

2nd International Conference on Vulnerability and Risk Analysis and Management (ICVRAM 2014)

Quantification, Mitigation and Management

**And the 6th International Symposium on Uncertainty, Modeling
and Analysis (ISUMA 2014)**

**Liverpool, United Kingdom
13-16 July 2014**

Volume 1 of 4

Editors:

**Michael Beer
Siu-Kui Au**

Jim W. Hail

ISBN: 978-1-63266-959-9

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2014) by the American Society of Civil Engineers
All rights reserved.

Printed by Curran Associates, Inc. (2014)

For permission requests, please contact the American Society of Civil Engineers
at the address below.

American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, VA 20191

Phone: (800) 548-2723
Fax: (703) 295-6333

www.asce.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com



VULNERABILITY, UNCERTAINTY, AND RISK

ASCE

 July 13–16, 2014
 Liverpool, UK

Table of Contents

Volume 1

Key Notes

Natural Hazards in a Changing Climate: Impacts, Adaptation and Risk Management	1
Bilal M. Ayyub	
Struggling with Epistemic Uncertainties in Environmental Modelling of Natural Hazards	13
Keith Beven, Philip Younger, and Jim Freer	
Vulnerability and Risk Analysis of Critical Infrastructures	23
Enrico Zio	

Robust, Performance-Based and Reliability-Based Structural Optimization Under Uncertainty

Robust Simulation: Why and When Needed and What Should be Qualified	31
C. E. Taylor, N. Uddin, W. Graf, F. Liu, and Y. Jerry Lee	
Application of S-PSA using FEM to Seismic Retrofit of Existing Structures	41
T. Hara, T. Kato, M. Nonoyama, and H. Yukimoto	
Probabilistic Parameters in the MR Hyperbolic Tangent Damper Model	51
S. C. Baxter and J. M. Caicedo	
Risk-Consistent Design Approach for Designing Innovative Hazard-Resistant Structures	60
Mohammed A. Mousa, Li Dong, and Nasim Uddin	
Reliability-Based Optimization of Updated Dynamical Systems	74
Hector A. Jensen and Camila Vergara	
Reliability and Redundancy of Two-Girder, Steel-Concrete Composite Bridges under Uncertainty	86
Weiwei Lin, Teruhiko Yoda, and Lam Heang	
Optimal Performance-Based Design of Non-Linear Stochastic Dynamical Systems	96
André T. Beck, Ioannis A. Kougiumtzoglou, and Ketson R. M. dos Santos	
Adaptive Implementation of Importance Sampling in	106

Optimization under Uncertainty	
Juan Camilo Medina and Alexandros A. Taflanidis	
Service Life Safety and Reliability of Building Facades	116
Saviz Moghtadernejad and Saeed Mirza	
Subjective Probabilities to Integrate Uncertainties in Levee Performance Assessment	125
M. Vuillet, L. Peyras, C. Carvajal, D. Serre, and Y. Diab	
Approximation Concepts for Fuzzy Structural Analysis	135
M. A. Valdebenito, H. A. Jensen, M. Beer, and C. A. Pérez	
Optimization of Urban Spatial Development Against Multiple Sustainability Objectives and Climate Risks	145
D. Caparros-Midwood, S. Barr, and R. Dawson	
A Novel Approach to Efficient Risk-Based Optimization	155
Wellison J. S. Gomes and André T. Beck	
Robust Risk-Based Optimization	165
Stuart G. Reid	
Binary Damage Classification in SHM Using Possibility Distributions	175
Jung. J. Kim, Mahmoud M. Reda Taha, and Timothy J. Ross	
Optimum Reliability Levels for Structures	184
M. Holický	
Cost-Optimization of Concrete Slabs Exposed to Natural Fires, Taking into Account Post-Fire Behavior	194
R. Van Coile, R. Caspeepe, and L. Taerwe	
Reliability Assessment of Structures Using Interval Uncertainty Analysis	204
M. Modares, R. Taha, and J. Mohammadi	
Robust Design Optimization of Structural Systems Under Evolutionary Stochastic Seismic Excitation	215
Ioannis P. Mitseas, Ioannis A. Kouglioumtzoglou, Michael Beer, Edoardo Patelli, and John E. Mottershead	
Performance Based-Optimization Studies on Design of Fireworks Industrial Structures Using Taguchi Technique	225
S. N. Ramaswamy	
Active Stabilization of a Slender Beam-Column under Static Axial Loading and Estimated Uncertainty in Actuator Properties	235
R. Platz, G. C. Enss, S. Ondoua, and T. Melz	
Robust Analysis of Current Reliability-Based Design Method for RC Columns with Tension Failure under Random Eccentricity.	245
Youbao Jiang, Qiang Liao, and Yihua He	

Dealing with Epistemic Uncertainties in Estimating Vulnerability and Risk

Uncertainty in the Swedish Operational Hydrological Forecasting Systems	253
I. G. Pechlivanidis, T. Bosshard, H. Spångmyr, G. Lindström, D. Gustafsson, and B. Arheimer	
Rethinking Concepts of Information Content of Hydrological Data to Account for Epistemic Errors	263
K. J. Beven and P. J. Smith	
Mathematics, Metaphors and the Management of Vulnerability and Risk	273
Yakov Ben-Haim	
The Impact of Scale on Probabilistic Flood Inundation Maps Using a 2D Hydraulic Model with Uncertain Boundary Conditions	279
James Savage, Paul Bates, Jim Freer, Jeffrey Neal, and Giuseppe Aronica	
Sensitivity Analysis of Environmental Models: A Systematic Review with Practical Workflow	290
F. Pianosi, T. Wagener, J. Rougier, J. Freer, and J. Hall	

Verified and Stochastic Approaches to Modeling and Simulation under Uncertainty in Engineering Applications

