

Lecture Notes in Networks and Systems

Volume 21

Series editor

Janusz Kacprzyk, Polish Academy of Sciences, Warsaw, Poland
e-mail: kacprzyk@ibspan.waw.pl

The series “Lecture Notes in Networks and Systems” publishes the latest developments in Networks and Systems—quickly, informally and with high quality. Original research reported in proceedings and post-proceedings represents the core of LNNS.

Volumes published in LNNS embrace all aspects and subfields of, as well as new challenges in, Networks and Systems.

The series contains proceedings and edited volumes in systems and networks, spanning the areas of Cyber-Physical Systems, Autonomous Systems, Sensor Networks, Control Systems, Energy Systems, Automotive Systems, Biological Systems, Vehicular Networking and Connected Vehicles, Aerospace Systems, Automation, Manufacturing, Smart Grids, Nonlinear Systems, Power Systems, Robotics, Social Systems, Economic Systems and other. Of particular value to both the contributors and the readership are the short publication timeframe and the world-wide distribution and exposure which enable both a wide and rapid dissemination of research output.

The series covers the theory, applications, and perspectives on the state of the art and future developments relevant to systems and networks, decision making, control, complex processes and related areas, as embedded in the fields of interdisciplinary and applied sciences, engineering, computer science, physics, economics, social, and life sciences, as well as the paradigms and methodologies behind them.

Advisory Board

Fernando Gomide, Department of Computer Engineering and Automation—DCA, School of Electrical and Computer Engineering—FEEC, University of Campinas—UNICAMP, São Paulo, Brazil

e-mail: gomide@dca.fee.unicamp.br

Okyay Kaynak, Department of Electrical and Electronic Engineering, Bogazici University, Istanbul, Turkey

e-mail: okyay.kaynak@boun.edu.tr

Derong Liu, Department of Electrical and Computer Engineering, University of Illinois at Chicago, Chicago, USA and Institute of Automation, Chinese Academy of Sciences, Beijing, China

e-mail: derong@uic.edu

Witold Pedrycz, Department of Electrical and Computer Engineering, University of Alberta, Alberta, Canada and Systems Research Institute, Polish Academy of Sciences, Warsaw, Poland

e-mail: wpedrycz@ualberta.ca

Marios M. Polycarpou, KIOS Research Center for Intelligent Systems and Networks, Department of Electrical and Computer Engineering, University of Cyprus, Nicosia, Cyprus

e-mail: mpolycar@ucy.ac.cy

Imre J. Rudas, Óbuda University, Budapest Hungary

e-mail: rudas@uni-obuda.hu

Jun Wang, Department of Computer Science, City University of Hong Kong Kowloon, Hong Kong

e-mail: jwang.cs@cityu.edu.hk

More information about this series at <http://www.springer.com/series/15179>

Elżbieta Macioszek · Grzegorz Sierpiński
Editors

Recent Advances in Traffic Engineering for Transport Networks and Systems

14th Scientific and Technical Conference
“Transport Systems. Theory & Practice 2017”
Selected Papers

 Springer

Editors

Elżbieta Macioszek
Faculty of Transport
Silesian University of Technology
Katowice
Poland

Grzegorz Sierpiński
Faculty of Transport
Silesian University of Technology
Katowice
Poland

ISSN 2367-3370

ISSN 2367-3389 (electronic)

Lecture Notes in Networks and Systems

ISBN 978-3-319-64083-9

ISBN 978-3-319-64084-6 (eBook)

DOI 10.1007/978-3-319-64084-6

Library of Congress Control Number: 2017947033

© Springer International Publishing AG 2018

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Printed on acid-free paper

This Springer imprint is published by Springer Nature

The registered company is Springer International Publishing AG

The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

Contemporary technical and technological development as well as the ever-growing mobility provide favourable conditions for designing innovative transport-related solutions. Consequently, transport systems and networks require new decisions to be continuously made with regard to planning, organization and control of traffic. These decisions entail the necessity of seeking increasingly efficient solutions.

This publication, entitled *Recent Advances in Traffic Engineering for Transport Networks and Systems*, provides an excellent opportunity to become familiar with the latest trends and achievements in the field of contemporary transport systems as well as traffic engineering challenges and solutions. It has been divided into four parts:

- Part 1. Recent Advances in Traffic Engineering and Travel Models,
- Part 2. Safety Analysis in Advanced Transport Networks and Transport Systems,
- Part 3. Determinants of the Development of Transport Systems in European Union,
- Part 4. The Problems of Optimisation of Transport Networks.

The publication contains selected papers submitted to and presented at the 14th “Transport Systems. Theory and Practice” Scientific and Technical Conference organized by the Department of Transport Systems and Traffic Engineering at the Faculty of Transport of the Silesian University of Technology (Katowice, Poland). The topics addressed in the book include the current problems of transport systems, among other subjects discussed. With reference to numerous practical examples, various novel solutions applied in traffic engineering have been proposed in the publication. They are considered to exert significant influence on increasing the functional efficiency of transport systems and networks, and their priorities include well-being and health of people, traffic safety, sustainable development of transport systems and protection of natural environment.

