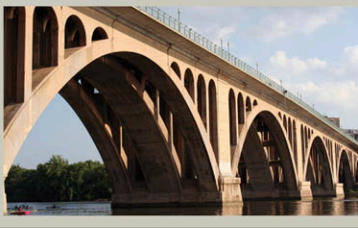

Vulnerability, Uncertainty, and Risk

ANALYSIS, MODELING, AND MANAGEMENT

Proceedings of the
ICVRAM 2011 and ISUMA 2011 Conferences

Edited by
Bilal M. Ayyub, Ph.D., P.E.

ASCE

This is a preview. Click here to purchase the full publication.

VULNERABILITY, UNCERTAINTY, AND RISK

ANALYSIS, MODELING, AND MANAGEMENT

PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON VULNERABILITY AND RISK ANALYSIS AND MANAGEMENT (ICVRAM 2011) AND THE FIFTH INTERNATIONAL SYMPOSIUM ON UNCERTAINTY MODELING AND ANALYSIS (ISUMA 2011)

April 11–13, 2011
Hyattsville, Maryland

SPONSORED BY
The Council on Disaster Risk Management (CDRM)
of the American Society of Civil Engineers

EDITED BY
Bilal M. Ayyub, Ph.D., P.E., F. ASCE

ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS

1801 ALEXANDER BELL DRIVE
RESTON, VIRGINIA 20191–4400

Cataloging-in-Publication Data on file with the Library of Congress.

American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, Virginia, 20191-4400

www.pubs.asce.org

Any statements expressed in these materials are those of the individual authors and do not necessarily represent the views of ASCE, which takes no responsibility for any statement made herein. No reference made in this publication to any specific method, product, process, or service constitutes or implies an endorsement, recommendation, or warranty thereof by ASCE. The materials are for general information only and do not represent a standard of ASCE, nor are they intended as a reference in purchase specifications, contracts, regulations, statutes, or any other legal document. ASCE makes no representation or warranty of any kind, whether express or implied, concerning the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed in this publication, and assumes no liability therefore. This information should not be used without first securing competent advice with respect to its suitability for any general or specific application. Anyone utilizing this information assumes all liability arising from such use, including but not limited to infringement of any patent or patents.

ASCE and American Society of Civil Engineers—Registered in U.S. Patent and Trademark Office.

Photocopies and permissions. Permission to photocopy or reproduce material from ASCE publications can be obtained by sending an e-mail to permissions@asce.org or by locating a title in ASCE's online database (http://cedb.asce.org) and using the "Permission to Reuse" link. *Bulk reprints.* Information regarding reprints of 100 or more copies is available at http://www.asce.org/reprints.

Copyright © 2011 by the American Society of Civil Engineers.
All Rights Reserved.
ISBN 978-0-7844-1170-4
Manufactured in the United States of America.

Preface

In recent years, significant advances have been made in the areas of risk, vulnerability and uncertainty modeling, analysis and management. The joint International Conference on Vulnerability and Risk Analysis and Management (ICVRAM) and International Symposium on Uncertainty Modeling and Analysis (ISUMA) provided a forum for experts and decision makers involved in vulnerability and risk analysis and management to share information on current and emerging hazards and research results affecting the built environment with means for an appropriate consideration of uncertainty. ISUMA complemented ICVRAM by providing in-depth coverage on uncertainty modeling and analysis that would offer opportunities for cross-pollination. As we make advancements in technology, exploit resources, and step into new realms of human endeavors, we are exposed to new hazards. The novelty of the situation with its attendant uncertainties can pose a challenging situation for experts and decision makers charged with providing technical assistance and policy recommendations. The proceedings of this joint conference contribute towards the transitioning of intellectual discussions into robust frameworks for handling emerging vulnerabilities and risks, and providing analytical bases to prepare for national and international disasters.

The first International Conference on Vulnerability and Risk Analysis and Management was initiated and sponsored by the Council on Disaster Risk Management (CDRM) of the American Society of Civil Engineers (ASCE). This conference was held April 11-13, 2011 at the Marriott Inn & Conference Center of the University of Maryland University College, Hyattsville, Maryland, USA.

All papers in the proceedings were subjected to peer review by qualified engineers or academics working or teaching in fields relating to the paper. This effort by the many reviewers is truly appreciated. Hundreds of hours were volunteered to produce the proceedings. The work of the International Program Committee is indeed noteworthy for its excellence and support throughout the development of the program and the proceedings, particularly Professor Nii Attoh-Okine, Professor William McGill, Professor Qingbin Cui, and Dr. Scott Ferson.

The efforts of the Conference Department and Technical Activities Committee of ASCE, particularly Ms. Barbara Hickman and Ms. Catherine Tehan, are acknowledged for providing much of the conference preparation including scheduling, accommodations, local tours, and the conference program. The University of Maryland, College Park campus provided student helpers for the paper presentations. Special thanks to Ms. Che-yu Chang for her help and support in making this conference successful.

