Model coupling for crowd motion modelisation and applications

E. Pinsard, B. Maury, J.-L. Paillat
Laboratoire de mathématiques d'Orsay (Université Paris-Saclay), *Laboratoire de mathématiques d'Orsay (Université Paris-Saclay), Laboratoire Central de la préfecture de Police*

Email : etiene.pinsard@universite-paris-saclay.fr

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Biographie – Je suis un docotrant en deuxième année en mathématiques appliquées entre le Laboratoire de Mathématiques d4orsay et le Laboratoire Central de la Préfecture de Police. Il s'agit d'une thèse sur l'étude de mouvement de piétons avec des cas d'applications, un sujet qui m'intéresse depuis plusieurs années. Je viens d'un cursus de physique et non de mathématiques, mais rassurez-vous je ne mords pas !

Resumé :

We are interested in crowd motion models for evacuation. Several alternatives have been proposed and are still being studied in the litterature and commercially, and rely on different ingredients to account for human behavior. These interactions are typically of multiscale nature, and are modeled with microscopic or microscopic models.

Microscopic models consist in a set of equations (usually ODEs) describing individual motions in time of each pedestrian in a Lagrangian manner. The seminal model of Helbing ([1]) is one of the founding example of the field. Many more models have been introduced since to refine the descriptions of individual interactions. Macroscopic models are based on the Eulerian point of view and consist of one or several PDEs for the global density of continuous agents, as in the model presented in [2].

It is generaly acknowledged that both approaches have pros and cons depending on the scenario considered for modelisation.

The LCPP (Laboratoire Central de la Préfecture de Police) is interested in this type of modelisation to evaluate the safety of buildings : one of the tasks of the laboratory is to assess the security measures and plans for new high scale structures. With the emergence of open air "FanZones" last years for big sport events and the upcoming Olympic Games in 2024 in Paris, new challenges arise in the need for applications of the aforementioned models.

The goal of my PhD thesis is to develop a coupled approach : since all models suit different types of situations, but the practicle cases are often a combination of complicated situations, we want to develop numerical approaches to couple different simulations. Many models have alternative formulation in both scopes, but do not generally yield similar results, hence the need of a coupled approach (see [3])

In this talk I will first introduce briefly crowd motions from a practical and mathematical standpoint, and will then present the models we are interested in as well as the coupling procedure we use. I will use comparison on real cases to show what the interest on the field of our study.

Références

[1] Dirk Helbing and Peter Molnar. Social force model for pedestrian dynamics. *Physical review E*, 51(5):4282, 1995.

[2] Roger L Hughes. A continuum theory for the flow of pedestrians. *Transportation Research Part B: Methodological*, 36(6):507–535, 2002.

[3] Bertrand Maury, Aude Roudneff-Chupin, Filippo Santambrogio, and Juliette Venel. Handling congestion in crowd motion modeling. *Networks and Heterogeneous Media*, 6(3):485–519, 2011.