Premier Reference Source

# Data Science and Simulation in Transportation Research

Part of the Advances in Data Mining and Database Management Series

Davy Janssens, Ansar-Ul-Haque Yasar, and Luk Knapen

IGI GLOBAL
DISSEMINATOR OF KNOWLEDGE

# Data Science and Simulation in Transportation Research

Davy Janssens
*Hasselt University, Belgium*

Ansar-Ul-Haque Yasar
*Hasselt University, Belgium*

Luk Knapen
*Hasselt University, Belgium*

A volume in the Advances in Data Mining and Database Management (ADMDM) Book Series

Information Science REFERENCE
An Imprint of IGI Global

Managing Director: Lindsay Johnston
Editorial Director: Myla Merkel
Production Manager: Jennifer Yoder
Publishing Systems Analyst: Adrienne Freeland
Development Editor: Austin DeMarco
Acquisitions Editor: Kayla Wolfe
Typesetter: Christina Barkanic
Cover Design: Jason Mull

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Copyright © 2014 by IGI Global. All rights reserved. No part of this publication may be reproduced, stored or distributed in any form or by any means, electronic or mechanical, including photocopying, without written permission from the publisher. Product or company names used in this set are for identification purposes only. Inclusion of the names of the products or companies does not indicate a claim of ownership by IGI Global of the trademark or registered trademark.

Library of Congress Cataloging-in-Publication Data

Data science and simulation in transportation research / Davy Janssens, Ansar-Ul-Haque Yasar, and Luk Knapen, editors.
pages cm
Includes bibliographical references and index.
ISBN 978-1-4666-4920-0 (hardcover) -- ISBN 978-1-4666-4921-7 (ebook) -- ISBN 978-1-4666-4922-4 (print & perpetual access) 1. Transportation--Planning--Data processing. 2. Transportation--Research--Data processing. 3. Traffic estimation--Mathematical models. 4. Traffic engineering--Data processing. 5. Transportation demand management--Data processing. I. Janssens, Davy, 1978- II. Yasar, Ansar-Ul-Haque, 1983- III. Knapen, Luk, 1954-
HE147.6.D37 2014
388.072--dc23

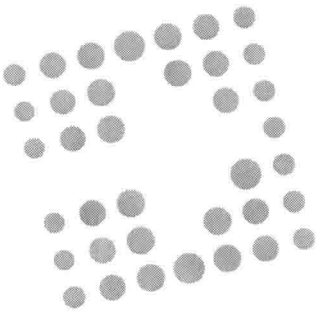
2013035206

This book is published in the IGI Global book series Advances in Data Mining and Database Management (ADMDM) (ISSN: 2327-1981; eISSN: 2327-199X)

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

All work contributed to this book is new, previously-unpublished material. The views expressed in this book are those of the authors, but not necessarily of the publisher.

For electronic access to this publication, please contact: eresources@igi-global.com.



# Advances in Data Mining and Database Management (ADMDM) Book Series

ISSN: 2327-1981
EISSN: 2327-199X

## Mission

With the large amounts of information available to businesses in today's digital world, there is a need for methods and research on managing and analyzing the information that is collected and stored. IT professionals, software engineers, and business administrators, along with many other researchers and academics, have made the fields of data mining and database management into ones of increasing importance as the digital world expands. The **Advances in Data Mining & Database Management (ADMDM) Book Series** aims to bring together research in both fields in order to become a resource for those involved in either field.

## Coverage

- Cluster Analysis
- Customer Analytics
- Data Mining
- Data Quality
- Data Warehousing
- Database Security
- Database Testing
- Decision Support Systems
- Enterprise Systems
- Text Mining

IGI Global is currently accepting manuscripts for publication within this series. To submit a proposal for a volume in this series, please contact our Acquisition Editors at Acquisitions@igi-global.com or visit: http://www.igi-global.com/publish/.

