Evacuation from a Room with two (contiguous) Exits

by Guillermo Frank (frank@ieee.org) & Ignacio Sticco (ignaciosticco@gmail.com) & Claudio Dorso (codorso@df.uba.ar)

Outline

Our research examines the statistical behaviour of escaping pedestrians when two contiguous exits are available, but placed at different separation distances. We found that the evacuation time can be improved if the separation exceeds a threshold distance. This threshold distance is related to changes in the clogging dynamics close to the doors.

What's about
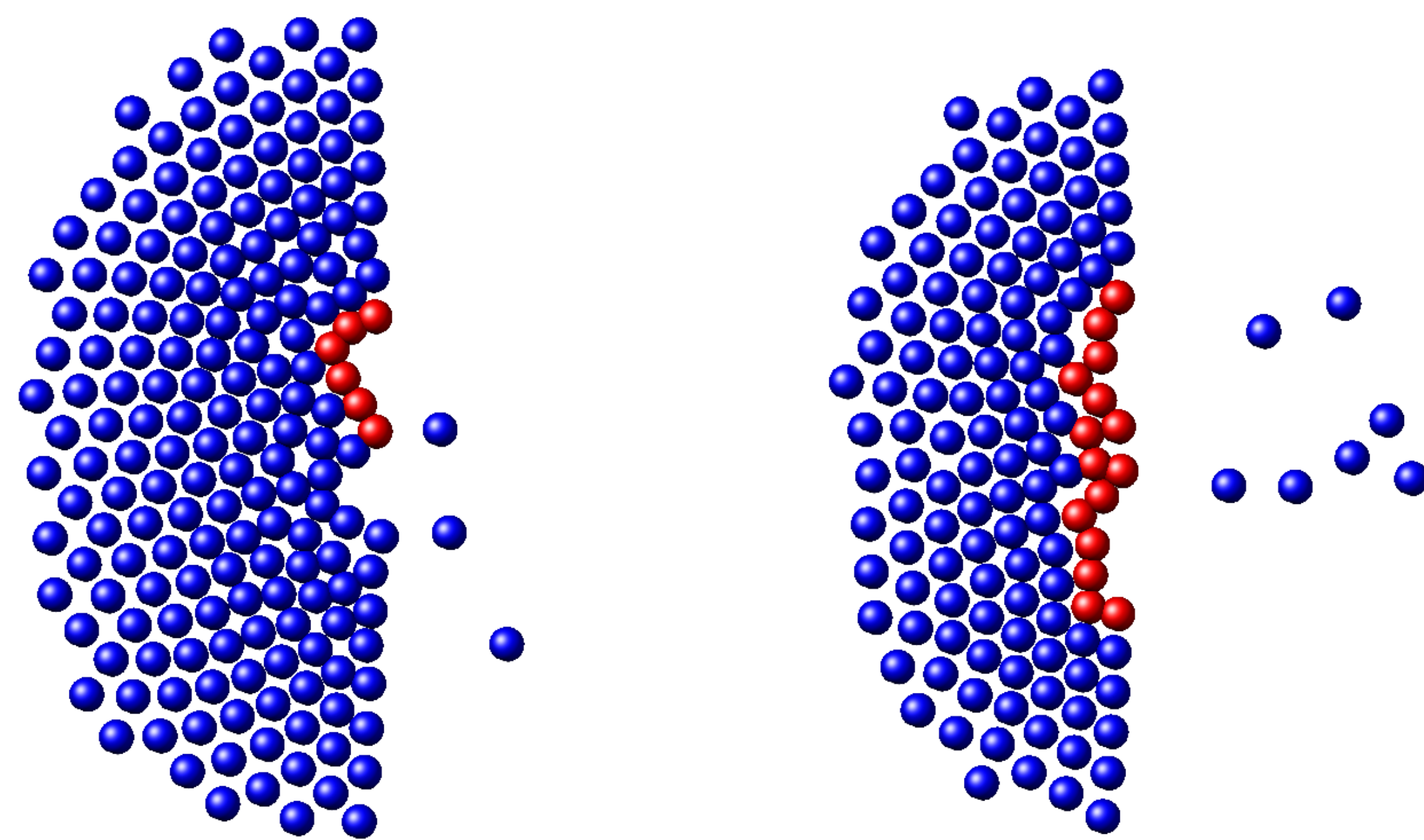
The Model (SFM):

$$m\frac{d\mathbf{v}}{dt} = \mathbf{f}_d + \mathbf{f}_s + \mathbf{f}_g$$

- $\mathbf{f}_d$ is the desire force
- $\mathbf{f}_s$ is the social force
- $\mathbf{f}_g$ is the sliding friction

