



A concept of congestion dynamics

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Fire Safety Engineering

General principles (e. g. ISO/TR 16738:2009-08)

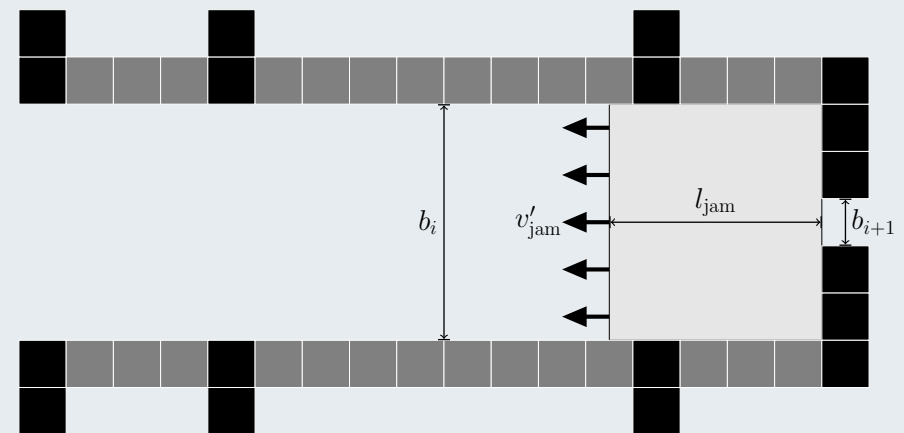
ASET/RSET concept

standard evolution of life-safety aspects of a fire-safety engineering design

$$ASET > RSET$$

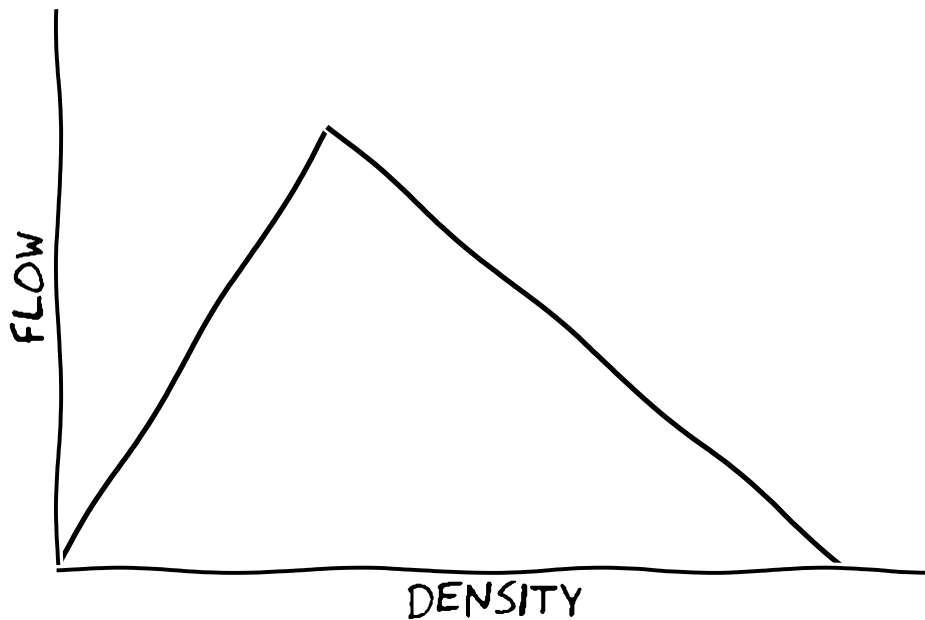
- **ASET** - available safe escape time
- **RSET** - required safe escape time

movement calculations



Fire Safety Engineering

concept of congestion dynamics



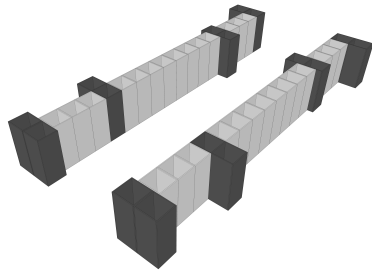
occurrence of congestion

possible performance criteria:

- length
- area
- time
- density
- velocity of propagation
- waiting time
- ...

Experimental Data

Unidirectional flow



- **PeTrack** – tool for automatic extraction of pedestrian trajectories from video recordings
- **JPSreport** – tool for analyzing the trajectories

The experiment **UNI_CORR_500** was performed within the project BaSiGo. The project was funded by the Federal Ministry of Education and Research (BMBF) within the programme „Research for Civil Security“ .

