Pedestrian and Evacuation Dynamics 2008
Preface

Proper management of evacuation processes is one of the basic requirements within life safety concepts, and it helps to prevent critical situations from getting out of control. Super high-rise buildings, deep underground stations or shopping areas, airplanes for the mass transportation, sport stadiums or meeting places with tens of thousands of visitors—they all call for new dimensions in safe evacuation planning. Research results in evacuation dynamics give answers to these challenges.

PED-conferences are the prime address for all research in this field. The increasing number of participants from different fields of research reflect their importance. After PED-conferences in Germany (Duisburg, 2001), Great Britain (Greenwich, 2003) and Austria (Vienna, 2005), the PED 2008 Conference in Wuppertal/Germany reached new heights with more than 120 participants from 20 countries and nearly 100 presentations. The wide field of topics discussed in presentations also reflects deeper understanding of fundamental effects as well as the stronger interactions between different research areas. New test designs offer new important basic data, new analysis procedures open a better understanding of complex interactions, new model designs allow more realistic simulations, and the input from architectural design and the medical references on physical limitations help to realize a safe evacuation design. On the one hand all these data give an outlook of future possibilities and sometimes they open an astonishing new understanding of seemingly well-known data. On the other hand, they make clear the limitations of our current knowledge. Integration of evacuation analysis into fire safety concepts is without doubt an important step to improve the quality of life safety planning. But incorporation of tools for calculating toxic gas concentrations, for example, should be accepted only with caution, as too little reliable information about the chemistry of fire sources and its modeling is available.

The PED 2008 Conference Proceedings offer a wealth of the latest information on all fields of pedestrian evacuation and will be an important source for all researchers working in their different disciplines.
Finally, we would like to thank all people who, mostly behind the scenes, have helped to make the conference a success. Special thanks go to Mrs. Birgit Dahm-Courths for the excellent job she has done in preparing these proceedings, and to Mrs. Sabine Mehring for the excellent assistance before and during the whole conference. Furthermore, we would like to thank Wahed Azimi, Tobias Rupprecht, Dimitrios Toris, Nina Wellenberg, and Andreas Winkens for their “helping hands”, without whose support this conference could not have been realized.

Wuppertal, Köln, Duisburg
July 2009

Wolfram W. F. Klingsch
Christian Rogsch
Andreas Schadschneider
Michael Schreckenberg
Contents

Part I Experiment and Evacuation

The UK WTC9/11 Evacuation Study: An Overview of the Methodologies Employed and Some Preliminary Analysis

Evacuation Movement in Photoluminescent Stairwells
Guylène Proulx and Noureddine Bénichou .......................... 25

Automatic Extraction of Pedestrian Trajectories from Video Recordings
Maik Boltes, Armin Seyfried, Bernhard Steffen, and Andreas Schadschneider .................................................. 43

Stairwell Evacuation from Buildings: What We Know We Don’t Know
Richard D. Peacock, Jason D. Averill, and Erica D. Kuligowski ........ 55

Evacuation of a High Floor Metro Train in a Tunnel Situation: Experimental Findings
Monika Oswald, Hubert Kirchberger, and Christian Lebeda ........... 67

Using Laser Scanner Data to Calibrate Certain Aspects of Microscopic Pedestrian Motion Models
Dietmar Bauer and Kay Kitazawa ........................................ 83

