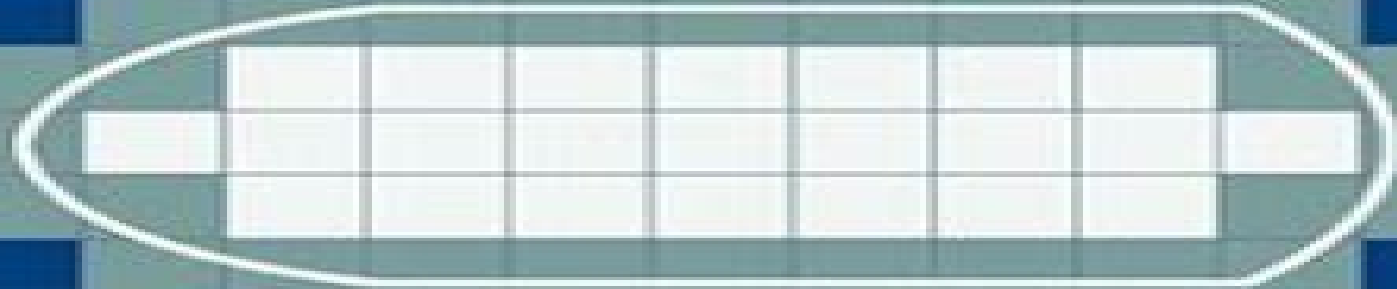


Uncertainty Modeling and Analysis in Engineering and the Sciences



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George J. Klir



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Mathematics of Uncertainty Modeling in the Analysis of Engineering and Science Problems Chakraverty, S., 2014-01-31 This book provides the reader with basic concepts for soft computing and other methods for various means of uncertainty in handling solutions analysis and applications Provided by publisher *Problem Solving and Uncertainty Modeling through Optimization and Soft Computing Applications* Saxena, Pratiksha, Singh, Dipti, Pant, Millie, 2016-03-01 Optimization techniques have developed into a modern day solution for real world problems in various industries As a way to improve performance and handle issues of uncertainty optimization research becomes a topic of special interest across disciplines Problem Solving and Uncertainty Modeling through Optimization and Soft Computing Applications presents the latest research trends and developments in the area of applied optimization methodologies and soft computing techniques for solving complex problems Taking a multi disciplinary approach this critical publication is an essential reference source for engineers managers researchers and post graduate students **Mathematics of Uncertainty Modeling in the Analysis of Engineering and Science Problems** Sneathish Chakraverty, 2014 This book provides the reader with basic concepts for soft computing and other methods for various means of uncertainty in handling solutions analysis and applications

Uncertainty Modeling and Analysis in Engineering and the Sciences Bilal M. Ayyub, George J. Klir, 2006-05-25 Engineers and scientists often need to solve complex problems with incomplete information resources necessitating a proper treatment of uncertainty and a reliance on expert opinions Uncertainty Modeling and Analysis in Engineering and the Sciences prepares current and future analysts and practitioners to understand the fundamentals of knowledge a *Handbook of Research on Predictive Modeling and Optimization Methods in Science and Engineering* Kim, Dookie, Sekhar Roy, Sanjiban, Länsivaara, Tim, Deo, Ravinesh, Samui, Pijush, 2018-06-15 The disciplines of science and engineering rely heavily on the forecasting of prospective constraints for concepts that have not yet been proven to exist especially in areas such as artificial intelligence Obtaining quality solutions to the problems presented becomes increasingly difficult due to the number of steps required to sift through the possible solutions and the ability to solve such problems relies on the recognition of patterns and the categorization of data into specific sets Predictive modeling and optimization methods allow unknown events to be categorized based on statistics and classifiers input by researchers The Handbook of Research on Predictive Modeling and Optimization Methods in Science and Engineering is a critical reference source that provides comprehensive information on the use of optimization techniques and predictive models to solve real life engineering and science problems Through discussions on techniques such as robust design optimization water level prediction and the prediction of human actions this publication identifies solutions to developing problems and new solutions for existing problems making this publication a valuable resource for engineers researchers graduate students and other professionals *Uncertainty Theory*

Baoding Liu,2011-11-07 Uncertainty theory is a branch of mathematics based on normality monotonicity self duality countable subadditivity and product measure axioms Uncertainty is any concept that satisfies the axioms of uncertainty theory Thus uncertainty is neither randomness nor fuzziness It is also known from some surveys that a lot of phenomena do behave like uncertainty How do we model uncertainty How do we use uncertainty theory In order to answer these questions this book provides a self contained comprehensive and up to date presentation of uncertainty theory including uncertain programming uncertain risk analysis uncertain reliability analysis uncertain process uncertain calculus uncertain differential equation uncertain logic uncertain entailment and uncertain inference Mathematicians researchers engineers designers and students in the field of mathematics information science operations research system science industrial engineering computer science artificial intelligence finance control and management science will find this work a stimulating and useful reference

