

# Experimental study of high-density pedestrian flow field characteristics at a crossing

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# **Main Content**



## Background

- Research status
- Experiment setup

## Motion detection and tracking



## Background





Hajj, 2015, Mecca

Love Parade, 2010, Germany

## **Research status**



## Local variables

Local density: 
$$\rho(\vec{r},t) = \sum_{j} f(\vec{r}_{j}(t) - \vec{r})$$
  
Local velocity:  $\vec{V}(\vec{r},t) = \frac{\sum_{j} \vec{v}_{j} f(\vec{r}_{j}(t) - \vec{r})}{\sum_{j} f(\vec{r}_{j}(t) - \vec{r})}$ 

In which

$$f\left(\vec{r}_{j}\left(t\right)-\vec{r}\right)=\frac{1}{\pi R^{2}}\exp\left[-\left\|\vec{r}_{j}\left(t\right)-\vec{r}\right\|^{2}/R^{2}\right]$$

- $\vec{r}_j(t)$ : Position of pedestrian j
- $\vec{v}_j$ : Instantaneous velocity of pedestrian j
- *R*: Measurement parameter

# (12) (10)

Time-averaged velocity field

Dynamics of crowd disasters: An empirical study, Physical review E, 2007, 75(4)

Dirk Helbing, Anders Johansson, Habib Zein Al-Abideen

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## **Research status**



## Traffic design at a crossing



Self-Organized Pedestrian Crowd Dynamics: Experiments, Simulations, and Design Solutions, Transportation science, 2005, 39(1)

Dirk Helbing, Lubos Buzna, Anders Johansson, Torsten Werner

## **Research status**



### Ant evacuation in panic



Investigating collective escape behaviours in complex situations, Safety science, 2013, 60(87-94)

Charitha Dias, Majid Sarvi, Nirajan Shiwakoti, Omid Ejtemai, Martin Burd

## **Experiment setup**





## **Experiment setup**





Scenario 1



Scenario 3

#### Conditions for each experiment scenario

Scenario	Name	Obstacle	Walking instruction	N(w)	N(e)	N(n)	N(s)
1	OO-WS		straight	100	88	96	80
2	OO-WR		right	91	97	76	99
3	WOH-WR	horizontal	right	100	92	90	72
4	WOV-WR	vertical	right	86	100	71	95

#### Note:

OO (without obstacle) WOH (with obstacle in horizontal direction) WOV (with obstacle in vertical direction) WS (walk straight) WR (walk on the right hand side).





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#### **Pedestrian Positions**

Instantaneous Velocities

**Experiment OO-WS** 



## Pedestrian gap



Density in the cross area:  $9.08 \text{ ped/m}^2$ 

Majian et al TGF2013

Experiment OO-WS









**Experiment OO-WR** 







## Turbulence intensity (I)



u': fluctuation velocity field
V: local velocity field
U: average velocity field



Local density distribution in experiment OO-WS









## "Turbulence intensity"







- Four-directional intersecting pedestrian flows are conducted
  - ✓ Local density in the cross area can exceed 10 ped/m<sup>2</sup>
  - ✓ Density in the cross area is higher than in corridor
- Pedestrian gap at high densities in the cross area
  - ✓ People are easy to fall





- Local velocity contour and streamlines at a crossing are obtained
  - Local velocity distribution and pedestrian flow field can be clearly seen
  - $\checkmark$  An approximate rotary traffic is formed
- Traffic in the cross area will be relatively stable when putting an obstacle in the cross area
  - ✓ Turbulence intensity will be smaller





PEDESTRIAN and EVACUATION DYNAMICS

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# Thank you! & Any questions?

