

5th Student Conference on Operational Research

SCOR 2016, April 8–10, 2016, Nottingham, UK

Edited by

Bradley Hardy

Abroon Qazi

Stefan Ravizza



Editors

Bradley Hardy	Abroon Qazi	Stefan Ravizza
Cardiff University	Strathclyde Business School	IBM Global Business Services
HardyB@cardiff.ac.uk	abroon.qazi@strath.ac.uk	stefan.ravizza@ch.ibm.com

ACM Classification 1998

B.8 Performance and Reliability, D.2.2 Design Tools and Techniques, F.2.2 Nonnumerical Algorithms and Problems, G.1.6 Optimization, G.1.10 Applications, G.2.3 Applications, I.2.6 Learning, I.2.8 Problem Solving, Control Methods, and Search, I.6 Simulation and Modelling, I.6.4 Model Validation and Analysis

ISBN 978-3-95977-004-0

Published online and open access by

Schloss Dagstuhl – Leibniz-Zentrum für Informatik GmbH, Dagstuhl Publishing, Saarbrücken/Wadern, Germany. Online available at <http://www.dagstuhl.de/dagpub/978-3-95977-004-0>.

Publication date

August, 2016

Bibliographic information published by the Deutsche Nationalbibliothek

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at <http://dnb.d-nb.de>.

License

This work is licensed under a Creative Commons Attribution 3.0 Unported license (CC-BY 3.0): <http://creativecommons.org/licenses/by/3.0/legalcode>.



In brief, this license authorizes each and everybody to share (to copy, distribute and transmit) the work under the following conditions, without impairing or restricting the authors' moral rights:

- Attribution: The work must be attributed to its authors.

The copyright is retained by the corresponding authors.

Digital Object Identifier: 10.4230/OASlcs.SCOR.2016.0

ISBN 978-3-95977-004-0

ISSN 2190-6807

<http://www.dagstuhl.de/oasics>

OASlcs – OpenAccess Series in Informatics

OASlcs aims at a suitable publication venue to publish peer-reviewed collections of papers emerging from a scientific event. OASlcs volumes are published according to the principle of Open Access, i.e., they are available online and free of charge.

Editorial Board

- Daniel Cremers (TU München, Germany)
- Barbara Hammer (Universität Bielefeld, Germany)
- Marc Langheinrich (Università della Svizzera Italiana – Lugano, Switzerland)
- Dorothea Wagner (*Editor-in-Chief*, Karlsruher Institut für Technologie, Germany)

ISSN 2190-6807

www.dagstuhl.de/oasics

■ Contents

Preface	
<i>Bradley Hardy, Abroon Qazi, and Stefan Ravizza</i>	vii
Utilizing Dual Information for Moving Target Search Trajectory Optimization	
<i>Manon Raap, Maximilian Moll, Martin Zsifkovits, and Stefan Pickl</i>	1:1–1:10
Reliability Modelling of Automated Guided Vehicles by the Use of Failure Modes Effects and Criticality Analysis, and Fault Tree Analysis	
<i>Rundong Yan, Sarah J. Dunnett, and Lisa M. Jackson</i>	2:1–2:11
Petri Net Modelling for Enhanced IT Asset Recycling Solutions	
<i>Christina Latsou, Sarah J. Dunnett, and Lisa M. Jackson</i>	3:1–3:10
Simulation Combined Approach to Police Patrol Services Staffing	
<i>Hanjing Zhang, Antuela Tako, Lisa M. Jackson, and Jiyin Liu</i>	4:1–4:11
A Column Generation approach for Pure Parsimony Haplotyping	
<i>Veronica Dal Sasso, Luigi De Giovanni, and Martine Labbé</i>	5:1–5:11
Model Validation and Testing in Simulation: a Literature Review	
<i>Naoum Tsiptsias, Antuela Tako, and Stewart Robinson</i>	6:1–6:11
Feature Extractors for Describing Vehicle Routing Problem Instances	
<i>Jussi Rasku, Tommi Kärkkäinen, and Nysret Musliu</i>	7:1–7:13
Towards the Integration of Power-Indexed Formulations in Multi-Architecture Connected Facility Location Problems for the Optimal Design of Hybrid Fiber-Wireless Access Networks	
<i>Fabio D'Andreagiovanni, Fabian Mett, and Jonad Pulaj</i>	8:1–8:11
Portfolio Optimisation Using Risky Assets with Options as Derivative Insurance	
<i>Mohd A. Maasar, Diana Roman, and Paresh Date</i>	9:1–9:17

