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one of the basic tenets of science is that deterministic systems are completely predictable given the initial condition and the equations describing a system the behavior of the system can be predicted 1 for all time the discovery of chaotic systems has eliminated this viewpoint simply put a chaotic system is a deterministic system that exhibits random behavior though identified as a robust phenomenon only twenty years ago chaos has almost certainly been encountered by scientists and engi neers many times during the last century only to be dismissed as physical noise chaos is such a wide spread phenomenon that it has now been reported in virtually every scientific discipline astronomy biology biophysics chemistry engineering geology mathematics medicine meteorology plasmas physics and even the social sci ences it is no coincidence that during the same two decades in which chaos has grown into an independent field of research computers have permeated society it is in fact the wide availability of inex pensive computing power that has spurred much of the research in chaotic dynamics the reason is simple the computer can calculate a solution of a nonlinear system this is no small feat unlike lin ear systems where closed form solutions can be written in terms of the system s eigenvalues and eigenvectors few nonlinear systems and virtually no chaotic systems possess closed form solutions this book discusses the mutual intersection of two interesting fields of research i e deterministic chaos and evolutionary computation evolutionary computation which are able to handle tasks such as control of various chaotic systems and synthesis of their structure are explored while deterministic chaos is investigated as a behavioral part of evolutionary algorithms this book is targeted for a number of audiences firstly it will be an instructional material for senior undergraduate and entry point graduate students in computer science physics applied mathematics and engineering who are working in the area of deterministic chaos and evolutionary algorithms secondly researchers who desire to know how to apply evolutionary techniques on chaos control as well as researchers interested in the emergence of chaos in evolutionary algorithms will find this book a very useful tool and starting point and finally this book can be viewed as a resource handbook and material for practitioners who want to apply these methods that solve practical problems to their challenging applications boundaries of basins of attraction can be breached vastly altering both global and local convergence properties strange attractor bridges can be found that connect previously unreachable points examples of both are shown the studies presented in this book should be of interest to anybody concerned with the teaching of arithmetic to young children or with cognitive development in general the eaching experiment was carried out with half a dozen children entering first grade over two years in biweekly sessions methodologically the authors research is original it is a longitudinal but not a naturalistic study since the experimenter teachers directed their interaction with each individual child with a view to his or her possible progress it is experimental in the sense that two groups of subjects were selected according to criteria derived from an earlier study steffe von glasersfeld richards cobb 1983 and that the problems proposed were comparable though far from identical across the subjects but unlike more rigid and shorter learning or training studies it does not include pre and posttests or predetermined procedures theoretically the authors subscribe to piagefs constructivism numbers are made by children not found as they may find some pretty rocks for example or accepted from adults as they may accept and use a toy the authors interpret changes in the children s counting behaviors in terms of constructivist concepts such as assimilation accommodation and reflective abstraction and certain excerpts from protocols provide on line examples of such processes at work they also subscribe to vygotsky s proposal for teachers 0 utilize the zone of proximal development and to lead the child to what he can not yet do 1965 p 104 boundaries of basins of attraction can be breached vastly altering both global and local convergence properties strange attractor bridges can be found that connect previously unreachable points examples of both are shown these proceedings contain the papers contributed to the international work shop on dimensions and entropies in chaotic systems at the pecos river conference center on the pecos river ranch in spetember 1985 the work shop was held by the center for nonlinear studies of the los alamos national laboratory at the center for nonlinear studies the investigation of chaotic dynamics and especially the quantification of complex behavior has a long tradition in spite of some remarkable successes there are fundamental as well as nu merical problems involved in the practical realization of these algorithms this has led to a series of publications in which modifications and improve ments of the original methods have been proposed at present there exists a growing number of competing dimension algorithms but no comprehensive review explaining how they are related further in actual experimental ap plications rather than a precise algorithm one finds frequent use of rules of thumb together with error estimates which in many cases appear to be far too optimistic also it seems that questions like what is the maximal dimension of an attractor that one can measure with a given number of data points and a given experimental resolution have still not been answered in a satisfactory manner for general cases chaos based cryptography attracting many researchers in the past decade is a research field across two fields i e chaos nonlinear dynamic system and cryptography computer and data security it chaos properties such as randomness and ergodicity have been proved to be suitable for designing the means for data protection the book gives a thorough description of chaos based cryptography which consists of chaos basic theory chaos properties suitable for cryptography chaos based cryptographic techniques and various secure applications based on chaos additionally it covers both the latest research results and some open issues or hot topics the book creates a collection of high quality chapters contributed by leading experts in the related fields it embraces a wide variety of aspects of the related subject areas and provide a scientifically and scholarly sound treatment of state of the art techniques to students researchers academics personnel of law enforcement and it practitioners who are interested or involved in the study research use design and development of techniques related to chaos based cryptography this book develops deterministic chaos and fractals from the standpoint of iterated maps but the emphasis makes it very different from all other books in the field it

