Mid-Project Review

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Guide: Prof. Pallab Sinha Mahapatra

Progress since Sept 22

Progress (estimated)

- **SEP-DEC**
  - Code development & Simulation
  - Validation of model
  - Identification of crowd dense areas near the exit
  - Placement of obstacles and Data collection

Progress (present)

- Completed development of code & Simulation
- Compared model
- Optimised code execution using matlab.

Qualitative comparison -Helbing's social force model

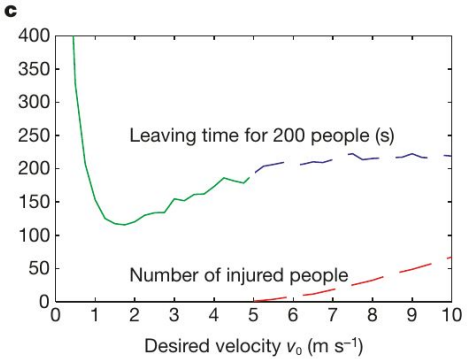
$$m_i \frac{dv_i}{dt} = F_i^{desired} + F_{iw}^{obstacle} + F_{ij}^{pedestrian}$$

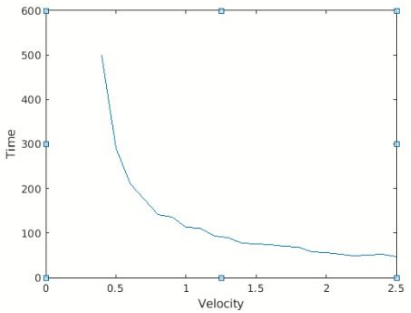
$$F_i^{desired} = m_i \frac{[v_{i_{max}}^o(t) - v_i(t)]}{\tau}$$

- Subjective comparison of the model
- Non - deterministic
- No constraint on crowd pressure

$$F_{ij}^{pedestrian} = we^{\frac{r_{ij}-d_{ij}}{w}}(\lambda+(1-\lambda)(\frac{1+cos\omega_i}{2})\bar{n}_{ij}+\mu g(r_{ij}-d_{ij})\Delta\bar{v}_{ij}(t)+w*(r_{ij}-d_{ij})\bar{n}_{ij}$$

$$F_{io}^{obstacle} = w.e^{\frac{r_i-d_{io}}{w}}\bar{n}_{io} + \mu g(r_i - d_{io})\Delta\bar{v}_{io}(t) + w*(r_i - d_{io})\bar{n}_{io}$$