Uncertainty Quantification Christian Soize,2017-04-24 This book presents the fundamental notions and advanced mathematical tools in the stochastic modeling of uncertainties and their quantification for large scale computational models in sciences and engineering In particular it focuses in parametric uncertainties and non parametric uncertainties with applications from the structural dynamics and vibroacoustics of complex mechanical systems from micromechanics and multiscale mechanics of heterogeneous materials Resulting from a course developed by the author the book begins with a description of the fundamental mathematical tools of probability and statistics that are directly useful for uncertainty quantification It proceeds with a well carried out description of some basic and advanced methods for constructing stochastic models of uncertainties paying particular attention to the problem of calibrating and identifying a stochastic model of uncertainty when experimental data is available This book is intended to be a graduate level textbook for students as well as professionals interested in the theory computation and applications of risk and prediction in science and engineering fields

Handbook of Research on Modern Optimization Algorithms and Applications in Engineering and Economics Vasant, Pandian,Weber, Gerhard-Wilhelm,Dieu, Vo Ngoc,2016-03-08 Modern optimization approaches have attracted many research scientists decision makers and practicing researchers in recent years as powerful intelligent computational techniques for solving several complex real world problems The Handbook of Research on Modern Optimization Algorithms and Applications in Engineering and Economics highlights the latest research innovations and applications of algorithms designed for optimization applications within the fields of engineering IT and economics Focusing on a variety of methods and systems as well as practical examples this book is a significant resource for graduate level students decision makers and researchers in both public and private sectors who are seeking research based methods for modeling uncertain real world problems

Uncertainty Theory Baoding Liu,2007-09-14 It was generally believed that the study of probability theory was started by Pascal and Fermat in 1654 when they succeeded in deriving the exact probabilities for certain gambling problem Great progress was achieved when Von Mises initialized the concept of sample space and filled the gap between probability theory

and measure theory in 1931 An axiomatic foundation of probability theory was given by Kolmogorov in his *Foundations of Probability Theory* of 1933 Since then probability theory has been developed steadily and has been widely applied in science and engineering Probability theory will be introduced in Chapter 2 Fuzzy set was initiated by Zadeh via membership function in 1965 and was well developed and applied in a wide variety of real problems In order to measure a fuzzy event Zadeh proposed the concept of possibility measure in 1978 Although possibility measure has been widely used it has no self duality property However a self dual measure is absolutely needed in both theory and practice In order to define a self dual measure Liu and Liu gave the concept of credibility measure in 2002 Credibility theory is a branch of mathematics that studies the behavior of fuzzy phenomena An axiomatic foundation of credibility theory was given by Liu in his *Uncertainty Theory* of 2004 Chapter 3 will provide the credibility theory Sometimes fuzziness and randomness simultaneously appear in a system

Uncertainty Quantification and Predictive Computational Science Ryan G. McClarren, 2018-11-23 This textbook teaches the essential background and skills for understanding and quantifying uncertainties in a computational simulation and for predicting the behavior of a system under those uncertainties It addresses a critical knowledge gap in the widespread adoption of simulation in high consequence decision making throughout the engineering and physical sciences Constructing sophisticated techniques for prediction from basic building blocks the book first reviews the fundamentals that underpin later topics of the book including probability sampling and Bayesian statistics Part II focuses on applying Local Sensitivity Analysis to apportion uncertainty in the model outputs to sources of uncertainty in its inputs Part III demonstrates techniques for quantifying the impact of parametric uncertainties on a problem specifically how input uncertainties affect outputs The final section covers techniques for applying uncertainty quantification to make predictions under uncertainty including treatment of epistemic uncertainties It presents the theory and practice of predicting the behavior of a system based on the aggregation of data from simulation theory and experiment The text focuses on simulations based on the solution of systems of partial differential equations and includes in depth coverage of Monte Carlo methods basic design of computer experiments as well as regularized statistical techniques Code references in python appear throughout the text and online as executable code enabling readers to perform the analysis under discussion Worked examples from realistic model problems help readers understand the mechanics of applying the methods Each chapter ends with several assignable problems **Uncertainty Quantification and Predictive Computational Science** fills the growing need for a classroom text for senior undergraduate and early career graduate students in the engineering and physical sciences and supports independent study by researchers and professionals who must include uncertainty quantification and predictive science in the simulations they develop and or perform