provides the reader with an introduction to more recent developments such as weak universality multifractals and shadowing as well as to older subjects like universal critical exponents devil s staircases and the farey tree the author uses a fully discrete method a theoretical computer arithmetic because finite but not fixed precision cannot be avoided in computation or experiment this leads to a more general formulation in terms of symbolic dynamics and to the idea of weak universality the connection is made with turing s ideas of computable numbers and it is explained why the continuum approach leads to predictions that are not necessarily realized in computation or in nature whereas the discrete approach yields all possible histograms that can be observed or computed mathematicians have devised different chaotic systems that are modeled by integer or fractional order differential equations and whose mathematical models can generate chaos or hyperchaos the numerical methods to simulate those integer and fractional order chaotic systems are quite different and their exactness is responsible in the evaluation of characteristics like lyapunov exponents kaplan yorke dimension and entropy one challenge is estimating the step size to run a numerical method it can be done analyzing the eigenvalues of self excited attractors while for hidden attractors it is difficult to evaluate the equilibrium points that are required to formulate the jacobian matrices time simulation of fractional order chaotic oscillators also requires estimating a memory length to achieve exact results and it is associated to memories in hardware design in this manner simulating chaotic hyperchaotic oscillators of integer fractional order and with self excited hidden attractors is quite important to evaluate their lyapunov exponents kaplan yorke dimension and entropy further to improve the dynamics of the oscillators their main characteristics can be optimized applying metaheuristics which basically consists of varying the values of the coefficients of a mathematical model the optimized models can then be implemented using commercially available amplifiers field programmable analog arrays fpaa field programmable gate arrays fpga microcontrollers graphic processing units and even using nanometer technology of integrated circuits the book describes the application of different numerical methods to simulate integer fractional order chaotic systems these methods are used within optimization loops to maximize positive lyapunov exponents kaplan yorke dimension and entropy single and multi objective optimization approaches applying metaheuristics are described as well as their tuning techniques to generate feasible solutions that are suitable for electronic implementation the book details several applications of chaotic oscillators such as in random bit number generators cryptography secure communications robotics and internet of things abstract control algorithms that exploit chaos s unique properties can vastly improve the performance of many practical and useful systems the program perfect moment is built around such an algorithm given a differential equation and two points in the system s state space it automatically maps the space chooses a set of trajectory segments from the maps uses them to construct a composite path between the points and causes the system to follow that path by monitoring the state and switching parameter values at the segment junctions the creation of and search through the maps are computationally intensive processes during the last ten years quantum information processing and communication qipc has established itself as one of the new hot topic fields in physics with the potential to revolutionize many areas of science and technology qipc replaces the laws of classical physics applied to computation and communication with the more fundamental laws of quantum mechanics this becomes increasingly important due to technological progress going down to smaller and smaller scales where quantum effects start to be dominant in addition to its fundamental nature qipc promises to advance computing power beyond the capabilities of any classical computer to guarantee secure communication and establish direct links to emerging quantum technologies such as for example quantum based sensors and clocks one of the outstanding feature of qipc is its interdisciplinary character it brings together researchers from physics mathematics and computer science in particular within physics we have seen the emergence of a new qipc community which ranges from theoretical to experimental physics and crosses boundaries of traditionally separated disciplines such as atomic physics quantum optics statistical mechanics and solid state physics all working on different and complementary aspects of qipc this publication covers the following topics introduction to quantum computing quantum logic information and entanglement quantum algorithms error correcting codes for quantum computations quantum measurements and control quantum communication quantum optics and cold atoms for quantum information quantum computing with solid state devices theory and experiments for superconducting qubits interactions in many body systems quantum chaos disorder and random matrices decoherence effects for quantum computing and flature prospects of quantum information processing this book offers a short and concise introduction to the many facets of chaos theory while the study of chaotic behavior in nonlinear dynamical systems is a well established research field with ramifications in all areas of science there is a lot to be learnt about how chaos can be controlled and under appropriate conditions can actually be constructive in the sense of becoming a control parameter for the system under investigation stochastic resonance being a prime example the present work stresses the latter aspects and after recalling the paradigm changes introduced by the concept of chaos leads the reader skillfully through the basics of chaos control by detailing the relevant algorithms for both hamiltonian and dissipative systems among others the main part of the book is then devoted to the issue of synchronization in chaotic systems an introduction to stochastic resonance and a survey of ratchet models in this second revised and enlarged edition two more chapters explore the many interfaces of quantum physics and dynamical systems examining in turn statistical properties of energy spectra quantum ratchets and dynamical tunneling among others this text is particularly suitable for non specialist scientists engineers and applied mathematical scientists from related areas wishing to enter the field quickly and efficiently from the reviews of the first edition this book is an excellent introduction to the key concepts and control of chaos in random dynamical systems the authors find an outstanding balance between main physical ideas and mathematical terminology to reach their audience in an impressive and lucid manner this book is ideal for anybody who would like to grasp quickly the main issues related to chaos in discrete and continuous time henri schurz zentralblatt math vol 1178 2010 this book discusses the mutual intersection of two fields of research evolutionary computation which can handle tasks such as control of various chaotic systems and deterministic chaos which is investigated as a behavioral part of evolutionary algorithms this book presents a new approach for the analysis of chaotic

behavior in non linear dynamical systems in which output can be represented in quaternion parametrization it offers a new family of methods for the analysis of chaos in the quaternion domain along with extensive numerical experiments performed on human motion data and artificial data all methods and algorithms are designed to allow detection of deterministic chaos behavior in quaternion data representing the rotation of a body in 3d space this book is an excellent reference for engineers researchers and postgraduate students conducting research on human gait analysis healthcare informatics dynamical systems with deterministic chaos or time series analysis a small army of physicists chemists mathematicians and engineers has joined forces to attack a classic problem the reversibility paradox with modern tools this book describes their work from the perspective of computer simulation emphasizing the authors approach to the problem of understanding the compatibility and even inevitability of the irreversible second law of thermodynamics with an underlying time reversible mechanics computer simulation has made it possible to probe reversibility from a variety of directions and chaos theory or nonlinear dynamics has supplied a useful vocabulary and a set of concepts which allow a fuller explanation of irreversibility than that available to boltzmann or to green kubo and onsager clear illustration of concepts is emphasized throughout and reinforced with a glossary of technical terms from the specialized fields which have been combined here to focus on a common theme the book begins with a discussion contrasting the idealized reversibility of basic physics against the pragmatic irreversibility of real life computer models and simulation are next discussed and illustrated simulations provide the means to assimilate concepts through worked out examples state of the art analyses from the point of view of dynamical systems are applied to many body examples from nonequilibrium molecular dynamics and to chaotic irreversible flows from finite difference finite element and particle based continuum simulations two necessary concepts from dynamical systems theory fractals and lyapunov instability are fundamental to the approach undergraduate level physics calculus and ordinary differential equations are sufficient background for a full appreciation of this book which is intended for advanced undergraduates graduates and research workers the generous assortment of examples worked out in the text will stimulate readers to explore the rich and fruitful field of study which links fundamental reversible laws of physics to the irreversibility surrounding us all this expanded edition stresses and illustrates computer algorithms with many new worked out examples and includes considerable new material on shockwaves lyapunov instability and fluctuations sample chapter s chapter 1 time reversibility computer simulation algorithms chaos 1 908 kb contents time reversibility computer simulation algorithms chaostime reversibility in physics and computationgibbs statistical mechanicsirreversibility in real lifemicroscopic computer simulationshockwaves revisitedmacroscopic computer simulationchaos lyapunov instability fractalsresolving the reversibility paradoxafterword a research perspective readership students of statistical physics and computer simulation keywords time reversibility computer simulation algorithms chaoskey features provides comprehensive resource for simulation and analysis of classical equilibrium and nonequilibrium systems both small and largeclear and thorough exposition of latest algorithms and techniques for research in simulationhands on algorithms clear analysis of recent developments assessment of the state of the artreviews bill and carol hoover have teamed up to produce this greatly expanded new edition of bill s earlier book grappling with one of the oldest problems in physics reconciling the irreversibility of thermodynamics with the reversibility of newtonian mechanics it represents a personal account of a lifetime of research including insights provided by advances in chaos fractals and computer simulation it is the best source for anyone seeking a deep understanding of these seemingly paradoxical basic laws of physics julien clinton sprott emeritus professor of physics university of wisconsin madison author of chaos and time series analysis and elegant chaos the second edition with over 100 pages of new material gives an up to date and distinctive treatment of physical issues emphasizing the need for a holistic view incorporating theory simulation and experiment it provides rich inspiration and insight for graduate students and more experienced researchers alike this work challenges philosophers and mathematicians to engage with the latest numerical and experimental findings and practitioners of quantum chaos and nanotechnology to incorporate and extend the underpinning classical irreversibility dr carl dettmann university of bristol many remarks and asides are very informative and will be of interest to a broad range of physicists i was pleasantly surprised by the overall ambition breadth and scope of this excellent book contemporary physics review of the first edition the author has written a lively informal and somewhat personal review of a branch of statistical physics that he has helped develop over the past two decades or so mathematical reviews the book reports on the latest advances in and applications of chaos theory and intelligent control written by eminent scientists and active researchers and using a clear matter of fact style it covers advanced theories methods and applications in a variety of research areas and explains key concepts in modeling analysis and control of chaotic and hyperchaotic systems topics include fractional chaotic systems chaos control chaos synchronization memristors jerk circuits chaotic systems with hidden attractors mechanical and biological chaos and circuit realization of chaotic systems the book further covers fuzzy logic controllers evolutionary algorithms swarm intelligence and petri nets among other topics not only does it provide the readers with chaos fundamentals and intelligent control based algorithms it also discusses key applications of chaos as well as multidisciplinary solutions developed via intelligent control the book is a timely and comprehensive reference guide for graduate students researchers and practitioners in the areas of chaos theory and intelligent control abstract control algorithms that exploit chaos s unique properties can vastly improve the performance of many practical and useful systems the program perfect moment is built around such an algorithm given a differential equation and two points in the system s state space it automatically maps the space chooses a set of trajectory segments from the maps uses them to construct a composite path between the points and causes the system to follow that path by monitoring the state and switching parameter values at the segment junctions the creation of and search through the maps are computationally intensive processes this book provides new research on the dynamics algorithms and synchronization of chaotic systems chapter one introduces some nonlinear techniques for the synchronization of a class of chaotic oscillator under the framework of observer design from control theory chapter two discusses in detail the application of a novel multi domain spectral collocation approach for finding solutions of ordinary differential

