Minicolloque MCPG9 **Oral presentation**

Lab on a chip for crowd experimental studies

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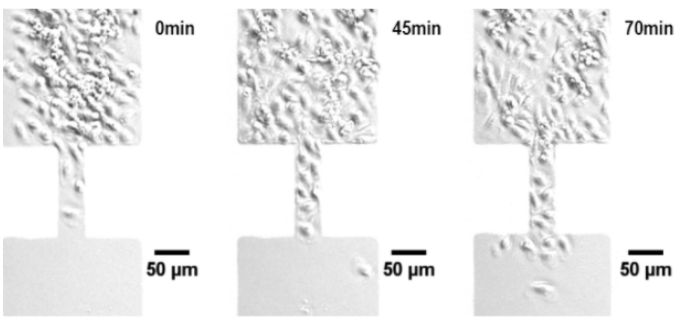
Studying crowd movement is becoming a major societal issue since, with demographic growth, we are also witnessing an increasing demand for individual mobility. Institutions must therefore organize themselves to manage the large flows and gathering of people. This societal issue leads, first, to a theoretical challenge, as it involves building new statistical models to simulate crowds. This brings an experimental issue: how to set up experiments in the laboratory, using living active matter, to test the robustness of these theoretical models?

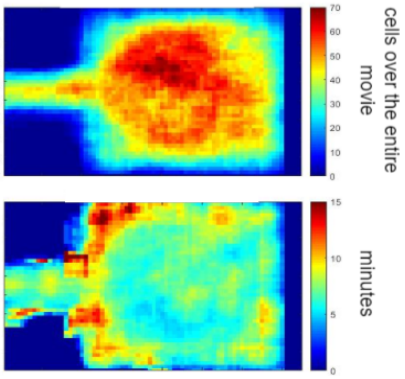
We propose to create a lab on a chip combining photolithography and living cells to model crowd movements. Keratocyte epidermal cells, extracted from fishes, are outstandingly fit for this task due to their exceptional motility. These cells are migrating from scales on a coverslip, by healing reflex. On this coverslip, micro-environments of adhesive proteins have been created using photolithography. It allows us to burn a specific region and to create the desired geometries. We can therefore multiplex the experiments, obtain quantitative datas and play on the geometries to infinity.

Abstracting this idea further, we imagined it would be an interesting task to compare the navigation of cells in the micro-world with the movement of living agents in the macro-world. We already obtained a proof-of-concept that this experimental setup can fit for humans moving in an escape scenario through a bottle-neck. It has been proved that when the desired velocity of pedestrians is increasing beyond a critical point, jams emerge around the exit, leading to lower flow rate and a 'stop-and-go' regime, where pedestrians move forward in intermittent waves. The same phenomenon has been observed on cells, in the same architecture at the right scale. Also, by displaying residence time and density maps, on human and cell experiments, we obtained very nice analogies, promising for the future of this project. A huge advantage of our system is the facility we have to control a whole bunch of parameters, allowing us to refine our study, and to play on the density and the initial speed of the cells, as it is done on humans with instructions on how they must behave.

The analogy could be taken further, by extending the studies to humans moving in urban spaces or vehicles navigating in cities. Contrasting the motility of cells with the movement of animals, each living in their own unique spatial and temporal scales, may just be the key to extracting universal insights into the dynamics of active matter systems.



Imaging of cells going through a bottleneck



Cell passage and mean residence time maps