Team-06: Checkpoint 2

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GitHub Repo: https://github.gatech.edu/zhao48/CSE6730-Project

1 Division of main works

- Zihong Hao: Code and visualization for main experiments.
- Hanzhang Liu: Design and write down the exit choosing session in report.
- Mian Wu: Design and write down the main experience of social forces.
- Qilin Li: Ablation studies of experiment.
- Chen Lin: Statistical analysis and visualization.

2 Current state of the project

2.1 Completed sections

In this report, we have programmed a framework for multi-exit agent-based simulation and added the social force and interactions. For more details, please refer to the GitHub repository.

Figure 1 are some screenshots of a run of a simple simulation.

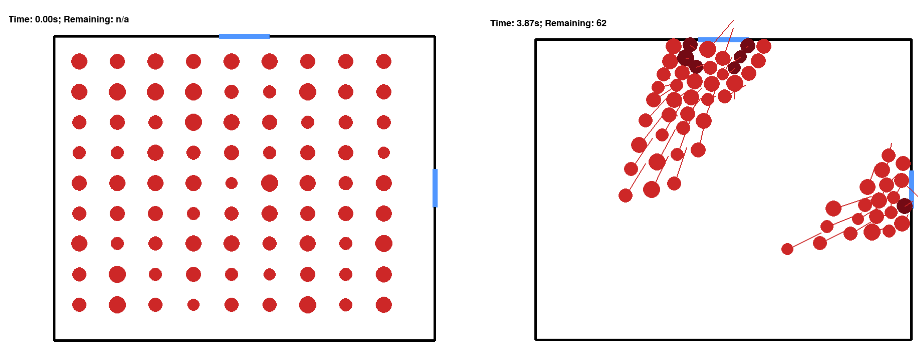

Figure 1: Simulation Program for multi gates

2.2 Experiments

For the experiments, we tested our model in a room with length 15m and width 12m, radius r of people with distribution Unif(0.25,0.35), and mass $m = 20 + 1850r^3$.

In the test, we first examined our model with fixed initial positions and number of people for different scenarios with changing the number of doors (1, 2, 3, and 4), width of doors (1.5m and 3m [HR21]), and desired speeds (1.5ms^{-1}, and $v_0 \sim \mathcal{N}(1.34, 0.26^2)$, the Gaussian distribution with mean 1.34ms^{-1} and standard deviation 0.26ms^{-1} [HM95]) (e.g. Figure 2). Though from Table 1 we can see

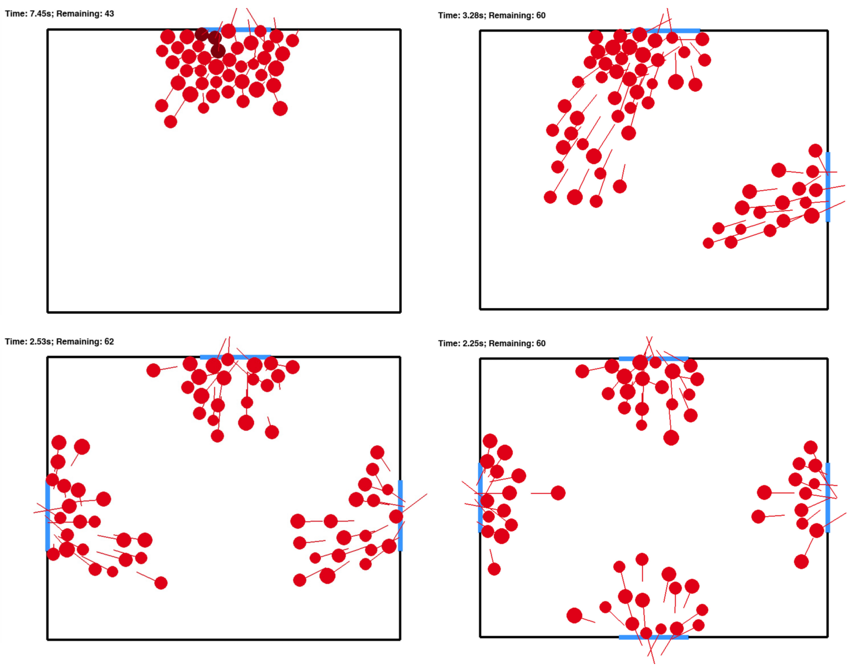

Figure 2: Example simulations for 3m doors with desired speed $v_0 \sim \mathcal{N}(1.34, 0.26^2)$