Kay Kitazawa and Taku Fujiyama........................................... 95
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDS+Evac: An Agent Based Fire Evacuation Model</td>
<td>109</td>
</tr>
<tr>
<td>Timo Korhonen, Simo Hostikka, Simo Heliovaara, and Harri Ehtamo</td>
<td></td>
</tr>
<tr>
<td>Comparisons of Evacuation Efficiency and Pre-travel Activity Times</td>
<td>121</td>
</tr>
<tr>
<td>in Response to a Sounder and Two Different Voice Alarm Messages</td>
<td></td>
</tr>
<tr>
<td>David Purser</td>
<td></td>
</tr>
<tr>
<td>Design of Voice Alarms—the Benefit of Mentioning Fire and the Use of</td>
<td>135</td>
</tr>
<tr>
<td>a Synthetic Voice</td>
<td></td>
</tr>
<tr>
<td>Daniel Nilsson and Hakon Frantzich</td>
<td></td>
</tr>
<tr>
<td>Enhanced Empirical Data for the Fundamental Diagram and the Flow</td>
<td>145</td>
</tr>
<tr>
<td>Through Bottlenecks</td>
<td></td>
</tr>
<tr>
<td>Armin Seyfried, Maik Boltes, Jens Khaeler, Wolfram Klingsch, Andrea</td>
<td></td>
</tr>
<tr>
<td>Portz, Tobias Rupprecht, Andreas Schadschneider, Bernhard Steffen,</td>
<td></td>
</tr>
<tr>
<td>Andreas Winkens</td>
<td></td>
</tr>
<tr>
<td>Parameters of Pedestrian Flow for Modeling Purposes</td>
<td>157</td>
</tr>
<tr>
<td>Valerii V. Kholshevnikov and Dmitrii A. Samoshin</td>
<td></td>
</tr>
<tr>
<td>Emergency Preparedness in the Case of a Tsunami—Evacuation Analysis</td>
<td>171</td>
</tr>
<tr>
<td>and Traffic Optimization for the Indonesian City of Padang</td>
<td></td>
</tr>
<tr>
<td>Gregor Lammel, Marcel Rieser, Kai Nagel, Hannes Taubenbock, Gunter</td>
<td></td>
</tr>
<tr>
<td>Strunz, Nils Goseberg, Thorsten Schlurmann, Hubert Klupfel, Neysa</td>
<td></td>
</tr>
<tr>
<td>Setiadi, and Jorn Birnmann</td>
<td></td>
</tr>
<tr>
<td>Case Studies on Evacuation Behaviour in a Hotel Building in BART</td>
<td>183</td>
</tr>
<tr>
<td>and in Real Life</td>
<td></td>
</tr>
<tr>
<td>Margrethe Kobes, Nancy Oberijie, and Martina Duyvis</td>
<td></td>
</tr>
<tr>
<td>Analysis of Empirical Trajectory Data of Pedestrians</td>
<td>203</td>
</tr>
<tr>
<td>Anders Johansson and Dirk Helbing</td>
<td></td>
</tr>
<tr>
<td>Model-Based Real-Time Estimation of Building Occupancy During</td>
<td>215</td>
</tr>
<tr>
<td>Emergency Egress</td>
<td></td>
</tr>
<tr>
<td>Robert Tomastik, Satish Narayanan, Andrzej Banaszuk, and Sean Meyn</td>
<td></td>
</tr>
<tr>
<td>Experiments on Evacuation Dynamics for Different Classes of</td>
<td>225</td>
</tr>
<tr>
<td>Situations</td>
<td></td>
</tr>
<tr>
<td>Jaroslaw Was</td>
<td></td>
</tr>
<tr>
<td>Prediction and Mitigation of Crush Conditions in Emergency Evacuations</td>
<td>233</td>
</tr>
<tr>
<td>Peter J. Harding, Martyn Amos, and Steve Gwynne</td>
<td></td>
</tr>
</tbody>
</table>
Start Waves and Pedestrian Movement—An Experimental Study
Christian Rogsch .......................................................... 247

Clearance Time for Pedestrian Crossing
Craig R. Childs, Taku Fujiyama, and Nick Tyler .................... 249

Ship Evacuation—Guidelines, Simulation, Validation, and Acceptance Criteria
Hubert Klüpfel .............................................................. 257

Empirical Study of Pedestrians’ Characteristics at Bottlenecks
Andreas Winkens, Tobias Rupprecht, Armin Seyfried, and Wolfram Klingsch ................................................ 263

RFID Technology Applied for Validation of an Office Simulation Model
Vincent Tabak, Bauke de Vries, and Jan Dijkstra .................... 269

Study on Crowd Flow Outside a Hall via Considering Velocity Distribution of Pedestrians
Xiang Shu Liu, Jia Xiu Pan, Liang Yujuan, and Yu Xue .............. 277

Analysis on the Propagation Speed of Pedestrian Reaction: Velocity of Starting Wave and Stopping Wave
Akiyasu Tomoeda, Daichi Yanagisawa, and Katsuhiro Nishinari .... 285