<http://ped.fz-juelich.de/da/2013unidirectional>

Measurement

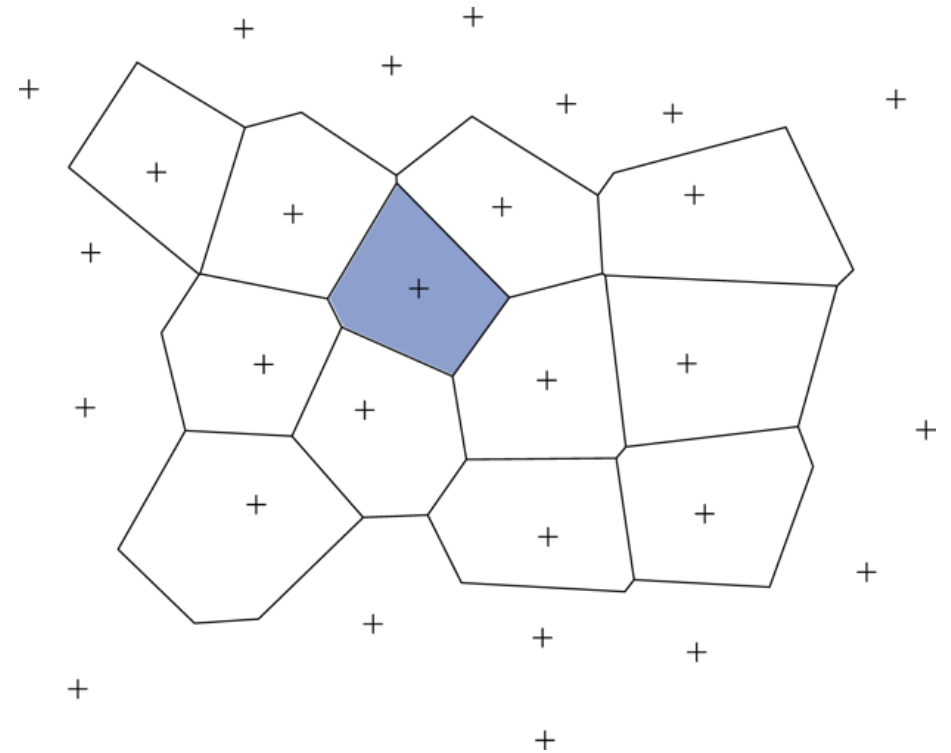
velocity and density

velocity

$$\vec{v}_{\Delta x,i}(t) = \frac{\vec{x}_i(t + \Delta t/2) - \vec{x}_i(t - \Delta t/2)}{\Delta t}$$

