An Agent-Based Model To Improve The Simulation Of Pedestrian Dynamics

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Outline

- Motivation
- Objectives
- Model Definition
- Project Status

Motivation

- Pedestrian Dynamics is complex
- Pedestrian activity increases with density
- Computer simulation of pedestrian dynamics allow:
  - Better comprehension of pedestrian dynamics principles
  - Experiments with room geometry and exit paths avoiding expensive experiments

Objectives

- Model must represents pedestrian dynamics features: lane formation, oscillations at narrow doors, jamming.
- Model must be able to simulate large crowds
- Pedestrian level of model representation
- Pedestrian model must be easily incremented to more detailed behavior descriptions

Model Definition - Model Concepts

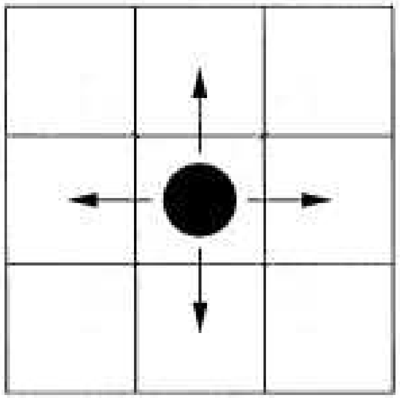
- Floor Field - **(Repulsion Floor Field - Contribution)**
- Preferences Matrix
- Sensitivity Coefficients
- Speed - **(Contribution)**
- Hindrance Coefficient - **(Contribution)**
- Transition Probabilities
- Collision Resolution

Floor Field

- Static Floor Field $S_{i,j} = MD - DIST_{i,j}$
- Dynamic Floor Field Diffusion and Decay
- Repulsion Floor Field

E2	E2	E2	E2	E2
E2	E1	E1	E1	E2
E2	E1		E1	E2
E2	E1	E1	E1	E2
E2	E2	E2	E2	E2

Preferences Matrix



	$M_{-1,0}$	
$M_{0,-1}$	$M_{0,0}$	$M_{0,1}$
	$M_{1,0}$	

Sensitivity Coefficients

- $K_s \in [0, \infty[$ is a static floor field sensitivity coefficient.
- $K_d \in [0, \infty[$ is a dynamic floor field sensitivity coefficient.
- $K_r \in [0, \infty[$ is a repulsion field sensitivity coefficient.

Speed

Gender	Medium	Variance
Male	1.62 ms^{-1}	0.22
Female	1.38 ms^{-1}	0.17

Hindrance Coefficient

We introduce a hindrance coefficient $T_{ij} \in [0, 1]$ to represent the possibility of a pedestrian jumping over an obstacle.