Variable Structure Approaches for Temperature Control of Solid Oxide Fuel Cell Stacks	300
Andreas Rauh, Luise Senkel, and Harald Aschemann	
Robust Sliding Mode Techniques for Control and State Estimation of Dynamic Systems with Bounded and Stochastic Uncertainty	310
Luise Senkel, Andreas Rauh, and Harald Aschemann	
Towards Efficient Ways of Estimating Failure Probability of Mechanical Structures Under Interval Uncertainty	320
M. Beer, M. de Angelis, and V. Kreinovich	
Uncertainty Management in Feature-Based Geometric Modelling and Data Exchange	330
Sonia Abdoli, Malika Boumedién-Zidani, and Neil F. Stewart	
How to Compare Different Range Estimations: A Symmetry-Based Approach	340
O. Kosheleva and V. Kreinovich	
A Flexible Environment for Accurate Simulation, Optimization, and Verification of SOFC Models	350
Ekaterina Auer, Stefan Kiel, Thomas Pusch, and Wolfram Luther	
Latest Developments on the IEEE 1788 Effort for the	360

Standardization of Interval Arithmetic

N. Revol and The IEEE P1788 Working Group

Uncertainty Quantification in Power Spectrum Estimation of Stochastic Processes Subject to Missing Data **370**

L. Comerford, I. A. Kougoumtzoglou, and M. Beer

Risk Assessment and Management of Infrastructure Projects

Planning and Management of Port Infrastructure Projects under Uncertainty **378**

P. Taneja, T. Vellinga, and S. R. Sol

Innovative Ways to Implement Risk Management in Infrastructure Projects **389**

Martin Th. van Staveren

Research on the Method of Social Stability Risks Assessment and Management in Major Construction Projects **399**

Ruijie Pu and Hongbo Zhou

A Group of Deterioration Curves of Bridges Estimated by Extended EM Algorithm **409**

I. Yoshida, Y. Otake, and Y. Honjo

The State of the Art of Risk Management Standards on Tunnels and Underground Works in China **419**

Qunfang Hu and Hongwei Huang

The Evaluation of Risk Factors of Population Safety in Transport Corridor of Georgian Military Road **427**

G. V. Gavardashvili and I. R. Iremashvili

Risk Identification and Assessment in Malaysian Public-Private Partnership Projects **436**

H. Sarvari, A. Valipour, N. Yahaya, and N. Md Noor

Structural Dynamics with Uncertainty

Uncertainty Quantification of the Squeal Instability in Real Brake Systems **446**

A. Nobari, H. Ouyang, and P. Bannister

Double Random Vibration Analysis for Coupled Vehicle-Track Systems with Parameter Uncertainties **456**

Y. Zhao, P. Xiang, and J. H. Lin

A Statistical Approach to Dynamic Response of Pile Groups in Foundations for Vibratory Machinery **465**

Konstantin Ashkinadze and Li Fang

Stochastic Model Updating of the DLR AIRMOD Structure **475**

Y. Govers, H. Haddad Khodaparast, M. Link, and J. E. Mottershead

Forced Vibration and Energy Flow Analysis of Plate Assemblies in Symplectic Space	485
Y. B. Ma and Y. H. Zhang	
Dynamic Load Estimation of Launch Vehicles Accounting for Uncertainties of Modeling	496
Y. M. Mao, H. Ouyang, and J. F. Lin	
Vibration Measurement of Occupational Exposed Workers, Experimental Quantification of the Individual Response Parameters for the Estimation of Uncertainty in the Vertical Direction	506
Andreas Kyprianou and Athanasios Vazouras	
Application of Wavelet and Spectral Representation Method in Nonstationary Process Simulation	516
Guoqing Huang, Liuliu Peng, and Yanwen Su	
Development of a Fragility Model for Moment-Frame RC Buildings in Portugal	525
Vitor Silva, Helen Crowley, Humberto Varum, Rui Pinho, and Luis Sousa	

Polymorphic Space- and Time-Dependent Uncertainty Modeling in Engineering

Limitations and Uncertainties in the Long-Term Deflection Calculation of Concrete Structures	535
Behnam Vakhshouri and Shami Nejadi	
Numerical Design Concepts With Polymorphic Uncertainty Models	547
Marco Götz, Wolfgang Graf, and Michael Kaliske	
Numerical Predictions of Surface Settlements in Mechanized Tunneling: Hybrid POD and ANN Surrogate Modeling for Reliability Analyses	557
S. Freitag, B. T. Cao, and G. Meschke	

Critical Infrastructures and Network Systems: Statistical Properties and Modeling for Reliability, Risk, Vulnerability and Resilience Analyses

Socio-Technical Impacts of Hurricane Isaac Power Restoration	567
Scott B. Miles and Nora Jagielo	
Impact of Functional Models in a Decision Context of Critical Infrastructure Vulnerability Reduction	577
Jonas Johansson and Henrik Hassel	
Decision Support Tools: Review of Risk Models in Drinking Water Network Asset Management	587
A. Large, Y. Le Gat, S. M. Elachachi, E. Renaud, and D. Breyse	

Bayesian Network Approach for Risk Assessment of a Spent Nuclear Fuel Pond	598
Silvia Tolo, Edoardo Patelli, and Michael Beer	
Systemic Vulnerability and Resilience Analysis of Electric and Transport Network Failure in Cases of Extreme Winter Storms	608
Riitta Molarius, Pekka Tuomaala, Kalevi Piira, Minna Räikkönen, Christoph Aubrecht, Maria Polese, Giulio Zuccaro, Karoliina Pilli-Sihvola, and Kalev Rannat	
The Fuzzy Random Reliability Analysis of Elevation Control in Composite Beam Cable-Stayed Bridge during the Construction Stage	618
Bu Yu Jia, Quan Sheng Yan, and Xiao Lin Yu	
Simulating Attack Plans Against ICT Infrastructures	627
Fabrizio Baiardi, Fabio Corò, Federico Tonelli, Luca Guidi, and Daniele Sgandurra	
The Value of New Cross-Radial Links for Public Transport Network Robustness	638
Erik Jenelius and Oded Cats	
Characterizing the Vulnerability of Future Configurations of Great Britain's Electricity Network Infrastructure to Climate-related Hazards	648
Scott Thacker, Raghav Pant, and Jim W. Hall	
Vulnerability of Transmission Grids with Variable Generation and Consumption: A Complex Network Systems Perspective	658
G. Sansavini and E. Zio	
A Non-Parametric Aggregation Technique for Identifying Critical Nodes in a Network, Using Three Topology-Based Cascade Models	668
Claudio M. Rocco, José E. Ramirez-Marquez, and César Yajure	
Spatial Risk Analysis of Interdependent Infrastructures Subjected to Extreme Hazards	677
R. Pant, J. W. Hall, S. Barr, and D. Alderson	
Bayesian Kernel Methods for Critical Infrastructure Resilience Modeling	687
H. Baroud and Kash Barker	
Evaluating the Resilience of Critical Infrastructures Assessing Interdependencies and Economic Impact: The Role of Inventories	695
Luca Galbusera, Ivano Azzini, Olaf Jonkeren, Stavros Ntalampiras, and Georgios Giannopoulos	
Too Big to Fail? The Spatial Vulnerability of the Chinese Infrastructure System to Flooding Risks	704
Xi Hu, Jim Hall, and Scott Thacker	
Analysis of the Robustness of Critical Infrastructures Within a Multistate Systems-of-Systems Framework in the Presence of Epistemic Uncertainties	715

