The world conceived at the visual level is constituted not by objects or static forms, but by processes appearing imbued with meaning. As G. Kanizsa stated, at the visual level the line per se does not exist: only the line which enters, goes behind, divides, etc., a line evolving according to a precise holistic context, in comparison with which function and meaning are indissolubly interlinked. Just as the meaning of words is connected with a universe of highly dynamic functions and functional processes which operate syntheses, cancellations, integrations, etc. (a universe which can only be described in terms of symbolic dynamics), in the same way, at the level of vision, we must continuously unravel and construct schemas; we must assimilate and make ourselves available for selection by the co-ordinated information penetrating from external Reality. Lastly, we must interrelate all this with the internal selection mechanisms through a precise “journey” into the regions of intensity. In accordance with these intuitions, we may directly consider, from the more general point of view of contemporary self-organisation theory, the network of meaningful programs living at the level of neural systems as a complex one which articulates and develops, functionally, within a “coupled universe” characterised by the existence of a double selection: external and internal, the latter regarding the universe of meaning. This network gradually posits itself as the basis for the emergence of natural and meaningful forms and the simultaneous, if indirect, surfacing of an “I-subject”- as the basic instrument, in other words, for the perception of real and meaningful processes, of “objects” possessing meaning, aims, intentions, etc.: above all, of biological objects possessing an inner plan and linked to the progressive expression of a specific cognitive action.

This book is an introductory course to accelerator physics at the level of graduate students. It has been written for a large audience which includes users of accelerator facilities, accelerator physicists and engineers, and undergraduates aiming to learn the basic principles of construction, operation, and applications of accelerators. The new concepts of dynamical systems developed in the last twenty years give the theoretical setting to analyse the stability of particle beams in accelerator. In this book a common language to both accelerator physics and dynamical systems is integrated and developed, aiming to eliminate the difficulties faced by accelerator physicists, engineers and applied mathematicians when they try to join efforts in the attempt to control the nonlinearities disturbing particle beams. Contents:Introduction to Accelerator PhysicsEquations of MotionIntroduction to the Qualitative Theory of Nonlinear Differential EquationsDynamics and Stability of Guiding and Focusing. Linear Optics of SynchrotronsNonlinear Motion in the Transverse Plane: SextupolesThe Beam-Beam Interaction Readership: Accelerator physicists, engineers and users of accelerator facilities. keywords: Synchrotron Accelerators; Design of Accelerators; Computer Assisted Design; Stability of Orbits; Dynamic Aperture; Transverse Motion; Longitudinal Motion; Beam-Beam Interaction; Sextupolar Effects; Non-Linear Effects

This book deals with the investigation of global attractors in nonlinear dynamical systems. The exposition proceeds from the simplest attracting sets, the so-called equilibrium to more complicated ones, i.e. to cycles, homoclinic and heteroclinic orbits; and finally, to strange attractors consisting of irregular unstable trajectories. On the complicated equilibria sets, the methods of Lyapunov stability theory are transferred. They are combined with stability techniques specially elaborated for such sets. The results are formulated as frequency-domain criteria. The methods connected with the theories of existence of cycles and homoclinic orbits are developed. The estimates of Hausdorf dimensions of attractors are presented.

A number of well-known theorems of the hydrodynamic theory of stability are interpreted in terms of the interaction of the waves having different energy signs. Attention is drawn to the plasma-hydrodynamic analogy, which is a powerful tool for physical analyses of general mechanisms of wave amplification and absorption in flows. Various wave-flow interaction problems are considered, for instance, sound generation in whisters, wave scattering and amplification by vortices, methods of wave remote sounding, and some nonlinear dynamical and chaotic phenomena.

The world that surrounds us is a complex system of interacting objects. The versatility of the links and interactions brings about the infinite multiplicity of natural phenomena. Synergetics studies nonlinear nonequilibrium processes and self-organization phenomena, allowing for description, systematization, and generalization of the phenomena that are described by the different branches of natural science: physics, chemistry, biology, and as well as sociology and economics. This book introduces the reader to the exciting world of the nonlinear phenomena that are studied in synergetics. The book comprises treatises on mathematical methods for the study of nonequilibrium processes and presents versatile phenomena studied in synergetics: multiflucity, self-oscillation, spatial stratification, autowaves, kinetic phase transitions and chaos. Examples of self-organization in physics, chemistry, biology covered in this volume include laser generation, optical bistability, self-oscillations in semiconductors and chemical reactions, spatial stratification in hydrodynamics and in crystals, auto-waves in semiconductors and nerve fibers and many other phenomena. The majority of the phenomena considered occur in physics but the book is also useful for chemists and biologists.

The editors felt that the time was right for a book on an important topic, the history and development of the notions of chaotic attractors and their “natural” invariant measures. We wanted to bring together a coherent collection of readable, interesting, outstanding papers for detailed study and comparison. We hope that this book will allow serious graduate students to hold seminars to study how the research in this field developed. Limitation of space forced us painfully to exclude many excellent, relevant papers, and the resulting choice reflects the interests of the editors. Since James Alan Yorke was born August 3, 1941, we chose to have this book commemorate his sixtieth birthday, honoring his research in this field. The editors are four of his collaborators. We would particularly like to thank Achi Dosanjh (senior editor math ematics), Elizabeth Young (assistant editor mathematics), Joel Ariaratnam (mathematics editorial), and Yong-Soon Hwang (book production editor) from Springer Verlag in New York for their efforts in publishing this book.