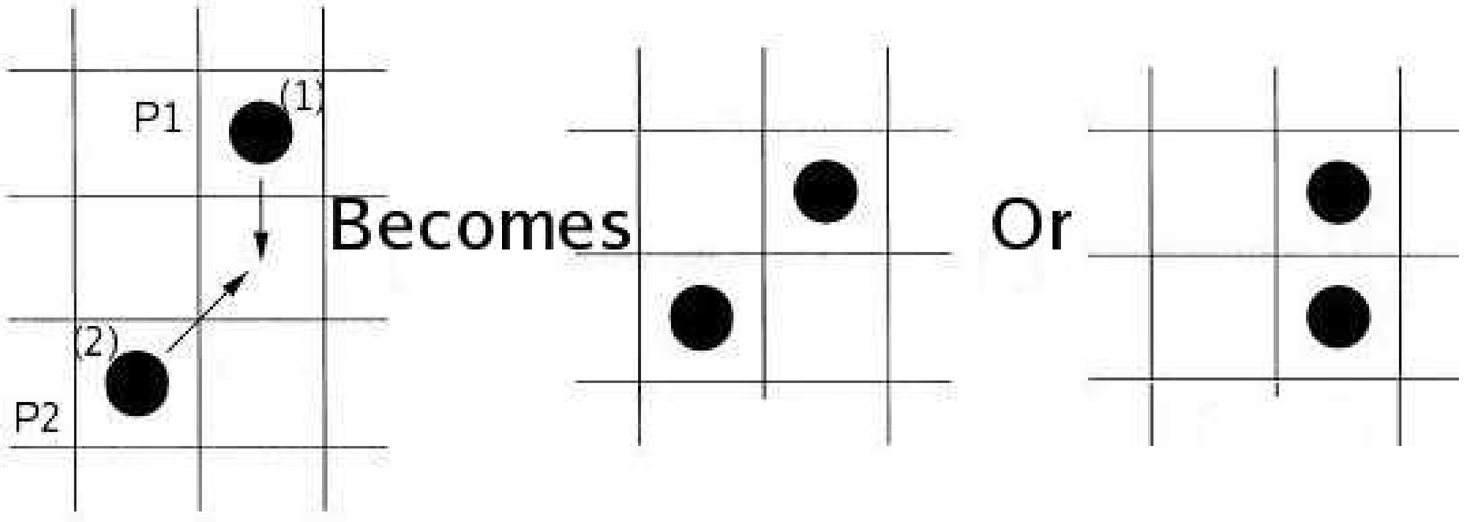
Transition Probability

(1) $$P_{ij} = \frac{N \cdot M_{ij} \cdot (1 - n_{ij}) \cdot exp(K_d \cdot D_{ij}) \cdot exp(K_s \cdot S_{ij})}{exp(K_r \cdot R_{ij})}$$

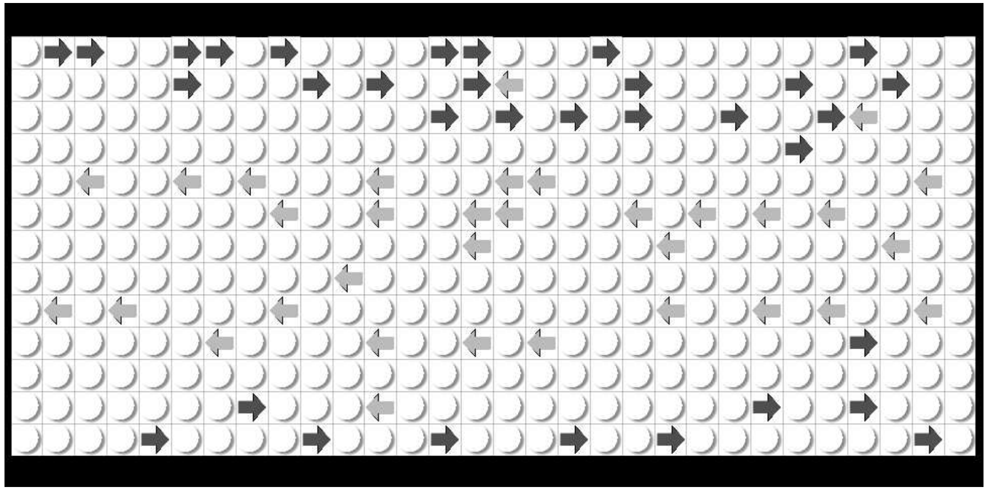
(2) $$P_{ij} = \frac{N \cdot M_{ij} \cdot (1 - n_{ij}) \cdot exp(K_d \cdot D_{ij}) \cdot exp(K_s \cdot S_{ij}) \cdot (1 - T_{ij})}{exp(K_r \cdot R_{ij})}$$

where N is the normalization factor to ensure that the sum over all the matrix cells is 1 ($\sum_i \sum_j P_{ij} = 1$).