Solutions Manual for Uncertainty Modeling and Analysis in Engineering and the Sciences Bilal M. Ayyub, George J. Klir, 2006-01

Uncertainty Analysis in Engineering and Sciences: Fuzzy Logic, Statistics, and Neural Network Approach Bilal

Ayyub, Madan M. Gupta, 1997-10-31 Uncertainty has been of concern to engineers managers and scientists for many centuries In management sciences there have existed definitions of uncertainty in a rather narrow sense since the beginning of this century In engineering and uncertainty has for a long time been considered as in sciences however synonymous with random stochastic statistic or probabilistic Only since the early sixties views on uncertainty have become more heterogeneous and more tools to model uncertainty than statistics have been proposed by several scientists The problem of modeling uncertainty adequately has become more important the more complex systems have become the faster the scientific and engineering world develops and the more important but also more difficult forecasting of future states of systems have become The first question one should probably ask is whether uncertainty is a phenomenon a feature of real world systems a state of mind or a label for a situation in which a human being wants to make statements about phenomena i e reality models and theories respectively One can also ask whether uncertainty is an objective fact or just a subjective impression which is closely related to individual persons Whether uncertainty is an objective feature of physical real systems seems to be a philosophical question This shall not be answered in this volume

Uncertainty Modelling in Data Science Sébastien Destercke, Thierry Denoeux, María Ángeles Gil, Przemyslaw Grzegorzewski, Olgierd Hryniewicz, 2018-07-25 This book features 29 peer reviewed papers presented at the 9th International Conference on Soft Methods in Probability and Statistics SMPS 2018 which was held in conjunction with the 5th International Conference on Belief Functions BELIEF 2018 in Compiegne France on September 17-21 2018 It includes foundational methodological and applied contributions on topics as varied as imprecise data handling linguistic summaries model coherence imprecise Markov chains and robust optimisation These proceedings were produced using EasyChair Over recent decades interest in extensions and alternatives to probability and statistics has increased significantly in diverse areas including decision making data mining and machine learning and optimisation This interest stems from the need to enrich existing models in order to include different facets of uncertainty like ignorance vagueness randomness conflict or imprecision Frameworks such as rough sets fuzzy sets fuzzy random variables random sets belief functions possibility theory imprecise probabilities lower previsions and desirable gambles all share this goal but have emerged from different needs The advances results and tools presented in this book are important in the ubiquitous and fast growing fields of data science machine learning and artificial intelligence Indeed an important aspect of some of the learned predictive models is the trust placed in them Modelling the uncertainty associated with the data and the models carefully and with principled methods is one of the means of increasing this trust as the model will then be able to distinguish between reliable and less reliable predictions In addition extensions such as fuzzy sets can be explicitly designed to provide interpretable predictive models facilitating user interaction and increasing trust

Proceedings of the 6th International Symposium on Uncertainty Quantification and Stochastic Modelling José Eduardo Souza De Cursi, 2023-10-21 This proceedings book covers a wide range of topics related to uncertainty analysis and its application in

various fields of engineering and science It explores uncertainties in numerical simulations for soil liquefaction potential the toughness properties of construction materials experimental tests on cyclic liquefaction potential and the estimation of geotechnical engineering properties for aerogenerator foundation design Additionally the book delves into uncertainties in concrete compressive strength bio inspired shape optimization using isogeometric analysis stochastic damping in rotordynamics and the hygro thermal properties of raw earth building materials It also addresses dynamic analysis with uncertainties in structural parameters reliability based design optimization of steel frames and calibration methods for models with dependent parameters The book further explores mechanical property characterization in 3D printing stochastic analysis in computational simulations probability distribution in branching processes data assimilation in ocean circulation modeling uncertainty quantification in climate prediction and applications of uncertainty quantification in decision problems and disaster management This comprehensive collection provides insights into the challenges and solutions related to uncertainty in various scientific and engineering contexts

