passengers, including checking tickets, queuing, and boarding.
3.2.3. Step3: agents characteristic setting
Agents characteristic setting includes the simulation period, agent amount, agent speed, and so on. The peak hour 12:00-13:00 of the airport terminal was set as the simulation period. The amount of the agents simulated was set to 2725—the number of peak-hour passengers predicted in 2020.

Many scholars have researched the pedestrian speed in their paper, Ren Guoyou who used the methods of observation and video acquisition to investigate the Beijing Capital Airport Terminal T3 obtained pedestrian walking speeds of different ages, genders, races, and luggage conditions [6]. Based on the research of Ren Guoyou, we set the agent speed to 1.36m/s.

Figure 2. The scenes of Massmotion model of Chaoshan international airport terminal

4. Results and analysis
The main objects we simulated were walls. By simulating, we obtained the vision time map on the walls. In the vision time map, different colors represent different ranges of view time. The range represented by each color is shown in table 1. We defined the vision time above 50s as the pedestrian view focus of attention.

| Color     | Value range (s) |
|-----------|-----------------|
| White     | -∞-0            |
| Dark blue | 0-10            |
| Light blue| 10-20           |
| Green     | 20-50           |
| Yellow    | 50-100          |
| Orange-red| 100-200         |
| Red       | 200-400         |
| Dark red  | 400-∞+          |

In figure 3, we found the view focus of attention of agents on walls during the boarding process. Agents more likely viewed the walls near the security checking area because of agents queuing there. In the domestic departure hall, most walls viewed by the agents were under 10s. The vision time in the commercial shops in the middle of the finger gallery (20s-50s) was longer than the vision time on the sides of the finger gallery (0s-20s). The walls near the security checking area are more suitable to place advertisements or commercial shops. The view focus of attention on walls can help designers arranging commercial ads and the information desk. In figure 3, we also found that the walls with low vision time which were more suitable to be designed as a lounge or logistic area.
5. Conclusion
We used Massmotion to simulate the pedestrian view focus of attention on walls in the domestic terminal hall of Chaoshan international airport. And we finally proposed the following conclusions:

- Pedestrian view focus of attention simulated by Massmotion can help designers arranging space and service facilities.
- The view focus of attention simulation is useful for terminal pedestrian behaviour prediction and space optimization.
- The walls near the security service facilities will be more easily to attract passengers' attention. They are more suitable to place commercial shops and information counters. The walls with lower vision time are more suitable to arrange the lounges, which need more privacy.

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