The Advances in Data Mining and Database Management (ADMDM) Book Series (ISSN 2327-1981) is published by IGI Global, 701 E. Chocolate Avenue, Hershey, PA 17033-1240, USA, www.igi-global.com. This series is composed of titles available for purchase individually; each title is edited to be contextually exclusive from any other title within the series. For pricing and ordering information please visit http://www.igi-global.com/book-series/advances-data-mining-database-management/37146. Postmaster: Send all address changes to above address.
Copyright © 2014 IGI Global. All rights, including translation in other languages reserved by the publisher. No part of this series may be reproduced or used in any form or by any means – graphics, electronic, or mechanical, including photocopying, recording, taping, or information and retrieval systems – without written permission from the publisher, except for non commercial, educational use, including classroom teaching purposes. The views expressed in this series are those of the authors, but not necessarily of IGI Global.

## Titles in this Series

*For a list of additional titles in this series, please visit: www.igi-global.com*

*Data Science and Simulation in Transportation Research*
Davy Janssens (Hasselt University, Belgium) Ansar-Ul-Haque Yasar (Hasselt University, Belgium) and Luk Knapen (Hasselt University, Belgium)
Information Science Reference • copyright 2014 • 350pp • H/C (ISBN: 9781466649200) • US $175.00 (our price)

*Big Data Management, Technologies, and Applications*
Wen-Chen Hu (University of North Dakota, USA) and Naima Kaabouch (University of North Dakota, USA)
Information Science Reference • copyright 2014 • 342pp • H/C (ISBN: 9781466646995) • US $175.00 (our price)

*Innovative Approaches of Data Visualization and Visual Analytics*
Mao Lin Huang (University of Technology, Sydney, Australia) and Weidong Huang (CSIRO, Australia)
Information Science Reference • copyright 2014 • 373pp • H/C (ISBN: 9781466643093) • US $200.00 (our price)

*Data Mining in Dynamic Social Networks and Fuzzy Systems*
Vishal Bhatnagar (Ambedkar Institute of Advanced Communication Technologies and Research, India)
Information Science Reference • copyright 2013 • 412pp • H/C (ISBN: 9781466642133) • US $195.00 (our price)

*Ethical Data Mining Applications for Socio-Economic Development*
Hakikur Rahman (University of Minho, Portugal) and Isabel Ramos (University of Minho, Portugal)
Information Science Reference • copyright 2013 • 359pp • H/C (ISBN: 9781466640788) • US $195.00 (our price)

*Design, Performance, and Analysis of Innovative Information Retrieval*
Zhongyu (Joan) Lu (University of Huddersfield, UK)
Information Science Reference • copyright 2013 • 508pp • H/C (ISBN: 9781466619753) • US $195.00 (our price)

*XML Data Mining Models, Methods, and Applications*
Andrea Tagarelli (University of Calabria, Italy)
Information Science Reference • copyright 2012 • 538pp • H/C (ISBN: 9781613503560) • US $195.00 (our price)

*Graph Data Management Techniques and Applications*
Sherif Sakr (University of New South Wales, Australia) and Eric Pardede (LaTrobe University, Australia)
Information Science Reference • copyright 2012 • 502pp • H/C (ISBN: 9781613500538) • US $195.00 (our price)

*Advanced Database Query Systems Techniques, Applications and Technologies*
Li Yan (Northeastern University, China) and Zongmin Ma (Northeastern University, China)
Information Science Reference • copyright 2011 • 410pp • H/C (ISBN: 9781609604752) • US $180.00 (our price)

www.igi-global.com

701 E. Chocolate Ave., Hershey, PA 17033
Order online at www.igi-global.com or call 717-533-8845 x100
To place a standing order for titles released in this series, contact: cust@igi-global.com
Mon-Fri 8:00 am - 5:00 pm (est) or fax 24 hours a day 717-533-8661