We would like to use this occasion to express our gratitude to the authors for the papers they have submitted and their substantial contribution to the discourse on the multiple challenges facing transport systems and traffic engineering in the

contemporary world as well as for rendering the results of their research and scientific work available. We would also like to thank the reviewers for their insightful remarks and suggestions which have ensured the high quality of the publication.

Readers interested in the latest achievements of traffic engineering and the overall body of problems addressed in this field of expertise may use this publication as an extensive collection of scientific research results, diverse insights and comments as well as new approaches and problem solutions. With the foregoing in mind, we are hoping that all readers will find this book valuable.

September 2017

Elżbieta Macioszek
Grzegorz Sierpiński

Organization

14th Scientific and Technical Conference “Transport Systems. Theory and Practice” (TSTP2017) is organized by the Department of Transport Systems and Traffic Engineering, Faculty of Transport, Silesian University of Technology (Poland).

Organizing Committee

Organizing Chair

Grzegorz Sierpiński Silesian University of Technology, Poland

Members

Renata Żochowska	Barbara Borówka
Grzegorz Karoń	Kazimierz Dąbała
Aleksander Sobota	Marcin J. Kłos
Marcin Staniek	Krzysztof Krawiec
Ireneusz Celiński	

The Conference Took Place Under the Honorary Patronage

Minister of Infrastructure and Construction
Marshal of the Silesian Voivodeship

Scientific Committee

Stanisław Krawiec (Chairman)	Silesian University of Technology, Poland
Tomasz Ambroziak	Warsaw University of Technology, Poland
Henryk Bałuch	The Railway Institute, Poland
Roman Bańczyk	Voivodeship Centre of Road Traffic in Katowice, Poland
Mehmet Dikmen	Baskent University, Turkey
Domokos Esztergár-Kiss	Budapest University of Technology and Economics, Hungary
József Gál	University of Szeged, Hungary
Andrzej S. Grzelakowski	Gdynia Maritime University, Poland
Mehmet Serdar Güzel	Ankara University, Turkey
Józef Hansel	AGH University of Science and Technology Cracow, Poland
Libor Ižvolt	University of Žilina, Slovakia
Marianna Jacyna	Warsaw University of Technology, Poland
Nan Kang	Tokyo University of Science, Japan
Jan Kempa	University of Technology and Life Sciences in Bydgoszcz, Poland
Michael Koniordos	Piraeus University of Applied Sciences, Greece
Bogusław Łazarz	Silesian University of Technology, Poland
Zbigniew Łukasik	Kazimierz Pulaski University of Technology and Humanities in Radom, Poland
Michał Maciejewski	Technical University Berlin, Germany
Elżbieta Macioszek	Silesian University of Technology, Poland
Ján Mandula	Technical University of Košice, Slovakia
Sylwester Markusik	Silesian University of Technology, Poland
Antonio Masegosa	IKERBASQUE Research Fellow at University of Deusto Bilbao, Spain
Agnieszka Merkisz-Guranowska	Poznań University of Technology, Poland
Maria Michałowska	University of Economics in Katowice, Poland
Leszek Mindur	International School of Logistic and Transport in Wrocław, Poland
Maciej Mindur	International School of Logistic and Transport in Wrocław, Poland
Goran Mladenović	University of Belgrade, Serbia
Kai Nagel	Technical University Berlin, Germany
Piotr Niedzielski	University of Szczecin, Poland
Piotr Olszewski	Warsaw University of Technology, Poland
Enrique Onieva	Deusto Institute of Technology University of Deusto Bilbao, Spain

Asier Perallos	Deusto Institute of Technology University of Deusto Bilbao, Spain
Hrvoje Pilko	University of Zagreb, Croatia
Antonio Pratelli	University of Pisa, Italy
Dariusz Pyza	Warsaw University of Technology, Poland
Cesar Queiroz	World Bank Consultant (Former World Bank Highways Adviser), Washington, DC, USA
Andrzej Rudnicki	Cracow University of Technology, Poland
František Schlosser	University of Žilina, Slovakia
Jacek Skorupski	Warsaw University of Technology, Poland
Aleksander Sładkowski	Silesian University of Technology, Poland
Wiesław Starowicz	Cracow University of Technology, Poland
Jacek Stumpf	Department of Documentation GDDKiA Section Katowice, Poland
Andrzej Szarata	Cracow University of Technology, Poland
Tomasz Szczuraszek	University of Technology and Life Sciences in Bydgoszcz, Poland
Antoni Szydło	Wrocław University of Technology, Poland
Grzegorz Ślaski	Poznań University of Technology, Poland
Paweł Śniady	Wrocław University of Environmental and Life Sciences, Poland
Andrew P. Tarko	Purdue University West Lafayette, USA
Frane Urem	Polytechnic of Šibenik, Croatia
Mariusz Wasiak	Warsaw University of Technology, Poland
Adam Weintrit	Gdynia Maritime University, Poland
Andrzej Więckowski	AGH University of Science and Technology Cracow, Poland
Katarzyna Węgrzyn-Wolska	Engineering School of Digital Science Villejuif, France
Adam Wolski	Polish Naval Academy, Gdynia, Poland
Olgierd Wyszomirski	University of Gdańsk, Poland
Elżbieta Załoga	University of Szczecin, Poland
Stanisława Zamkowska	Kazimierz Pulaski University of Technology and Humanities in Radom, Poland
Jacek Żak	Poznań University of Technology, Poland
Jolanta Żak	Warsaw University of Technology, Poland

