SIMULATION

The role of crowd behavior and cooperation strategies during evacuation

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Abstract

Crowd dynamics have constituted a hotspot of research in recent times, particularly in areas where developmental progress has taken place in crowd evacuation for ensuring human safety. In high-density crowd events which happen frequently, panic or an emergency can lead to an increase in congestion which may cause disastrous incidents. Crowd control planning via simulation of people's movement and behavior can promote safe departures from a space, despite threatening circumstances. Up until now, the evolution of distinctive types of crowd behavior towards cooperative flow remains unexplored. Hence, in this paper, we investigate the impact of potential crowd behavior, namely best-response, risk-seeking, risk-averse, and risk-neutral agents in achieving cooperation during evacuation and its connection with evacuation time using a game-theoretic evacuation simulation model. We analyze the crowd evacuation of a rectangular room with either a single-door or multiple exits in a continuous space. Simulation results show that mutual cooperation during evacuation can be realized when the agents' population is dominated by risk-averse agents. The results also demonstrate that the risk-seeking agents tend toward aggressiveness by opting for a defector strategy regardless of the local crowd densities, while other crowd behavior shows cooperation under high local crowd density.

Keywords

Evacuation simulation, cooperation dilemma, evolutionary game theory, agent-based model, behavioral model

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