AGH University of Science and Technology

Granularity of pre-movement time distribution in crowd evacuation simulations

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Agenda

- What are the current requirements for models ?
- What we obsevre ?
- Does it affect evacuation/egress process ?
- Under what conditions it is imporatant ?
- Conclusions and future work

Pre-movement time - requirements

MSC.1/Circ.1238 - Guidelines for evacuation analysis for new and existing passenger ships

- Ten persons in a room of size 8 m by 5 m with a 1 m exit located centrally on the 5 m wall. Impose response times as follows uniformly distributed in the range between 10 s and 100 s. Verify that each occupant starts moving at the appropriate time.

NIST Technical Note 1822 The Process of Verification and Validation of Building Fire Evacuation Models

- Ten persons are randomly located in the room. (...). Impose a pre-defined distribution (e.g. uniform, normal, log-normal, etc.) of pre-evacuation times in accordance with the input distributions provided within the evacuation model. (...)
- Verify that each occupant starts moving at the appropriate time and that the responses of the population fall within the specified range.

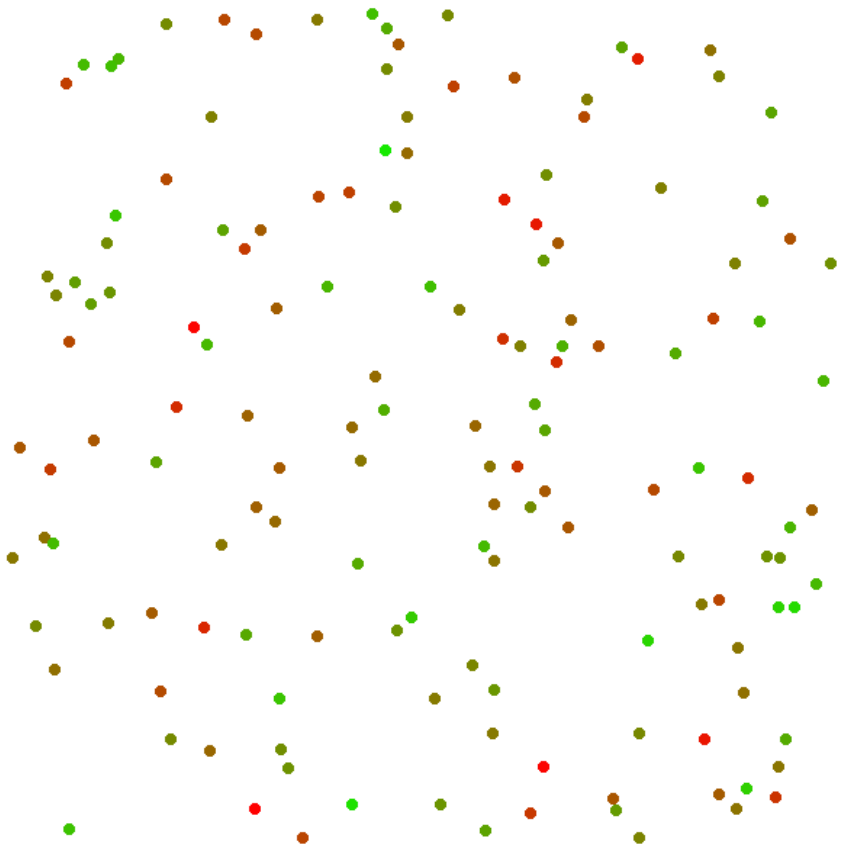
Normal conditions egrees of Wisla Kraków stadium – stage 1

Normal conditions egrees of Wisla Kraków stadium – stage 2

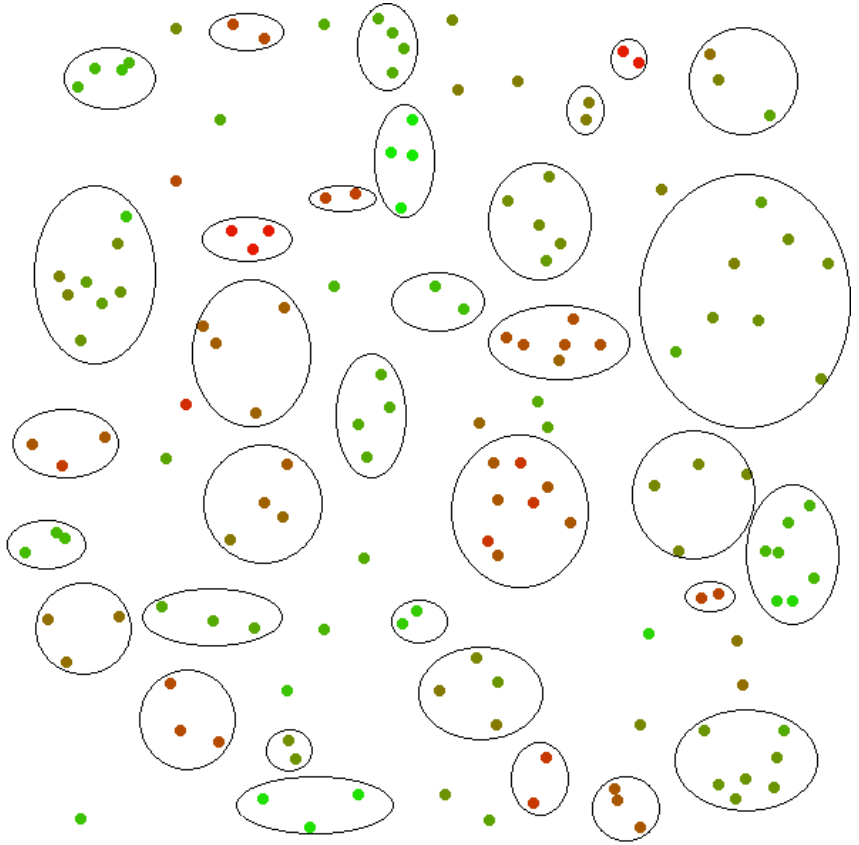
Normal conditions egrees of Wisla Kraków stadium – stage 3