E. Ferrario, N. Pedroni, and E. Zio	725
Comparing Topological and Physical Approaches to Network Modeling for the Optimization of Failure-Resilient Electrical Infrastructures	
Yi-Ping Fang, Nicola Pedroni, and Enrico Zio	736
Risk Assessment of the Disruption of Resource Movements from Flooding	
Shaun A. Brown and Richard Dawson	

J c i a Y &

Real Time Asset Monitoring and Risk Management of Critical Infrastructures	746
V. Tsoukias, D. Kostopoulos, and G. Leventakis	
The Effectiveness of Existing Methodologies for Predicting Electrical Substation Damage Due to Earthquakes in New Zealand	752
Indranil Kongar, Tiziana Rossetto, and Sonia Giovinazzi	
Mitigation Strategies for Lifeline Systems Based on the Interdependent Network Design Problem	762
Andrés D. González, Mauricio Sánchez-Silva, Leonardo Dueñas-Osorio, and Andrés L. Medaglia	
Analysis of Road Vulnerability for Population Evacuation Using Complex Network	772
Nan Zhang, Hong Huang, Boni Su, and Jinlong Zhao	

Generalized Engineering Reliability—A Physical Approach

First-Passage Reliability Evaluation Based on the Probability Density Evolution of Stochastic Processes	782
J. B. Chen, P. H. Lin, and J. Li	
Reliability Analysis Using Field Data Findings With Undefined Failure Mode—An Analysis Not Necessarily Conservative	792
Raphael C. F. de Melo and Gilberto F. M. de Souza	
Stochastic Nonlinear Analysis for Seismic Performance of Buried Pipeline Systems	804
W. Liu, Q. W. Sun, and J. Li	
A Random Function Model of Ground Motion and PDEM-Based Seismic Reliability Analysis of Nonlinear Structures	814
Zhangjun Liu, Linqiang Wu, and Bo Zeng	
Provident Damper Control for Reliability Enhancement of Randomly Excited Structures	822
Y. B. Peng, Z. Mei, and J. Li	
Probabilistic Resonance and Variance Spectra	832
X. F. Xu	
Reliabilities of Steel Structural Systems Designed by Inelastic	843

Analysis

Hao Zhang, Bruce R. Ellingwood, and Kim J. R. Rasmussen

Failure Probability Assessment of Structures Considering Post-Instability Behavior **853**

J. Xu and J. Li

Imprecise Probability in Reliability

Stochastic Response Surfaces, Interval Analysis, and the Reliability of Structures **864**

M. Oberguggenberger

Training Generalized Hidden Markov Model with Interval Probability Parameters **876**

Yan Wang

Reliability Analysis with Ill-Known Probabilities and Dependencies **887**

S. Destercke, M. Poss, and M. Sallak

Computing with Confidence: Imprecise Posteriors and Predictive Distributions **895**

Scott Ferson, Jason O'Rawe, and Michael Balch

Estimation of the Lower and Upper Probabilities of Failure Using Random Sets and Subset Simulation **905**

Diego A. Alvarez, Jorge E. Hurtado, and Felipe Uribe

Line Sampling for Assessing Structural Reliability with Imprecise Failure Probabilities **915**

M. de Angelis, E. Patelli, and M. Beer

East-West Contributions on Risk Management for Floods, Tsunamis, Earthquakes, and other Natural Hazards

Resilience Metrics for Multi-Hazard Environments **925**

Bilal M. Ayyub

Dynamic Reliability of Offshore Wind Turbine Tower Systems **937**

J. B. Chen, W. L. Liu, and J. Li

A Resilience Engineering Framework: Adapting to Extreme Events **948**

Yumei Wang and Qisong "Kent" Yu

Liquefaction Hazard Zonation Based on a Probabilistic Model of Lateral Spread Exceeding a Pre-Defined Threshold **958**

Fang Liu, Zhen Li, Peizhen Li, and Mingjing Jiang

Investigation on the Construction of Flood Insurance Model in China **969**

Quanhe Ju, Shuguang Liu, Yi Cai, and Guihui Zhong

Lifeline System Interdependencies—Key for Resilience in Practice	979
Alex K. Tang, Jian Li, and Leonardo Duenas-Osorio	
Variable Load Distribution	989
T. T. Poutanen	
Flood Control and Disaster Mitigation in Shanghai	998
Shuguang Liu, Guihui Zhong, Zhengzheng Zhou, and Yi Cai	

Remote Sensing for Disaster Study and Risk Assessment

Uncertainty Analysis in Crop Productivity and Remote Estimation for Agricultural Risk Assessment	1008
Dmytro Movchan, Yuriy V. Kostyuchenko, Laszlo Marton, Olexiy Frayer, and Sergiy Kyryzyuk	
Urban Infrastructure Risk Assessment toward Extreme Snowstorms Using Satellite Data	1016
Yuriy V. Kostyuchenko, Yu. H. Bilous, D. M. Solovyov, and I. M. Kopachevsky	
Seismic Vulnerability Assessment at Urban Scale Based on Different Building Stock Data Sources	1027
P. Ricci, C. Del Gaudio, G. M. Verderame, G. Manfredi, M. Pollino, and F. Borfecchia	