Applied Research in Uncertainty Modeling and Analysis

Bilal M. Ayyub, 2007-12-29 The application areas of uncertainty are numerous and diverse including all fields of engineering computer science systems control and finance Determining appropriate ways and methods of dealing with uncertainty has been a constant challenge The theme for this book is better understanding and the application of uncertainty theories This book with invited chapters deals with the uncertainty phenomena in diverse fields The book is an outgrowth of the Fourth International Symposium on Uncertainty Modeling and Analysis ISUMA which was held at the center of Adult Education College Park Maryland in September 2003 All of the chapters have been carefully edited following a review process in which the editorial committee scrutinized each chapter The contents of the book are reported in twenty three chapters covering more than pages This book is divided into six main sections Part I Chapters 1 4 presents the philosophical and theoretical foundation of uncertainty new computational directions in neural networks and some theoretical foundation of fuzzy systems Part II Chapters 5 8 reports on biomedical and chemical engineering applications The sections looks at noise reduction techniques using hidden Markov models evaluation of biomedical signals using neural networks and changes in medical image detection using Markov Random Field and Mean Field theory One of the chapters reports on optimization in chemical engineering processes

Quantification of Uncertainty: Improving Efficiency and Technology Marta D'Elia, Max

Gunzburger, Gianluigi Rozza, 2020-07-30 This book explores four guiding themes reduced order modelling high dimensional problems efficient algorithms and applications by reviewing recent algorithmic and mathematical advances and the development of new research directions for uncertainty quantification in the context of partial differential equations with random inputs Highlighting the most promising approaches for near future improvements in the way uncertainty quantification problems in the partial differential equation setting are solved and gathering contributions by leading international experts the book's content will impact the scientific engineering financial economic environmental social and

commercial sectors *Uncertainty Modeling for Engineering Applications* Flavio Canavero, 2018-12-29 This book provides an overview of state of the art uncertainty quantification UQ methodologies and applications and covers a wide range of current research future challenges and applications in various domains such as aerospace and mechanical applications structure health and seismic hazard electromagnetic energy its impact on systems and humans and global environmental state change Written by leading international experts from different fields the book demonstrates the unifying property of UQ theme that can be profitably adopted to solve problems of different domains The collection in one place of different methodologies for different applications has the great value of stimulating the cross fertilization and alleviate the language barrier among areas sharing a common background of mathematical modeling for problem solution The book is designed for researchers professionals and graduate students interested in quantitatively assessing the effects of uncertainties in their fields of application The contents build upon the workshop Uncertainty Modeling for Engineering Applications UMEMA 2017 held in Torino Italy in November 2017 *Uncertainty Analysis in Engineering and Sciences: Fuzzy Logic, Statistics, and Neural Network Approach* Bilal Ayyub, Madan M. Gupta, 2011-09-28 Uncertainty has been of concern to engineers managers and scientists for many centuries In management sciences there have existed definitions of uncertainty in a rather narrow sense since the beginning of this century In engineering and uncertainty has for a long time been considered as in sciences however synonymous with random stochastic statistic or probabilistic Only since the early sixties views on uncertainty have become more heterogeneous and more tools to model uncertainty than statistics have been proposed by several scientists The problem of modeling uncertainty adequately has become more important the more complex systems have become the faster the scientific and engineering world develops and the more important but also more difficult forecasting of future states of systems have become The first question one should probably ask is whether uncertainty is a phenomenon a feature of real world systems a state of mind or a label for a situation in which a human being wants to make statements about phenomena i e reality models and theories respectively One can also ask whether uncertainty is an objective fact or just a subjective impression which is closely related to individual persons Whether uncertainty is an objective feature of physical real systems seems to be a philosophical question This shall not be answered in this volume *Uncertainty Modeling* Vladik Kreinovich, 2017-01-31 This book commemorates the 65th birthday of Dr Boris Kovalerchuk and reflects many of the research areas covered by his work It focuses on data processing under uncertainty especially fuzzy data processing when uncertainty comes from the imprecision of expert opinions The book includes 17 authoritative contributions by leading experts

Uncertainty Quantification in Multiscale Materials Modeling Yan Wang, David L. McDowell, 2020-03-10 Uncertainty Quantification in Multiscale Materials Modeling provides a complete overview of uncertainty quantification UQ in computational materials science It provides practical tools and methods along with examples of their application to problems in materials modeling UQ methods are applied to various multiscale models ranging from the nanoscale to macroscale This

book presents a thorough synthesis of the state of the art in UQ methods for materials modeling including Bayesian inference surrogate modeling random fields interval analysis and sensitivity analysis providing insight into the unique characteristics of models framed at each scale as well as common issues in modeling across scales Synthesizes available UQ methods for materials modeling Provides practical tools and examples for problem solving in modeling material behavior across various length scales Demonstrates UQ in density functional theory molecular dynamics kinetic Monte Carlo phase field finite element method multiscale modeling and to support decision making in materials design Covers quantum atomistic mesoscale and engineering structure level modeling and simulation

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