试读结束，需要全本PDF请购买 www.ertongbook.com

# Editorial Advisory Board

T.A. Arentze, *Eindhoven University of Technology, The Netherlands*
Sean T. Doherty, *Wilfrid Laurier University, Canada*
Giannotti Fosca, *University of Pisa, Italy*
Stephane Galland, *Université de Technologie de Belfort-Montbéliard, France*
Nicolas Gaud, *Université de Technologie de Belfort-Montbéliard, France*
Bruno Kochan, *Hasselt University, Belgium*
Kai Nagel, *TU Berlin, Germany*
Dino Pedreschi, *University of Pisa, Italy*
Ram M. Pendyala, *Arizona State University, USA*
Tomas Ruiz, *Universidad Politécnica de Valencia, Spain*
Adel W. Sadek, *SUNY Buffalo, USA*
Harry Timmermans, *Eindhoven University of Technology, The Netherlands*
Rashid A. Waraich, *ETH Zurich, Switzerland*
Geert Wets, *Hasselt University, Belgium*

# Foreword

New technology and changing social and economic environments have a potentially substantial impact on the travel behavior of individuals and households. Current thinking about transport policy is heavily influenced by the discussion on sustainable transport. A wide variety of policies, ranging from new urbanism and land use planning to transport demand management initiatives and pricing mechanisms have been suggested and implemented to trigger individuals to switch from cars to alternative transport modes. Whether such spatial, transportation, and economic policies are sufficient is doubtful: it is likely that sustainable transport also requires a dramatic shift to alternative transport modes such as electric cars.

To provide adequate academic answers to emerging policy questions, novel methodologies need to be developed and enhanced. It has become increasingly clear that individuals differ widely in terms of their preferences, behavior, acceptance of new technology, and reaction to these new policies. Classic modeling approaches and underlying theories of human choice and decision making only partially address the relevant issues. Moreover, they are often too stringent to sufficiently represent this behavioral heterogeneity.

Agent-based models that are increasingly explored in travel behavior research have the potential to establish the required breakthrough. Only a few such models that go beyond toy problems are available. This book should be applauded by bringing together some state of the art agent-based models applied to current policy issues and new technological developments. It is complemented by underexplored issues in the application of these models such as uncertainty analysis and the creation of synthetic populations.

The chapters witness the creative ideas, academic rigor, and professionalism of the authors. They can serve as benchmarks for other researchers to improve.

The book is important reading for new researchers entering this field of travel behavior research. It offers new perspectives and documents important progress in modeling travel behavior.

*Harry Timmermans*
*Technical University of Eindhoven, The Netherlands*

*Harry Timmermans (1952) holds a PH D degree in Geography/Urban and Regional Planning. He studied at the Catholic University of Nijmegen, The Netherlands. His dissertation concerned a theory of the functional and spatial structure and the dynamics of central place systems. Since 1976, he is affiliated with the Faculty of Architecture, Building and Planning of the Eindhoven University of Technology, The Netherlands. First as an assistant professor of Quantitative and Urban Geography, later as an associate professor of Urban Planning Research. In 1986, he was appointed chaired professor of Urban Planning at the same institute. In 1992, he founded the European Institute of Retailing and Services Studies (EIRASS) in Eindhoven, The Netherlands (a sister institute of the Canadian Institute of Retailing and Services Studies). His main research interests concern the study of human judgment and choice processes, mathematical modeling of urban systems, and spatial interaction and choice patterns and the development of decision support and expert systems for application in urban planning. He has published several books and many articles in journals in the fields of marketing, urban planning, architecture and urban design, geography, environmental psychology, transportation research, urban and regional economics, urban sociology, leisure sciences, and computer science.*

