

ENTROPY THEORY and its APPLICATION in ENVIRONMENTAL and WATER ENGINEERING

Vijay P. Singh

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Entropy Theory And Its Application In Environmental And Water Engineering

Roman Wölfel



Entropy Theory And Its Application In Environmental And Water Engineering:

Entropy Theory and its Application in Environmental and Water Engineering Vijay P. Singh, 2013-01-10 Entropy Theory and its Application in Environmental and Water Engineering responds to the need for a book that deals with basic concepts of entropy theory from a hydrologic and water engineering perspective and then for a book that deals with applications of these concepts to a range of water engineering problems The range of applications of entropy is constantly expanding and new areas finding a use for the theory are continually emerging The applications of concepts and techniques vary across different subject areas and this book aims to relate them directly to practical problems of environmental and water engineering The book presents and explains the Principle of Maximum Entropy POME and the Principle of Minimum Cross Entropy POMCE and their applications to different types of probability distributions Spatial and inverse spatial entropy are important for urban planning and are presented with clarity Maximum entropy spectral analysis and minimum cross entropy spectral analysis are powerful techniques for addressing a variety of problems faced by environmental and water scientists and engineers and are described here with illustrative examples Giving a thorough introduction to the use of entropy to measure the unpredictability in environmental and water systems this book will add an essential statistical method to the toolkit of postgraduates researchers and academic hydrologists water resource managers environmental scientists and engineers It will also offer a valuable resource for professionals in the same areas governmental organizations private companies as well as students in earth sciences civil and agricultural engineering and agricultural and rangeland sciences This book Provides a thorough introduction to entropy for beginners and more experienced users Uses numerous examples to illustrate the applications of the theoretical principles Allows the reader to apply entropy theory to the solution of practical problems Assumes minimal existing mathematical knowledge Discusses the theory and its various aspects in both univariate and bivariate cases Covers newly expanding areas including neural networks from an entropy perspective and future developments

Entropy Applications in Environmental and Water Engineering Huijuan Cui, Bellie Sivakumar, Vijay P. Singh, 2019-03-07 Entropy theory has wide applications to a range of problems in the fields of environmental and water engineering including river hydraulic geometry fluvial hydraulics water monitoring network design river flow forecasting floods and droughts river network analysis infiltration soil moisture sediment transport surface water and groundwater quality modeling ecosystems modeling water distribution networks environmental and water resources management and parameter estimation Such applications have used several different entropy formulations such as Shannon Tsallis Rnyi Burg Kolmogorov Kapur configurational and relative entropies which can be derived in time space or frequency domains More recently entropy based concepts have been coupled with other theories including copula and wavelets to study various issues associated with environmental and water resources systems Recent studies indicate the enormous scope and potential of entropy theory in advancing research in the fields of environmental and water engineering including establishing and

explaining physical connections between theory and reality The objective of this Special Issue is to provide a platform for compiling important recent and current research on the applications of entropy theory in environmental and water engineering The contributions to this Special Issue have addressed many aspects associated with entropy theory applications and have shown the enormous scope and potential of entropy theory in advancing research in the fields of environmental and water engineering

Water and Environmental Engineering: Entropy Theory and Its Application

Cohen Foster,2023-09-19 Water and environmental engineering is an area of engineering that aims to address environmental issues related to air water and soil It deals with the development and management of water resources designing hydraulic structures such as dams and tunnels water quality engineering water resources engineering outdoor and indoor air quality engineering ocean engineering and hazardous waste management Entropy is referred to as a measure of the disorder or randomness of a system It has been used to solve numerous issues in geographical earth and environmental sciences In the field of water and environment engineering it has numerous applications in areas such as water distribution networks sediment transport river flow forecasting and water monitoring network design This book aims to shed light on some of the unexplored aspects of entropy and its applications in water and environmental engineering It will also provide interesting topics for research which interested readers can take up A number of latest studies have been included to keep the readers up to date with the global concepts in this area of study