Differences in spatial distribution of pre-movement times between models and real cases

The model



The reality

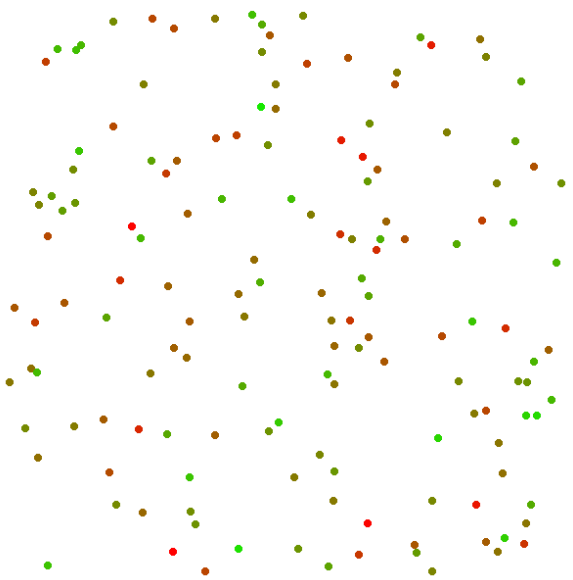


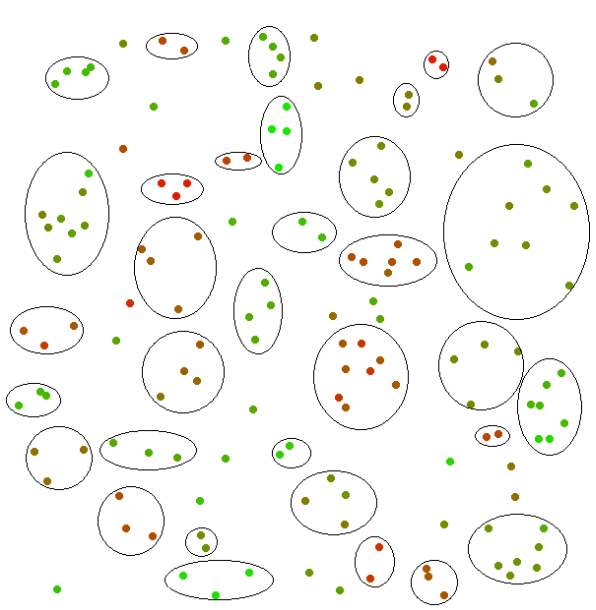
Short pre-movement time

Long pre-movement time

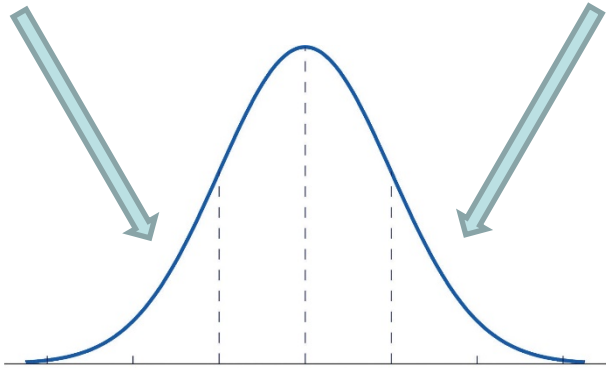
Differences in spatial distribution of pre-movement times between models and real cases

- The same distribution.
- Diffeent spatial relations between pedestrians with similar pre-movement time.