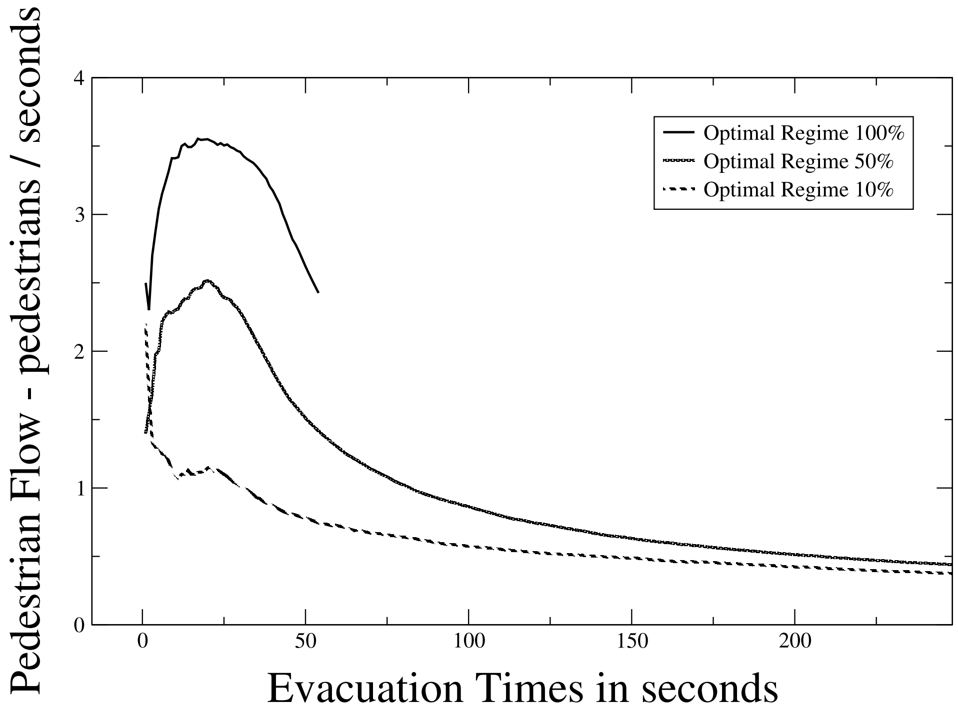
Colision Resolution



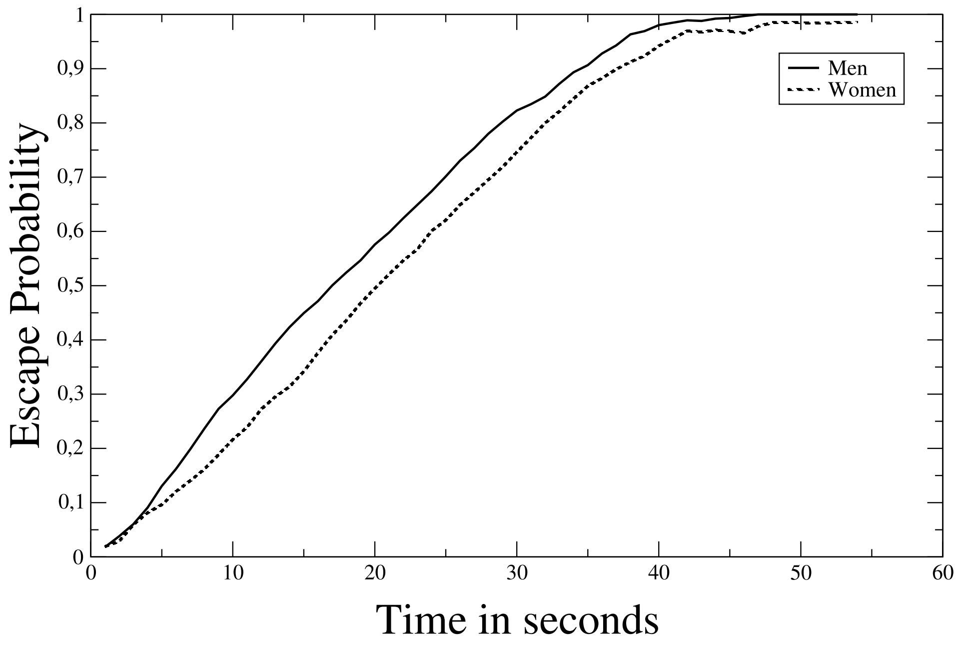
Results - Lane Formation



Results - Flow



Results - Men and Women



Project Status

- Model Validation in SeSAm
- Model implementation
- Writing an article with more details and results

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