Modeling and control of pedestrian behaviors: an environment optimization approach

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Abstract

In this talk we present a new mathematical model for pedestrians moving in built environments, considering different degree of reasoning and predictive capabilities. We describe both *normal* pedestrians, who perform basic short-range interactions with the others, and *highly rational* pedestrians, who instead know the environment they move in and are able to optimize their path by means of a perfect prediction of the behavior of the others. The new model allows one to turn on or off the rational capabilities of the pedestrians or even fine-tune the degree of rationality.

From the mathematical point of view, the pedestrian flow is described by means of a **2D conservation law** with nonlocal flux, in the spirit of the model presented in [1]. The rationality is instead managed by means of a coupled **Hamilton-Jacobi-Bellman equation**, along the lines of [2, 3].

The final goal is to "force" normal pedestrians to behave in a highly rational way, in order to improve the global flow. More precisely, we modify the environment adding barriers and obstacles in such a way that the normal behavior is as close as possible to the rational one. This gives rise to a challenging problem in **shape optimization** that, as a by-product, proves the well-known Braess' paradox.

Numerical simulations will be presented to illustrate the different behaviors of pedestrians and the effect of the shape optimization.

Acknowledgments The research leading to these results has received funding from the European Union FP7 under grant No. 257462 HYCON2 Network of Excellence. The research was also supported by the Google Research Award "Multipopulation Models for Vehicular Traffic and Pedestrians", 2012-2013.

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References

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