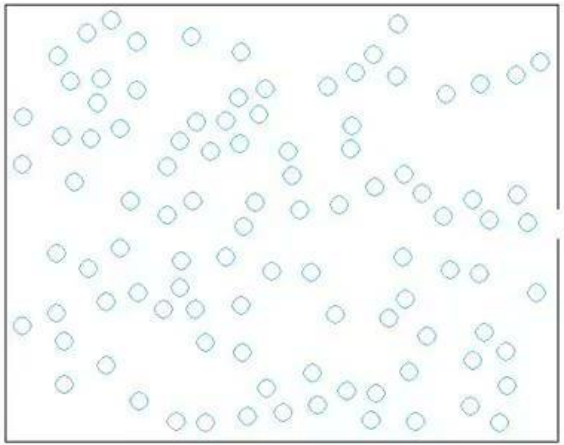




Workings of the model

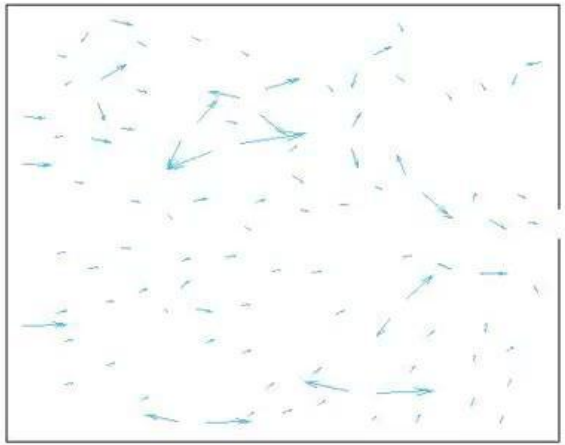
Demonstration

- Crowd agent positions with time



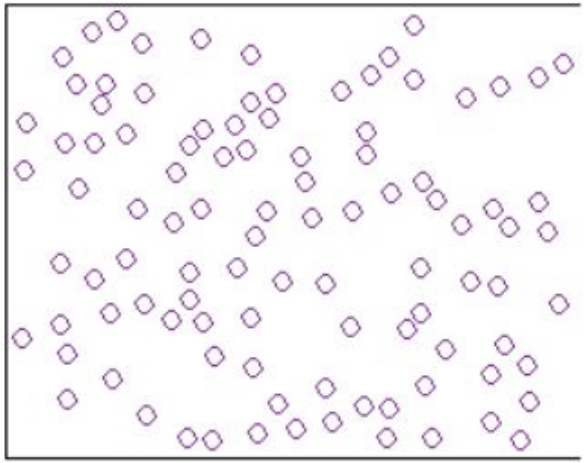
Time series velocity

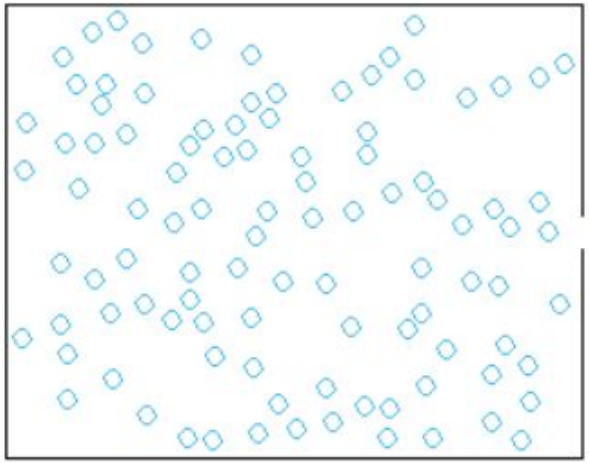
- Velocities of crowd agents with time
- Changes represent the acceleration due to repulsion forces.



Crowd evacuation dynamics as an optimization problem

- Best evacuation time? Having no walls
- Trade-off Engineering requirements vs Efficient evacuation

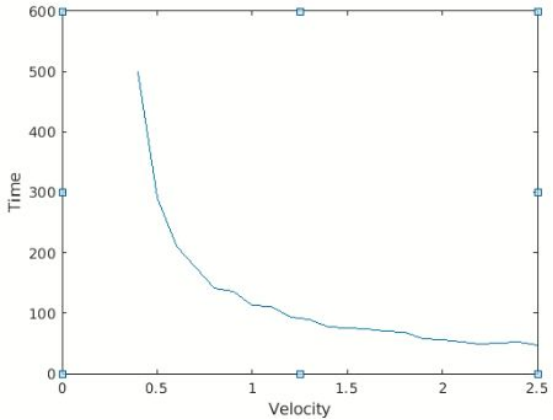




Parametric performance of model & Causal Analysis

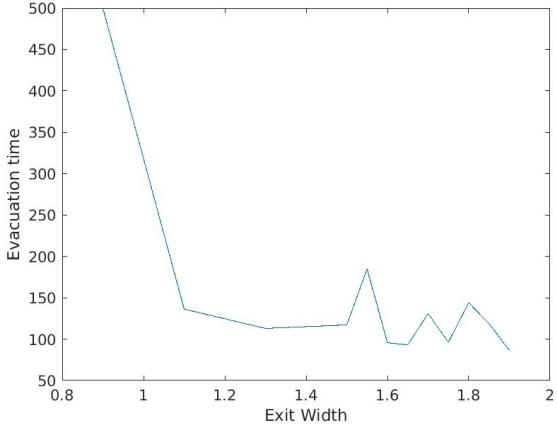
Speed variation

- With increase in agent desired velocity, evacuation time decreases.
- No constraints on crowd pressures.



Exit width

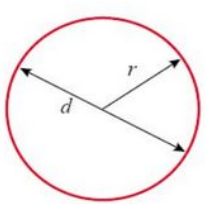
- Estimation: Evacuation time decreases with increase in exit width.
- Observation: Oscillation in time for a range of exit width(s).
  - Checked: Random crowd initial positions.
  - Checked: Lowering time steps

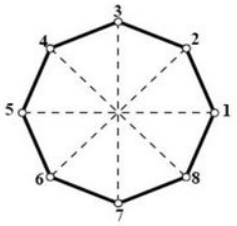


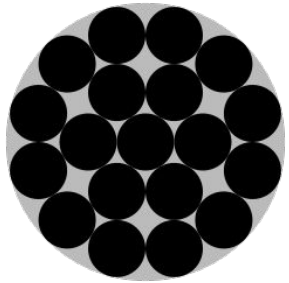
Methodology - Obstacle placement

- Simplification of obstacle
- Placement of obstacle at crowd dense locations.
- Defining parameters of placement
  - Distance from exit
  - Lateral shift
  - Size of obstacle

- Curved Objects







Methodology - Sensitivity analysis

Estimation of pressure density

- Division of space into discretized nodes.
- Crowd agents allotted to closest node
- At t, Eulerian approach in treating pressure on the agents within the node.
- Averaged over time:0,end

Sensitivity Analysis

- Comparison of pressure density maps before and after placement of obstacles.
- Output params: P,time
- Input params: Object placement