Control Theory of Uncertain Systems and its Application

On the Response of LTI Higher Order Differential-Algebraic Systems with Perturbed Coefficients¹	1039
P. Tzekis, E. Antoniou, and A. Pantelous	
Robust Stabilization and Robust H_∞ Control of Uncertain Linear Stochastic Systems with Markovian Switching	1047
Bujar Gashi and Haochen Hua	
Robust LMI Stability of a Premium Pricing Model into a Discrete-Time Stochastic Framework	1057
Athanasios A. Pantelous and Lin Yang	
Generalised Risk-Sensitive Control in Infinite Horizon	1067
Bujar Gashi and Moyu Zhang	
Risk-Sensitive Control for a Class of Nonlinear Square-Root Processes	1076
Fan Fei and Bujar Gashi	
A Novel Mathematical Model for TLCD: Theoretical and Experimental Investigations	1086
A. Di Matteo, F. Lo Iacono, G. Navarra, and A. Pirrotta	

Hazards Risk Assessment and Management

- The Influence of Velocity on Vulnerability of Building Structure to Debris Flow** **1095**
Chih-Hao Hsu and Ting-Chi Tsao
- Anatomy of Natural Hazard Analysis: Uncertainty Propagation and Visualization** **1105**
K. Goda, T. Wagener, and W. P. Aspinall
- The Development of a Simplified Model for Urban Flood Risk Mitigation in Developing Countries** **1116**
U. C. Nkwunonwo, M. Whitworth, B. Baily, and R. Inkpen
- An Investigation into Aggregate vs. Occurrence Losses for European Extra-Tropical Cyclones** **1128**
S. Latchman, S. Higgs, and B. Evans
- Preliminary Structural Performance Assessment of Recycled Materials for Disaster Reconstruction** **1138**
Matija Radovic, Terri R. Norton, and Meagan Kurmel
- Detecting Shift Moments in Construction Activity to Estimate Disaster Recovery** **1148**
Henry D. Lester, Marcus B. Perry, and Gary P. Moynihan
- Challenges in Assessing the Seismic Preparedness of the State of New Mexico, USA** **1158**
Claudia Mara Dias Wilson, Alexander Brewster, Richard Benda, Glenn Gavi, Colton Lake, Kelsey McCaslin, Olufunsho Ogungbade, Amanda Thom, and Elyce Yates
- Multi-Criteria Spatial Analysis of Hazardous Materials Transportation** **1168**
Francyelly Giovany Cordeiro, Barbara Stolte Bezerra, Anna Silvia P. Peixoto, and Ilza Machado Kaiser

Actuarial and Financial Risk Theory with Applications

- Asset Allocation with Disappointment Aversion** **1180**
Yuxin Xie and Athanasios A. Pantelous
- Structural Breaks in Mortality Models and their Consequences** **1190**
C. O'Hare and Y. Li
- A Wiener Path Integral Technique for the Asset Price Process: Geometric Brownian Motion and Vasicek** **1205**
John C. McCarthy, Ioannis A. Kougioumtzoglou, and Athanasios A. Pantelous
- Optimal Strategies for Long-Term Sustainability in PAYGO Pension Systems using Control Theory in a Dynamic Nonlinear Framework** **1214**

Humberto Godínez-Olivares, María del Carmen Boado-Penas, and Athanasios A. Pantelous

Forecasting Financial Volatility with Interval-Valued Time Series Data **1224**

Wei Yang, Ai Han, and Shouyang Wang

Bonus-Malus Systems with Hybrid Claim Severity Distributions **1234**

Weihong Ni, Bo Li, Corina Constantinescu, and Athanasios A. Pantelous

A Hedging Approach to Insurance Company Solvency **1245**

Hirbod Assa

Uncertainty in Design and Service Life of Civil Engineering Structures

Risk of GRP Panel Failure During Installation in Sewers When Using Relining Technology **1254**

Z. Fyall and A. Wysocka

Modeling Uncertainty in the Context of Finite Element Analyses of Deteriorated Structures **1264**

D. L. Allaix, V. I. Carbone, and G. Mancini

Probabilistic Analysis of High Strength Concrete Girders Strengthened with CFRP **1274**

S. Gomes, L. Neves, D. Dias-da-Costa, P. Fernandes, and E. Júlio

Safety Estimation of the Plate-Girder Structures with Uncertain Parameters from the Shakedown Theory Point of View **1283**

R. Sieniawska, W. Zielichowski-Haber, and St. Zukowki

Accuracy of Frequency Domain Fatigue Damage Estimation Methods for Offshore Wind Turbine Support Structures **1293**

Laszlo Arany, Subhamoy Bhattacharya, John Macdonald, and S. J. Hogan

Dynamic Reliability-Based Seismic Design Method of Nonlinear Multi-Grid Composite Wall **1303**

Pei Liu

Stochastic Analysis to Assess Uncertainty in Pushover Analysis to Modeling Methods **1311**

Neena Panandikar (hede) and K. S. Babu Narayan

Quantification of the Approximations Introduced by Assumptions on the Marginal Distribution of the Demand for Highway Bridge Fragility Analysis **1321**

Aman Karamlou and Paolo Bocchini

Dealing with Uncertainties When Using Non Destructive Techniques for Assessing Construction Material Properties: Identification of Major Sources and Their Consequences **1331**

