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Modeling the dynamics of a multi-component crowd via a two-scale approach, working in a setting of measure-theory, mixture-theory and thermodynamics

We present a strategy to describe the dynamics of crowds in heterogeneous domains. In this framework, the behavior of the crowd is considered from a two-fold perspective: both macroscopically and microscopically. This means that we are enabled to examine the large scale behavior of the crowd (where the crowd is essentially considered as a continuum), and simultaneously we are able to capture phenomena happening at the individual pedestrian's level. On both scales we specify mass measures and their transport, and we unify the micro and macro approaches in a single model. Thus we benefit from the advantages of working with a continuum description, while we can also tract (i.e. zoom in to) microscopic features. In this model we couple the measure-theoretical framework described above to the ideas of mixture theory in continuum mechanics (formulated in terms of measures). This allows us to define several constituents (read: sub-populations) of the large crowd, each having its own partial velocity field. We thus have the possibility to examine the interactive behavior between sub-groups that have distinct characteristics. We especially aim at giving special properties to those pedestrians that are represented by the microscopic (discrete) part in the model. In real life situations they would play the role of firemen, tourist guides, leaders, terrorists, predators (considering animals instead of people) etc. Since typically there is only a relatively small number of such people in a crowd, they are most naturally modeled as individuals on the micro-scale. However, we are not interested in the exact behavior of pedestrians in the rest of the (large) crowd, thus it suffices to simplify here, and model them as a continuum. By identifying a suitable concept of entropy for the system, we derive an entropy inequality. From this inequality restrictions on the proposed velocity fields follow. Obeying these restrictions in the modeling phase, we make our assumptions more feasible. Joint work with Adrian Muntean.