Making irrational pedestrian behave as rational: A challenge in control of PDEs

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Abstract. In this talk we present a new mathematical model for pedestrians moving in a large built environment. The model allows one to switch on and off the rational and predictive abilities of pedestrians. We assume that poorly rational, pedestrians just move following signs and perform basic short–range interactions with the others. On the contrary, highly rational pedestrians are assumed to known the environment they move in and optimize their path on the basis of a perfect prevision on the movements of the others, thus minimizing the time to reach their destinations.
From the mathematical point of view, the pedestrian flow in the environment is described by a 2D scalar conservation law with nonlocal flux, in the spirit of multiscale model approach presented in [1], where the desired velocity of the pedestrian is either assigned at start (poorly rational behavior) or deduced by solving at each time an Hamilton–Jacobi equation to obtain the time–optimal path to the target (highly rational behavior), along the lines of [2,3].
The final goal of our research is to "optimize" the shape of the environment, by adding barriers and obstacles, in such a way that the solution corresponding to poor rationality is as close as possible to the target solution corresponding to high rationality, so to get a "good" behavior of the pedestrians even in the case of incomplete information and limited predictive capabilities.
Numerical simulations will be presented to illustrate the different behaviors of pedestrian and the effect of the shape of the domain on the dynamics.

[**1**] E. Cristiani, B. Piccoli, A. Tosin, *Multiscale modeling of granular flows with application to crowd dynamics,* Multiscale Model. Simul., **9**(1),155–182, 2011

[**2**] R. L. Hughes, *A continuum theory for the flow of pedestrians,* Transportation Res. B, **36**, 507–535, 2002.

[**3**] S. P. Hoogendoorn, P. H. L. Bovy, *Simulation of pedestrian flows by optimal control and differential games,* Optimal Control Appl. Methods, **24**, 153–172, 2003.