D. Breyse, J. P. Balayssac, and Z. M. Sbartai

Probabilistic Risk Assessment for Weather-Related Phenomena

- Development of Real-Time Tools for Hurricane Risk Assessment** **1341**
Alexandros A. Taflanidis, Gaofeng Jia, Norberto C. Nadal-Caraballo, Andrew B. Kennedy, Jeffrey A. Melby, and Jane M. Smith
- Climate-Related Extreme Events with High-Resolution Regional Simulations: Assessing the Effects of Climate Change Scenarios in Ouagadougou, Burkina Faso** **1351**
Edoardo Bucchignani, Alexander Garcia-Aristizabal, and Myriam Montesarchio
- A Plan for Characterizing Uncertainties in Extreme Environmental Loads with Climate Change Considerations: Wind Speed and Wave Height as Case Studies** **1363**
Franklin T. Lombardo and Bilal Ayyub
- A Methodology for Evaluation and Mapping of Flood Risk—A Case Study of Oued Mekerra in the West of Algeria** **1373**
A. Yahiaoui, B. Touaibia, and E. Ferrari
- An Hourly and Multi-Hourly Extreme Precipitation Climatology for the UK and Long-Term Changes in Extremes** **1385**
S. Blenkinsop and H. J. Fowler
- When to Issue a Flood Warning: Towards a Risk-Based Approach Based on Real Time Probabilistic Forecasts** **1395**
Paul J. Smith and Keith J. Beven
- Probabilistic Prediction of Landslides Induced by Rainfall** **1405**
M. Rossi, A. C. Mondini, S. Luciani, D. Kirschbaum, D. Valigi, and F. Guzzetti
- A Statistical Model for Flood Depth Estimation in Southeast Europe** **1415**
Carmine Galasso and Sharika U. S. Senarath
- Probabilistic Characterization of Flood Hazard Using Bivariate Analysis Based on Copulas** **1425**
A. Candela and G. T. Aronica
- The Assessment of Mudflow Peak Discharge through A Monte Carlo Simulation Method** **1435**
F. De Paola, R. De Risi, G. Di Crescenzo, M. Giugni, F. Jalayer, A. Santo, and G. Speranza
- A Semi-Probabilistic GIS-Based Method for Meso-Scale Flood Hazard Zonation** **1445**
R. De Risi, F. Jalayer, F. De Paola, and G. Manfredi
- Development of a Framework to Model Flood Loss Uncertainty** **1455**
N. Peiris, D. A. Gatey, and M. Hill
- A Real Options-Based Framework to Evaluate Investments in** **1465**

- River Flood Control under Uncertainty**
Luis A. Gomez Cunya, Hyun Woo Lee, and Arturo S. Leon **1475**
- Probabilistic Damage Estimate of Rural Houses Subjected to Cyclonic Wind**
Pradeep K. Goyal and T. K. Datta

Volume 3

- Statistical Modeling of Synthetic Climates for Applications on Construction Materials** **1484**
D. Breyse, E. Rodney, A. Marache, and M. Chaplain

Uncertainty Quantification and Propagation in Engineering Systems

- Uncertainty Quantification for State Estimation in Nonlinear Structural Systems** **1494**
K. Erazo and E. M. Hernandez
- A Bayesian Multilevel Approach to Optimally Estimate Material Properties** **1504**
Joseph B. Nagel and Bruno Sudret
- Global Sensitivity Analysis of Power Systems Components—Markov Reliability Models** **1514**
Claudio M. Rocco and Enrico Zio
- Model Updating by Uncertain Parameter Inference** **1523**
H. M. Gomes, M. Broggi, E. Patelli, and J. E. Mottershead
- Observability and Identifiability Methods for Structural Dynamic Systems** **1533**
M. N. Chatzis, E. N. Chatzi, and A. W. Smyth
- Sensitivity Analysis and Uncertainty Quantification for a Coupled Secondary Air System Thermo-Mechanical Model of a Jet Engine Low Pressure Turbine Rotor** **1543**
Giulia Antinori, Fabian Duddeck, and Andreas Fischersworing-Bunk
- Global Sensitivity Analysis for Multidisciplinary Studies of Vane Clusters** **1554**
I. Arsenyev, F. Duddeck, and A. Fischersworing-Bunk
- Risk Analysis of Composite Structures by Subset Estimation Using the Hysteretic Multiscale Finite Element Method** **1564**
S. P. Triantafyllou and E. N. Chatzi
- A Stochastic Simulation Algorithm for Updating Robust Reliability of Nonlinear Structural Dynamic Systems Based on Incomplete Modal Data** **1574**
Sai Hung Cheung and Sahil Bansal
- Probabilistic Sensitivity Analysis of Corrugated Skins with Random Elastic Parameters and Surface Topology** **1584**
F. A. Diaz De la O, A. Kundu, M. I. Friswell, and S. Adhikari

Effect of Parameter Uncertainty on Water Distribution Systems Modeling	1596
Muhammad A. Al-Zahrani	
Value of Information Analysis in Structural Safety	1605
Katerina Konakli and Michael H. Faber	
Bayesian Hierarchical Models for Uncertainty Quantification in Structural Dynamics	1615
G. C. Ballesteros, P. Angelikopoulos, C. Papadimitriou, and P. Koumoutsakos	

Simulation-based Structural Vulnerability Assessment and Risk Quantification in Earthquake Engineering

Harmonic Wavelets-Based Response Power Spectrum Determination of MDOF Nonlinear Structural Systems	1625
I. A. Kougoumtzoglou, Fan Kong, P. D. Spanos, and J. Li	
Probabilistic Seismic Safety Assessment of Chinese RC Frame Structures Using Fragility Curves	1635
Xiaohui Yu and Dagang Lu	
Effectiveness Evaluation of Seismic Protection Devices for Bridges in the PBEE Framework	1645
Paolo Emidio Sebastiani, Jamie E. Padgett, Francesco Petrini, and Franco Bontempi	
Advances in Simulation-Based Quantification/Assessment of Seismic Risk Supported by Stochastic Ground Motion Modeling	1655
A. A. Taflanidis and C. R. Vetter	
Sensitivity Analysis of Different Capacity Spectrum Approaches to Assumptions in the Modeling, Capacity and Demand Representations	1665
Tiziana Rossetto, Pierre Gehl, Stylianos Minas, Arash Nassirpour, Joshua Macabuag, Philippe Duffour, and John Douglas	
Investigating the Use of Record-to-Record Variability in Static Capacity Approaches	1675
Pierre Gehl, John Douglas, Tiziana Rossetto, Joshua Macabuag, Arash Nassirpour, Stylianos Minas, and Philippe Duffour	
Rational Framework for Probability of Collapse in Buildings	1685
Tareq Hatahet and Carsten Koenke	
Reliability of Bridges under Seismic and Tsunami Hazards	1696
Mitsuyoshi Akiyama and Dan M. Frangopol	
Local Wavelet-Based Spectral "Epsilon" Modification of Ground Motions in Support of Incremental Dynamic Analysis	1706
A. Giaralis and D. Vamvatsikos	
Including Multiple IMTs in the Development of Fragility Functions for Earthquake Loss Estimation	1716