Bilal M. Ayyub, Ph.D., P.E., F.ASCE
Proceedings Editor
Professor and Director, Center for Technology & Systems Management
University of Maryland, College Park, Maryland, USA

This page intentionally left blank

Acknowledgments

Organizing Institutions
Council on Disaster Risk Management, ASCE
University of Maryland at College Park, USA Center for Technology and Systems Management
University of Delaware, USA

Collaborating Institutions
Society for Risk Analysis

General Chair
Bilal M. Ayyub (USA)

Conference Co-Chairs
Nii O. Attoh-Okine (USA)
M. Gupta (Canada)

Publications Chair
William L. McGill (USA)

Honorary Co-Chairs
Alfredo Ang (USA)
George Klir (USA)
Lotfi Zadeh (USA)

International Program Committee

L. Achenie (USA)
J. Agarwal (UK)
T. Aven (Norway)
F. Awadallah (Palestine)
A. Badiru (USA)
M. Beer (Singapore)
Y. Ben-Haim (Israel)
D. Bentil (USA)
D. Blockley (UK)
D. Bowles (USA)
R.-H. Cheng (Taiwan)
K. Cogger (USA)
K. Crowther (USA)
Q. Cui (USA)
G. de Souza (Brazil)
A. Der Kiureghian (USA)
D. Dubois (France)
I. Elishakoff (USA)
B. Ellingwood (USA)
B. Ezell (USA)
M. Faber (Switzerland)
S. Fan (USA)
S. Ferson (USA)
D. Frangopol (USA)
H. Furuta (Japan)
G. Gavardashvili (Georgia)
S. Guikema (USA)
Y. Haimes (USA)
J. Hall (UK)
A. Harkness (USA)
A. Haldar (USA)
P. Johnson (USA)
J. Kacprzyk (Poland)
H. Kamal (Kuwait)
M. Kearney (USA)
S. Kikuchi (USA)
S.-H. Kim (Korea)
G. Klir (USA)
R. Kohout (USA)
S. Labi (USA)
J. Lambert (USA)
J. Li (China)
D. Linzell (USA)
S. Liu (China)
Y. Lin (USA)
C. Loh (Taiwan)
M. Maes (Canada)
C. Menches (USA)
A. Mosleh (USA)
V. Mujumdar (USA)
Y. Najjar (USA)
T. Norton (USA)

B. Ogunnaike (USA)
L. Parker (USA)
G. Parnell (USA)
M. Pecht (UMD)
J. Peerenboom (USA)
K.-K. Phoon (Singapore)
S. Prakash (USA)
M. Popescu (USA)
A. Ruedin (Argentina)
Y. Seda-Sanabria (USA)
E. Simui (USA)
I. Smith (Switzerland)
A. Sorensen (USA)
J. Sørensen (Denmark)
P. Spanos (USA)
S. Tabsh (UAE)
W. Tang (Hong Kong)
B. Tansel (USA)
S. Timashev (Russia)
N. Uddin (USA)
E. VanMarcke (USA)
W. Wallace (USA)
G. Woo (UK)
G. Wyss (USA)
R. Yager (USA)
L. Zadeh (USA)
Y. Zhao (Japan)
M. Ziara (Palestine)

This is a preview. Click here to purchase the full publication.

Contents

Keynote Papers

Application of Evolutionary Computing to Disaster Restoration and Prevention Problems 1
Hitoshi Furuta and Koichiro Nakatsu

Quantitative Risk Analysis of Damage to Structures during Windstorms: Random Field and System Reliability Aspects 11
Erik Vanmarcke and Ning Lin

Imprecision, Statistics, and Simulation Method

Statistical Decisions with Random Fuzzy Data—A Possibilistic Approach 21
Olgierd Hryniewicz

Statistic Inference under Two Structurally Different Approaches to Interval Data 29
Scott Ferson and Jack Siegrist

Independence in Generalized Interval Probability 37
Yan Wang

Embodied Knowledge of Gesture Motion Acquired by Singular Spectrum Analysis 45
I. Hayashi, Y. Jiang, and S. Wang

Fuzzy Probability in Engineering Analyses 53
M. Beer and S. Ferson

A Process for the Estimation of the Duration of Activities in Fuzzy Project Scheduling 62
A. Maravas and J. P. Pantouvakis

Uncertainty Arithmetic on Excel Spreadsheets: Add-In for Intervals, Probability Distributions, and Probability Boxes 70
Scott Ferson, James Mickley, and William McGill

Extended Uniform Distribution Accounting for Uncertainty of Uncertainty 78
James-A. Goulet and Ian F. C. Smith

Efficiency Comparison of Markov Chain Monte Carlo Simulation with Subset Simulation (MCMC/ss) to Standard Monte Carlo Simulation (sMC) for Extreme Event Scenarios 86
Duzgun Agdas, Michael T. Davidson, and Ralph D. Ellis

Multi-Agent Simulation Considering the Influence of Leader during Flood Disaster 96
Michiyuki Hirokane, Yusuke Miyawaki, and Yuhei Inoue

This is a preview. Click here to purchase the full publication.

