CROWDS' RESPONSE TO THEIR CROSSING BY AN AUTONOMOUS VEHICLE (PHYSICS + AI)

LABORATORY : Institut Lumière Matière
IN COOPERATION WITH : ILM - Citilab

LEVEL : M1 / M2
TEAM(S) : MMCI

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KEYWORD(S) : statistical physics / pedestrian dynamics / autonomous vehicle

SCIENTIFIC CONTEXT :

Autonomous cars have started to appear on the streets of several cities across the globe and may become the dominant form of urban transport by 2040 [1]. So far, most research has focused on their interactions with the built environment and other cars in their vicinity, but interactions with pedestrians are also a subject of major concern for public safety, for sparse pedestrians [2] as well as for denser crowds. Navigation through dense crowds has recently started to attract academic

interest [3-4], but these endeavours are faced with the intricacy of modelling the response of such crowds. In particular, reproducing the crossing of a static crowd by an intruder is still a challenge for models of pedestrian dynamics [5-6].

The research internship is aimed at unlocking this situation by modelling admissible and non-admissible trajectories of a (simplified) autonomous car through a crowd. More precisely, agent-based models will be exploited and further developed to simulate a realistic crowd's response to the traversing motion of an autonomous vehicle. More precisely,
the intern will tackle the following problem : Assuming that the car follows a given trajectory or obeys simple equations of motion, is there a risk of collision with pedestrians in the crowd ? Can one delineate the crowd's responses that are admissible (i.e., those that do not lead to any collision) and those that are not?

MISSIONS :

To this end, the intern will
- make use and further develop agent-based models for pedestrian motion
- develop a theoretical method to delineate admissible crowd's responses, notably by putting forward quantitative indicators to gauge how acceptable a crossing is
- contribute to the development of a 3D visualisation tool to illustrate the output of the model.

We are looking for a motivated and autonomous intern
- with a solid background in Physics (Complex Systems and/or Statistical Physics and/or Condensed Matter Physics)
- with a good grasp of numerical tools and programming (ideally, C++ and Python).
Previous experience with 3D modelling tools (like the Unity Platform) would certainly be an asset, but is not a requirement in any way.

The intern will be co-supervised by Alexandre NICOLAS (Institut Lumière Matière) and Olivier SIMONIN (Citi-lab) and will be based in one of these two labs. The project takes place in the frame of a joint programme funded by Fédération d'Informatique de Lyon (CROSS).

OUTLOOKS :

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BIBLIOGRAPHY :

[1] Cugurullo, F.et al (2020). Urban Geography, 1-27
[2] Poibrenski, A., et al (2021). ACM SIGAPP Applied Computing Review, 20(4), 5-17.
[3] Bresson, R. et al (2019). 2019 IEEE Intelligent Vehicles Symposium (IV) (pp. 64-69). IEEE;
[4] Prédhumeau, M. et al (2022). Journal of Artificial Intelligence Research, 73, 1385-1433.
[5] Nicolas, A. et al (2019). Scientific reports, 9(1), 1-10.
[6] Bonnemain, T. et al (2023). Phys. Rev. E.
[7] Echeverría-Huarte, I. et al. arXiv:2309.12798.