# Preface

This provides an overview of latest state-of-the-art research about spatial-temporal micro-simulation methodologies for human mobility, grounded on massive amounts of big data of various types and from various sources (e.g. GPS, mobile phones, and social networking sites). One of the applications explored in this book is the forecasting of nationwide consequences of a massive switch to electric vehicles, given the intertwined nature of mobility and power distribution networks. Many scientists have already pointed out that the goal of the social sciences is not simply to understand how people behave in large groups but to understand what motivates individuals to behave the way they do. If this fundamental insight can be gained, it certainly is a large step forward towards the solution of this important challenge; it can help us to better understand the dynamics of our society and, in the longer run, have an impact on overall societal well-being. In a nutshell, this book will help achieve some very novel objectives in the field of data-mining, transportation sciences, and its applications. Some of these objectives include:

1. **Big data challenges:** Big data coming from mobile call records, GPS trackers, and social networking sites (e.g. Facebook), along with microscopic energy consumption, land-use, road network, and public transport level-of-service data pose an enormous challenge in terms of data storage, integration, management, and privacy.
2. **Big data joined with behavioral motivation leading to truly novel social science laws:** Big data needs to be merged with behaviorally rich activity-travel diaries, generating a novel data-driven theory that enables us to analyze mobility demand from the individual point-of-view, not neglecting the behavioral and contextual situation of the individual.
3. **The behavioral sensitivity of the individual as the core entity in the novel simulation standard:** Agent-based reality mining of big data is combined with behavioral sensitivity of the agent, accounting for changes in human behavior when circumstances change, either due to control (e.g. policy actions to prevent peak loads in the power network) or due to general trends (e.g. the use of electric vehicles).
4. **A novel standard for evaluation and benchmarking:** The massive amounts of big data can be used to estimate origin-destination matrices, setting a novel, better, and more detailed standard for evaluating, validating, and benchmarking agent-based micro-simulation models.
5. **An issue of scalability:** Computational power needs to be enhanced by orders of magnitude using state-of-the-art advances in high-performance fine-grain parallel computing systems, addressing scalability problems resulting from the behavioral theory extraction from big data and from the adoption of this theory in a nationwide simulation environment of electrification of road transport.

The ability to understand dynamics of human mobility is crucial for tasks like urban planning and transportation management. The rapid growth of large spatio-temporal datasets gives us the possibility to develop more sophisticated and accurate methods and algorithms going towards a complete view on mobility. Private and public institutions have recognized mobility data as a source of information to assess the lifestyle, habits, and demands of citizens in terms of mobility. Chapter 1 provides an overview of a few approaches to extract mobility profiles of individuals from two important examples of big data sources: the GPS traces of vehicles and the GSM traces of mobile phones. The key of all the methods presented is that from the analysis of the individual histories it is possible to derive better information about the collectivity. Similarly, the pervasiveness of mobile devices and location-based services produces as side effects an increasing volume of mobility data, which in turn creates the opportunity for a novel generation of analysis methods of movement behaviors. Chapter 2 relies upon the same amount of big data but focuses on the specific problem of predicting future locations, which is aimed at predicting with a certain accuracy the next location of a moving object.

An activity-based approach, which estimates an individual induced traffic demand derived from activities, has been applied for traffic demand forecast research. The activity-based approach normally uses different types of input data: daily activity-trip schedule and population data, as well as environment information. In general, for privacy reasons, population data is made available only as aggregated frequency distributions; furthermore, that data is snapshots that apply to a specific moment in time. Therefore, it is indispensable to develop disaggregation and evolution simulation methods to population data. A synthetic population technique that provides a solution to this problem is presented in chapter 3.

Over the last decades, the trip-based approach, also known as the four-step model, has been playing an unrivalled role in transportation demand research in Korea. It has been used to predict changes in traffic volume resulting from new transportation policy measures and has allowed benefit-cost analyses for new infrastructure provisions. It has been increasingly difficult for the trip-based model to anticipate individual responses to new transportation policy inputs and infrastructure provision as the society becomes personalized and diversified. Activity-Based Modeling (ABM) approaches, predicting travel demand derived from individual activity participations, were introduced to complement the trip-based approach in this regard. Chapter 4 provides some deep insights on using an activity-based approach for a real world scenario (i.e. Seoul city). Similarly, chapter 5 demonstrates the feasibility of applying an integrated micro-simulation model of activity-travel demand and dynamic traffic assignment for analyzing the impact of pricing policies on traveler activity-travel choices. From a market's point of view, the realistic example presented in both of these chapters show strong valorisation potential of the approaches used.

