

Inhomogeneities in dense crowds: a case study on active and passive pedestrians

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Abstract Until now in bottleneck experiments crowds with homogeneous instructions and therewith equal motivation levels were studied. In this study, we investigate how the presence of both active and passive participants influences the dynamics within the crowd and compare the results to those of a homogeneous crowd. We are interested in density profiles, changes in neighborhood, waiting time and fairness.

Keywords experiments, bottleneck, high density

Instruction

Generally, high density is one of the main causes for dangerous situations within pedestrian crowds. Therefore, it is important to understand potentially dangerous dynamics and investigate their origin to prevent accidents. However, currently the knowledge about how dangerous dynamics are triggered is limited as the factors which cause these dynamics are not yet fully understood.

Until now in bottleneck experiments crowds with homogeneous instructions and therewith equal motivation levels were studied. However, real crowds are heterogeneous, meaning that individuals have e.g. different levels of motivation. While some people actively move forward and are willing to get in contact with others, e.g. by pushing to reach their goal faster, others adopt a more passive waiting posture and like to avoid contacts.

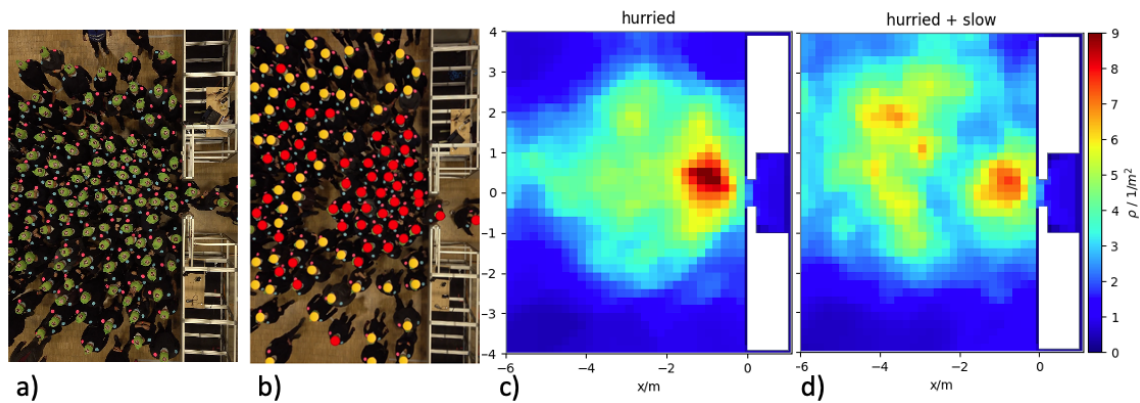


Figure 1: High motivation in bottleneck: a) homogeneous crowd b) inhomogeneous crowd: active participants (red) try to get closer to their goal, while passive participants (yellow) wait and create gaps. c) density profiles for homogeneous crowd (all hurried), d) density profiles for inhomogeneous crowd (20% (secretly) instructed to move slowly).

In this study, we investigate how the presence of both active and passive participants influences the dynamics within the crowd and compare the results to those of a homogeneous crowd. As case study we use laboratory bottleneck experiments [1] performed during the projects CrowdDNA (EU) and CroMa (BMBF). One of the experimental parameters, that was systematically varied to study its impact on the dynamics, was the level of motivation. There were three defined levels being either *normal*, *hurried* or *full commitment*. Generally, all participants were given the same instructions. Following the assumption

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that most participants followed the instructions, we define these crowds as being more homogeneous. However, in one experimental run 20% of the participants were (secretly) given the instruction to move slowly (meaning that they should reduce their motivation), while all others were told to hurry. This run will be our case study of an inhomogeneous crowd which is being compared to the other experimental runs. The data set consists of individual head trajectories extracted with PeTrack [2] from over-head video recordings. For the data analysis we mainly use the software PedPy [3].

In the video recordings it is visible that in experiments with inhomogeneous instructions not all participants actively move forward (e.g. by closing gaps or pushing), but some adopt a more passive waiting posture (see Figure 1a-b). In the density profiles (Figure 1c-d), it can be seen how this affects the spatial structure of the crowd, as this behaviour leads to different space requirements. Additionally, we plan to investigate how this affects the dynamics within the crowd by e.g. studying the waiting-time to target-distance relations, fairness as well as changes in neighborhood.

Bibliography

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