Simulation model of self-organizing pedestrian movement considering following behavior

Key words: Gravitation; Pedestrian counterflow; Social force model (SFM); Lane formation; Self-organizing

Contact: Hongfei Jia
E-mail: jiahf@jlu.edu.cn

Introduction

- In this paper, a new force is introduced in the social force model (SFM) for computing following behavior in pedestrian counterflow, whereby an individual tries to approach others in the same direction to avoid conflicts with pedestrians from the opposite direction.

- The force, like a kind of gravitation, is modeled based on the movement state and visual field of the pedestrian, and is added to the classical SFM.

- The modified model is presented to study the impact of following behavior on the process of lane formation, the conflict, the number of lane formed, and the traffic efficiency in the simulations.

- The simulation results show that the following behavior has a significant effect on the phenomenon of lane formation and the traffic efficiency

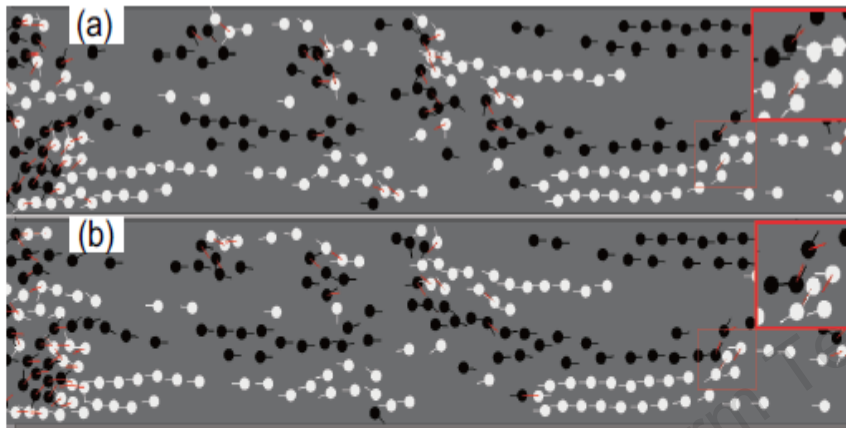# Impact of following behavior on the process of lane formation.

Fig. 3 Snapshots of the lane formation simulation at the time instances 1541 s (a) and 1543 s (b) with the following behavior considered. The red regions are magnified in the upper right of each figures (References to color refer to the online version of this figure)
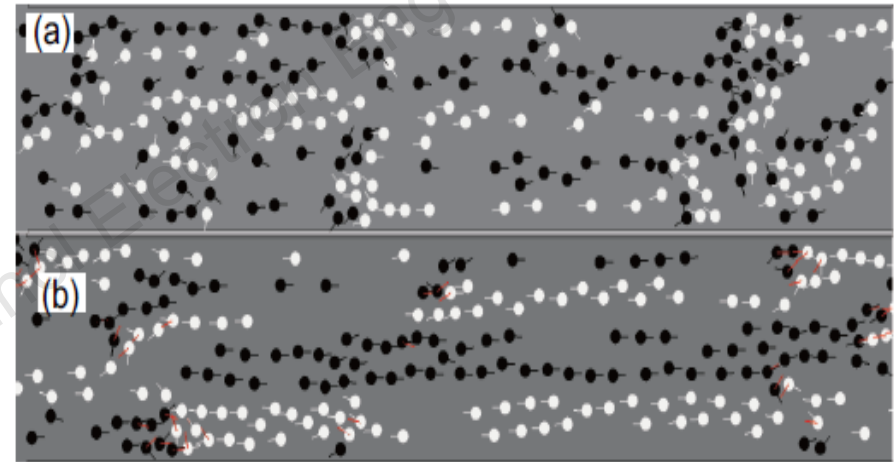

