

# Contents

<b>Abstract</b>	<b>ix</b>
<b>Zusammenfassung</b>	<b>xi</b>
<b>1 This Dissertation: Research Goal, Steps and Structure</b>	<b>1</b>
1.1 Generalizability . . . . .	3
1.2 Inclusion of Leisure Traffic . . . . .	4
1.3 Chapters . . . . .	4
<b>2 An Overview</b>	<b>5</b>
2.1 Transport System Equilibrium . . . . .	5
2.1.1 Types of Equilibria . . . . .	6
2.1.2 Existence, Uniqueness, Stability and Behavioral Basis of Equilibria . . . . .	7
2.2 Transport Modeling . . . . .	8
2.2.1 Modeling . . . . .	8
2.2.2 Model Types . . . . .	9
2.2.3 Calibration, Verification and Validation . . . . .	14
2.3 Transport Microsimulations . . . . .	17
2.3.1 Basic Procedure of Equilibrium-Based Microsim- ulations . . . . .	20
2.4 The Multi-Agent Transport Simulation MATSim . . . . .	23
2.4.1 The Basics . . . . .	23
2.4.2 The Underlying Principles of MATSim . . . . .	26
<b>3 Destination Choice Analysis</b>	<b>33</b>
3.1 Destination Choice Research Fields, Methods and Choice Determinants . . . . .	33
3.1.1 Methods . . . . .	33
3.1.2 Choice Determinants . . . . .	34
3.2 Data Availability . . . . .	37
3.3 Operational and Large-Scale Models . . . . .	39

3.4	MATSim Destination Choice . . . . .	41
3.4.1	Choice Determinants . . . . .	41
3.4.2	MATSim's Relationship to Other Operational Large-Scale Models . . . . .	44
3.4.3	MATSim Model Improvement . . . . .	44
<b>4</b>	<b>Basic Model</b>	<b>47</b>
4.1	Earlier Approaches . . . . .	47
4.1.1	Local Search Based on Time Geography . . . . .	47
4.1.2	Hollow Space-Time Prisms . . . . .	47
4.2	Random Error Terms . . . . .	48
4.2.1	Repeated Draws: Quenched vs. Annealed Randomness . . . . .	48
4.2.2	Search Space and Search Method . . . . .	51
<b>5</b>	<b>Destination Choice Utility Function Extension</b>	<b>57</b>
5.1	Destination Choice Model Estimation . . . . .	58
5.1.1	Model Specification . . . . .	58
5.2	Choice Set Definition and Destination Choice Process . . . . .	59
5.2.1	Modeled Decision Horizon . . . . .	63
5.2.2	Are Discrete Destination Choice Models a Statistical or a Behavioral Tool? . . . . .	65
5.3	Probabilistic Choice Set Model Estimation . . . . .	66
5.3.1	Model Specification . . . . .	68
5.4	Choice Sets Survey . . . . .	69
5.4.1	Survey Design Summary . . . . .	69
5.4.2	Descriptive Analysis and Comments . . . . .	72
5.5	Model Application . . . . .	72
5.5.1	Configuration and Parameters . . . . .	75
5.5.2	Imputation of Missing Store Attribute Values . . . . .	77
<b>6</b>	<b>Variability and System Specification</b>	<b>79</b>
6.1	Microsimulation Variability Analysis . . . . .	80
6.1.1	Aggregation and Random Variability . . . . .	81
6.1.2	MATSim Variability . . . . .	84
6.2	Temporal Variability . . . . .	84
6.3	Sampling and Oversampling . . . . .	87
<b>7</b>	<b>Agent Interactions in Activities Infrastructure and Spatial Correlations in Choices</b>	<b>89</b>
7.1	Person Interaction Effects at Activity Locations . . . . .	89

7.1.1	A First Approach: A Singly-Constrained Dynamic Model . . . . .	90
7.1.2	Parking . . . . .	91
7.2	Spatial Distribution of Destinations . . . . .	93
7.3	Including Supply-Side Interactions . . . . .	93
<b>8</b>	<b>Results, Conclusions and Future Work</b>	<b>97</b>
8.1	Zurich Scenario . . . . .	97
8.1.1	Road Count Data . . . . .	98
8.2	Error Term Runs . . . . .	99
8.3	Utility Function Extension . . . . .	100
8.3.1	MNL Estimation Based on the Universal Choice Set . . . . .	100
8.3.2	Probabilistic Choice Set Model Estimation . . . . .	100
8.3.3	Survey . . . . .	102
8.3.4	Application of Estimated Utility Function in MAT-Sim . . . . .	104
8.3.5	Discussion . . . . .	105
8.4	Variability Runs . . . . .	108
8.4.1	Zurich Scenario . . . . .	108
8.4.2	Temporal Variability . . . . .	109
8.4.3	Discussion . . . . .	111
8.5	Interaction Runs . . . . .	113
8.5.1	Singly-Constrained Dynamic Model . . . . .	113
8.5.2	Parking . . . . .	114
8.6	Synthesis Run . . . . .	118
8.7	Figures and Tables . . . . .	120
<b>9</b>	<b>Discussion</b>	<b>151</b>
9.1	Discussion . . . . .	151
9.1.1	Summary . . . . .	151
9.1.2	Current and Further Development . . . . .	151
9.2	Further Research Avenues . . . . .	154
9.2.1	Further Heterogeneity of Agents and Alternatives . . . . .	154
9.2.2	Destination Choice Equilibration . . . . .	156
9.2.3	Longer Time Horizon . . . . .	156
9.2.4	Speeding up the Destination Choice Module . . . . .	158
9.2.5	Incorporation of Spatial Correlations . . . . .	158
9.2.6	Artificial Intelligence Approaches and Social Networks Models . . . . .	159

9.2.7	General MATSim Topics: Convergence, Equilibrium and Volume-Delay Relationship . . . . .	159
	<b>Acknowledgements</b>	<b>161</b>
	<b>Bibliography</b>	<b>163</b>
	<b>Curriculum Vitae</b>	<b>221</b>