L. Sousa, V. Silva, M. Marques, H. Crowley, and R. Pinho

Investigation of the Characteristics of the Portuguese Moment-Frame RC Building Stock **1726**

Vitor Silva, Helen Crowley, Humberto Varum, Rui Pinho, and Mário Marques

Probabilistic Approach to Performance-Based Seismic Design of RC Frames **1736**

Ali Reza Manafpour and Parisa Kamrani Moghaddam

Developing a Knowledge Based Expert System (KBES) for Seismic Risk Management **1746**

Kamran Vahdat, Nigel J. Smith, and Ghodrati Amiri

Influence of Record Selection Procedures on Seismic Loss Estimations **1756**

Mário Marques, Luís Macedo, Miguel Araújo, Luís Martins, José Miguel Castro, Luís Sousa, Vítor Silva, and Raimundo Delgado

Reliability-Based Design of Fluid Viscous Damper for Seismic Protection of Building Frames **1767**

E. Tubaldi, A. Dall'Asta, M. Broggi, E. Patelli, and M. De Angelis

Influence of the Axial Load Ratio on the Fragility Function for RC Walls **1777**

S. Marzban and A. Azarbakht

Stochastic and Nonlinear Dynamics in Complex Systems

Probability Density Evolution Analysis of Complex Random-Parameter Structures Subjected to Ground Motions **1785**

J. B. Chen, J. Y. Yang, and J. Li

Empirical Analysis of Nonlinearities of China's and International Coal Prices **1795**

Qiang Lei and Dianhong Jiang

On Study of Nonlinear Network Dynamics of Flexibly Connected Multi-Module Very Large Floating Structures **1805**

D. L. Xu, H. C. Zhang, Lu C, E. R. Qi, J. J. Hu, and Y. S. Wu

Complexity Analysis of 2010 Baja California Earthquake Based on Entropy Measurements **1815**

Lei Min, Meng Guang, and Nilanjan Sarkar

Analysis of a Cournot Duopoly Model Based on Uncertain Strategy **1823**

Jiaorui Li and Jian Chang

Stochastic Responses of Viscoelastic System with Real-Power Stiffness under Randomly Disordered Periodic Excitations **1836**

Wei Xu, Hongqi Zang, and Di Liu

Stochastic Responses of Duffing-Van Der Pol Vibro-Impact **1846**

Oscillator with Colored Noise	
Wei Xu, Chao Li, and Liang Wang	
The Influence of Oscillatory Correlation on the Zero Crossings of Gaussian Processes	1856
Lorna R. M. Wilson, Keith I. Hopcraft, and Eric Jakeman	
Energy Response Probability Density Function of a Rotating Parametric Pendulum	1866
P. Alevras, D. Yurchenko, and A. Naess	
Time-Dependent Uncertainty Analysis of Structures Based on Copula Functions	1875
Y. F. Liu, X. P. Fan, and D. G. Lu	
High-Dimensional Chaotic Dynamics in Cutting Systems with Time-Delay Effects	1888
Xianbo Liu, Min Lei, Xinhua Long, Hongguang Li, and Guang Meng	
Low-Pass Filter-Based Control of Chaos by Bounded Damping Feedback	1898
Lin Du and Yan Zhang	
A Weighted Dual Criterion for the Problem of Equivalent Replacement	1913
N. D. Anh, N. N. Linh, and N. Q. Hai	
A Wiener Path Integral Technique for Non-Stationary Response Determination of Nonlinear Oscillators with Fractional Derivative Elements	1923
A. Di Matteo, M. Di Paola, I. A. Kougioumtzoglou, A. Pirrotta, and P. D. Spanos	
Stochastic Resonance of an Under-Damped Linear System Driven by Trichotomous Noise	1933
Li Zheng and Jiaorui Li	
Error Estimation of Erase Variables in Multi-index Variables	1941
Zuoren Wang and Qian Shi	
Solutions to Stochastic Dynamical Systems with Fractional Derivative Damping	1949
Wei Li, Jun F. Zhao, Natasa. Trisovic, and Ying Zhang	

Water Resources and Infrastructure: Risks and Responses

Equipment Replacement Under Event- and Consequence-Uncertainty: An Info-Gap Approach	1964
Yakov Ben-Haim	
Robust Decision Analysis for Environmental Management of Groundwater Contamination Sites	1970
Velimir V. Vesselinov, Daniel O'Malley, and Danny Katzman	

Uncertainty and Risk Inclusions in Water Distribution Systems Management: Review and Challenges	1980
Avi Ostfeld	
A Risk-Based Framework for Water Planning under Non-Stationary Climate Change	1986
Edoardo Borgomeo and Jim W. Hall	
Modeling Alternation of Dry and Wet Spells Using the Langevin Equation	1994
Erfaneh Sharifi, Koichi Unami, and Masayuki Fujihara	
Flood-Prone Areas Assessment Using Linear Binary Classifiers based on Morphological Indices	2002
Salvatore Manfreda, Caterina Samela, Aurelia Sole, and Mauro Fiorentino	
Emergency Management of Drinking Water Infrastructures Based on a Bayesian Decision Support System	2012
A. Pagano, R. Giordano, I. Portoghese, M. Vurro, and U. Fratino	

Monte Carlo Methods and Engineering Applications

Asymptotically Independent Markov Sampling: A New MCMC Scheme for Bayesian Inference	2022
Konstantin M. Zuev and James L. Beck	
Practical Reliability-Based Design of Deep Foundations Using Subset Simulation	2032
Z. Cao and Y. Wang	
Adaptive Response Surface Method Based Efficient Monte Carlo Simulation	2043
Somdatta Goswami and Subrata Chakraborty	
Weighted Simulation for Failure Probability Function Estimation	2053
Xiukai Yuan and Lin Zeng	
Estimation of Failure Probability by Limit State Sampling	2063
Ivan Depina, Gudmund Eiksund, Thi Minh Hue Le, and Gordon Fenton	
Subset Simulation for Reliability Assessment of Multiple Stochastic Responses	2073
H. S. Li, Y. Z. Ma, and Z. Cao	
Simulation of Multivariate Nonstationary Ground Motions Based on New Formulation of Cholesky Decomposition	2083
Yanwen Su, Guoqing Huang, and Liuliu Peng	
MCMC-based Updating of an Epidemiological Temporal Aftershock Forecasting Model	2093
F. Jalayer and H. Ebrahimian	
An Improvement of a Metamodel-Based Importance	2104