Fig. 4 Comparison of the snapshots of the lane formation simulations without (a) and with (b) considering the following behavior (References to color refer to the online version of this figure)
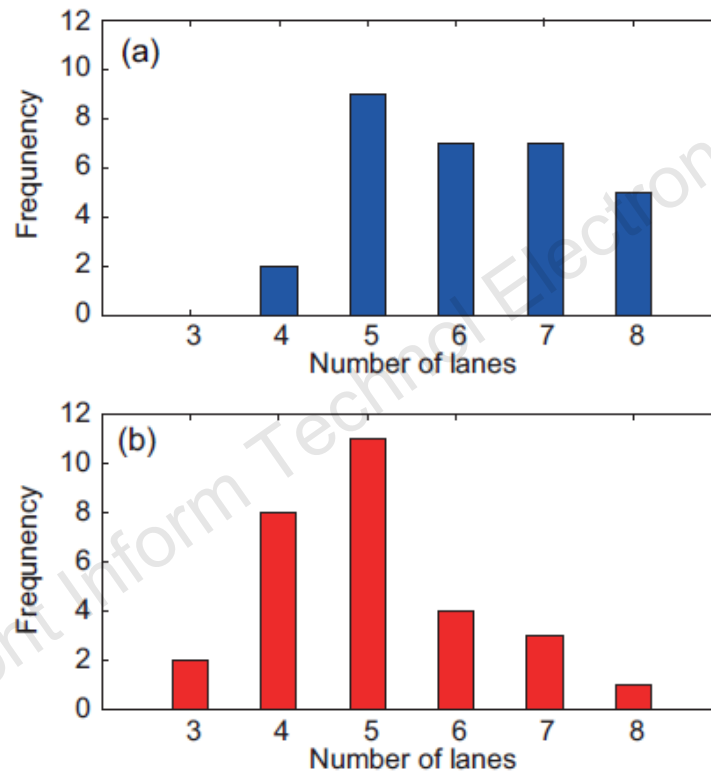
Distributions of the numbers of lanes formed

Fig. 8 Distributions of the numbers of lanes formed without (a) and with (b) considering the following behavior
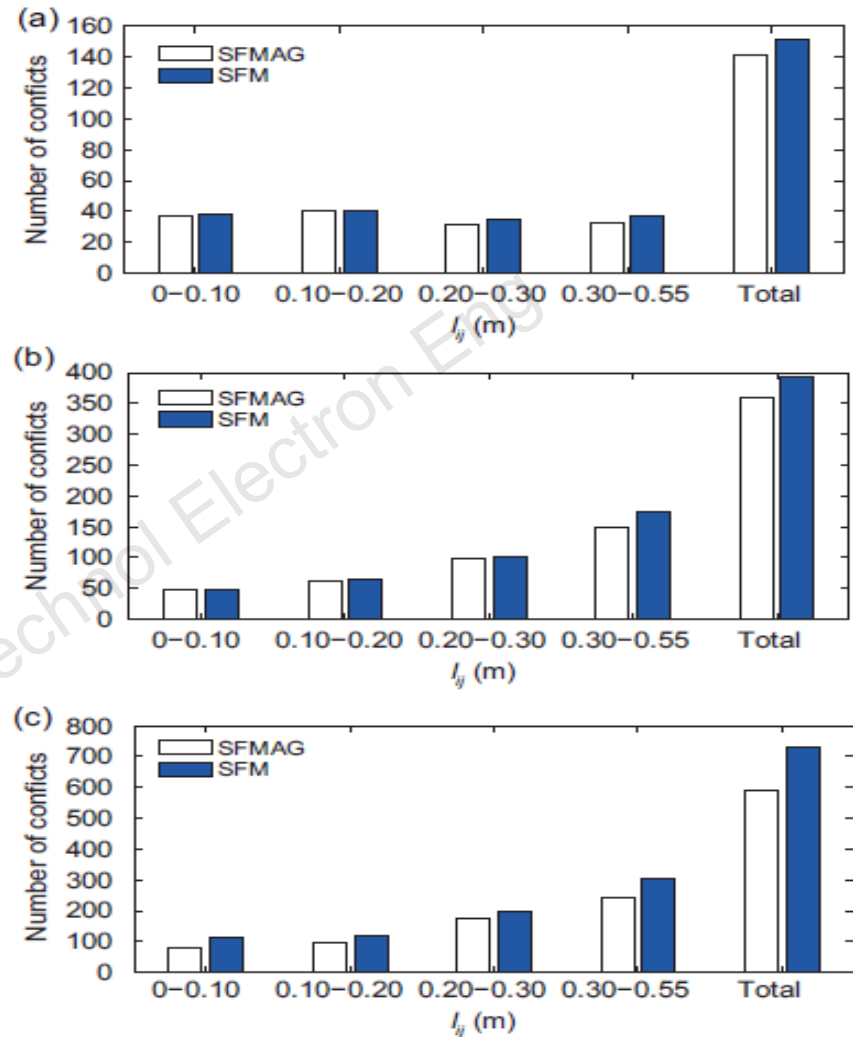
Impact on the number of conflict