equations that exhibit general chaotic behaviour chapter three designs an adaptive state feedback controller guaranteeing the asymptotic stability followed by the synchronization of the nonlinear discrete time error of two identical hyper chaotic systems in this book various chaos maps are embedded in eleven efficient and well known metaheuristics and a significant improvement in the optimization results is achieved the two basic steps of metaheuristic algorithms consist of exploration and exploitation the imbalance between these stages causes serious problems for metaheuristic algorithms which are immature convergence and stopping in local optima chaos maps with chaotic jumps can save algorithms from being trapped in local optima and lead to convergence toward global optima embedding these maps in the exploration phase exploitation phase or both simultaneously corresponds to three efficient and useful scenarios by creating competition between different modes and increasing diversity in the search space and creating sudden jumps in the search phase improvements are achieved for chaotic algorithms four chaotic algorithms including chaotic cyclical parthenogenesis algorithm chaotic water evaporation optimization chaotic tug of war optimization and chaotic thermal exchange optimization are developed chaotic dynamics and fractals covers the proceedings of the 1985 conference on chaotic dynamics held at the georgia institute of technology this conference deals with the research area of chaos dynamical systems and fractal geometry this text is organized into three parts encompassing 16 chapters the first part describes the nature of chaos and fractals the geometric tool for some strange attractors and other complicated sets of data associated with chaotic systems this part also considers the henon hiles hamiltonian with complex time a henon family of maps from c2 into itself and the idea of turbulent maps in the course of presenting results on iteration of continuous maps from the unit interval to itself the second part discusses complex analytic dynamics and associated fractal geometry specifically the bursts into chaos algorithms for obtaining geometrical and combinatorial information and the parameter space for iterated cubic polynomials this part also examines the differentiation of julia sets with respects to a parameter in the associated rational map permitting the formulation of taylor series expansion for the sets the third part highlights the applications of chaotic dynamics and fractals this book will prove useful to mathematicians physicists and other scientists working in or introducing themselves to the field the subject of chaos has invaded practically every area of the natural sciences weather patterns are referred to as chaotic there are chemical reactions and chaotic evolution of insect populations atomic and molecular physics have also seen the emergence of the study of chaos in these microscopic domains this book examines the issue of chaos in nonlinear and dynamical systems quantum mechanics biology and economics this book highlights the solution algorithms and characteristic analysis methods of fractional order chaotic systems fractal dimensions exist broadly in the study of nature and the development of science and technology fractional calculus has become a hot research area in nonlinear science fractional order chaotic systems are an important part of fractional calculus the book discusses the numerical solution algorithms and characteristic analysis of fractional order chaotic systems and introduces the techniques to implement the systems with circuits to facilitate a quick grasp the authors present examples from their years of work in the appendix intended for graduate students and researchers interested in chaotic systems the book helps one to build a theoretical and experimental foundation for the application of fractional order chaotic systems the author first introduces the basic framework for cultural algorithms and he then explains the social structure of a cultural system as a mechanism for the distribution of problem solving information throughout a population three different models for social organizations are presented the homogeneous nuclear family heterogeneous expanded family and subculture descent groups social models the chapters that follow compare the learning capabilities of these social organizations relative to problems of varying complexity the book concludes with a discussion of how the results can impact our understanding of social evolution the 1960s were perhaps a decade of confusion when scientists faced d culties in dealing with imprecise information and complex dynamics a new set theory and then an in nite valued logic of lot a zadeh were so c fusing that they were called fuzzy set theory and fuzzy logic a deterministic system found by e n lorenz to have random behaviours was so unusual that it was lately named a chaotic system just like irrational and imaginary numbers negative energy anti matter etc fuzzy logic and chaos were gr ually and eventually accepted by many if not all scientists and engineers as fundamental concepts theories as well as technologies in particular fuzzy systems technology has achieved its maturity with widespread applications in many industrial commercial and technical elds ranging from control automation and arti cial intelligence to image signal processing patternrecognition andelectroniccommerce chaos ontheother hand wasconsideredoneofthethreemonumentaldiscoveriesofthetwentieth century together with the theory of relativity and quantum mechanics as a very special nonlinear dynamical phenomenon chaos has reached its current outstanding status from being merely a scienti c curiosity in the mid 1960s to an applicable technology in the late 1990s finding the intrinsic relation between fuzzy logic and chaos theory is certainlyofsigni cantinterestandofpotentialimportance thepast20years have indeed witnessed some serious explorations of the interactions between fuzzylogicandchaostheory leadingtosuchresearchtopicsasfuzzymodeling of chaotic systems using takagi sugeno models linguistic descriptions of chaotic systems fuzzy control of chaos and a combination of fuzzy control technology and chaos theory for various engineering practices for computer scientists especially those in the security field the use of chaos has been limited to the computation of a small collection of famous but unsuitable maps that offer no explanation of why chaos is relevant in the considered contexts discrete dynamical systems and chaotic machines theory and applications shows how to make finite mac this brief studies the general problem of constructing digital chaotic systems in devices with finite precision from low dimensional to high dimensional settings and establishes a general framework for composing them the contributors demonstrate that the associated state networks of digital chaotic systems are strongly connected they then further prove that digital chaotic systems satisfy devaney s definition of chaos on the domain of finite precision the book presents lyapunov exponents as well as implementations to show the potential application of digital chaotic systems in the real world the authors also discuss the basic advantages and practical benefits of this approach the authors explore the solutions to dynamic degradation including short cycle length decayed distribution and low linear complexity by proposing novel modelling methods and hardware designs for two different one dimensional