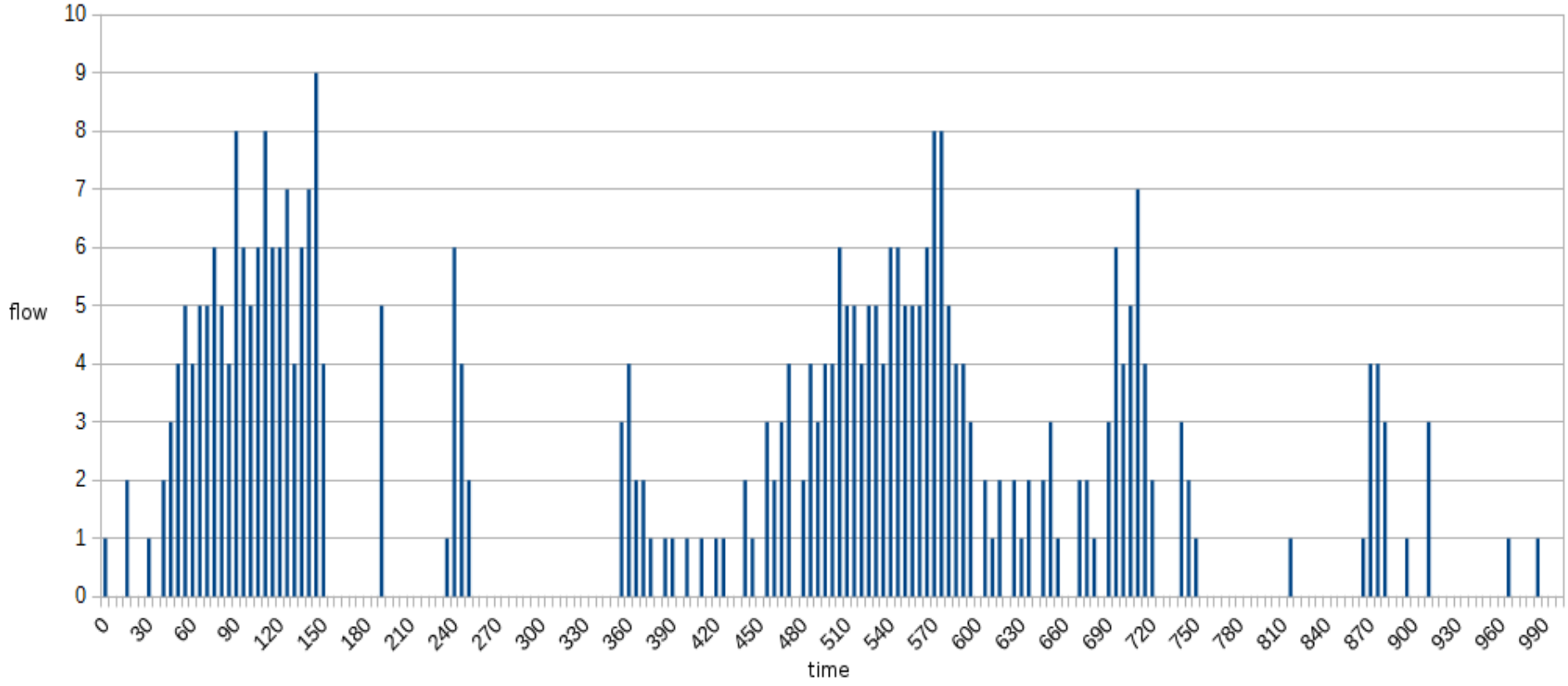
- **Decision about movement is taken in groups or by the leader**



Does it matter ?

Under what conditions the spatial distributions of pre-movemnt time affect the evacuation process?

Trial evacuation – flow on staircase



flow is calculated as the number of evacuated pedestrians in consecutive 5 sec. time windows

Influence of spatial pre-movement distribution on evacuation process

Significant influence

- Long avarage pre-movement time.
- Groups of occupants located in different rooms. (can not see each other).
- Existence of natural leaders.
- Occupants are unprepared for evacuation.

Unannounced evacuation of multifloor buildings, offices, schools, academic buildings, (large open areas?).

Complex simulation scenarios.

No significant influence

- Short avarage pre-movement time.
- Occupants are in the same room (can see each other) or in a lot of small rooms.
- Lack of natural leaders.
- Occupants are well prepared for evacuation.

Announced test evacuations, most of crowd dynamics experiments, (hotels evacuation ?), (stadiums?), small and medium open areas.

Simple simulation scenarios

Conclusions

- Currently, the only requirements to crowd dynamics models is that pre-movement time should fall in given distribution.
- Pedestrians pre-movement time is influenced by the existence of groups.
- In some kinds of situations this influence is higher than in others, and can significatnly change the pedestrians flow.
- There is a certain set of circumstances that increase the influence.
- In complex scenario it is hard to define the real distribution of premovement time.

Future work

- Run simulations for different scenario to measure quantitative influence of pre-movement time granularity.
- Determine the extended set of scenario where the influence is strong.
- Try to propose new requirements for models in terms of spatial distribution of pre-movement time.

„SIS - Student Invigilation System” – invitation to cooperation ?

- Two cameras.
- Approximately 6 months of students groups entering and leaving the lecture hall.
- Automatic recording during lecture hours.