Proper, accurate, and on time data collection is an important challenge for transportation scientists. For example, the underreporting of road accidents has been widely accepted as a common phenomenon. In many developing countries this remains a critical problem as inappropriate information regarding road accidents does not provide a base to analyse its root causes. Chapter 6 shows various features of a unique data collection mechanism along with the discussion of some success stories where the collected data has contributed significantly to improving road safety conditions.

Travel Demand Management (TDM) consists of a variety of policy measures that affect the transportation system's effectiveness by changing travel behavior. Although the primary objective to implement such TDM strategies is not to improve traffic safety, their impact on traffic safety should not be neglected.

Chapter 7 explains that activity-based transportation models provide an adequate range of in-depth information about individuals' travel behavior to realistically simulate and evaluate TDM strategies. The main advantage of these models is that the impact of applying a TDM strategy will be accounted for, for each individual, throughout a decision making process instead of applying the scenario to a general population level.

The increasing expressiveness of spatio-temporal micro-simulation systems makes them attractive for a wide range of real world applications. However, the broad field of applications puts new challenges to the quality of micro-simulation systems. They are no longer expected to reflect a few selected mobility characteristics but to be a realistic representation of the real world. In consequence, the validation of spatio-temporal micro-simulations has to be deepened and to be especially moved towards a holistic view on movement validation. Chapter 8 paves the way for a novel, better, and more detailed evaluation standard for spatio-temporal micro-simulation systems. The chapter collects and structures' various aspects that have to be considered for the validation and comparison of movement data.

In the next chapter, the issue of validation is explained further because in the specific case of activity-based models of travel demand, a micro-simulation approach is adopted, thereby inevitably including a stochastic error that is caused by the statistical distributions of random components. As a result, running a transport micro-simulation model several times with the same input will generate different outputs. In order to take the variation of outputs in each model run into account, a common approach is to run the model multiple times and to use the average value of the results. The question then becomes: What is the minimum number of model runs required to reach a stable result? Chapter 9 provides details on systematic experiments that are carried out by using FEATHERS, an activity-based micro-simulation modeling framework currently implemented for Flanders (Belgium). Six levels of geographic detail are taken into account, which are building block level, subzone level, zone level, superzone level, province level, and the whole Flanders. Three travel indices (i.e. the average daily number of activities per person, the average daily number of trips per person, and the average daily distance travelled per person) as well as their corresponding segmentations with respect to socio-demographic variables, transport mode alternatives, and activity types are calculated by running the model 100 times. The results show that application of FEATHERS at a highly aggregated level only requires limited model runs. However, when a more disaggregated level is considered (the degree of the aggregation here not only refers to the size of the geographical scale but also to the detailed extent of the index), a larger number of model runs is needed to ensure confidence of a certain percentile of zones at this level to be stable.

Over the last decade, traffic simulation frameworks advanced into an indispensable tool for traffic planning and infrastructure management. For these simulations, sophisticated models are used to "mimic" traffic systems in a lifelike fashion. In most cases, these models focus on a rather technical scope. Human factors, such as the drivers' behaviour, are either neglected or estimated without any proven connection to reality. Chapter 10 presents an analysis of psychological driver models in order to establish such connection.

Chapter 11 describes the authors' continued efforts and experiences with the development, calibration, validation, and application of a regional agent-based traffic model of a medium-sized metropolitan area with the goal of shedding light on the challenges, lessons learned, and the opportunities of regional agent-based transportation models. Specifically, the chapter highlights efficient procedures for identifying network coding errors and describes how one might go about validating and calibrating such complex models so as to achieve a good match between the model's simulated results and the field counts.

