2D meso modeling of crowd motion with kinetic theory approach

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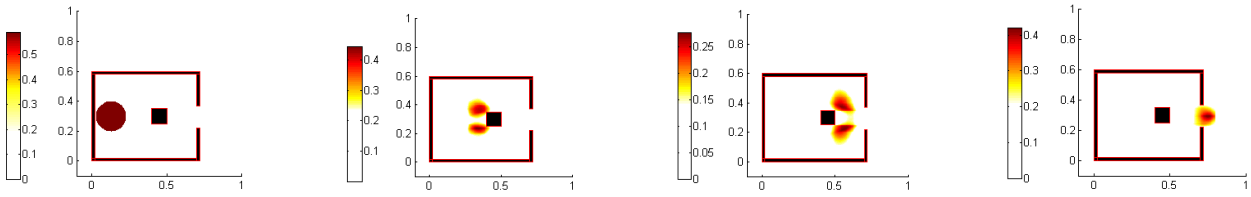
The modeling of a crowd by a kinetic approach started with Bellemo's and Bellouquid's works [1], in which the set of main governing equations are introduced. In this approach, the crowd is seen as a complex system in which the interactions between people (particles) are managed from a probabilistic point of view and the microscopic state of each people (particle) is characterized by his/her position and speed. Most of works of a crowd's modeling by a this approach considered connected areas, while the non connected area is not yet treated. In this work, the kinetic theory applied to crowd dynamics is extended to its motion in a non-connected bounded domain, with the presence of fixed obstacles. The existence and uniqueness of the solution of the proposed mathematical model have been proved for large times thanks to the Banach fixed-point theorem, assuming that the internal interactions between pedestrians are negligible. The proposed model is able to describe some characteristics of the dynamics of a crowd in a bounded domain (with walls an exit and an obstacle) namely, avoidance and evacuation. Indeed, the numerical results to check the ability of pedestrians to avoid fixed obstacles during their trajectory towards the exit are shown in the following figures:



(a) $t = 0s$ (b) $t = 3.4s$ (c) $t = 6.48s$ (d) $t = 9.52s$

Figure 1: Time evolution of the local pedestrians density, (a): $t = 0s$, (b): $t = 3.4s$, (c): $t = 6.48s$ and (d): $t = 9.52s$.

Finally, the influence of a square-shaped obstacle on the evacuation time is shown. Indeed, with a suitable choice of obstacle's parameters (dimensions, position), the time of the pedestrian evacuation may become much better than that obtained without any obstacle [2].

Références

[1] N. Bellomo, A. Bellouquid, *On the modeling of crowd dynamics: Looking at the beautiful shapes of swarms*, Netw. Heterog. Media 6(3), 2011.

[2] A.Elmoussaoui, P.Argoul, M.El Ghabi, A.Hakim, *Discrete kinetic theory for 2D modeling of a moving crowd : Application to the evacuation of a non-connected bounded domain*, Comput. and Math. with Appl. under review.

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