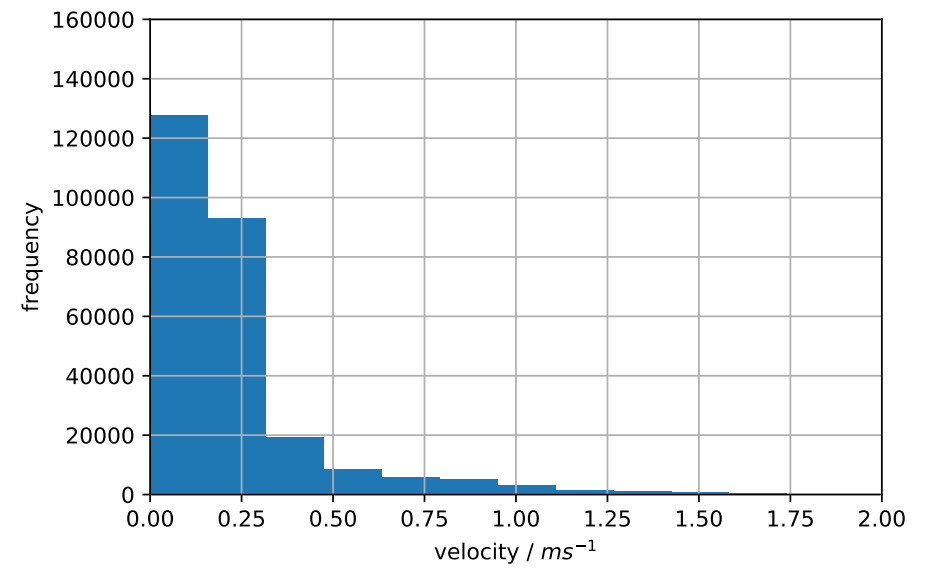
voronoi density

$$D_{v,i} = \frac{1}{A_{v,i}}$$



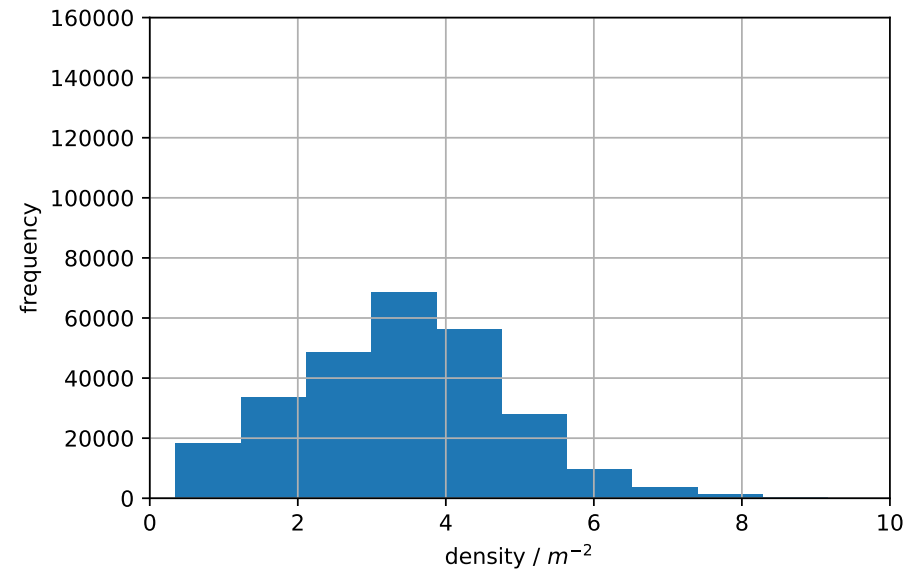
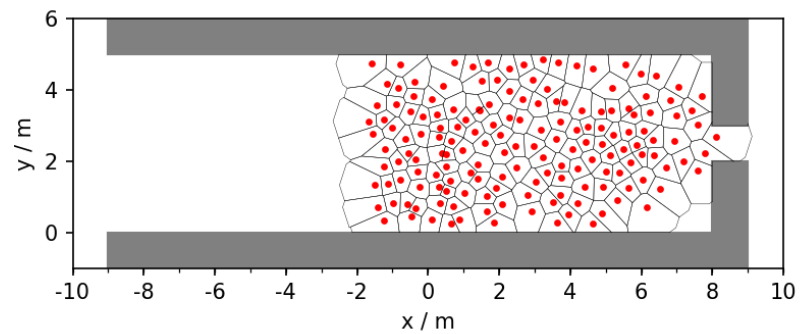
UNI_CORR_500_09