Fig. 6 The relationship between the number of conflicts and the relative position parameter l_{ij} obtained by SFM and SFMAG simulations under different pedestrian arrival rates (λ): (a) $\lambda = 0.250$ person/(m·s); (b) $\lambda = 0.375$ person/(m·s); (c) $\lambda = 0.500$ person/(m·s)
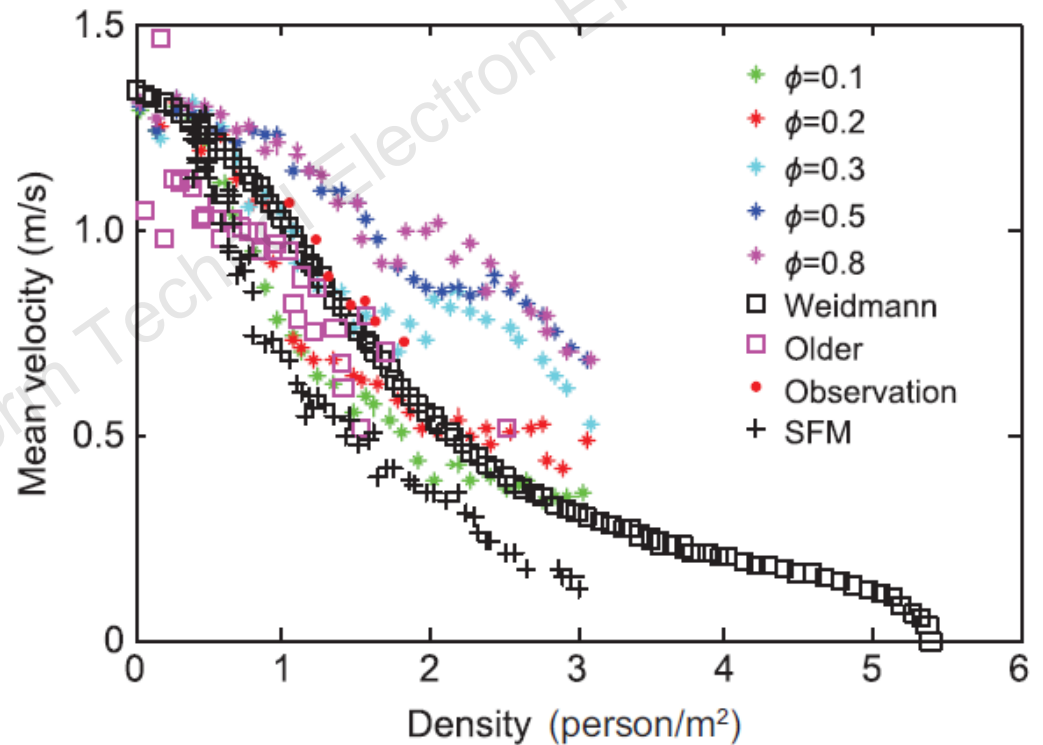
Impact on the traffic efficiency

Fig. 9 Fundamental diagram comparing with experimental data.

Conclusions

- In the paper, a new pedestrian flow model with gravitation is proposed to simulate following behavior and the lane formation phenomenon.

- In our simulation, the differences of the macroeconomic phenomenon and the impact of following behavior on the conflict, the number of lanes formed , and the traffic efficiency with the classical model are analyzed.

- It is found that following behavior is helpful in avoiding unnecessary conflicts and in easing the conflicts, and it is conducive to improving the efficiency of the passage.