MULTISCALE MODELING OF PEDESTRIAN DYNAMICS: INDIVIDUALITY VS. COLLECTIVITY

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Summary

The dynamics of human crowds are mainly ruled by mutual interactions among pedestrians. The latter develop indeed behavioral strategies based on their perception of the state of the surrounding environment, including especially the presence of neighboring individuals. For instance, when heading for a certain destination pedestrians normally deviate from their preferred paths in order to avoid crowded areas. Remarkably, interactions are usually non-cooperative, i.e., walkers do not pursue a goal collectively, and are expressed without the application of any external organizing principle.

Due to the intrinsic granularity (viz. discreteness) of the system (the number N of pedestrians is possibly large, yet the approximation $N \to \infty$ may not be always coherent), one-to-one or one-to-few interactions are better described at an *individual* level. On the other hand, *collective* representations, focused on the crowd distribution as a whole, are often preferable over particle-based ones, in order to catch the spontaneously emerging self-organized group behaviors, such as lane formation in counter-flows or traffic light effect at bottlenecks. Moreover, they are often more amenable to additional mathematical analysis, numerics, and optimization.

In this talk I will present a measure-theoretic approach, which offers useful conceptual tools for tackling such an "individuality vs. collectivity" dualism. Indeed, it allows for a *multiscale* representation of the crowd in which single individuals, described as point masses, are embedded into a continuous pedestrian flow. This way it is possible to study the effects of a balanced interplay between small and large scales on the overall dynamics.

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