chaotic systems which satisfy devaney s definition of chaos they then extend it to a higher dimensional digital domain chaotic system which has been used in image encryption technology this ensures readers do not encounter large differences between actual and theoretical chaotic orbits through small errors digital chaotic systems serves as an up to date reference on an important research topic for researchers and students in control science and engineering computing mathematics and other related fields of study the book begins with a discussion contrasting the idealized reversibility of basic physics against the pragmatic irreversibility of real life computer models and simulation are next discussed and illustrated simulations provide the means to assimilate concepts through worked out examples state of the art analyses from the point of view of dynamical systems are applied to many body examples from nonequilibrium molecular dynamics and to chaotic irreversible flows from finite difference finite element and particle based continuum simulations two necessary concepts from dynamical systems theory fractals and lyapunov instability are fundamental to the approach undergraduate level physics calculus and ordinary differential equations are sufficient background for a full appreciation of this book which is intended for advanced undergraduates graduates and research workers chaos and nonlinear dynamics initially developed as a new emergent field with its foundation in physics and applied mathematics the highly generic interdisciplinary quality of the insights gained in the last few decades has spawned myriad applications in almost all branches of science and technology and even well beyond wherever quantitative modeling and analysis of complex nonlinear phenomena is required chaos theory and its methods can play a key role this third volume concentrates on reviewing further relevant contemporary applications of chaotic nonlinear systems as they apply to the various cutting edge branches of engineering this encompasses but is not limited to topics such fluctuation relations and chaotic dynamics in physics fractals and their applications in epileptic seizures as well as chaos synchronization featuring contributions from active and leading research groups this collection is ideal both as a reference and as a recipe book full of tried and tested successful engineering applications the previous edition of this text was the first to provide a quantitative introduction to chaos and nonlinear dynamics at the undergraduate level it was widely praised for the clarity of writing and for the unique and effective way in which the authors presented the basic ideas these same qualities characterize this revised and expanded second edition interest in chaotic dynamics has grown explosively in recent years applications to practically every scientific field have had a far reaching impact as in the first edition the authors present all the main features of chaotic dynamics using the damped driven pendulum as the primary model this second edition includes additional material on the analysis and characterization of chaotic data and applications of chaos this new edition of chaotic dynamics can be used as a text for courses on chaos for physics and engineering students at the second and third year level this book is primarily concerned with the computational aspects of predictability of dynamical systems in particular those where observation modeling and computation are strongly interdependent unlike with physical systems under control in laboratories for instance in celestial mechanics one is confronted with the observation and modeling of systems without the possibility of altering the key parameters of the objects studied therefore the numerical simulations offer an essential tool for analyzing these systems with the widespread use of computer simulations to solve complex dynamical systems the reliability of the numerical calculations is of ever increasing interest and importance this reliability is directly related to the regularity and instability properties of the modeled flow in this interdisciplinary scenario the underlying physics provide the simulated models nonlinear dynamics provides their chaoticity and instability properties and the computer sciences provide the actual numerical implementation this book introduces and explores precisely this link between the models and their predictability characterization based on concepts derived from the field of nonlinear dynamics with a focus on the finite time lyapunov exponents approach the method is illustrated using a number of well known continuous dynamical systems including the contopoulos hénon heiles and rössler systems to help students and newcomers quickly learn to apply these techniques the appendix provides descriptions of the algorithms used throughout the text and details how to implement them in order to solve a given continuous dynamical system this book gives an exposition of the exciting field of control of oscillatory and chaotic systems which has numerous potential applications in mechanics laser and chemical technologies communications biology and medicine economics ecology etc a novelty of the book is its systematic application of modern nonlinear and adaptive control theory to the new class of problems the proposed control design methods are based on the concepts of lyapunov functions poincare maps speed gradient and gradient algorithms the conditions which ensure such control goals as an excitation or suppression of oscillations synchronization and transformation from chaotic mode to the periodic one or vice versa are established the performance and robustness of control systems under disturbances and uncertainties are evaluated the described methods and algorithms are illustrated by a number of examples including classical models of oscillatory and chaotic systems coupled pendula brusselator lorenz van der pol duffing henon and chua systems practical examples from different fields of science and technology such as communications growth of thin films synchronization of chaotic generators based on tunnel diods stabilization of swings in power systems increasing predictability of business cycles are also presented the book includes many results on nonlinear and adaptive control published previously in russian and therefore were not known to the west researchers teachers and graduate students in the fields of electrical and mechanical engineering physics chemistry biology economics will find this book most useful applied mathematicians and control engineers from various fields of technology dealing with complex oscillatory systems will also benefit from it this volume contains the proceedings of a conference held in wiirzburg august 20 24 1990 the theme of the conference was bifurcation and chaos analysis algorithms ap plications more than 100 scientists from 21 countries presented 80 contributions many of the results of the conference are described in the 49 refereed papers that follow the conference was sponsored by the deutsche forschungsgemeinschaft and by the deutscher akademischer austauschdienst we gratefully acknowledge the support from these agen cies the science of nonlinear phenomena is evolving rapidly over the last 10 years the emphasis has been gradually shifting how trends vary may be seen by comparing these proceedings with previous ones in particular with the conference held in dortmund 1986 proceedings published in isnm 79 concerning the range of phenomena

chaos has joined the bifurcation scenarios as expected the acceptance of chaos is less emotional among professionals than it has been in some popular publications a nalytical methods appear to have reached a state in which basic results of singularities symmetry groups or normal forms are everyday experience rather than exciting news similarly numerical algorithms for frequent situations are now well established implemented in several packages such algorithms have become standard means for attacking nonlinear problems the sophisti cation that analytical and numerical methods have reached supports the vigorous trend to more and more applications pioneering equations as those named after duffing van der pol or lorenz are no longer exclusively the state of art evolutionary algorithms constitute a class of well known algorithms which are designed based on the darwinian theory of evolution and mendelian theory of heritage they are partly based on random and partly based on deterministic principles due to this nature it is challenging to predict and control its performance in solving complex nonlinear problems recently the study of evolutionary dynamics is focused not only on the traditional investigations but also on the understanding and analyzing new principles with the intention of controlling and utilizing their properties and performances toward more effective real world applications in this book based on many years of intensive research of the authors is proposing novel ideas about advancing evolutionary dynamics towards new phenomena including many new topics even the dynamics of equivalent social networks in fact it includes more advanced complex networks and incorporates them with the cmls coupled map lattices which are usually used for spatiotemporal complex systems simulation and analysis based on the observation that chaos in cml can be controlled so does evolution dynamics all the chapter authors are to the best of our knowledge originators of the ideas mentioned above and researchers on evolutionary algorithms and chaotic dynamics as well as complex networks who will provide benefits to the readers regarding modern scientific research on related subjects the study of nonlinear dynamical systems has advanced tremendously in the last 15 years making a big impact on science and technology this book provides all the techniques and methods used in nonlinear dynamics the concepts and underlying mathematics are discussed in detail the numerical and symbolic methods are implemented in c symbolicc and java object oriented techniques are also applied the book contains more than 100 ready to run programs the text has also been designed for a one year course at both the junior and senior levels in nonlinear dynamics the topics discussed in the book are part of e learning and distance learning courses conducted by the international school for scientific computing request inspection copy this book is the first attempt to give a chaotic dynamics interpretation of processes having to do with category formation and pattern recognition by systems possessing simple hardware e g few degrees of freedom it is multidisciplinary in its approach and would be useful to readers from various fields

Practical Numerical Algorithms for Chaotic Systems 2012-12-06 one of the basic tenets of science is that deterministic systems are completely predictable given the initial condition and the equations describing a system the behavior of the system can be predicted 1 for all time the discovery of chaotic systems has eliminated this viewpoint simply put a chaotic system is a deterministic system that exhibits random behavior though identified as a robust phenomenon only twenty years ago chaos has almost certainly been encountered by scientists and engi neers many times during the last century only to be dismissed as physical noise chaos is such a wide spread phenomenon that it has now been reported in virtually every scientific discipline astronomy biology biophysics chemistry engineering geology mathematics medicine meteorology plasmas physics and even the social sci ences it is no coincidence that during the same two decades in which chaos has grown into an independent field of research computers have permeated society it is in fact the wide availability of inex pensive computing power that has spurred much of the research in chaotic dynamics the reason is simple the computer can calculate a solution of a nonlinear system this is no small feat unlike lin ear systems where closed form solutions can be written in terms of the system s eigenvalues and eigenvectors few nonlinear systems and virtually no chaotic systems possess closed form solutions