velocity



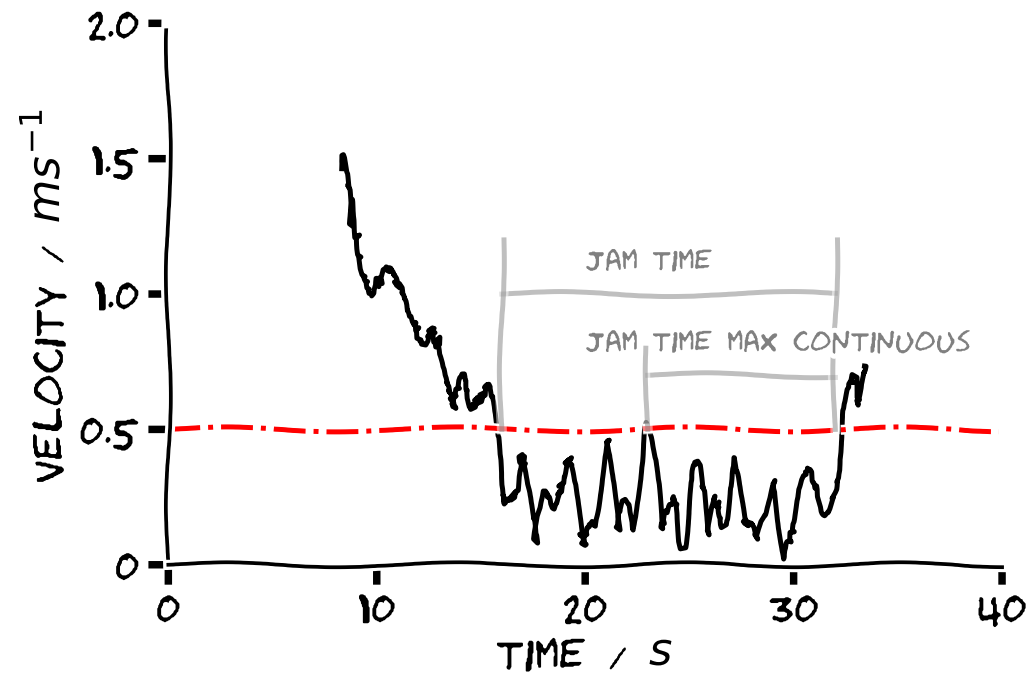
UNI_CORR_500_09

density



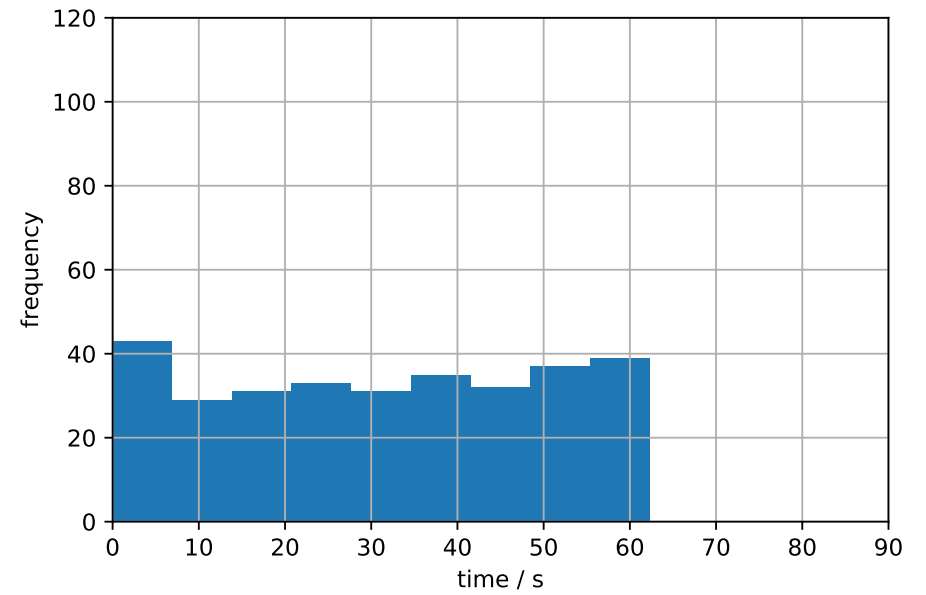
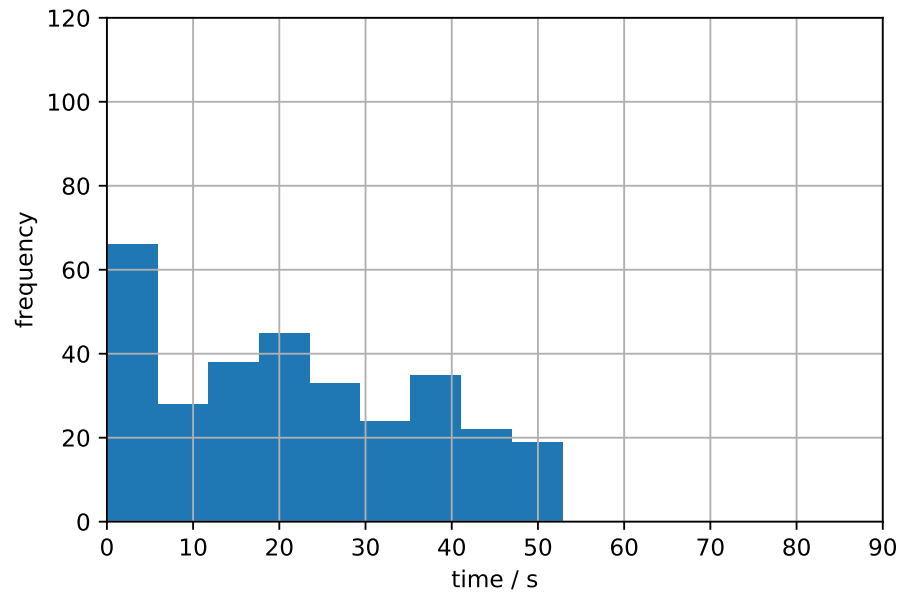
Measurement