Modeling activities and travel for individuals in order to estimate traffic demand leads to large-scale simulations. Most current models simulate individuals acting in a mutually independent way except for the use of the shared transportation infrastructure. As soon as cooperation between autonomous individuals is accounted for, the need for agent-based simulation emerges. Chapter 12 presents a novel agent-based model for the carpooling application.

The last series of chapters in this book relate to the rise in both development and usage of electric vehicles all around the world. This rise has influenced not only the transportation infrastructure but also has an impact on the electricity grid. Chapter 13 provides an overview of electric power systems. The purpose is to describe the structure and operation of the power system and its evolution to the new smart grids.

Battery-electric and plug-in hybrid-electric vehicles are envisioned by many as a way to reduce $CO_2$ traffic emissions, support the integration of renewable electricity generation, and increase energy security. Electric vehicle modeling is an active field of research, especially with regards to assessing the impact of electric vehicles on the electricity network. Chapter 14 presents a framework for electric vehicle modeling that provides strong capabilities for detailed electricity demand modeling. This model is built on an agent-based travel demand and traffic simulation.

As mentioned earlier, electric mobility is becoming an option for reducing greenhouse gas emissions of road transport and decreasing the external dependence on fossil fuels. However, this new kind of mobility will introduce additional loads to the power system, and it is important to determine its effects on it. An application related to electric mobility and its impact on the electric grid from Flanders region is presented in chapter 15.

Similarly, chapter 16 presents a coordination algorithm for charging electric vehicles that can be used for avoiding capacity problems in the power distribution grid and for decreasing imbalance costs for retailers. Since it is expected that the fraction of electric vehicles will exceed 50% in the next decades, charging these vehicles will roughly double the domestic power consumption, and not all parts of the grid are expected to be able to provide the required power. Therefore, this chapter is quite interesting for the stakeholders from the power industry to be able to manage the future needs.

Last, but not the least, chapter 17 assesses the impact of different technical solutions and their impact on the ability of a fleet of plug-in hybrid-electric vehicles to drive in electric mode as much as possible. The technical solutions covered in this chapter to attain this objective include: charging at low and medium power; charging at home, at work, and at other locations; and using fleets with small, medium, and large battery sizes. The driving behavior of the fleet is modeled using an availability analysis based on statistical data from Flanders and The Netherlands.

This book is mostly based on the work performed within the European FP7 project called Data Science for Simulating the Era of Electric Vehicles (DATASIM) (www.datasim-fp7.eu). Many researchers are working on the problems defined above in the framework of this project. However, it would be difficult for any small group of people to cover such a broad topic with the appropriate depth and expertise. In order to tackle this challenge for this book, we, the editors, looked to our colleagues from within and outside the DATASIM project consortium to find experts from the domain in question. You can see that the list of authors has grown quite large and contains a good mixture of academics, consultants, and people from the industry. We are very fortunate to have received contributions from the knowledgeable

试读结束，需要全本PDF请购买 www.ertongbook.com

authors in this book, and we are extremely grateful for this. We applaud the efforts of our contributors, partners, advisory board, reviewers, and all the others who helped us make this book a success. We all hope to see the important research work presented in this book used in our everyday lives soon!

*Davy Janssens*
*Hasselt University, Belgium*

*Ansar-Ul-Haque Yasar*
*Hasselt University, Belgium*

*Luk Knapen*
*Hasselt University, Belgium*

# Acknowledgment

We are thankful to the EU FP7 programme for their support throughout the project's life cycle. The work presented in this book is mostly based on the work performed within the Data Science for Simulating the Era of Electric Vehicles (DATASIM) (www.datasim-fp7.eu) project funded by the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement number 270833. We would like to show our gratitude for the contributions from the authors in this book. We also applaud the efforts of our project partners, editorial advisory board, reviewers, and all others who helped us make this book a success.