Practical Numerical Algorithms for Chaotic Systems 1989-08-01 this book discusses the mutual intersection of two interesting fields of research i e deterministic chaos and evolutionary computation evolutionary computation which are able to handle tasks such as control of various chaotic systems and synthesis of their structure are explored while deterministic chaos is investigated as a behavioral part of evolutionary algorithms this book is targeted for a number of audiences firstly it will be an instructional material for senior undergraduate and entry point graduate students in computer science physics applied mathematics and engineering who are working in the area of deterministic chaos and evolutionary algorithms secondly researchers who desire to know how to apply evolutionary techniques on chaos control as well as researchers interested in the emergence of chaos in evolutionary algorithms will find this book a very useful tool and starting point and finally this book can be viewed as a resource handbook and material for practitioners who want to apply these methods that solve practical problems to their challenging applications

Evolutionary Algorithms and Chaotic Systems 2010 boundaries of basins of attraction can be breached vastly altering both global and local convergence properties strange attractor bridges can be found that connect previously unreachable points examples of both are shown

Control Algorithms for Chaotic Systems 1991 the studies presented in this book should be of interest to anybody concerned with the teaching of arithmetic to young children or with cognitive development in general the eaching experiment was carried out with half a dozen children entering first grade over two years in biweekly sessions methodologically the authors research is original it is a longitudinal but not a naturalistic study since the experimenter teachers directed their interaction with each individual child with a view to his or her possible progress it is experimental in the sense that two groups of subjects were selected according to criteria derived from an earlier study steffe von glasersfeld richards cobb 1983 and that the problems proposed were comparable though far from identical across the subjects but unlike more rigid and shorter learning or training studies it does not include pre and posttests or predetermined procedures theoretically the authors subscribe to piagefs constructivism numbers are made by children not found as they may find some pretty rocks for example or accepted from adults as they may accept and use a toy the authors interpret changes in the children s counting behaviors in terms of constructivist concepts such as assimilation accommodation and reflective abstraction and certain excerpts from protocols provide on line examples of such processes at work they also subscribe to vygotsky s proposal for teachers 0 utilize the zone of proximal development and to lead the child to what he can not yet do 1965 p 104

Construction of Arithmetical Meanings and Strategies 1987-12-18 boundaries of basins of attraction can be breached vastly altering both global and local convergence properties strange attractor bridges can be found that connect previously unreachable points examples of both are shown

Control Algorithms for Chaotic Systems 1991 these proceedings contain the papers contributed to the international work shop on dimensions and entropies in chaotic systems at the pecos river conference center on the pecos river ranch in spetember 1985 the work shop was held by the center for nonlinear studies of the los alamos national laboratory at the center for nonlinear studies the investigation of chaotic dynamics and especially the quantification of complex behavior has a long tradition in spite of some remarkable successes there are fundamental as well as nu merical problems involved in the practical realization of these algorithms this has led to a series of publications in which modifications and improve ments of the original methods have been proposed at present there exists a growing number of competing dimension algorithms but no comprehensive review explaining how they are related further in actual experimental ap plications rather than a precise algorithm one finds frequent use of rules of thumb together with error estimates which in many cases appear to be far too optimistic also it seems that questions like what is the maximal dimension of an attractor that one can measure with a given number of data points and a given experimental resolution have still not been answered in a satisfactory manner for general cases

Dimensions and Entropies in Chaotic Systems 2012-12-06 chaos based cryptography attracting many researchers in the past decade is a research field across two fields i e chaos nonlinear dynamic system and cryptography computer and data security it chaos properties such as randomness and ergodicity have been proved to be suitable for designing the means for data protection the book gives a thorough description of chaos based cryptography which consists of chaos basic theory chaos properties suitable for cryptography chaos based cryptographic techniques and various secure applications based on chaos additionally it covers both the latest research results and some open issues or hot topics the book creates a collection of high quality chapters contributed by leading experts in the related fields it embraces a wide variety of aspects of the related subject areas and provide a

scientifically and scholarly sound treatment of state of the art techniques to students researchers academics personnel of law enforcement and it practitioners who are interested or involved in the study research use design and development of techniques related to chaos based cryptography

Chaos-based Cryptography 2011-06-17 this book develops deterministic chaos and fractals from the standpoint of iterated maps but the emphasis makes it very different from all other books in the field it provides the reader with an introduction to more recent developments such as weak universality multifractals and shadowing as well as to older subjects like universal critical exponents devil s staircases and the farey tree the author uses a fully discrete method a theoretical computer arithmetic because finite but not fixed precision cannot be avoided in computation or experiment this leads to a more general formulation in terms of symbolic dynamics and to the idea of weak universality the connection is made with turing s ideas of computable numbers and it is explained why the continuum approach leads to predictions that are not necessarily realized in computation or in nature whereas the discrete approach yields all possible histograms that can be observed or computed

Chaos, Dynamics, and Fractals 1993 mathematicians have devised different chaotic systems that are modeled by integer or fractional order differential equations and whose mathematical models can generate chaos or hyperchaos the numerical methods to simulate those integer and fractional order chaotic systems are quite different and their exactness is responsible in the evaluation of characteristics like lyapunov exponents kaplan yorke dimension and entropy one challenge is estimating the step size to run a numerical method it can be done analyzing the eigenvalues of self excited attractors while for hidden attractors it is difficult to evaluate the equilibrium points that are required to formulate the jacobian matrices time simulation of fractional order chaotic oscillators also requires estimating a memory length to achieve exact results and it is associated to memories in hardware design in this manner simulating chaotic hyperchaotic oscillators of integer fractional order and with self excited hidden attractors is quite important to evaluate their lyapunov exponents kaplan yorke dimension and entropy further to improve the dynamics of the oscillators their main characteristics can be optimized applying metaheuristics which basically consists of varying the values of the coefficients of a mathematical model the optimized models can then be implemented using commercially available amplifiers field programmable analog arrays fpaa field programmable gate arrays fpga microcontrollers graphic processing units and even using nanometer technology of integrated circuits the book describes the application of different numerical methods to simulate integer fractional order chaotic systems these methods are used within optimization loops to maximize positive lyapunov exponents kaplan yorke dimension and entropy single and multi objective optimization approaches applying metaheuristics are described as well as their tuning techniques to generate feasible solutions that are suitable for electronic implementation the book details several applications of chaotic oscillators such as in random bit number generators cryptography secure communications robotics and internet of things

Optimization of Integer/Fractional Order Chaotic Systems by Metaheuristics and their Electronic Realization 2021-05-10 abstract control algorithms that exploit chaos s unique properties can vastly improve the performance of many practical and useful systems the program perfect moment is built around such an algorithm given a differential equation and two points in the system s state space it automatically maps the space chooses a set of trajectory segments from the maps uses them to construct a composite path between the points and causes the system to follow that path by monitoring the state and switching parameter values at the segment junctions the creation of and search through the maps are computationally intensive processes

A Control Algorithm for Chaotic Physical Systems 1991 during the last ten years quantum information processing and communication qipc has established itself as one of the new hot topic fields in physics with the potential to revolutionize many areas of science and technology qipc replaces the laws of classical physics applied to computation and communication with the more fundamental laws of quantum mechanics this becomes increasingly important due to technological progress going down to smaller and smaller scales where quantum effects start to be dominant in addition to its fundamental nature qipc promises to advance computing power beyond the capabilities of any classical computer to guarantee secure communication and establish direct links to emerging quantum technologies such as for example quantum based sensors and clocks one of the outstanding feature of qipc is its interdisciplinary character it brings together researchers from physics mathematics and computer science in particular within physics we have seen the emergence of a new qipc community which ranges from theoretical to experimental physics and crosses boundaries of traditionally separated disciplines such as atomic physics quantum optics statistical mechanics and solid state physics all working on different and complementary aspects of qipc this publication covers the following topics introduction to quantum computing quantum logic information and entanglement quantum algorithms error correcting codes for quantum computations quantum measurements and control quantum communication quantum optics and cold atoms for quantum information quantum computing with solid state devices theory and experiments for superconducting qubits interactions in many body systems quantum chaos disorder and random matrices decoherence effects for quantum computing and flature prospects of quantum information processing