Sampling Algorithm for Estimating Small Failure Probabilities	
F. Cadini, A. Gioietta, and E. Zio	
Computation of the Sobol' Indices using Importance Sampling	2115
Pierre Beaurepaire, Matteo Broggi, and Edoardo Patelli	
Application of MCMC in Failure Sampling	2125
K. D. Patki and C. D. Eamon	
Structural Model Updating of a Steel Truss Structure Utilizing Ambient Vibration Measurement	2137
H. F. Lam, H. Y. Peng, and S. K. Au	

Non-Probabilistic Modeling and Analysis of Uncertainty

Buckling Analysis under Uncertainty	2147
Arthur Seibel and Josef Schlattmann	
Some Thoughts on Permanent Risk in the Earthquake Engineering Context	2157
G. K. Gabrichidze	
Interval Limit Analysis of Structures with Uncertain but Non-probabilistic Applied Forces	2167
S. Tangaramvong, F. Tin-Loi, and W. Gao	
A Generalized Influence Measure for Fuzzy Uncertainty Analysis	2177
Nico-Philipp Walz and Michael Hanss	
Finite Element-Based Uncertainty Analysis of Deteriorated Structures by Perturbation Techniques	2187
D. L. Allaix and V. I. Carbone	

Volume 4

Hybrid Probabilistic and Non-Probabilistic Analysis of Structures with Mixed Uncertainties	2197
C. Wang, W. Gao, and S. Tangaramvong	
Incorporating Uncertainty in Ground Motion and Local Windspeed Calculations into Loss Estimation Calculations	2207
Tristan Lloyd, Shane Latchman, and Ioana Dima	
Static Analysis of Timoshenko Beams with Interval Young's Modulus	2217
A. Sofi, G. Muscolino, and I. Elishakoff	
Nonlinear Interval Finite Elements for Beams	2227
Rafi L. Muhanna, Robert L. Mullen, and M. V. Rama Rao	
Static Analysis of Structures Subjected to Interval Displacements	2237
M. Modares	

Inner and Outer Approximations of Probabilistic Sets 2244
Luc Jaulin, Alexandru Stancu, and Benoît Desrochers

Risk and Uncertainty Modeling for Transportation and Logistics

A Review of Crash Surrogate Events 2254
Yan Kuang and Xiaobo Qu

Toll Pricing with Elastic Demand and Heterogeneous Users 2265
Shuaian Wang, Mark Harrison, and Michelle Dunbar

Probabilistic Capacity Modeling for Single-Lane Roundabout 2272
Liang Ren, Xiaobo Qu, and Erwin Oh

Park-and-Ride Network Design in a Bi-Modal Transport Network to Prompt Public Transport Mode Share 2282
Xinyuan Chen, Zhiyuan Liu, Shahi Islam, and Wei Deng

Tools for an Extended Risk Assessment for Ropax Ship-Ship Collision 2292
Floris Goerlandt, Jakub Montewka, and Pentti Kujala

Strategies for Teaching Travel Time Uncertainty Modeling 2303
Xiaobo Qu and Shuaian Wang

The Equity Issue for Cordon-Based Congestion Pricing with Distance Toll 2310
Xin Sun, Zhiyuan Liu, and Shuyan Chen

Risk Assessment of Liner Shipping from a Business Environment Perspective 2320
N. H. M. Salleh, R. Riahi, Z. Yang, and J. Wang

Geotechnical Risk, Uncertainty, and Decision Making

Model Uncertainty of Unsaturated Hydraulic Properties and Effects on Slope Reliability 2330
Lulu Zhang, Jian Zeng, and Yan Cheng

Spatial Landslide Susceptibility Modeling of Deokjeok-ri Creek Using Index of Entropy Method and Its Validation in Karisan-ri Creek 2340
Ananta Man Singh Pradhan and Yun-Tae Kim

Reliability-Based Design of Earth-Fill Dams to Mitigate Damage Due to Severe Earthquakes 2350
S. Nishimura, T. Shuku, and T. Shibata

Quantile Value Method for Geotechnical Reliability Code Calibration 2360
Jiany Ching and Kok-Kwang Phoon

Determination of Undrained Shear Strength Characteristic Values	2370
Z. Cao and Y. Wang	
Prediction of Young's Modulus of Intact Rock Using Bayesian Approach	2380
X. D. Feng and Rafael Jimenez	
Reliability Analysis of Circular Tunnel Face Stability Obeying Hoek-Brown Failure Criterion	2390
Peng Zeng, Salvador Senent, and Rafael Jimenez	
Spatial Distribution Simulation of SPT-N Values	2399
Wen-Chao Huang and Shih-Hung Yang	
Reliability Analysis of Long River Dike Against Liquefaction Failure	2409
Y. Otake, Y. Honjo, Y. Hiramatsu, M. Mase, and I. Yoshida	
How Eurocode 7 Addresses Uncertainty, Risk, and Decision Making in Geotechnical Design	2419
Trevor L. L. Orr	
Reliability Analysis of Unsaturated Slope with Spatially Correlated Soil Properties	2429
S. H. Jiang and D. Q. Li	
Influence of Spatially Varying Soil on Basal Heave Analysis of Braced Excavation	2439
Yu-Geng Tang and Gordon Tung-Chin Kung	
Observational Design Method for Earth Structures using Particle Filter	2449
Takayuki Shuku, Shin-ichi Nishimura, and Toshifumi Shibata	
Probabilistic Dam Erosion Risk Evaluation	2459
Chin Man W. Mok, Engsew Aw, Robert Wright, and James Cooley	
Reliability-Based Geotechnical Design Code Development	2468
Gordon A. Fenton and Farzaneh Naghibi	
Infiltration Characteristics of Two Natural Unsaturated Slope formed by One Layer Residual Soil	2478
Mohamed Elbyhagi Elfadil	
Consideration on Major Uncertainty Sources in Geotechnical Design	2488
Y. Honjo and Y. Otake	
Calculation of Subgrade Reaction Modulus Considering the Footing-Soil System Rigidity	2498
Hany Farouk and Mohammed Farouk	
Effect of Foundation Embedment Depth on Contact Stress Distribution and Differential Settlement	2508
Hany Farouk and Mohammed Farouk	

