



# Crowd Management at Train Stations in Case of Large-Scale Emergency Events

Anna Lisa Braun

IAS Series

Band / Volume 54

ISBN 978-3-95806-706-6

Forschungszentrum Jülich GmbH  
Institute for Advanced Simulation (IAS)  
Zivile Sicherheitsforschung (IAS-7)

# **Crowd Management at Train Stations in Case of Large-Scale Emergency Events**

Anna Lisa Braun

Schriften des Forschungszentrums Jülich  
IAS Series

Band / Volume 54

---

ISSN 1868-8489

ISBN 978-3-95806-706-6

# Table of Contents

<b>1. Introduction</b>	<b>1</b>
1.1. Motivation . . . . .	1
1.1.1. Large-Scale Emergency Events using Railway . . . . .	1
1.1.2. Abstraction and Crowd Management . . . . .	2
1.2. State of the Art . . . . .	3
1.2.1. Capacity of Train Stations in a Large-Scale Evacuation Context – Scientific Studies and other Concepts . . . . .	3
1.2.2. Crowd Management at Train Stations . . . . .	4
1.2.3. Station Processes – From Regular to Evacuation Operation . . . . .	7
1.2.3.1. Waiting Behaviour at Train Stations . . . . .	7
1.2.3.2. Boarding Times . . . . .	8
1.2.4. Level-of-Service Concept . . . . .	9
1.2.5. Jülich Pedestrian Simulator . . . . .	11
1.2.5.1. New Features in JPSScore . . . . .	11
1.2.5.2. Geometry Structure, Router and Operational Model . . . . .	14
1.2.5.3. Model Limitations of JPSScore . . . . .	15
1.2.5.4. JPSSeditor, JPSSreport and JPSSvis . . . . .	15
1.2.5.5. Software Version . . . . .	15
1.3. Objectives and Approach . . . . .	16
1.4. Thesis Outline . . . . .	17
<b>2. Methodology</b>	<b>19</b>
2.1. Setup . . . . .	19
2.1.1. Geometries . . . . .	19
2.1.2. Train Types . . . . .	25
2.2. Hand Calculation . . . . .	27
2.3. Simulation Studies . . . . .	28
2.3.1. Zero Cases . . . . .	28
2.3.2. Operational and Tactical Crowd Management Measures . . . . .	28
2.3.2.1. Train Arriving Intervals and Waiting Areas . . . . .	29
2.3.2.2. Time Schedules . . . . .	30
2.3.2.3. Filling Platforms . . . . .	31
2.3.2.4. Multivariate Crowd Management Measures . . . . .	32
2.3.3. Variable Geometries . . . . .	33
2.4. Evaluation Theory . . . . .	34
<b>3. Evaluation and Result</b>	<b>37</b>
3.1. Zero Cases . . . . .	37
3.1.1. Multi-directional Zero Case . . . . .	37
3.1.2. Uni-directional Zero Cases . . . . .	40

3.2. Parameter Studies . . . . .	42
3.2.1. Train Arriving Intervals and Waiting Areas . . . . .	42
3.2.1.1. Multiple WAs and a Five-Minute Time Schedule . . . . .	42
3.2.1.2. Multiple WAs and a Ten-Minute Time Schedule . . . . .	44
3.2.1.3. Single WA and a Ten-Minute Time Schedule . . . . .	45
3.2.2. Time Schedules . . . . .	47
3.2.3. Filling Platforms . . . . .	53
3.2.3.1. Inflow Rate . . . . .	54
3.2.3.2. Filling Process . . . . .	58
3.2.3.3. Door Status . . . . .	59
3.2.3.4. Train Types . . . . .	61
3.2.3.5. Overall Assessment . . . . .	62
3.2.3.6. Double-sided Filling . . . . .	63
3.2.4. Multivariate Crowd Management Measures . . . . .	68
3.2.4.1. Densities . . . . .	69
3.2.4.2. Total Evacuation Times . . . . .	73
3.2.4.3. Filling Processes – Distribution of Passengers over the Platform . . . . .	75
3.2.4.4. Interim Conclusion . . . . .	78
3.3. Applicability to Variable Geometries . . . . .	79
3.3.1. Hand Calculation . . . . .	80
3.3.2. Densities . . . . .	80
3.3.3. Maximum Evacuation Times and Peoples Distribution along the Event Access Area . . . . .	86
3.3.4. Interim Conclusion . . . . .	90
<b>4. Conclusion</b>	<b>93</b>
<b>5. Outlook</b>	<b>95</b>
<b>A. Initial conditions of JPSScore</b>	<b>101</b>
<b>B. Evaluation Final</b>	<b>105</b>
<b>C. Evaluation Easy</b>	<b>111</b>

IAS Series  
Band / Volume 54  
ISBN 978-3-95806-706-6