Entropy Applications in Environmental and Water Engineering

Vijay P. Singh,Huijuan Cui,Bellie Sivakumar,2019 Entropy theory has wide applications to a range of problems in the fields of environmental and water engineering including river hydraulic geometry fluvial hydraulics water monitoring network design river flow forecasting floods and droughts river network analysis infiltration soil moisture sediment transport surface water and groundwater quality modeling ecosystems modeling water distribution networks environmental and water resources management and parameter estimation Such applications have used several different entropy formulations such as Shannon Tsallis R nyi Burg Kolmogorov Kapur configurational and relative entropies which can be derived in time space or frequency domains More recently entropy based concepts have been coupled with other theories including copula and wavelets to study various issues associated with environmental and water resources systems Recent studies indicate the enormous scope and potential of entropy theory in advancing research in the fields of environmental and water engineering including establishing and explaining physical connections between theory and reality The objective of this Special Issue is to provide a platform for compiling important recent and current research on the applications of entropy theory in environmental and water engineering The contributions to this Special Issue have addressed many aspects associated with entropy theory applications and have shown the enormous scope and potential of entropy theory in advancing research in the fields of environmental and water engineering

Generalized Frequency Distributions for Environmental and Water Engineering

Vijay P. Singh,Lan Zhang,2022-04-07 A multitude of processes in hydrology and environmental engineering are either random or

entail random components which are characterized by random variables These variables are described by frequency distributions This book provides an overview of different systems of frequency distributions their properties and applications to the fields of water resources and environmental engineering A variety of systems are covered including the Pearson system Burr system and systems commonly applied in economics such as the D Addario Dagum Stoppa and Esteban systems The latter chapters focus on the Singh system and the frequency distributions deduced from Bessel functions maximum entropy theory and the transformations of random variables The final chapter introduces the genetic theory of frequency distributions Using real world data this book provides a valuable reference for researchers graduate students and professionals interested in frequency analysis

Chaos in Hydrology Bellie Sivakumar, 2016-11-16 This authoritative book presents a comprehensive account of the essential roles of nonlinear dynamic and chaos theories in understanding modeling and forecasting hydrologic systems This is done through a systematic presentation of 1 information on the salient characteristics of hydrologic systems and on the existing theories for their modeling 2 the fundamentals of nonlinear dynamic and chaos theories methods for chaos identification and prediction and associated issues 3 a review of the applications of chaos theory in hydrology and 4 the scope and potential directions for the future This book bridges the divide between the deterministic and the stochastic schools in hydrology and is well suited as a textbook for hydrology courses

Climate Change in Sustainable Water Resources Management Omid Bozorg-Haddad, 2022-06-29 This book provides a comprehensive approach to all aspects of water related subjects affected by climate change that expand readers attitudes toward future of the management strategies and improve management plans It summarizes climate change scenarios models downscaling methods and how to select the appropriate method It also introduces practical steps in assessing climate change impacts on water issues through introducing hydrological models and climate change data applications in hydrologic analysis The book caters to specialist readers who are interested in analyzing climate change effects on water resources and related issues can gain a profound understanding of the practical concepts and step by step analysis which is enriched with real case studies all around the world Moreover readers will be familiar with potential mitigation and adaptation measures in sustainable water engineering considering the results of hydrologic modeling

Water Resources Systems Planning and Management Sharad K. Jain, V.P. Singh, 2023-11-25 Water Resources Systems Planning and Management Second Edition Volume 51 presents new and updated material including case studies examples and important updates on topics such as climate change and integrated water resources management Authored by two renowned experts in the field of water resources this text provides an overview of the current status of water resources utilization the likely scenario of future demands simulation and techniques of economic analysis concepts of planning the planning process integrated planning public involvement reservoir sizing and finally systems operation and management This book presents a comprehensive overview of the field that is relevant for students professors scholars researchers and consultants in the fields of Water Resources Civil Engineering

Environmental Engineering and Hydrology Provides an overview of the current status of water resources utilization the likely scenario of future demands and advantages and disadvantages of systems techniques Includes numerous examples and real world case studies Discusses the concepts of planning the planning process integrated planning public involvement and reservoir sizing New to this edition Thoroughly updated content with an improved presentation new figures examples and case studies Includes comprehensive new coverage focusing on the impact of climate change and environmental flows All chapters are updated with three brand new chapters Environmental flows and their assessment Climate change and its impacts on water management Integrated river basin planning and management Integrated Water Resources Management