■ Preface

We are delighted to present the proceeding for the 5th Student Conference on Operational Research (SCOR 2016). The aim of SCOR is for students who are studying Operational Research, Management Science or a related field to share their work, practice their presentation skills, receive constructive feedback, and network in a relaxed and friendly environment.

The conference took place from Friday the 8th to Sunday the 10th of April 2016 at the University of Nottingham's Jubilee campus where we welcomed delegates from the UK, Europe and even further afield. Of those who attended, 43 presented their work across several streams which included: Data Envelopment Analysis, Graphs and Networks, Healthcare, Mathematical Programming, Metaheuristics, Multiple Criteria Decision Analysis, Operations Management, Optimisation, Safety and Reliability Analysis, Simulation, Stochastic Modelling, Transport and Logistics, and Vehicle Routing. This year's prize and runner-up award for Best Presentation (sponsored by Nationwide) were presented to Carlos Lamas-Fernandez and Jussi Rasku, respectively.

Along with our delegates' talks we were also happy to have plenary talks from four excellent invited speakers: Louise Allison (The OR Society), Ralf Keuthen (EY), Timo P. Kunz (Net-a-Porter.com) and Richard Wood (Principality). These plenary talks covered a range of topics from outlining the benefits of OR Society membership, a series of case studies highlighting how OR is used in the consulting industry, the desirable skills OR students have for careers outside of academia, and how OR techniques can be used for contingency planning against bio-terrorism. Returning from 2014, we welcomed back Piero Vitelli (Island41) to round off our first day with a shortened version of his "Potential Energy" workshop on presentation skills.

On behalf of the organising committee, we'd like to thank all of our sponsors and partners. This year we were blessed with sponsorship from the OR Society, EY, Nationwide, Prospect Recruitment, and Gower Optimal Algorithms Ltd. (G.O.A.L.), along with being partnered with the National Taught Course Centre in Operational Research (NATCOR) and the University of Nottingham. The conference never would have taken place without the support and encouragement of these institutions.

Finally, we'd like to thank the authors who submitted a paper for this year's proceedings. The review process was based on the presentation, quality and originality of the research and there were at least two referees assigned to each paper.

Thank you to everyone who was involved in SCOR 2016, this truly is a conference made special by those who attend it.

Bradley Hardy
Abroon Qazi
Stefan Ravizza

■ Organisation

Conference Committee

- Bradley Hardy, Cardiff University, UK (Conference Chair)
- Kingshuk Jubaer Islam, University of Nottingham, UK (Local Chair)
- Pedro Crespo Del Granado, ETH Zurich, Switzerland (Chair of Steering Committee)
- Tim Gruchmann, Witten/Herdecke University, Germany
- Samuel Luen-English, Cardiff University, UK
- Wasin Padungwech, Cardiff University, UK
- Abroon Qazi, Strathclyde Business School, UK
- Andrea Taverna, Università degli Studi di Milano, Italy
- Penny Holborn, University of South Wales, UK
- Stefan Ravizza, IBM Global Business Services, Switzerland
- Martim Moniz, Université Libre de Bruxelles, Belgium

Sponsors

- The OR Society
- EY
- Nationwide Building Society
- Gower Optimal Algorithms Ltd. (G.O.A.L.)
- Prospect Recruitment

Partners

- A National Taught Course Center in Operational Research (NATCOR)
- The University of Nottingham



■ List of Authors

Antuela Tako
School of Business and Economics,
Loughborough University
Leicestershire, LE11 3TU, UK
a.takou@lboro.ac.uk

Christina Latsou
Department of Aeronautical and Automotive
Engineering, Loughborough University
Leicestershire, LE11 3TU, UK
c.latsou@lboro.ac.uk

Diana Roman
Department of Mathematics, College of
Engineering Design and Physical Science,
Brunel University
London, UB83PH, UK
Diana.Roan@brunel.ac.uk

