Models for simulating pedestrian behaviour and escape panic

Jonathan Larsson

Based on:
Presentation Outline

- Background
- Modelling pedestrians
- Social force model
- Behavioural heuristics model
- Model comparison
- Results
Background

- Predicting possible danger
- Architecture, exit routes
- Organization of mass events
- Urban planning
- Possibly dangerous situations
Modelling pedestrians

- Two dimensional
- Position, velocity
- Contact forces $\sim d_{ij}$
- Desired destinations
- Desired speeds
- Walls, exits
Social force model

- Physics inspired
- Additional forces:
  - Repulsion $\sim \exp(d_{ij})$
  - Attraction
  - Friction
- No long range interactions
- Useful in very crowded simulations
Behavioural heuristics model

What kind of information is used by the pedestrian?

How is this information used to adapt walking behaviour?
(How does it affect speed and direction?)
Behavourial heuristics model

- Direction
  - Trade-off, a minimization problem
- Speed
  - No collision within reaction time
<table>
<thead>
<tr>
<th>Model comparison</th>
<th>Social force</th>
<th>Behavioural</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>● Inspired by physics</td>
<td>● Derived from observations</td>
</tr>
<tr>
<td></td>
<td>● No realistic interpretation</td>
<td>● Information dependent</td>
</tr>
<tr>
<td></td>
<td>● Collisions, pushing</td>
<td>● Avoiding, waiting</td>
</tr>
</tbody>
</table>
Results

- Single pedestrian
- Avoiding stationary and moving obstacles
- Compares well to empirical data
Results

- Bidirectional flow
- Spontaneous separation
- Characteristic property
Results

- Unidirectional flow
- Different occupancy ➔ Different collective motion
THANKS FOR LISTENING

ANY QUESTIONS?