Minicolloque n° MCPG9 X Oral Poster

Active flow of pedestrian crowds: from large-scale measurements to variational modeling

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Pedestrians walk and choose their direction based on individual objectives and instantaneous traffic: this yields high variability in crowd dynamics, from diluted to dense regimes. Despite the unpredictability of single individuals, ensemble-level universal physical features emerge. These encompass frequent fluctuations and rare events within «solo» dynamics, mutual interactions, as well as routing choices. Reaching a quantitative understanding of these features is a major scientific challenge retaining great societal impact (e.g., in the design of civil infrastructures or crowd management measures), and sharing deep connections with the statistical physics of active matter.

To move towards a quantitative physics-based understanding of crowd dynamics, over the previous years, we established large-scale observational experiments held in real-life settings (stations, festivals, museums), aimed at investigating statistical features of pedestrian motion [1,2,3]. Via homemade high-fidelity tracking systems, we have collected datasets including millions of trajectories acquired with and without external influencing stimuli (i.e., crowd control measures, like signage or visual cues). In this talk, I will discuss the issue of modeling in (statistically) quantitative terms the observed dynamics, including PDFs of individual velocity, position, body rotation mutual-contact-avoidance, as well as path choice, based on Langevin-like equations and variational principles.

Based on works is in collaboration with: A. Gabbana, J. Meeusen, C. Lee, A. Muntean, R. Benzi, F. Toschi

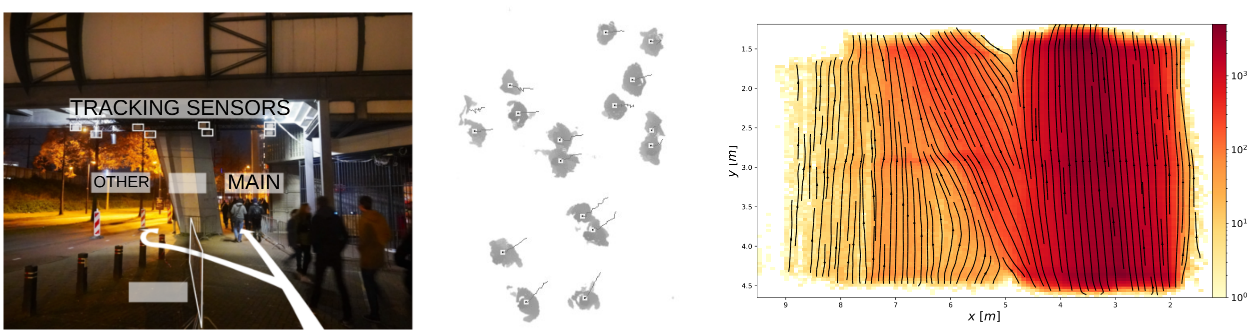

Figure 1 : Large-scale tracking experiment during the GLOW festival 2019 (Eindhoven, The Netherlands). About 200K trajectories have been collected and used to validate a stochastic variational model for crowd-level routing.

[1] A. Corbetta, C. Lee, R. Benzi, A. Muntean, F. Toschi. Fluctuations around mean walking behaviours in diluted pedestrian flows. Phys. Rev. E. 95, 032316, 2017
[2] A. Corbetta, J.A. Meeusen, C. Lee, R. Benzi, F. Toschi. Physics-based modeling and data representation of pairwise interactions among pedestrians. Phys. Rev. E. 98, 062310, 2018
[3] J. Willems, A. Corbetta, V. Menkovski, F. Toschi. Pedestrian orientation dynamics from high-fidelity measurements. Sci. Rep. 10, 11653, 2020