Number of doors	**Width of doors**	**Desired speed**	**Mean**	**Time**
1	1.5	1.5	1.154	37
	1.5	$v_0 \sim \mathcal{N}(1.34, 0.26^2)$	0.607	41.867
	3	1.5	0.97	12.85
	3	$v_0 \sim \mathcal{N}(1.34, 0.26^2)$	1.08	14.467
2	1.5	1.5ms^{-1}	1.166	26.283
	1.5	$v_0 \sim \mathcal{N}(1.34, 0.26^2)$	0.774	28.567
	3	1.5ms^{-1}	1.23	10.95
	3	$v_0 \sim \mathcal{N}(1.34, 0.26^2)$	1.153	11.633
3	1.5	1.5ms^{-1}	1.305	14.85
	1.5	$v_0 \sim \mathcal{N}(1.34, 0.26^2)$	0.67	15.183
	3	1.5ms^{-1}	1.359	6.133
	3	$v_0 \sim \mathcal{N}(1.34, 0.26^2)$	1.367	7.117
4	1.5	1.5ms^{-1}	0.766	12.183
	1.5	$v_0 \sim \mathcal{N}(1.34, 0.26^2)$	0.685	12.25
	3	1.5ms^{-1}	1.297	5.417
	3	$v_0 \sim \mathcal{N}(1.34, 0.26^2)$	0.983	6.3

Table 1: Overall Descriptive Statistics of All Door Conditions

Number of People	Distribution of People	Distribution Parameter	Time
30	Normal	$\mu_x = 0.5, \mu_y = 0.5, \sigma = 0.1$	7.13
	Random	seed=1	8.80
	Uniform	min=0, max=1	10.38
	Beta	a=0.5, b=0.5	9.71
50	Normal	$\mu_x = 0.5, \mu_y = 0.5, \sigma = 0.1$	9.67
	Random	seed=1	9.25
	Uniform	min=0, max=1	10.63
	Beta	a=0.5, b=0.5	10.28
100	Normal	$\mu_x = 0.5, \mu_y = 0.5, \sigma = 0.1$	11.93
	Random	seed=1	12.4
	Uniform	min=0, max=1	12.53
	Beta	a=0.5, b=0.5	11.88
200	Normal	$\mu_x = 0.5, \mu_y = 0.5, \sigma = 0.1$	20.28
	Random	seed=1	19.92
	Uniform	min=0, max=1	20.65
	Beta	a=0.5, b=0.5	24.81

Table 2: Overall Escape Time with Different Distribution of People

that changing the desired speed to Gaussian distribution causes delay in time, the results are closer to the real world cases comparing to desired speed of 1.5ms^{-1}.

Since in real world, the initial positions of people are unlikely be the scenario as shown in Figure 1, we also tested the model for different numbers of people and different initial position in distributions like normal distribution, uniform distribution, random distribution, and beta distribution Table 2.

Additionally, our experiment results suggest that the spatial distribution of people in a room has a significant impact on evacuation time. Specifically, when people are normally distributed, they tend to evacuate more quickly than when they are clustered together or dispersed throughout the room. This is likely because normal distributions provide more even and efficient pathways for people to move through.

However, we observed that as the number of people in the room increased, the overall evacuation time also increased. This suggests that there may be a threshold beyond which adding more people to a space results in diminishing returns in terms of evacuation efficiency. Moreover, as more people are added, the average speed at which each individual moves decreases, likely due to increased congestion and interference from other evacuees.

2.3 The remaining part

Finish the session of separated parts for the final reports. Adding more statistical tables for our experiments (for example, the bounds for 95% confidence interval, comparison with other models).

References

[HM95] Dirk Helbing and Peter Molnar. Social force model for pedestrian dynamics. *Physical review E*, 51(5):4282, 1995.

[HR21] Sajjad Hassanpour and Amir Abbas Rassafi. Agent-based simulation for pedestrian evacuation behaviour using the affordance concept. *KSCE Journal of Civil Engineering*, 25(4):1433–1445, 2021.