*Davy Janssens*
*Hasselt University, Belgium*

*Ansar-Ul-Haque Yasar*
*Hasselt University, Belgium*

*Luk Knapen*
*Hasselt University, Belgium*

# Table of Contents

**Foreword** ..... xviii

**Preface** ..... xix

**Acknowledgment** ..... xxiv

**Chapter 1**
Mobility Profiling ..... 1
*Mirco Nanni, ISTI-CNR, Italy*
*Roberto Trasarti, ISTI-CNR, Italy*
*Paolo Cintia, ISTI-CNR, Italy*
*Barbara Furletti, ISTI-CNR, Italy*
*Chiara Renso, ISTI-CNR, Italy*
*Lorenzo Gabrielli, ISTI-CNR, Italy*
*Salvatore Rinzivillo, ISTI-CNR, Italy*
*Fosca Giannotti, ISTI-CNR, Italy*

**Chapter 2**
On Predicting the Future Locations of Moving Objects: The State of the Art ..... 30
*Nicola Corona, University of Pisa, Italy & ISTI-CNR, Italy*
*Fosca Giannotti, ISTI-CNR, Italy*
*Anna Monreale, University of Pisa, Italy & ISTI-CNR, Italy*
*Roberto Trasarti, ISTI-CNR, Italy*

**Chapter 3**
Synthetic Population Techniques in Activity-Based Research ..... 48
*Sungjin Cho, Hasselt University, Belgium*
*Tom Bellemans, Hasselt University, Belgium*
*Lieve Creemers, Hasselt University, Belgium*
*Luk Knapen, Hasselt University, Belgium*
*Davy Janssens, Hasselt University, Belgium*
*Geert Wets, Hasselt University, Belgium*

**Chapter 4**
Issues in FEATHERS Application in the Seoul Metropolitan Area ..... 71
*Won Do Lee, Kyung Hee University, Korea*
*Chang-Hyeon Joh, Kyung Hee University, Korea*
*Sungjin Cho, Hasselt University, Belgium*
*Bruno Kochan, Hasselt University, Belgium*

**Chapter 5**
The Application of an Integrated Behavioral Activity-Travel Simulation Model for Pricing Policy Analysis ..... 86
*Karthik C. Konduri, University of Connecticut, USA*
*Ram M. Pendyala, Arizona State University, USA*
*Daehyun You, Arizona State University, USA*
*Yi-Chang Chiu, The University of Arizona, USA*
*Mark Hickman, University of Queensland, Australia*
*Hyunsoo Noh, University of Arizona, USA*
*Paul Waddell, University of California – Berkeley, USA*
*Liming Wang, Portland State University, USA*
*Brian Gardner, U.S. Department of Transportation, USA*

**Chapter 6**
An Effective Methodology for Road Accident Data Collection in Developing Countries ..... 103
*Muhammad Adnan, NED University of Engineering and Technology, Pakistan*
*Mir Shabbar Ali, NED University of Engineering and Technology, Pakistan*

**Chapter 7**
Traffic Safety Implications of Travel Demand Management Policies: The Cases of Teleworking and Fuel Cost Increase ..... 115
*Ali Pirdavani, Hasselt University, Belgium*
*Tom Bellemans, Hasselt University, Belgium*
*Tom Brijs, Hasselt University, Belgium*
*Bruno Kochan, Hasselt University, Belgium*
*Geert Wets, Hasselt University, Belgium*