Part II Simulation and Modeling

Toward Smooth Movement of Crowds
Katsuhiro Nishinari, Yushi Suma, Daichi Yanagisawa, Akiyasu Tomoeda, Ayako Kimura, and Ryousuke Nishi ................. 293

Modeling Evacuees’ Exit Selection with Best Response Dynamics
Harri Ehtamo, Simo Heliövaara, Simo Hostikka and Timo Korhonen ................................................................. 309

Front-to-Back Communication in a Microscopic Crowd Model
Colin Marc Henein and Tony White .................................. 321

Comparison of Various Methods for the Calculation of the Distance Potential Field
Tobias Kretz, Cornelia Bönisch, and Peter Vortisch ................. 335

Agent-Based Simulation of Evacuation: An Office Building Case Study
Yiqing Lin, Igor Fedchenia, Bob LaBarre, and Robert Tomastik .... 347
A Genetic Algorithm Module for Spatial Optimization in Pedestrian Simulation
Lukas Kellenberger and Ruedi Müller ........................................ 359

Opinion Formation and Propagation Induced by Pedestrian Flow
Yu Xue, Yan-fang Wei, Huan-huan Tian, and Li-juan Liang ........... 371

Passenger Dynamics at Airport Terminal Environment
Michael Schultz, Christian Schulz, and Hartmut Fricke ............. 381

Application Modes of Egress Simulation
Steve M.V. Gwynne and Erica D. Kuligowski ............................ 397

Investigating the Impact of Aircraft Exit Availability on Egress Time Using Computer Simulation
Edwin R. Galea, Madeleine Togher, and Peter Lawrence ............ 411

Bounded Rationality Choice Model Incorporating Attribute Threshold, Mental Effort, and Risk Attitude: Illustration to Pedestrian Walking Direction Choice Decision in Shopping Streets
Wei Zhu and Harry Timmermans .......................................... 425

A SCA-Based Model for Open Crowd Aggregation
Stefania Bandini, Mizar Luca Federici, Sara Manzoni, and Stefano Redaelli ................................................................. 439

Hardware Implementation of a Crowd Evacuation Model Based on Cellular Automata
Ioakeim G. Georgoudas, Georgios C. Sirakoulis, and Ioannis T. Andreadis ................................................................. 451

Applying a Discrete Event System Approach to Problems of Collective Motion in Emergency Situations
Paolo Lino and Guido Maione ........................................... 465

SIMULEM: Introducing Goal Oriented Behaviours in Crowd Simulation
Sébastien Paris, Delphine Lefebvre, and Stéphane Donikian ........... 479

Conflicts at an Exit in Pedestrian Dynamics
Daichi Yanagisawa, Akiyasu Tomoeda, and Katsuhiro Nishinari ...... 491

Improving Pedestrian Dynamics Modeling Using Fuzzy Logic
Phillip Tomé, François Bonzon, Bertrand Merminod, and Kamiar Aminian ................................................................. 503
Modeling the Link Volume Counts as a Function of Temporally Dependent OD-Flows
Dietmar Bauer ................................................................. 509

Effect of Subconscious Behavior on Pedestrian Counterflow in a Lattice Gas Model Under Open Boundary Conditions
Kuang Hua, Song Tao, Li Xingli, and Dai Shiqiang ....................... 517

Hand-Calculation Methods for Evacuation Calculation—Last Chance for an Old-Fashioned Approach or a Real Alternative to Microscopic Simulation Tools?
Christian Rösch, Henning Weigel, and Wolfram Klingsch .............. 523

Adding Higher Intelligent Functions to Pedestrian Agent Model
Toshiyuki Kaneda, Takumi Yoshida, Yanfeng He, Masaki Tamada, and Yasuhiro Kitakami ........................................... 529

“FlowTech” and “EvaTech”: Two Computer-Simulation Methods for Evacuation Calculation
Ilya Karkin, Vladimir Grachev, Andrey Skochilov, and Vladimir Zverev 537

Large Scale Microscopic Evacuation Simulation
Gregor Lämmel, Marcel Rieser, and Kai Nagel .......................... 547

Numerical Optimisation Techniques Applied to Evacuation Analysis
Rodrigo Machado Tavares and Edwin R. Galea .......................... 555

A Multi-Method Approach to the Interpretation of Pedestrian Spatio-Temporal Behaviour
Alexandra Millonig and Georg Gartner .................................. 563

