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Modeling detour behavior of pedestrian dynamics under different conditions

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Abstract: Pedestrian simulation approach has been widely used to reveal the human behavior and evaluate the performance of crowd evacuation. In the existing pedestrian simulation models, the social force model is capable of predicting many collective phenomena. Detour behavior occurs in many cases, and the important behavior is a dominate factor of the crowd evacuation efficiency. However, limited attention has been attracted for analyzing and modeling the characteristics of detour behavior. In this paper, a modified social force model integrated by Voronoi diagram is proposed to calculate the detour direction and preferred velocity. Besides, with the consideration of locations and velocities of neighbor pedestrians, a Logit-based choice model is built to describe the detour direction choice. The proposed model is applied to analyze pedestrian dynamics in a corridor scenario with either unidirectional or bidirectional flow, and a building scenario in real-world. Simulation results show that the modified social force model including detour behavior could reduce the frequency of collision and deadlock, increase the average speed of the crowd, and predict more practical crowd dynamics with detour behavior. This model can also be potentially applied to understand the pedestrian dynamics and design emergent management strategies for crowd evacuations.

Keywords: Pedestrian dynamics, social force model, detour behavior, Voronoi diagram

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