The Sustainable City VIII (2 Volume Set) S.S. Zubir,C.A. Brebbia,2013-12-03 With majority of the Earth s people now urban dwellers and cities being the most efficient habitat for the utilisation of resources it is imperative that we continue to support standards of living and efficiencies of urban areas However the urbanisation process has not been without its problems While much has been done to address the original issues surrounding the quality of urban life new challenges continue to arise It is no longer sustainable to achieve improvements by means that require greater and greater energy consumption as we did in the past Despite their complexity however cities are a great laboratory for architects engineers and other key professionals to apply new ideas and new technology to meet our requirements for more sustainable city environments Containing papers presented at the latest in a series of conferences organised by the Wessex Institute of Technology these proceedings split in to two volumes address not just environmental architectural and engineering concerns but also quality of life security risk and heritage The diversity of topics and the case studies based on existing projects make the book an important contribution to the literature on urban planning

Integrated Drought Management, Volume 1 Vijay P. Singh,Deepak Jhajharia,Rasoul Mirabbasi,Rohitashw Kumar,2023-09-12 The first volume of this comprehensive global perspective on Integrated Drought Management is focused on understanding drought causes and the assessment of drought impacts It explains different types of drought agricultural meteorological hydrological and socioeconomic droughts their indices and the impact of climate change on drought The volume also examines spatiotemporal analysis of drought variability and patterns assessment and drought evaluation With numerous case studies from India Mexico Turkey Brazil US and other countries this volume serves as a valuable resource for all readers who want to advance their knowledge on drought and risk management Features Provides a global perspective on drought prediction and management and a synthesis of the recent state of knowledge Covers a wide range of topics from essential concepts and advanced techniques for forecasting and modeling drought to societal impacts consequences and planning Presents numerous case studies with different management approaches from different regions and countries Addresses how climate change impacts drought the increasing challenges associated with managing drought decision making and policy implications Includes contributions from hundreds of experts around the world Professionals researchers academics and postgraduate students with knowledge in

environmental sciences ecology agriculture forestry hydrology water resources engineering and earth sciences as well as those interested in how climate change impacts drought management will gain new insights from the experts featured in this two volume handbook *Hydrological Processes Modelling and Data Analysis* Vijay P. Singh, Rajendra Singh, Pranesh Kumar Paul, Deepak Singh Bisht, Srishti Gaur, 2024-04-01 This book provides a state of the art overview of the concepts and methodologies of data and modelling driven hydrological analyses and their wide range of practical applications The book is driven by the realisation that science technology engineering and mathematics STEM concepts are essential in engineering hydrology to produce well trained hydrologists Such hydrologists will be equipped to face future societal challenges that require enhanced information and communication technology tools and integration of technical and non technical areas The book contains 12 chapters that introduce the principles of hydrological data analysis and highlight the current and emerging tools and techniques for analysing hydrologic data The book describes the types of data typically used in hydrological analyses It highlights the revolutionary technological advancements made toward hydrological data collection including the use of drones and smartphones The foremost objective of the book is to present the hydrological data analysis procedures It explains the steps involved in data analysis for easy understanding of the reader including students and professionals This book presents case studies that demonstrate step by step procedures involved in typical analysis problems and may guide students and professionals in planning and executing steps to analyse the problem at hand Case study examples will guide them to understand the intricacies of hydrological data analysis It provides the readers with a complete package to enrich their understanding of the hydrological data analysis tools and techniques Subsequently as well trained hydrologists they could execute their learning to meet any specific grand challenge of the twenty first century

Physics of Complex Systems Dragutin Mihailović, Darko Kapor, Siniša Crvenković, Anja Mihailović, 2023-09-01 This book analyses the physics of complex systems to elaborate the problems encountered in teaching and research Inspired by the of Kurt G del including his incompleteness theorems it considers the concept of time the idea of models and the concept of complexity before trying to assess the state of physics in general Using both general and practical examples the idea of information is discussed emphasizing its physical interpretation debates ideas in depth using examples and evidence to provide detailed considerations on the topics Based on the authors own research on these topics this book puts forward the idea that the application of information measures can provide new results in the study of complex systems Helpful for those already familiar with the concepts who wish to deepen their critical understanding Physics of Complex Systems will be extremely valuable both for people that are already involved in complex systems and also readers beginning their journey into the subject This work will encourage readers to follow and continue these ideas enabling them to investigate the various topics further