The Microscopic Model and the Panicking Ball-Bearing
Colin Marc Henein and Tony White ....................................... 569

Design of Decision Rules for Crowd Controlling Using Macroscopic Pedestrian Flow Simulation
Stefan Seer, Norbert Brändle, and Dietmar Bauer ....................... 577

3-Tier Architecture for Pedestrian Agent in Crowd Simulation
Gao Peng and Xu Ruihua .................................................. 585

Optimising Vessel Layout Using Human Factors Simulation
Steven J. Deere, Edwin R. Galea, and Peter J. Lawrence ............... 597
Agent-Based Animated Simulation of Mass Egress Following an Improvised Explosive Device (IED) Attack
Douglas A. Samuelson, Matthew Parker, Austin Zimmerman, Stephen Guerin, Joshua Thorp, and Owen Densmore .......................... 605

A Novel Kinetic Model to Simulate Evacuation Dynamics
Sergei Burlatsky, Vladim Atrazhev, Nikolay Erikhman, and Satish Narayanan .......................................................... 611

Egress Route Choice Modelling—Concepts and Applications
Volker Schneider and Rainer Könnecke ................................. 619

Architectural Cue Model in Evacuation Simulation for Underground Space
Chengyu Sun, Bauke de Vries, and Qi Zhao ............................ 627

Integrating Strategies in Numerical Modelling of Crowd Motion
Juliette Venel ................................................................. 641

Small-Grid Analysis of Evacuation Processes with a Lattice Gas Model for Mixed Pedestrian Dynamics
Yan-fang Wei, Yu Xue, and Shi-qiang Dai ............................... 647

Evacuation Simulation and Human Behaviour Models in Tall Buildings
Marja-Liisa Siikonen and Janne S. Sorsa ............................... 653

Proof of Evacuation Routes and Safety Exits: Time Data as the Main Criteria for the Evaluation of Escape Routes and Safety Exits?
Nathalie Waldau, Marita Kersken-Bradley, and Thilo Hoffmann ...... 659

Dependence of Modelled Evacuation Times on Key Parameters and Interactions
David Purser ................................................................. 667

A Modification of the Social Force Model by Foresight
Bernhard Steffen ............................................................ 677

Models for Crowd Movement and Egress Simulation
Hubert Klüpfel ............................................................... 683

Modelling Pedestrian Escalator Behaviour
Introducing a Coupled Model for Simulating Crowd Behaviour
Alicia Guadalupe Ortega Camarena and Dominik Jürgens ................. 697

Evacuation Modelling of Fire Scenarios in Passenger Trains
Jorge Capote, Daniel Alvear, Orlando Abreu, Mariano Lázaro, and Arturo Cuesta ................................................... 705

Pedestrian Dynamics with Event-Driven Simulation
Mohcine Chraibi and Armin Seyfried ........................................ 713

Part III Psychology

The Need for Behavioral Theory in Evacuation Modeling
Erica D. Kuligowski and Steve M.V. Gwynne ......................... 721

NO_PANIC. “Escape and Panic in Buildings”—Architectural Basic Research in the Context of Security and Safety Research
Christa Illera, Matthias Fink, Harry Hinneberg, Karin Kath, Nathalie Waldau, Andrea Rosić, and Gabriel Wurzer ......................... 733

Was It Panic? An Overview About Mass-Emergencies and Their Origins All Over the World for Recent Years
Christian Rogsch, Michael Schreckenberg, Eric Tribble, Wolfram Klingsch, and Tobias Kretz ........................................ 743

Hierarchical Structure of the Mass and Group-Level Behaviors in Urban Rail Transfer Stations
Xiaolei Zou, Ruihua Xu, and Peng Gao .................................. 757

The Use of a Structure and Its Influence on Evacuation Behavior
Steve M.V. Gwynne and Dave Boswell ................................. 773

Part IV Miscellaneous

Inhalation Injury of Lung and Heart After Inhalation of Toxic Substances
Herbert Löllgen and Dieter Leyk ........................................... 781

Quantitative Comparison of International Design Standards of Escape Routes in Assembly Buildings
Burkhard Forell, Ralf Seidenspinner, and Dietmar Hosser ......... 791