Probabilistic Modeling and Analysis, Simulation, and Soft Computing

- Method of Critical Stochastic Inputs for Extreme Uncertainty Problems: Theory and Applications** **2518**
Konstantin Ashkinadze
- Optimal Maintenance Time Under Imperfect Preventive Maintenance** **2528**
M. A. Coque Jr and G. F. M. Souza
- The Improved FORM for Stochastic Dynamic Analysis** **2536**
U. Alibrandi, C. Y. Ma, and C. G. Koh
- Uncertainties in Effective Tension and Bending Moment of a Steel Catenary Riser under Random Wave** **2546**
C. Y. Ma, U. Alibrandi, and C. G. Koh
- UQLab: A Framework for Uncertainty Quantification in Matlab** **2554**
Stefano Marelli and Bruno Sudret
- OpenCossan: An Efficient Open Tool for Dealing with Epistemic and Aleatory Uncertainties** **2564**
Edoardo Patelli, Matteo Broggi, Marco de Angelis, and Michael Beer
- Linear Dynamic Reliability Analysis of Profiled Blast Wall Structures** **2574**
Mohammad H. Hedayati, Srinivas Sriramula, and Richard D. Neilson
- Probabilistic Modelling of Fatigue Life of Composite Laminates Using Bayesian Inference** **2586**
Nikolay Dimitrov and Armen Der Kiureghian
- Diagnosis for Axial Force of High-Strength Bolts Using Pattern Recognition** **2598**
Michiyuki Hirokane, Hirokazu Nakata, Ryoma Yataka, Hideyuki Konishi, and Naoto Suzuki
- Sinc and Sigmoid Higher Order Neural Network for Data Modeling and Simulation** **2608**
Ming Zhang

Risk Analysis and Risk Management

- Genesis and Perpetuation of Errors in Construction** **2618**
Franz Knoll
- A Risk-Based Framework for Defense Products Overhaul** **2626**
G. E. C. Barbosa and G. F. M. Souza
- Theorizing Community Resilience to Improve Computational Modeling** **2636**
Scott B. Miles

Understanding the Conceptual Lineage and Limitations of Resilience in Contemporary Social Policy	2646
S. Walklate, R. McGarry, and G. Mythen	
Human Factor Evaluation as a Validation of Risk Assessment	2656
M. de la Canal and I. Ferraris	
Risk Analysis of Power Supply in San Juan, Surigao City, Philippines Due to Extreme Floods	2665
Lessandro Estelito O. Garciano, Ma. Renan T. Tanhueco, Takeshi Koike, and Ikumasa Yoshida	
Seismic Risk Management: A System-Based Perspective	2675
Kamran Vahdat, Nigel J. Smith, and Ghodrati Amiri	
Risk Assessment Framework for Improved Internal Control	2685
I. M. SriKamalaDevi M Marathamuthu, Saravanan Muthaiyah, Murali Raman, and Samuel Jebaraj Benjamin	
The Cumulative Claim Cost (C³) Index: A Tool for Managing the Book of Long-Tail Casualty Claims	2695
Andrew D. Banasiewicz	
Reliability Analysis of a Circular Bridge Pier Subject to Intentional Vehicular Impact	2702
Kylie Steel and Andrew D. Sorensen	
Human Error—Case Studies	2710
Franz Knoll	

Natural, Environmental, and Human-Induced Hazards and Vulnerabilities

Probabilistic Bridge Pier Scour Factors	2720
Peggy Johnson, Paul Clopper, and Lyle Zevenbergen	
Projection of Future Changes in Storm Surge Risk in Japan using Regional Climate Model Output	2724
T. Yasuda, N. Katahira, N. Mori, and H. Mase	
Bayesian Model Calibration using Structural Reliability Methods: Application to the Hydrological <i>abc</i> Model	2734
W. Betz, C. M. Mok, I. Papaioannou, and D. Straub	
Large Variance and Fat Tail of Damage by Natural Disaster	2744
Hang-Hyun Jo and Yu-li Ko	
What Does Flood Risk Mean? Innovation in Risk Communications	2754
Jacqui Cotton, Paula Orr, Clare Twigger Ross, Michael Steel, Steven Forrest, and Katya Brooks	
Precariousness and Hazard of Lateral Earth Pressure Theory	2765
P. Koudelka	

- Sensitivity of Tsunami Profile and Inundation Modeling
Considering Stochastic Earthquake Slips** 2780
K. Goda, T. Yasuda, and N. Mori

Complex Networks and Infrastructure Systems

- Developing Resilience to Natural Hazards—A Challenge for
Community as a System -** 2791
Vilas Mujumdar
- Habitat Flexibility and Synergy Mitigate Multiple Risks and
Uncertainties** 2801
L. Gene Zellmer
- Vulnerability and Resilience of Networked Infrastructures** 2811
J. Agarwal, M. Liu, and G. Galvan
- A National Model for Strategic Planning of Infrastructure
Systems** 2821
J. W. Hall, A. Otto, M. Tran, S. Barr, and D. Alderson
- Using Network Theory to Explore the Vulnerability of the
Subway System** 2830
Yongliang Deng, Qiming Li, Ying Lu, Liangliang Song, and Yusi Cheng

Risk-Informed Decision Making

- Climate Decision-Making as a Recursive Process** 2838
David Leedal, Andrew Jarvis, and Lawrence Jackson
- 50-Year Resilience Master Plans for Coastal Communities** 2847
Jay Raskin and Yumei Wang
- Optimal Flood Risk Management—Decision Process in
Practice** 2857
O. Špa ková, A. Rimböck, and D. Straub
- Flood Risk Management Decision Analysis with Finite
Historical Records and Highly Variable Climate Effects** 2867
Balqis M. Rehan and Jim W. Hall
- Method Selection of Lubrication Policy Centered in
Reliability: Application in Food Industry Machinery** 2880
Marjorie Belinelli and Gilberto F. M. de Souza