Copulas and their Applications in Water Resources Engineering Lan Zhang, V. P. Singh, 2019-01-10 Complex environmental and hydrological processes are characterized by more than one correlated random variable These

events are multivariate and their treatment requires multivariate frequency analysis Traditional analysis methods are however too restrictive and do not apply in many cases Recent years have therefore witnessed numerous applications of copulas to multivariate hydrologic frequency analyses This book describes the basic concepts of copulas and outlines current trends and developments in copula methodology and applications It includes an accessible discussion of the methods alongside simple step by step sample calculations Detailed case studies with real world data are included and are organized based on applications such as flood frequency analysis and water quality analysis Illustrating how to apply the copula method to multivariate frequency analysis engineering design and risk and uncertainty analysis this book is ideal for researchers professionals and graduate students in hydrology and water resources engineering

Water Resources Management and Sustainability Ahmed Sefelnasr, Mohsen Sherif, Vijay P. Singh, 2025-03-03 The first section deals with hydrological topics problems and principles In this chapter detailed studies related to hydrological monitoring are carried out Overland flow velocity estimation wireless sensor networks and application of deep learning techniques are discussed These topics are helpful to estimate overland flow velocities using tracer techniques based on the infrared thermography and fluorescent properties of quinine which can help in the visualization of shallow flows evaluation of high resolution rainfall measurement and extracting water bodies from high resolution drones and satellite imagery using an integrated deep learning method The chapter critically discusses the advantage of thermal tracers utilizing the wireless sensor networks for the accurate capture of spatially varied precipitation patterns and evaluation and quality assessment of water extraction using deep learning techniques It highlights recommendations and limitations that should be taken into account for hydrological monitoring Moreover this section discusses rainfall and floods and their related attributes in arid regions including flood mitigation and risk assessment Flood mapping and assessment recent trends of floods and their impacts are comprehensively discussed The outcomes are for useful hydrologic infrastructure design under changing climate This part also highlights the importance of applying new methodologies considering the statements and questions asked by scientists and researchers The second section addresses droughts and their analysis and assessment Drought events are great challenges faced by nature in the wake of climate change This part will help stakeholders gather useful information and develop a deep understanding of these salient features of climate change s impacts It deals with the various studies conducted in the field of drought and flash drought Flash drought is a composition of various factors leading to intense drought conditions So limitations and recommendations to mitigate drought events are discussed in detail The third section discusses groundwater as an important component in the water budget in arid regions Threats recharges quality and management options of this resource are also discussed Beginning with a perspective on the management of this resource the papers go on to discuss rational decision making challenges use of information technology integrated management and modeling for groundwater resources management Section four deals with water quality This part discusses modern techniques for water quality assessment and

treatment procedures The industrial and commercial area generates a large amount of waste which is indiscriminately disposed of leading to several environmental issues This section provides a detailed analysis on water quality hydrogeochemistry impact and benefits of treating municipal wastewater to tertiary quality groundwater table and quality deterioration Recommendations for adequate planning design construction and location of open dumpsites to ameliorate groundwater pollution and the closing of trace metal boreholes to avoid possible health implications or outbreaks that are likely occurring or are expected to occur Section five discusses water resources management This topic has been receiving a fair amount of attention in many arid countries of the world and more specifically in the Gulf region This section addresses regulations for conservation reuse and security The limited freshwater resources must be developed managed and used as efficiently as possible Decision support systems for water resources planning management and water rights analyses and control have been discussed as well

Smart Sensors Networks Fatos Xhafa, Fang-Yie Leu, Li-Ling Hung, 2017-06-14 *Smart Sensors Networks Communication Technologies and Intelligent Applications* explores the latest sensor and sensor networks techniques and applications showing how networked wireless sensors are used to monitor and gather intelligence from our surrounding environment It provides a systematic look at the unique characteristics of wireless sensor networks through their usage in a broad range of areas including healthcare for the elderly energy consumption industrial automation intelligent transportation systems smart homes and cities and more The book shows how sensor networks work and how they are applied to monitor our surrounding environment It explores the most important aspects of modern sensors technologies providing insights on the newest technologies and the systems needed to operate them Readers will find the book to be an entry point for understanding the fundamental differences between the various sensor technologies and their use in for different scenarios Indexing The books of this series are submitted to EI Compendex and SCOPUS Presents numerous specific use cases throughout showing practical applications of concepts Contains contributions from leading experts around the globe Collects in one place the latest thinking on an emerging topic Addresses the security and privacy issues inherent in sensor deployment