Multi-Agent Simulation to Uncertain Civilian Return Trips during a Hypothetical Earthquake **104**
Seiichi Kagaya, Yukako Ishiguro, and Ken-etsu Uchida

Statistical Characterization and Prediction of Sea Waves Based on Buoy Data **113**
Che-Yu Chang and Bilal M. Ayyub

Measuring Validity of Reasoning Process for Transportation Planning Using Bayesian Inference and Dempster-Shafer Theory **121**
Nopadon Kronprasert and Shinya Kikuchi

A Simulation Framework for the Path Planning of Unmanned Autonomous Systems **129**
M.-W. Kang, S. Wang, M. K. Jha, C.-C. Chen, and P. Schonfeld

Development of Gap Acceptance Fuzzy Models Using Data from Driving Simulator Experiments **138**
R. Rossi, M. Gastaldi, and G. Gecchele

Infrastructure Risk, Management, and Protection

Entropy Approach to Risk-Analysis of Critical Infrastructure Systems **147**
S. A. Timashev and A. N. Tyrsin

A Survey of Network Theoretic Approaches for Risk Analysis of Complex Infrastructure Systems **155**
Sarah LaRocca and Seth Guikema

Regional Social and Economic Risks As Conditions of Formation of Critical Infrastructure **163**
Alexander V. Shibin, Julia L. Shibina, and Alexander A. Kuklin

Decomposition Methods for Restoring Infrastructure Systems **171**
Burak Cavdaroglu, Sarah G. Nurre, John E. Mitchell, Thomas C. Sharkey, and William A. Wallace

Strategic Planning for Power System Restoration **180**
Carleton Coffrin, Pascal Van Hentenryck, and Russell Bent

Preparedness of Finnish Electricity Users against Major Disturbances in Supply of Electric Power **188**
J. Sarsama, R. Molarius, P. Verho, J. Strandén, and H. Krohns

Development of Spatial Risk Profiles of Cargo Rail Systems **197**
Bilal M. Ayyub, Kristen Markham, and Che-yu Chang

Probabilistic Study of Cascading Failures in Complex Interdependent Lifeline Systems **205**
Isaac Hernandez-Fajardo and Leonardo Dueñas-Osorio

Vulnerability Assessment of Infrastructure Networks by Using Hierarchical Decomposition Methods **214**
C. Gómez, J. Buriticá, M. Sánchez-Silva, and L. Dueñas-Osorio

Sustainability: Complexity, Regulations, and Decisions **222**
Tonatiuh Rodriguez-Nikl and Colin B. Brown

A Systems Approach to Vulnerability Assessment **230**
Jitendra Agarwal, Mei Liu, and David Blockley

This is a preview. Click here to purchase the full publication.

System Reliability Analysis of Fatigue-Induced Sequential Failure.....238
Young-Joo Lee and Junho Song

Sample Treatment of Uncertainties in Earthquake Portfolio Risk Analysis 246
Craig Taylor, William Graf, Yajie (Jerry) Lee, Charles Huyck, and Zhenghui Hu

Probabilistic Application in Seismic Vulnerability Assessment of Structures 252
Mohsen Javanpour and Panam Zarfam

Options for the Treatment of Uncertainty in Seismic Probabilistic Safety Assessment of Nuclear Power Plants.....260
Tamas J. Katona

Seismic Investigation for the Temple of Antioch Reconstruction 268
Ece Erdogmus, Terri Norton, Cody M. Buckley, Kyle Kauzlarich, and Brad Petersen

Risk Issues, Management, and Decision Making

Multicriteria Optimization under Uncertainty: Average Criteria Method 276
L. E. K. Achenie, I. V. Datskov, and G. M. Ostrovsky

National-Level Infrastructure Risk Evaluation Framework and Best Practices 284
Yujie Lu, Qingbin Cui, Longquan Mao, and Liang Chen

Probabilistic Performance Risk Evaluation of Infrastructure Projects.....292
Byung-Cheol Kim

Optimal Planning of Public Works Using Improved Genetic Algorithm.....300
Koichiro Nakatsu, Hitoshi Furuta, and Ken Ishibashi

Quantitative Risk Assessment, Public Policy, and Decision-Making.....308
Vilas Mujumdar

Research on the Establishment of Mega Public Building Safety Risk Assessment System in China 316
Liang Chen, Longquan Mao, Ye Feng, and Hu Cheng

A New Model of Supervision of Chinese Government over Building Safety: Based on the Third-Party Assessment Mechanism 326
Hu Cheng, Longquan Mao, Youliang Huang, and Xin Zhao

Development of Spatial Risk Profiles Resulting from Sea Level Rise 334
Bilal M. Ayyub, Michael Kearney, Josue Ramirez, Kristen Markham, and Che-Yu Chang

Evaluating the Source of the Risks Associated with Natural Events.....342
P. Gardoni and C. Murphy

Florida International University's Wall of Wind: A Tool for Improving Construction Materials and Methods for Hurricane-Prone Regions.....352
Aly Mousaad Aly, Girma Bitsuamlak, and Arindam Gan Chowdhury

Risk Management of Long Term Infrastructure Projects "PPP-BOT Projects" by Using Uncertainty, Probabilistic and Stochastic Methods, and Models.....360
Meghdad Attarzadeh, David Kim Huat Chua, and Michael Beer

This is a preview. Click here to purchase the full publication.