Individuals blocking the doors are coloured in red. The room size is 20 m×20 m (door width 1.2 m). The desired velocity is $\mathbf{v_d} = 4$ m/s.

The pressures

Separation distance of 1.5 m.   Separation distance of 5 m.
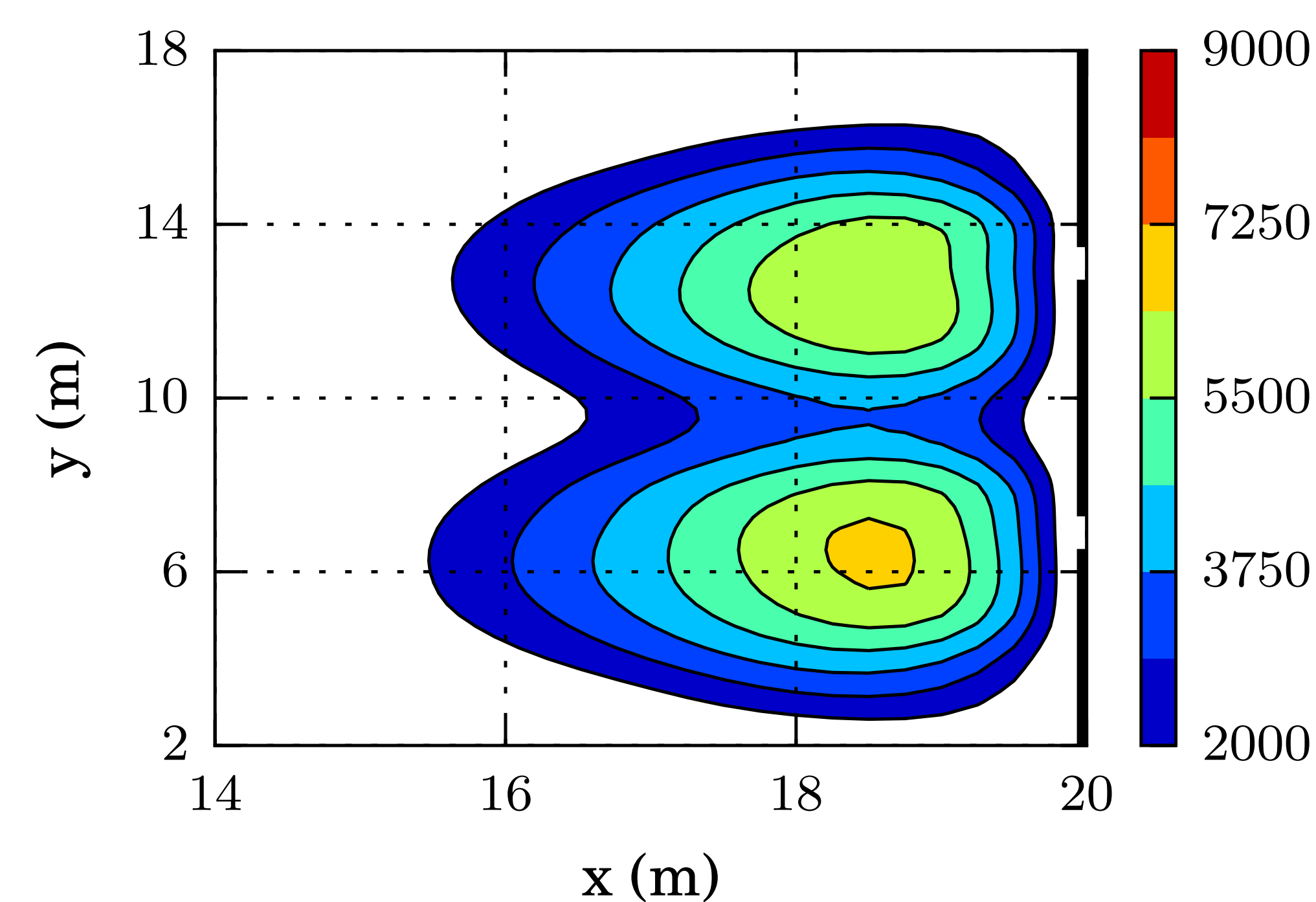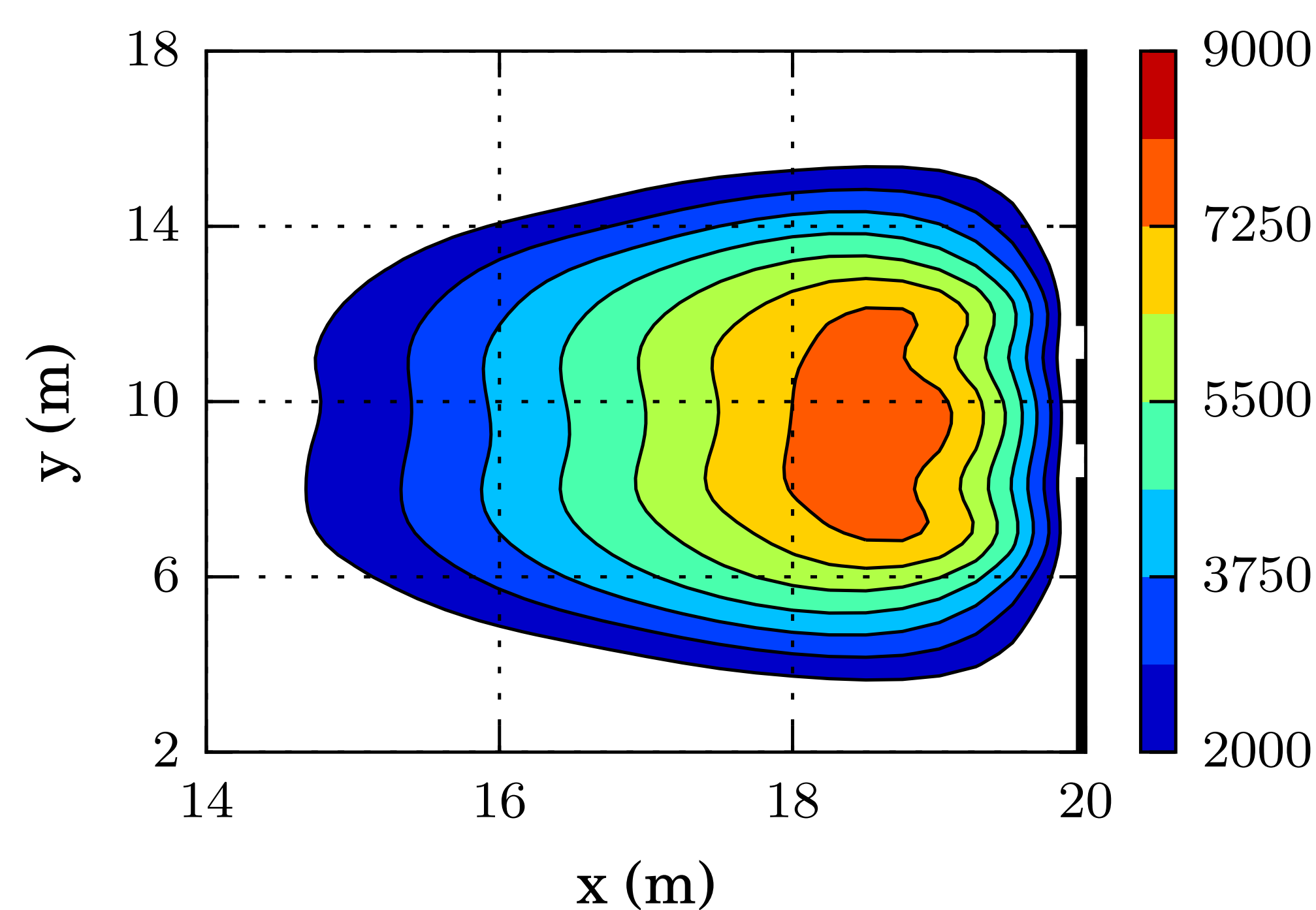