Referees

Marek Bauer
Przemysław Borkowski
Piotr Czech
Domokos Esztergár-Kiss
Michał Fabian

Robert Grega
Mehmet Serdar Güzel
Katarzyna Hebel
Peter Kaššay
Jozef Kuřka

Michał Maciejewski
Elżbieta Macioszek
Krzysztof Małecki
Martin Mantič
Antonio D. Masegosa
Silvia Medvecká-Beňová
Katarzyna Nosal
Romanika Okraszewska
Enrique Onieva
Wiesław Pamuła
Asier Perallos
Hrvoje Pilko

Antonio Pratelli
Michał Puškár
Alžbeta Sapietová
Grzegorz Sierpiński
Marcin Staniek
Andrzej Szarata
Dariusz Tłoczyński
Andrzej Więckowski
Grzegorz Wojnar
Adam Wolski
Ninoslav Zuber

Contents

Recent Advances in Traffic Engineering and Travel Models	
Vehicle Speed Impact on the Design of Efficient Urban Single-Lane Roundabouts	3
Hrvoje Pilko and Šime Šarić	
The Comparison of Models for Follow-up Headway at Roundabouts	16
Elżbieta Macioszek	
Analysis of Selected Types of Transport Behaviour of Urban and Rural Population in the Light of Surveys	27
Jacek Chmielewski and Paulina Olenkowicz-Trempała	
Selected Aspects of the Methodology of Traffic Flows Surveys and Measurements on an Urban Agglomeration Scale with Regard to ITS Projects	37
Renata Źochowska, Grzegorz Karoń, Ryszard Janecki, and Aleksander Sobota	
The Warehouse Location Problem in the Context of Vehicle Routing Problem in the Production Companies	50
Ilona Jacyna-Gołda and Mariusz Izdebski	
Safety Analysis in Advanced Transport Networks and Transport Systems	
Road Infrastructure Condition Assessment as Element of Road Traffic Safety – Concept of the RCT Solution in the S-mileSys Platform	65
Marcin Staniek	
Safe Routes as One of the Ways to Reduce the Number of Road Accidents Victims	73
Irina Makarova, Anton Pashkevich, and Ksenia Shubenkova	

Impact of the Factors Determining the Natural Stack Effect on the Safety Conditions in a Road Tunnel	85
Aleksander Król and Małgorzata Król	
Studying the Behaviour of Pedestrians and Drivers Within Pedestrian Crossings	96
Marcin Budzyński, Kazimierz Jamroz, Łukasz Jeliński, and Mariusz Kieć	
Failure Evaluation of the Level Crossing Protection System Based on Fault Tree Analysis	107
Waldemar Nowakowski, Tomasz Ciszewski, Jakub Młyńczak, and Zbigniew Łukasik	
Determinants of the Development of Transport Systems in European Union	
Transport Planning - It's Not Rocket Science.	119
David Williams	
Parameters of Bus Lines Influencing the Allocation of Electric Buses to the Transport Tasks.	129
Krzysztof Krawiec and Marcin Jacek Kłós	
Possibilities for Enhancement of the Quality of Krakow's Tram Transport with Tunnel Sections.	139
Marek Bauer	
Using GT Planner to Improve the Functioning of Public Transport.	151
Ireneusz Celiński	
Development of the Bike-Sharing System on the Example of Polish Cities	161
Piotr Czech, Katarzyna Turoń, and Grzegorz Sierpiński	
Privatization of Entities in the Air Transport Sector - Airports	170
Stanisław Miecznikowski and Dariusz Tłoczyński	
The Problems of Optimisation of Transport Networks	
The Impact of the Analysis Period on the Estimation Accuracy of Queue Lengths at Intersection Inlets with Traffic Lights.	181
Tomasz Szczuraszek and Damian Iwanowicz	
Comparative Analysis of Chosen Adaptive Traffic Control Algorithms	193
Krzysztof Małecki and Piotr Pietruszka	
Traffic Time Delay Modelling on the Intersection in the City of Martin, Using Software Aimsun	203
Alica Kalašová, Jana Kupčuljaková, Simona Kubíková, and Jozef Paľo	

Mixed Public Transport Lines Construction and Vehicle's Depots Location Problems	213
Piotr Sawicki and Szymon Fierek	
Computer Support of Decision-Making for the Planning Movement of Freight Wagons on the Rail Network	225
Marianna Jacyna and Mirosław Krześniak	
Author Index	237