**Chapter 8**
Evaluation of Spatio-Temporal Microsimulation Systems ..... 141
*Christine Kopp, Fraunhofer Institute for Intelligent Analysis and Information Systems (IAIS), Germany*
*Bruno Kochan, University of Hasselt, Belgium*
*Michael May, Fraunhofer Institute for Intelligent Analysis and Information Systems (IAIS), Germany*
*Luca Pappalardo, ISTI-CNR, Italy & University of Pisa, Italy*
*Salvatore Rinzivillo, ISTI-CNR, Italy*
*Daniel Schulz, Fraunhofer Institute for Intelligent Analysis and Information Systems (IAIS), Germany*
*Filippo Simini, University of Bristol, UK*

**Chapter 9**
Activity-Based Travel Demand Forecasting Using Micro-Simulation: Stochastic Error Investigation of FEATHERS Framework ..... 167
*Qiong Bao, Hasselt University, Belgium*
*Bruno Kochan, Hasselt University, Belgium*
*Tom Bellemans, Hasselt University, Belgium*
*Davy Janssens, Hasselt University, Belgium*
*Geert Wets, Hasselt University, Belgium*

**Chapter 10**
A Driver's Mind: Psychology Runs Simulation ..... 182
*Marco Lützenberger, Technische Universität Berlin, Germany*

**Chapter 11**
Large-Scale Agent-Based Models for Transportation Network Management under Unplanned Events ..... 206
*Yunjie Zhao, SUNY Buffalo, USA*
*Adel W. Sadek, SUNY Buffalo, USA*

**Chapter 12**
Agent-Based Modeling for Carpooling ..... 232
*Luk Knapen, Hasselt University, Belgium*
*Ansar-Ul-Haque Yasar, Hasselt University, Belgium*
*Sungjin Cho, Hasselt University, Belgium*
*Tom Bellemans, Hasselt University, Belgium*

**Chapter 13**
The Evolution from Electric Grid to Smart Grid ..... 259
*Jesus Fraile-Ardanuy, Universidad Politecnica de Madrid, Spain*
*Dionisio Ramirez, Universidad Politecnica de Madrid, Spain*
*Sergio Martinez, Universidad Politecnica de Madrid, Spain*
*Jairo Gonzalez, Universidad Politecnica de Madrid, Spain*
*Roberto Alvaro, Universidad Politecnica de Madrid, Spain*

**Chapter 14**
Adding Electric Vehicle Modeling Capability to an Agent-Based Transport Simulation ..... 282
*Rashid A. Waraich, ETH Zurich, Switzerland*
*Gil Georges, ETH Zurich, Switzerland*
*Matthias D. Galus, ETH Zurich, Switzerland*
*Kay W. Axhausen, ETH Zurich, Switzerland*

**Chapter 15**
Impacts of Electric Mobility on the Electric Grid ..... 319
*Jesus Fraile-Ardanuy, Universidad Politecnica de Madrid, Spain*
*Dionisio Ramirez, Universidad Politecnica de Madrid, Spain*
*Sergio Martinez, Universidad Politecnica de Madrid, Spain*
*Roberto Alvaro, Universidad Politecnica de Madrid, Spain*
*Jairo Gonzalez, Universidad Politecnica de Madrid, Spain*
*Luk Knapen, University of Hasselt, Belgium*
*Davy Janssens, University of Hasselt, Belgium*

**Chapter 16**
Electric Vehicles in the Smart Grid ..... 340
*Fjo De Ridder, EnergyVille, Belgium*
*Reinhilde D'hulst, EnergyVille, Belgium*
*Luk Knapen, Hasselt University, Belgium*
*Davy Janssens, Hasselt University, Belgium*

**Chapter 17**
Grid and Fleet Impact Mapping of EV Charge Opportunities ..... 364
*Niels Leemput, KU Leuven, Belgium*
*Juan Van Roy, KU Leuven, Belgium*
*Frederik Geth, KU Leuven, Belgium*
*Johan Driesen, KU Leuven, Belgium*
*Sven De Breucker, VITO, Belgium*

**Compilation of References** ..... 391

**About the Contributors** ..... 420

**Index** ..... 431

试读结束，需要全本PDF请购买 www.ertongbook.com