Quantum Computers, Algorithms and Chaos 2006-12-19 this book offers a short and concise introduction to the many facets of chaos theory while the study of chaotic behavior in nonlinear dynamical systems is a well established research field with ramifications in all areas of science there is a lot to be learnt about how chaos can be controlled and under appropriate conditions can actually be constructive in the sense of becoming a control parameter for the system under investigation stochastic resonance being a prime example the present work stresses the latter aspects and after recalling the paradigm changes introduced by the concept of chaos leads the reader skillfully through the basics of chaos control by detailing the relevant algorithms for both hamiltonian and dissipative systems among others the main part of the book is then devoted to the issue of synchronization in chaotic systems

an introduction to stochastic resonance and a survey of ratchet models in this second revised and enlarged edition two more chapters explore the many interfaces of quantum physics and dynamical systems examining in turn statistical properties of energy spectra quantum ratchets and dynamical tunneling among others this text is particularly suitable for non specialist scientists engineers and applied mathematical scientists from related areas wishing to enter the field quickly and efficiently from the reviews of the first edition this book is an excellent introduction to the key concepts and control of chaos in random dynamical systems the authors find an outstanding balance between main physical ideas and mathematical terminology to reach their audience in an impressive and lucid manner this book is ideal for anybody who would like to grasp quickly the main issues related to chaos in discrete and continuous time henri schurz zentralblatt math vol 1178 2010

Chaos: Concepts, Control and Constructive Use 2016-10-24 this book discusses the mutual intersection of two fields of research evolutionary computation which can handle tasks such as control of various chaotic systems and deterministic chaos which is investigated as a behavioral part of evolutionary algorithms

Evolutionary Algorithms and Chaotic Systems 2010-03-10 this book presents a new approach for the analysis of chaotic behavior in non linear dynamical systems in which output can be represented in quaternion parametrization it offers a new family of methods for the analysis of chaos in the quaternion domain along with extensive numerical experiments performed on human motion data and artificial data all methods and algorithms are designed to allow detection of deterministic chaos behavior in quaternion data representing the rotation of a body in 3d space this book is an excellent reference for engineers researchers and postgraduate students conducting research on human gait analysis healthcare informatics dynamical systems with deterministic chaos or time series analysis

Analysis of Chaotic Behavior in Non-linear Dynamical Systems 2018-07-12 a small army of physicists chemists mathematicians and engineers has joined forces to attack a classic problem the reversibility paradox with modern tools this book describes their work from the perspective of computer simulation emphasizing the authors approach to the problem of understanding the compatibility and even inevitability of the irreversible second law of thermodynamics with an underlying time reversible mechanics computer simulation has made it possible to probe reversibility from a variety of directions and chaos theory or nonlinear dynamics has supplied a useful vocabulary and a set of concepts which allow a fuller explanation of irreversibility than that available to boltzmann or to green kubo and onsager clear illustration of concepts is emphasized throughout and reinforced with a glossary of technical terms from the specialized fields which have been combined here to focus on a common theme the book begins with a discussion contrasting the idealized reversibility of basic physics against the pragmatic irreversibility of real life computer models and simulation are next discussed and illustrated simulations provide the means to assimilate concepts through worked out examples state of the art analyses from the point of view of dynamical systems are applied to many body examples from nonequilibrium molecular dynamics and to chaotic irreversible flows from finite difference finite element and particle based continuum simulations two necessary concepts from dynamical systems theory fractals and lyapunov instability are fundamental to the approach undergraduate level physics calculus and ordinary differential equations are sufficient background for a full appreciation of this book which is intended for advanced undergraduates graduates and research workers the generous assortment of examples worked out in the text will stimulate readers to explore the rich and fruitful field of study which links fundamental reversible laws of physics to the irreversibility surrounding us all this expanded edition stresses and illustrates computer algorithms with many new worked out examples and includes considerable new material on shockwaves lyapunov instability and fluctuations sample chapter s chapter 1 time reversibility computer simulation algorithms chaos 1 908 kb contents time reversibility computer simulation algorithms chaostime reversibility in physics and computationgibbs statistical mechanicsirreversibility in real lifemicroscopic computer simulationshockwaves revisitedmacroscopic computer simulationchaos lyapunov instability fractalsresolving the reversibility paradoxafterword a research perspective readership students of statistical physics and computer simulation keywords time reversibility computer simulation algorithms chaoskey features provides comprehensive resource for simulation and analysis of classical equilibrium and nonequilibrium systems both small and largeclear and thorough exposition of latest algorithms and techniques for research in simulationhands on algorithms clear analysis of recent developments assessment of the state of the artreviews bill and carol hoover have teamed up to produce this greatly expanded new edition of bill s earlier book grappling with one of the oldest problems in physics reconciling the irreversibility of thermodynamics with the reversibility of newtonian mechanics it represents a personal account of a lifetime of research including insights provided by advances in chaos fractals and computer simulation it is the best source for anyone seeking a deep understanding of these seemingly paradoxical basic laws of physics julien clinton sprott emeritus professor of physics university of wisconsin madison author of chaos and time series analysis and elegant chaos the second edition with over 100 pages of new material gives an up to date and distinctive treatment of physical issues emphasizing the need for a holistic view incorporating theory simulation and experiment it provides rich inspiration and insight for graduate students and more experienced researchers alike this work challenges philosophers and mathematicians to engage with the latest numerical and experimental findings and practitioners of quantum chaos and nanotechnology to incorporate and extend the underpinning classical irreversibility dr carl dettmann university of bristol many remarks and asides are very informative and will be of interest to a broad range of physicists i was pleasantly surprised by the overall ambition breadth and scope of this excellent book contemporary physics review of the first edition the author has written a lively informal and somewhat personal review of a branch of statistical physics that he has helped develop over the past two decades or so mathematical reviews

Time Reversibility, Computer Simulation, Algorithms, Chaos 2012-06-11 the book reports on the latest advances in and applications of chaos theory and intelligent control written by eminent scientists and active researchers and using a clear matter of fact style it covers advanced theories methods and applications in a variety of research areas and

explains key concepts in modeling analysis and control of chaotic and hyperchaotic systems topics include fractional chaotic systems chaos control chaos synchronization memristors jerk circuits chaotic systems with hidden attractors mechanical and biological chaos and circuit realization of chaotic systems the book further covers fuzzy logic controllers evolutionary algorithms swarm intelligence and petri nets among other topics not only does it provide the readers with chaos fundamentals and intelligent control based algorithms it also discusses key applications of chaos as well as multidisciplinary solutions developed via intelligent control the book is a timely and comprehensive reference guide for graduate students researchers and practitioners in the areas of chaos theory and intelligent control

Advances in Chaos Theory and Intelligent Control 2016-04-15 abstract control algorithms that exploit chaos s unique properties can vastly improve the performance of many practical and useful systems the program perfect moment is built around such an algorithm given a differential equation and two points in the system s state space it automatically maps the space chooses a set of trajectory segments from the maps uses them to construct a composite path between the points and causes the system to follow that path by monitoring the state and switching parameter values at the segment junctions the creation of and search through the maps are computationally intensive processes

