

**Lecture Notes in
Operations Research**

14

Series Editors:
Ding-Zhu Du and Xiang-Sun Zhang

**OPERATIONS RESEARCH
AND ITS APPLICATIONS
IN ENGINEERING, TECHNOLOGY AND MANAGEMENT**

The Tenth International Symposium, ISORA 2011
Dunhuang, China, August 28–31, 2011
Proceedings

Edited by
Xiang-Sun Zhang
De-Gang Liu
Ling-Yun Wu
Yong Wang

WORLD PUBLISHING CORPORATION

Series Editors

Ding-Zhu Du
Department of Computer Science
University of Texas at Dallas
Richardson, TX 75083-0688, USA

Xiang-Sun Zhang
Institute of Applied Mathematics
Academy of Mathematics and Systems
Science
Chinese Academy of Sciences
Beijing 100190, P.R. China

Volume Editors

Xiang-Sun Zhang
De-Gang Liu
Ling-Yun Wu
Yong Wang

Published by **World Publishing Corporation**

137 Chaonei Dajie, Beijing 100010
The People's Republic of China

Copyright ©2011 by World Publishing Corporation

The book has been photographically reproduced from the best available copy. Unauthorized use might infringe on privately owned patents of publication rights. Please contact the individual authors for the permission to reprint or otherwise use information from their papers.

ISBN 978-7-5100-3887-7

Printed in the People's Republic of China

ABOUT ISORA 2011

THEME AND SCOPE

After the past 9 successful ISORA symposia, the 10th International Symposium on Operations Research and Its Applications in engineering, technology and management (ISORA), will be held in Dunhuang in Gansu, a northwestern province of China, from August 28 to 31, 2011.

ISORA is a series international symposium organized by Asia-Pacific Operations Research Center (APORC) under APORS and the Chinese Academy of Sciences (CAS), with goals to provide an international forum for scientists, researchers, educators, and practitioners in OR/MS to exchange ideas and approaches, to present research findings and state-of-the-art solutions, to share experiences on potentials and limits, and to open new avenues of research and developments, on all issues and topics related to the theories and applications of Operations Research. The previous 9 ISORAs under the support of CAS and National Science Foundation of China (NSFC) have been considered very successful and attracted many international scholars.

The theme of ISORA 2011 focuses on both OR techniques and applications in engineering, technology and management. We are particularly interested in submissions that report on experimental and applied research motivated by real-world problems. Theoretical and applied papers are expected to show convincingly the usefulness and efficiency of OR methods and algorithms discussed in a practical setting. Typical, but not exclusive, topics of interest are:

- Optimization Theory and Applications
- Deterministic and Stochastic Models
- Algorithm Analysis and Design
- Graph Theory and Combinatorics
- Supply Chain and Logistics Management
- Marketing Science
- Reliability
- OR Methods in Bioinformatics
- Applications in Engineering, Technology and Management
- Complex Networks

We thank the OR Society of Japan for their strong support in the organization of this symposium. Thanks are also given to the National Natural Science Foundation of China for the financial support to the symposium.

PROGRAM COMMITTEE

Xiang-Sun Zhang	Chinese Academy of Sciences, China (Co-Chair)
Tatsuo Oyama	National Graduate Institute for Policy Studies, Japan (Co-Chair)
Masanori Fushimi	Nanzan University, Japan (Co-Chair)
Xiuli Chao	University of Michigan, USA
Shu-Cherng Fang	North Carolina State University, USA
Masao Fukushima	Kyoto University, Japan
Toshiharu Hasegawa	Kyoto College of Graduate Studies for Informatics, Japan
Toshihide Ibaraki	Kwansei Gakuin University, Japan
Richard C. Larson	Massachusetts Institute of Technology, USA
Sung Joo Park	Korea Advanced Institute of Science and Technology, Korea
Naihua Xiu	Beijing Jiaotong University, China
Yaxiang Yuan	Chinese Academy of Sciences, China
Wuyi Yue	Konan University, Japan
Hanqin Zhang	Chinese Academy of Sciences, China
Yuzhong Zhang	Qufu Normal University, China

PROCEEDING PAPERS AND CONTRIBUTING AUTHORS

In the Proceedings of the Tenth International Symposium on Operations Research and its Applications in engineering, technology and management (ISORA 2011), the papers are indexed by ISTP (Index to Scientific & Technical Proceedings).

Forty-one papers in this volume cover wide range of operations research and its applications. Authors of these papers come from China Mainland, Hong Kong, Macao, Japan, United States, Canada, Poland, Saudi Arabia, Algeria. Many active researchers in various areas contributed their overview and introduction in their fields besides specific deep research achievements. During the symposium, focusing sessions are organized such as in policy study, logistics, supply chain management, scheduling, queueing, network optimization, bioinformatics, and management science.

ISORA 2011 is held in Dunhuang. Dunhuang was a major stop on the ancient Silk Road. For centuries, Buddhist monks at Dunhuang collected scriptures from the West, and many pilgrims passed through the area, painting murals inside the Mogao Caves, or Mogao Grottoes (also known as the Caves of Thousand Buddhas). The Mogao Caves are one of the three famous ancient Buddhist sculptural sites of China. We hope all the participants will enjoy very much not only the academic exchange, but also the cultural exchange and beautiful trip of Dunhuang.

AVAILABILITY

The electronic version of the proceedings can be downloaded from the web sites of ORSC and APORC.

ORSC: <http://www.orsc.org.cn>

APORC: <http://www.aporc.org>