jam time and jam time max continuous



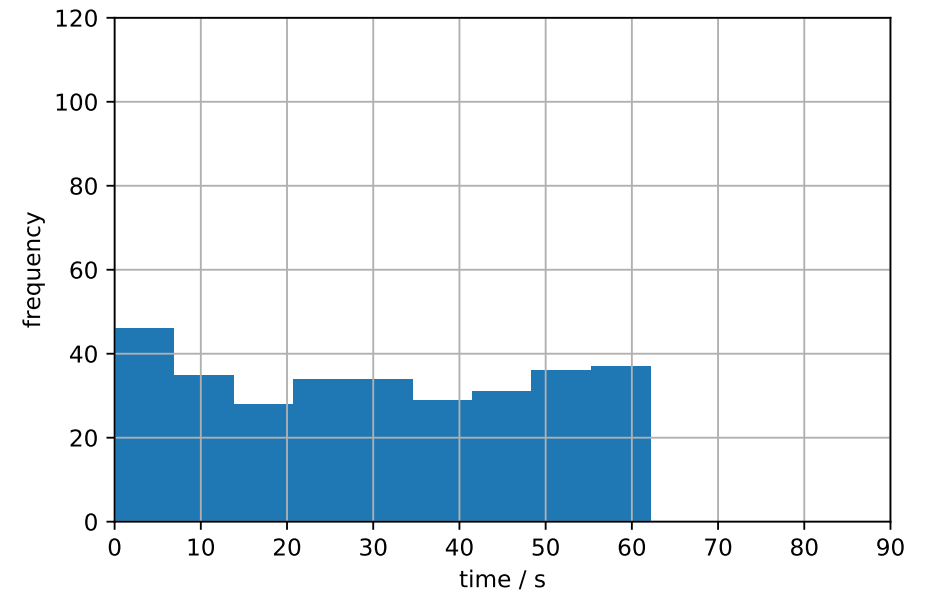
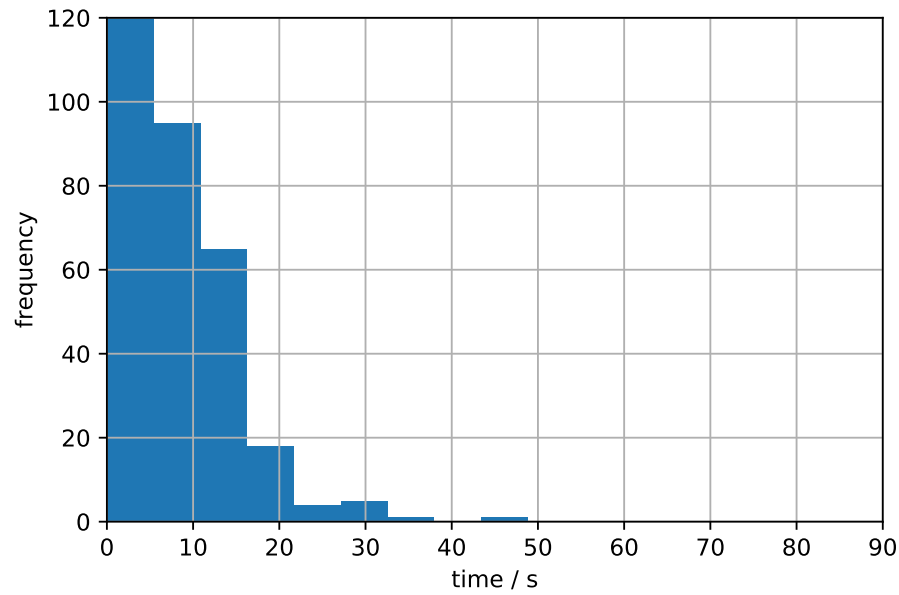
UNI_CORR_500_09

jam time



UNI_CORR_500_09

jam time max continuous



Summary & Outlook

Summary

- Congestions are (highly) dynamic – it is difficult to recognize different phases.
- The density in front of a bottleneck is not uniform.
- The length of a congestion is dependent on the density.
- The **individual jam time** and the **jam time max continuous** depend on the threshold value.

outlook

- Evaluation with a new method for calculating the velocity at low values.
- Evaluation of other existing experiments in the context of our new project
CroMa - crowd management in traffic stations