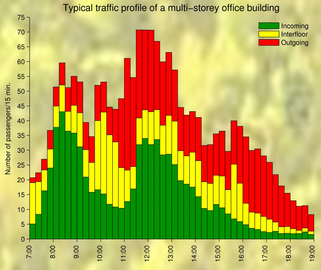
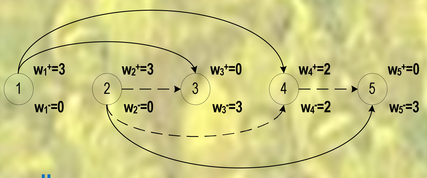
ELEVATOR TRAFFIC OPTIMIZATION CROWD DYNAMICS SIMULATION

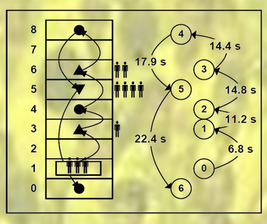
analysis of passenger traffic



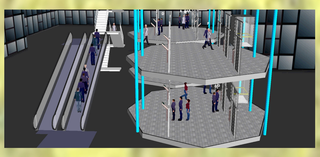
modeling and forecasting elevator usage



optimal allocation of elevators to passenger calls



simulator for elevator system design



computational models for the behavior and interaction of people in crowds

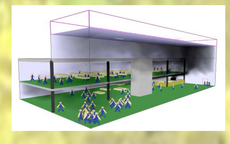
best-response reactions

$$BR_i(s_{-i}) := \arg\max_{s'_i \in S_i} u_i(s'_i, s_{-i}),$$

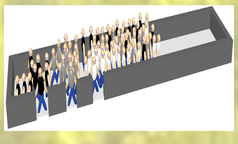
$$s_i^{(t)} = \begin{cases} BR_i(s_{-i}^{(t-1)}; \mathbf{r}), & i \in N_i \\ s_i^{(t-1)}, & i \notin N_i \end{cases}$$

methods
-agent-based modeling
-game theoretic learning models
-evolutionary game theory

human behavior
-psychology
-observations on real crowds
-experiments with students
-similarities with animal swarms



FDS+Evac simulation model
- integration of crowd simulation and state-of-the-art fire simulation



applications
building design:
-evacuation safety analysis
-optimization of the usability of venues

design of Helsinki Music Centre

safety analysis of Porvoo Musem

selected publications

M. Ruokokoski, J. Sorsa, M.-L. Siikonen, and H. Ehtamo: On the quality of the assignment model for the elevator dispatching problem. *European Journal of Operational Research* (to appear)

M. Ruokokoski, H. Ehtamo, and P. M. Pardalos: Elevator dispatching problem: a mixed integer linear programming formulation and polyhedral results. *Journal of Combinatorial Optimization*, 2013

J.-M. Kuusinen, M. Ruokokoski, J. Sorsa, and M.-L. Siikonen: Linear programming formulation of the elevator trip origin-destination matrix estimation problem. *Proceedings of the 2nd International Conference on Operations Research and Enterprise Systems*, 2013

J.-M. Kuusinen, J. Sorsa, and M.-L. Siikonen: The elevator trip origin-destination matrix estimation problem. *Transportation Science*, 2014

J.-M. Kuusinen, J. Sorsa, M.-L. Siikonen, and H. Ehtamo: A study on the arrival process of lift passengers in a multi-storey office building. *Building Services Engineering Research & Technology*, 2011

A. von Schantz and H. Ehtamo: Cellular automaton evacuation model coupled with a spatial game. *Lecture Notes in Computer Science*, 2014

S. Heliövaara, H. Ehtamo, D. Helbing, and T. Korhonen: Patient and impatient pedestrians in a spatial game for egress congestion. *Physical Review E*, 2013

S. Heliövaara, J.-M. Kuusinen, T. Rinne, T. Korhonen, and H. Ehtamo: Pedestrian behavior and exit selection in evacuation of a corridor – an experimental study. *Safety Science*, 2012

S. Heliövaara, T. Korhonen, S. Hostikka, and H. Ehtamo: Counterflow model for agent-based simulation of crowd dynamics, *Building and Environment*, 2012

T. Korhonen and S. Heliövaara: FDS+Evac: herding behavior and exit selection. *Fire Safety Science – Proceedings of the tenth International Symposium*, 2011

H. Ehtamo, S. Heliövaara, T. Korhonen, and S. Hostikka: Game theoretic best-response dynamics for evacuees' exit selection. *Advances in Complex Systems*, 2010

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