Fabian Mett
Department of Mathematical Optimization,
Zuse Institute Berlin (ZIB)
Takustraße 7, 14195 Berlin, Germany
mett@zib.de

Fabio D'Andreagiovanni
Department of Mathematical Optimization,
Zuse Institute Berlin (ZIB)
Takustraße 7, 14195 Berlin, Germany
d.andreagiovanni@zib.de

Hanjing Zhang
School of Business and Economics,
Loughborough University
Leicestershire, LE11 3TU, UK
h.zhang@lboro.ac.uk

Jiyin Liu
School of Business and Economics,
Loughborough University
Leicestershire, LE11 3TU, UK
j.y.liu@lboro.ac.uk

Jonad Pulaj
Department of Mathematical Optimization,
Zuse Institute Berlin (ZIB)
Takustraße 7, 14195 Berlin, Germany
pulaj@zib.de

Jussi Rasku
Department of Mathematical Information
Technology, University of Jyväskylä
P.O. Box 35, FI-40014, Finland
jussi.rasku@jyu.fi

Lisa M. Jackson
Department of Aeronautical and Automotive
Engineering, Loughborough University
Leicestershire, LE11 3TU, UK
l.m.jackson@lboro.ac.uk

Luigi De Giovanni
Dipartimento di Matematica, Università
degli Studi di Padova
via Trieste 63, 35121 Padova, Italy
luigi@math.unipd.it

Manon Raap
Universität der Bundeswehr München,
Fakultät für Informatik
Werner-Heisenberg-Weg 39, 85577
Neubiberg, Germany
manon.raap@unibw.de

Martin Zsifkovits
Universität der Bundeswehr München,
Fakultät für Informatik
Werner-Heisenberg-Weg 39, 85577
Neubiberg, Germany
martin.zsifkovits@unibw.de

Martine Labbé
GOM, Université Libre de Bruxelles
Bd du Triomphe CP210/01, 1050 Bruxelles,
Belgium
mlabbe@ulb.ac.be

Maximilian Moll
Universität der Bundeswehr München,
Fakultät für Informatik
Werner-Heisenberg-Weg 39, 85577
Neubiberg, Germany
maximilian.moll@unibw.de

5th Student Conference on Operational Research (SCOR'16).
Editors: Bradley Hardy, Abroon Qazi, and Stefan Ravizza



Open Access Series in Informatics

Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

Mohd A. Maasar
Department of Mathematics, College of
Engineering Design and Physical Science,
Brunel University
London, UB83PH, UK
Mohd.Maasar@brunel.ac.uk

Naoum Tsiptsias
School of Business and Economics,
Loughborough University
Leicestershire, LE11 3TU, UK
n.tsiptsias@lboro.ac.uk

Nysret Musliu
Institute of Information Systems, Vienna
University of Technology
A-1040 Vienna, Austria
musliu@dbai.tuwien.ac.at

Paresh Date
Department of Mathematics, College of
Engineering Design and Physical Science,
Brunel University
London, UB83PH, UK
Paresh.Date@brunel.ac.uk

Rundong Yan
Department of Aeronautical and Automotive
Engineering, Loughborough University
Leicestershire, LE11 3TU, UK
r.yan@lboro.ac.uk

Sarah J. Dunnett
Department of Aeronautical and Automotive
Engineering, Loughborough University
Leicestershire, LE11 3TU, UK
s.j.dunnett@lboro.ac.uk

Stefan Pickl
Universität der Bundeswehr München,
Fakultät für Informatik
Werner-Heisenberg-Weg 39, 85577
Neubiberg, Germany
stefan.pickl@unibw.de

Stewart Robinson
School of Business and Economics,
Loughborough University
Leicestershire, LE11 3TU, UK
s.l.robinson@lboro.ac.uk

Tommi Kärkkäinen
Department of Mathematical Information
Technology, University of Jyväskylä
P.O. Box 35, FI-40014, Finland
tommi.karkkainen@jyu.fi

Veronica Dal Sasso
Dipartimento di Matematica, Università
degli Studi di Padova
via Trieste 63, 35121 Padova, Italy
dalsasso@math.unipd.it