A Control Algorithm for Chaotic Physical Systems 1991 this book provides new research on the dynamics algorithms and synchronization of chaotic systems chapter one introduces some nonlinear techniques for the synchronization of a class of chaotic oscillator under the framework of observer design from control theory chapter two discusses in detail the application of a novel multi domain spectral collocation approach for finding solutions of ordinary differential equations that exhibit general chaotic behaviour chapter three designs an adaptive state feedback controller guaranteeing the asymptotic stability followed by the synchronization of the nonlinear discrete time error of two identical hyper chaotic systems

Chaotic Systems 2017 in this book various chaos maps are embedded in eleven efficient and well known metaheuristics and a significant improvement in the optimization results is achieved the two basic steps of metaheuristic algorithms consist of exploration and exploitation the imbalance between these stages causes serious problems for metaheuristic algorithms which are immature convergence and stopping in local optima chaos maps with chaotic jumps can save algorithms from being trapped in local optima and lead to convergence toward global optima embedding these maps in the exploration phase exploitation phase or both simultaneously corresponds to three efficient and useful scenarios by creating competition between different modes and increasing diversity in the search space and creating sudden jumps in the search phase improvements are achieved for chaotic algorithms four chaotic algorithms including chaotic cyclical parthenogenesis algorithm chaotic water evaporation optimization chaotic tug of war optimization and chaotic thermal exchange optimization are developed

Chaotic Meta-Heuristic Algorithms for Optimal Design of Structures 2024-05-06 chaotic dynamics and fractals covers the proceedings of the 1985 conference on chaotic dynamics held at the georgia institute of technology this conference deals with the research area of chaos dynamical systems and fractal geometry this text is organized into three parts encompassing 16 chapters the first part describes the nature of chaos and fractals the geometric tool for some strange attractors and other complicated sets of data associated with chaotic systems this part also considers the henon hiles hamiltonian with complex time a henon family of maps from c2 into itself and the idea of turbulent maps in the course of presenting results on iteration of continuous maps from the unit interval to itself the second part discusses complex analytic dynamics and associated fractal geometry specifically the bursts into chaos algorithms for obtaining geometrical and combinatorial information and the parameter space for iterated cubic polynomials this part also examines the differentiation of julia sets with respects to a parameter in the associated rational map permitting the formulation of taylor series expansion for the sets the third part highlights the applications of chaotic dynamics and fractals this book will prove useful to mathematicians physicists and other scientists working in or introducing themselves to the field

Chaotic Dynamics and Fractals 2014-05-10 the subject of chaos has invaded practically every area of the natural sciences weather patterns are referred to as chaotic there are chemical reactions and chaotic evolution of insect populations atomic and molecular physics have also seen the emergence of the study of chaos in these microscopic domains this book examines the issue of chaos in nonlinear and dynamical systems quantum mechanics biology and economics

Research Advances in Chaos Theory 2020-03-11 this book highlights the solution algorithms and characteristic analysis methods of fractional order chaotic systems fractal dimensions exist broadly in the study of nature and the development of science and technology fractional calculus has become a hot research area in nonlinear science fractional order chaotic systems are an important part of fractional calculus the book discusses the numerical solution algorithms and characteristic analysis of fractional order chaotic systems and introduces the techniques to implement the systems with circuits to facilitate a quick grasp the authors present examples from their years of work in the appendix intended for graduate students and researchers interested in chaotic systems the book helps one to build a theoretical and experimental foundation for the application of fractional order chaotic systems

Solution and Characteristic Analysis of Fractional-Order Chaotic Systems 2022-09-04 the author first introduces the basic framework for cultural algorithms and he then explains the social structure of a cultural system as a mechanism for the distribution of problem solving information throughout a population three different models for social organizations are presented the homogeneous nuclear family heterogeneous expanded family and subculture descent groups social models the chapters that follow compare the learning capabilities of these social organizations relative to problems of varying complexity the book concludes with a discussion of how the results can impact our understanding of social evolution

Culture on the Edge of Chaos 2018-05-02 the 1960s were perhaps a decade of confusion when scientists faced d culties in dealing with imprecise information and complex dynamics

a new set theory and then an in nite valued logic of lot a zadeh were so c fusing that they were called fuzzy set theory and fuzzy logic a deterministic system found by e n lorenz to have random behaviours was so unusual that it was lately named a chaotic system just like irrational and imaginary numbers negative energy anti matter etc fuzzy logic and chaos were gr ually and eventually accepted by many if not all scientists and engineers as fundamental concepts theories as well as technologies in particular fuzzy systems technology has achieved its maturity with widespread applications in many industrial commercial and technical elds ranging from control automation and arti cial intelligence to image signal processing patternrecognition andelectroniccommerce chaos ontheother hand wasconsideredoneofthethreemonumentaldiscoveriesofthetwentieth century together with the theory of relativity and quantum mechanics as a very special nonlinear dynamical phenomenon chaos has reached its current outstanding status from being merely a scienti c curiosity in the mid 1960s to an applicable technology in the late 1990s finding the intrinsic relation between fuzzy logic and chaos theory is certainlyofsigni cantinterestandofpotentialimportance thepast20years have indeed witnessed some serious explorations of the interactions between fuzzylogicandchaostheory leadingtosuchresearchtopicsasfuzzymodeling of chaotic systems using takagi sugeno models linguistic descriptions of chaotic systems fuzzy control of chaos and a combination of fuzzy control technology and chaos theory for various engineering practices

Integration of Fuzzy Logic and Chaos Theory 2008-07-21 for computer scientists especially those in the security field the use of chaos has been limited to the computation of a small collection of famous but unsuitable maps that offer no explanation of why chaos is relevant in the considered contexts discrete dynamical systems and chaotic machines theory and applications shows how to make finite mac

Bifurcation and Chaos 1991-04-01 this brief studies the general problem of constructing digital chaotic systems in devices with finite precision from low dimensional to high dimensional settings and establishes a general framework for composing them the contributors demonstrate that the associated state networks of digital chaotic systems are strongly connected they then further prove that digital chaotic systems satisfy devaney s definition of chaos on the domain of finite precision the book presents lyapunov exponents as well as implementations to show the potential application of digital chaotic systems in the real world the authors also discuss the basic advantages and practical benefits of this approach the authors explore the solutions to dynamic degradation including short cycle length decayed distribution and low linear complexity by proposing novel modelling methods and hardware designs for two different one dimensional chaotic systems which satisfy devaney s definition of chaos they then extend it to a higher dimensional digital domain chaotic system which has been used in image encryption technology this ensures readers do not encounter large differences between actual and theoretical chaotic orbits through small errors digital chaotic systems serves as an up to date reference on an important research topic for researchers and students in control science and engineering computing mathematics and other related fields of study

Dimensions and Entropies in Chaotic Systems 1985 the book begins with a discussion contrasting the idealized reversibility of basic physics against the pragmatic irreversibility of real life computer models and simulation are next discussed and illustrated simulations provide the means to assimilate concepts through worked out examples state of the art analyses from the point of view of dynamical systems are applied to many body examples from nonequilibrium molecular dynamics and to chaotic irreversible flows from finite difference finite element and particle based continuum simulations two necessary concepts from dynamical systems theory fractals and lyapunov instability are fundamental to the approach undergraduate level physics calculus and ordinary differential equations are sufficient background for a full appreciation of this book which is intended for advanced undergraduates graduates and research workers