Fig 1.   Mean pressures computed from 30 evacuation processes. $v_d = 4$ m/s. The scale bar on the right is expressed in N.m units.
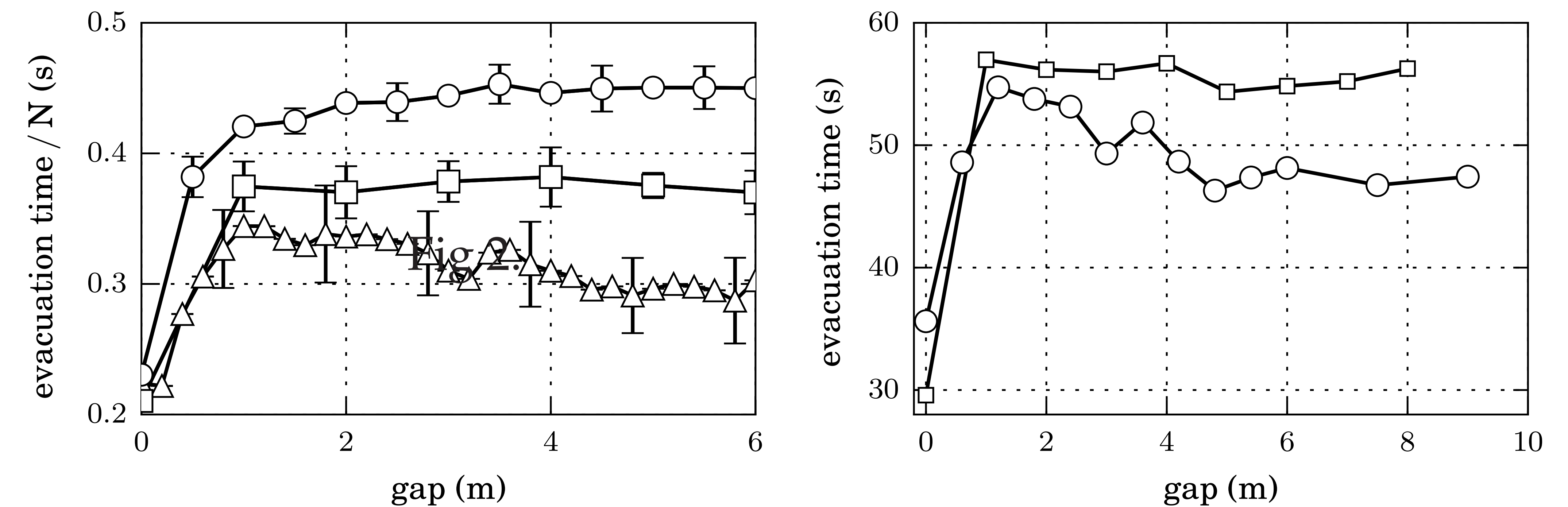
Evacuation Time

Fig 2. Mean evacuation time for 225 pedestrians computed from 30 evacuation processes. (Left) △ corresponds to 225 individuales, □ corresponds to 584 individuals and ◯ corresponds to 960 individuals ($v_d = 4$ m/s). (Right) ◯ 225 individuals and $v_d = 4$ m/s. □ 225 individuals and $v_d = 8$ m/s.

Conclusions

✓ Short separation distances ($d_g \simeq 1.2$ m) worsen the evacuation performance for all the explored situations, while larger distances ($d_g > 1.2$ m) enhances the evacuation time for relatively small crowds and moderate anxiety levels.

✓ As the separation distance approaches 1.2 m (from the null distance), the probability of having blocking structures around each door raises, resembling the situation of two independent doors.

✓ Increasing the crowd size (N) or the pedestrian's anxiety level (v_d) slows down the evacuation. Both magnitudes raise the pressure acting on the pedestrians.

Acknowledgements