CEMRACS Project: Crowd movement

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We introduced in [1] a macroscopic crowd motion model to account for congestion. This model is based on simple principle : a desired velocity field is defined (velocity that single persons would follow if they were alone), and this field is projected to the set of admissible velocities (i.e. that do not lead to a violation of the congestion constraint). As detailed in [1], it takes the form of a gradient flow in the Wasserstein space, for a functional that is the sum of a "dissatisfaction" function (integral of the geodesic distance to the exit against the current density, and a term that accounts for the congestion constraint (the density must remain below a fixed value). This model, in its current form, does not behaves realistically in the neighborhood of an exit door. In particular, it can be shown that congestion always lead to a reduction of evacuation times, and this feature is not conform to experimental reality.

The core of the proposed project is twofold:

1) We proposed a stochastic algorithm to compute approximate solution to this gradient flow. It has been tested in academic situations, the idea would be to implement this algorithm in real-life architectures, study its properties, and possibly propose alternative ways to perform numerical computations.

2) Investigate possible ways to enrich the model in order to reproduce more realistic behaviors in terms of evacuation, by designing appropriate boundary conditions at exits, or change the model upstream exit doors.

More generally, starting from the basic model mentioned above, the project consists in improving the approach in terms of numerics (check and possibly improve the efficiency of the existing algorithm) and modeling (enrich the model to integrate more realistic features).

[1] A macroscopic Crowd Motion Model of the gradient-flow type, Mathematical Models and Methods in Applied Sciences Vol. 20, No. 10 (2010) 1787-1821. ArXiv http://arxiv.org/abs/1002.0686