Discrete Dynamical Systems and Chaotic Machines 2013-06-07 chaos and nonlinear dynamics initially developed as a new emergent field with its foundation in physics and applied mathematics the highly generic interdisciplinary quality of the insights gained in the last few decades has spawned myriad applications in almost all branches of science and technology and even well beyond wherever quantitative modeling and analysis of complex nonlinear phenomena is required chaos theory and its methods can play a key role this third volume concentrates on reviewing further relevant contemporary applications of chaotic nonlinear systems as they apply to the various cutting edge branches of engineering this encompasses but is not limited to topics such fluctuation relations and chaotic dynamics in physics fractals and their applications in epileptic seizures as well as chaos synchronization featuring contributions from active and leading research groups this collection is ideal both as a reference and as a recipe book full of tried and tested successful engineering applications

Design of Digital Chaotic Systems Updated by Random Iterations 2018-02-23 the previous edition of this text was the first to provide a quantitative introduction to chaos and nonlinear dynamics at the undergraduate level it was widely praised for the clarity of writing and for the unique and effective way in which the authors presented the basic ideas these same qualities characterize this revised and expanded second edition interest in chaotic dynamics has grown explosively in recent years applications to practically every scientific field have had a far reaching impact as in the first edition the authors present all the main features of chaotic dynamics using the damped driven pendulum as the primary model this second edition includes additional material on the analysis and characterization of chaotic data and applications of chaos this new edition of chaotic dynamics can be used as a text for courses on chaos for physics and engineering students at the second and third year level

Time Reversibility, Computer Simulation, Algorithms, Chaos 2012 this book is primarily concerned with the computational aspects of predictability of dynamical systems in particular those where observation modeling and computation are strongly interdependent unlike with physical systems under control in laboratories for instance in celestial mechanics one is confronted with the observation and modeling of systems without the possibility of altering the key parameters of the objects studied therefore the numerical simulations offer an

essential tool for analyzing these systems with the widespread use of computer simulations to solve complex dynamical systems the reliability of the numerical calculations is of ever increasing interest and importance this reliability is directly related to the regularity and instability properties of the modeled flow in this interdisciplinary scenario the underlying physics provide the simulated models nonlinear dynamics provides their chaoticity and instability properties and the computer sciences provide the actual numerical implementation this book introduces and explores precisely this link between the models and their predictability characterization based on concepts derived from the field of nonlinear dynamics with a focus on the finite time lyapunov exponents approach the method is illustrated using a number of well known continuous dynamical systems including the contopoulos hénon heiles and rössler systems to help students and newcomers quickly learn to apply these techniques the appendix provides descriptions of the algorithms used throughout the text and details how to implement them in order to solve a given continuous dynamical system

Applications of Chaos and Nonlinear Dynamics in Science and Engineering - Vol. 3 2013-06-12 this book gives an exposition of the exciting field of control of oscillatory and chaotic systems which has numerous potential applications in mechanics laser and chemical technologies communications biology and medicine economics ecology etc a novelty of the book is its systematic application of modern nonlinear and adaptive control theory to the new class of problems the proposed control design methods are based on the concepts of lyapunov functions poincare maps speed gradient and gradient algorithms the conditions which ensure such control goals as an excitation or suppression of oscillations synchronization and transformation from chaotic mode to the periodic one or vice versa are established the performance and robustness of control systems under disturbances and uncertainties are evaluated the described methods and algorithms are illustrated by a number of examples including classical models of oscillatory and chaotic systems coupled pendula brusselator lorenz van der pol duffing henon and chua systems practical examples from different fields of science and technology such as communications growth of thin films synchronization of chaotic generators based on tunnel diods stabilization of swings in power systems increasing predictability of business cycles are also presented the book includes many results on nonlinear and adaptive control published previously in russian and therefore were not known to the west researchers teachers and graduate students in the fields of electrical and mechanical engineering physics chemistry biology economics will find this book most useful applied mathematicians and control engineers from various fields of technology dealing with complex oscillatory systems will also benefit from it

Chaotic Dynamics 1996 this volume contains the proceedings of a conference held in wiirzburg august 20 24 1990 the theme of the conference was bifurcation and chaos analysis algorithms ap plications more than 100 scientists from 21 countries presented 80 contributions many of the results of the conference are described in the 49 refereed papers that follow the conference was sponsored by the deutsche forschungsgemeinschaft and by the deutscher akademischer austauschdienst we gratefully acknowledge the support from these agen cies the science of nonlinear phenomena is evolving rapidly over the last 10 years the emphasis has been gradually shifting how trends vary may be seen by comparing these proceedings with previous ones in particular with the conference held in dortmund 1986 proceedings published in isnm 79 concerning the range of phenomena chaos has joined the bifurcation scenarios as expected the acceptance of chaos is less emotional among professionals than it has been in some popular publications a nalytical methods appear to have reached a state in which basic results of singularities symmetry groups or normal forms are everyday experience rather than exciting news similarly numerical algorithms for frequent situations are now well established implemented in several packages such algorithms have become standard means for attacking nonlinear problems the sophisti cation that analytical and numerical methods have reached supports the vigorous trend to more and more applications pioneering equations as those named after duffing van der pol or lorenz are no longer exclusively the state of art

Predictability of Chaotic Dynamics 2017-03-27 evolutionary algorithms constitute a class of well known algorithms which are designed based on the darwinian theory of evolution and mendelian theory of heritage they are partly based on random and partly based on deterministic principles due to this nature it is challenging to predict and control its performance in solving complex nonlinear problems recently the study of evolutionary dynamics is focused not only on the traditional investigations but also on the understanding and analyzing new principles with the intention of controlling and utilizing their properties and performances toward more effective real world applications in this book based on many years of intensive research of the authors is proposing novel ideas about advancing evolutionary dynamics towards new phenomena including many new topics even the dynamics of equivalent social networks in fact it includes more advanced complex networks and incorporates them with the cmls coupled map lattices which are usually used for spatiotemporal complex systems simulation and analysis based on the observation that chaos in cml can be controlled so does evolution dynamics all the chapter authors are to the best of our knowledge originators of the ideas mentioned above and researchers on evolutionary algorithms and chaotic dynamics as well as complex networks who will provide benefits to the readers regarding modern scientific research on related subjects

Introduction to Control of Oscillations and Chaos 1998 the study of nonlinear dynamical systems has advanced tremendously in the last 15 years making a big impact on science and technology this book provides all the techniques and methods used in nonlinear dynamics the concepts and underlying mathematics are discussed in detail the numerical and symbolic methods are implemented in c symbolicc and java object oriented techniques are also applied the book contains more than 100 ready to run programs the text has also been designed for a one year course at both the junior and senior levels in nonlinear dynamics the topics discussed in the book are part of e learning and distance learning courses conducted by the international school for scientific computing request inspection copy

Bifurcation and Chaos: Analysis, Algorithms, Applications 1991-04-01 this book is the first attempt to give a chaotic dynamics interpretation of processes having to do with category formation and pattern recognition by systems possessing simple hardware e g few degrees of freedom it is multidisciplinary in its approach and would be useful to readers from various fields

From Chaos to Order 1986

Dimensions and Entropies in Chaotic Systems 2017-11-25

Evolutionary Algorithms, Swarm Dynamics and Complex Networks 2002-12-30

The Nonlinear Workbook 1991-03-29

Chaos And Information Processing

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