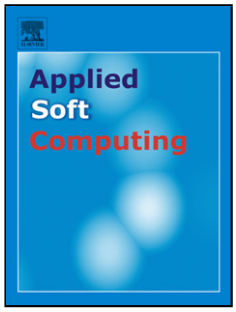

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A Path Planning Approach for Crowd Evacuation in Buildings Based on Improved Artificial Bee Colony Algorithm

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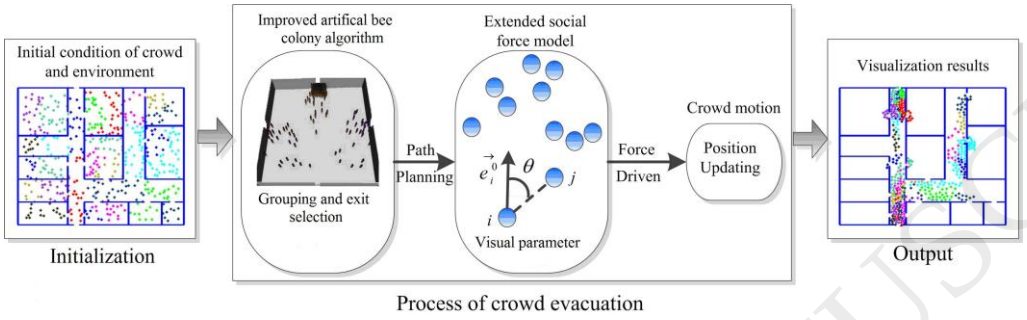
Graphical abstract



Highlights

- We propose an Extended Social Force Model (ESFM) by adding a visual parameter for prejudging the congestion of the exits.
- We present an Improved Artificial Bee Colony (IABC) algorithm by employing the strategies of grouping and multiple exits selection.
- We simulate crowd evacuation by our new path planning algorithm which combines ESFM and the IABC algorithm.

Abstract: This paper proposes a new path planning approach for emergency evacuation simulation. This technique combines the Extended Social Force Model (ESFM) and the Improved Artificial Bee Colony (IABC) algorithm to enhance the visual realism and improve the efficiency of crowd evacuation. In the ESFM, we introduce a visual parameter to the original SFM and obtain the anisotropic psychological force rather than the isotropic one in the SFM so as to better fit crowd behaviors, such as long-range obstacle avoidance and self-organizing group formation. In addition, the IABC algorithm is proposed to improve the evacuation efficiency and provide support for building design and evacuation management by employing the strategies of grouping and exit selection. The algorithm uses the evacuation time of the individuals as the evaluation metric. If an exit is overcrowded and congested, the individuals will assess the degree of congestion, estimate the time needed to escape, and determine whether to select a farther exit for escape. By selecting the optimal exit and avoiding congestion, the evacuation efficiency can be improved. We have simulated the crowd evacuation with our new path planning approach via a crowd evacuation simulation system. The results show the effectiveness of our method.

Keywords: crowd evacuation; simulation model; path planning; social force model; artificial bee colony algorithm

1. Introduction