Experimental study of pedestrian dynamics and Modeling of 2-runners races using Game Theory

Cecile Appert Rolland, Lab. Of Theoretical Physics – Univ. Paris Sud - CNRS

The talk will be divided into two parts.
The first part will deal with some experimental studies of pedestrian dynamics. After a short review presenting several tracking techniques that we have used in different experiments, including Kinect cameras [1] and VICON tracking system [2,3], we will focus on the case of pedestrians moving in lines.
In a first set of experiments [3], unidimensional flows were realized along prescribed trajectories, allowing to scan a large range of densities.
Based on the experimental results, a 'follow-the-leader' model with time delay has been proposed [2,4]. The parameters of the model have been determined from the experimental data and discussed in the light of some stability calculation [4].
In a new set of experiments performed in Rennes in 2016 [5], we realized again unidimensional flows. But contrarily to the previous ones, the pedestrians were now free to fix themselves the density of the flow. We will present the first results of the data analysis.

In a second part, we will focus on athletics and present a model for a race involving two runners. The optimal running velocity profile for a single runner has already been studied in the frame of optimal theory [6]. In a race involving several runners however, there are some interactions between the runners. These interactions may for example sometimes allow a weaker runner to win against a stronger one.
We propose a minimal stochastic model allowing to describe this phenomenon [7]. The tools of Game Theory allow us to find the Nash equilibrium, which turns out to consists in mixed strategies composed of continuous parts and Dirac peaks.

[1] PERCEFOULE Project – Collab. with Alexandre Nicolas (LPTMS, Paris Sud)

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[3] A. Jelic et al, Phys. Rev. E 85, 036111 (2012); Phys. Rev. E 86, 046111 (2012)

[4] J. Fehrenbach, J. Narski, J. Hua, S. Lemercier, A. Jelić, C. Appert-Rolland, S. Donikian, J. Pettré, and P. Degond. Networks and Heterogeneous Media, 10 (2015) 579-608

[5] Collaboration Julien Pettre (INRIA-Rennes), William Warren (Brown Univ.).

[6] A. Aftalion and J.F. Bonnans, SIAM J. Appl. Math. 74, 1615 (2014)

[7] C. Appert-Rolland, H.J. Hilhorst, A. Aftalion, in preparation.