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Individuality vs. Collectivity in Crowd Dynamics

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Abstract: The dynamics of human crowds are mainly ruled by mutual interactions among pedestrians. Walkers develop indeed behavioral strategies based on their perception of the surrounding environment, including especially the presence of neighboring individuals. For instance, when heading for a certain destination, they normally deviate from their preferred paths in order to avoid crowded areas.
One-to-one (or one-to-few) interactions take place at an *individual* level. Nevertheless, their massive effect, i.e., the spontaneous emergence of self-organized behaviors, is visible by observing the *collective* crowd distribution. For this reason, mathematical descriptions which assimilate the crowd to a continuum with density may be preferable to particle-based ones. On the other hand, they lose the intrinsic granularity of crowds, which may play a non-negligible role in the aforesaid interaction-driven/perception-based dynamics.
In this talk we discuss a measure-theoretic modeling approach, which offers conceptual tools for tackling such an *individuality vs. collectivity* dualism. Indeed, it allows for a multiscale description of the crowd in which single individuals, regarded as point masses, are embedded into a continuous pedestrian flow. These complementary representations coexist and exchange information, hence particle trajectories and the continuous density affect each other. This way one can study the effects of a balanced interplay between small and large scales on the overall dynamics.

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