Risk Analysis Based on Data and Crisis Response Beyond Knowledge Chongfu Huang, Zoe Nivolianitou, 2019-10-11 This book collects the papers presented at the 7th International Conference on Risk Analysis and Crisis Response RACR 2019 held in Athens Greece on October 15 19 2019 The overall theme of the seventh international conference on risk analysis and crisis response is Risk Analysis Based on Data and Crisis Response Beyond Knowledge highlighting science and technology to improve risk analysis capabilities and to optimize crisis response strategy This book contains primarily research articles of risk issues Underlying topics include natural hazards and major chemical accidents prevention disaster risk reduction and society resilience information and communication technologies safety and cybersecurity modern trends in crisis management energy and resources security critical infrastructure nanotechnology safety and others All topics include aspects of multidisciplinary and complexity of safety in education and research The book

should be valuable to professors engineers officials businessmen and graduate students in risk analysis and risk management

Mechano-Electric Correlations in the Human Physiological System A. Bakiya, K. Kamalanand, R. L. J. De Britto, 2021-04-28 The aim of Mechano Electric Correlations in the Human Physiological System is to present the mechanical and electrical properties of human soft tissues and the mathematical models related to the evaluation of these properties in time as well as their biomedical applications This book also provides an overview of the bioelectric signals of soft tissues from various parts of the human body In addition this book presents the basic dielectric and viscoelastic characteristics of soft tissues an introduction to the measurement and characteristics of bioelectric signals and their relationship with the mechanical activity electromyography and the correlation of electromyograms with the muscle activity in normal and certain clinical conditions The authors also present a case study on the effect of lymphatic filariasis on the mechanical and electrical activity of the muscle Features Explains the basics of electrical and mechanical properties of soft tissues in time and frequency domain along with the mathematical models of soft tissue mechanics Explores the correlation of electrical properties with the mechanical properties of biological soft tissues using computational techniques Provides a detailed introduction to electrophysiological signals along with the types applications properties problems and associated mathematical models Explains the electromechanics of muscles using electromyography recordings from various muscles of the human physiological system Presents a case study on the effect of lymphatic filariasis on the mechanical and electrical activity of the muscle Mechano Electric Correlations in the Human Physiological System is intended for biomedical engineers researchers and medical scientists as well graduate and undergraduate students working on the mechanical properties of soft tissues

Sponge Cities: Emerging Approaches, Challenges and Opportunities Chris Zevenbergen, Dafang Fu, Assela Pathirana, 2018-10-18 This book is a printed edition of the Special Issue Sponge Cities Emerging Approaches Challenges and Opportunities that was published in Water

Optimisation of Dynamic Heterogeneous Rainfall Sensor Networks in the Context of Citizen Observatories Juan Carlos Chacon-Hurtado, 2019-11-21 Precipitation drives the dynamics of flows and storages in water systems making its monitoring essential for water management Conventionally precipitation is monitored using in situ and remote sensors In situ sensors are arranged in networks which are usually sparse providing continuous observations for long periods at fixed points in space and due to the high costs of such networks they are often sub optimal To increase the efficiency of the monitoring networks we explore the use of sensors that can relocate as rainfall events develop dynamic sensors as well as increasing the number of sensors involving volunteers citizens This research focusses on the development of an approach for merging heterogeneous observations in non stationary precipitation fields exploring the interactions between different definitions of optimality for the design of sensor networks as well as development of algorithms for the optimal scheduling of dynamic sensors This study was carried out in three different case studies including Bacchiglione River Italy Don River U K and Brue Catchment U K The results of this study indicate that optimal use of

dynamic sensors may be useful for monitoring precipitation to support water management and flow forecasting

Thermodynamic Approaches in Engineering Systems Stanislaw Sieniutycz, 2016-05-20 Thermodynamic Approaches in Engineering Systems responds to the need for a synthesizing volume that throws light upon the extensive field of thermodynamics from a chemical engineering perspective that applies basic ideas and key results from the field to chemical engineering problems This book outlines and interprets the most valuable achievements in applied non equilibrium thermodynamics obtained within the recent fifty years It synthesizes nontrivial achievements of thermodynamics in important branches of chemical and biochemical engineering Readers will gain an update on what has been achieved what new research problems could be stated and what kind of further studies should be developed within specialized research Presents clearly structured chapters beginning with an introduction elaboration of the process and results summarized in a conclusion Written by a first class expert in the field of advanced methods in thermodynamics Provides a synthesis of recent thermodynamic developments in practical systems Presents very elaborate literature discussions from the past fifty years

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Entropy Theory And Its Application In Environmental And Water Engineering Introduction

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