John Cage: Composed in America is the first book-length work to address the “other” John Cage, a revisionist treatment of the way Cage
himself has composed and been “composed” in America. Cage, as these original essays testify, is a contradictory figure. A disciple of Duchamp and Schoenberg, Satie and Joyce, he created compositions that undercut some of these artists’ central principles and then attracted rationalist thought that came to define the so-called Americanization of the Bernstein tradition.” An American in the composition-theorized mold, he paradoxically won his biggest audience in Europe. A freewheeling, Californian artist, Cage was committed to a severe work ethic and a firm discipline, especially the discipline of Zen Buddhism.

Authoritative and visionary, this festchrift features 12 highly readable expositions of virtually all currently active aspects of nonlinear science. It has been painstakingly researched and written by leading scientists and eminent expositors, including I. Shilnikov, R. Seydel, I. Prigogine, W. Porod, C. Mira, M. Lakshmanan, W. Lauterborn, A. Holden, H. Haken, C. Grebogi, E. Doedel and I. Chua; each chapter addresses a current and intensively researched area of nonlinear science and chaos, including nonlinear dynamics, mathematics, numerics and technology. Handsomely produced with high resolution color graphics for enhanced readability, this book has been carefully written at a high level of exposition and is somewhat self-contained. Each chapter includes a tutorial and background information, as well as a survey of each area’s main results and state of the art. Of special interest to both beginners and seasoned researchers is the identification of future trends and challenging yet tractable problems that are likely to be solved before the end of the 21st century. The visionary and provocative nature of this book makes it a valuable and lasting reference. Contents:Chua’s Circuit and the Qualitative Theory of Dynamical Systems (C. Mira)Nonlinear Science and the Laws of Nature (I. Prigogine)Visions of Synergetics (H. Haken)Mathematical Problems of Nonlinear Dynamics: A Tutorial (I. Shilnikov)Experimental Nonlinear Physics (W. Lauterborn et al.)Nonlinear Physics: Integrability, Chaos and Beyond (M. Lakshmanan)Nonlinear Science: The Impact of Biology (A. V. Holden)Nonlinear Computation (R. Seydel)Nonlinear Numerics (E. Doedel)Some Historical Aspects of Nonlinear Dynamics: Possible Trends for the Future (C. Mira)Control and Applications of Chaos (C. Grebogi et al.)Quantum Dot Devices and Quantum-Dot Cellular Automata (W. Porod)CNN: A Paradigm for Complexity (I. Chua)Readership: Nonlinear scientists. Keywords:Chua’s Circuit; Qualitative Theory; Dynamical Systems; Nonlinear Science; Laws of Nature; Visions of Synergetics; Experimental Nonlinear Physics; Nonlinear Dynamics; Nonlinear Physics; Integrability; Chaos; Nonlinear Computation; Nonlinear Numerics; Control of Chaos; Applications of Chaos; Quantum Dot Devices; Quantum-Dot Cellular Automata; CNN; Cellular Neural Networks

The book covers the fundamentals of the mechanics of multibody systems, i.e., systems of interconnected rigid bodies. A geometric view is emphasized in which the techniques and algorithms are motivated by the picture of the rigid body system as a point in the multidimensional space of all possible configurations. The reader is introduced to computer algebra methods in the form of a system, called Sophie, which is implemented in the Maple symbolic manipulation system. The first chapter provides a motivational introduction to the basic principles and an introduction to kinematics based on the idea of tangent vectors to the configuration manifold sets the stage for dynamical analysis. The latter ranges from the Lagrange and Gibbs-Appell to Kane’s equations. Coverage includes nonholonomic systems and redundant variable methods. The computer algebra methods included enable the treatment of nontrivial mechanical systems and the development of efficient numerical codes for simulation.

At what level of physical existence does “quantum behavior” begin? How does it develop from classical mechanics? This book addresses these questions and thereby sheds light on fundamental conceptual problems of quantum mechanics. It elucidates the problem of quantum-classical correspondence by developing a procedure for quantizing stochastic systems (e.g. Brownian systems) described by Fokker-Planck equations. The logical consistency of the scheme is then verified by taking the classical limit of the equations of motion and corresponding physical quantities. Perhaps equally important, conceptual problems concerning the relationship between classical and quantum physics are identified and discussed. Graduate students and physical scientists will find this an accessible entrée to an intriguing and thorny issue at the core of modern physics.

Revolutionary and original, this treatise presents a new paradigm of Emergence and Complexity, with applications drawn from numerous disciplines, including artificial life, biology, chemistry, computation, physics, image processing, information science, etc. CNN is an acronym for Cellular Neural Networks when used in the context of brain science, or Cellular Nonlinear Networks, when used in the context of emergence and complexity. A CNN is modeled by cells and interactions: cells are defined as dynamical systems and interactions are defined via coupling laws. The CNN paradigm is a universal Turing machine and includes cellular automata and lattice dynamical systems as special cases. While the CNN paradigm is an example of Reductionism par excellence, the true origin of emergence and complexity is traced to a much deeper new concept called local activity. The numerous complex phenomena unified under this mathematically precise principle include self organization, dissipative structures, synergetics, order from disorder, far-from-thermodynamic equilibrium, collective behaviors, edge of chaos, etc. Written with a high level of exposition, this completely self-contained monograph is profusely illustrated with over 200 stunning color illustrations of emergent phenomena.

This book is devoted to the frequency domain approach, for both regular and degenerate Hopf bifurcation analyses. Besides showing that the time and frequency domain approaches are in fact equivalent, the fact that many significant results and computational formulas obtained in the frequency domain approach can be directly translated and reformulated to the corresponding time domain setting, and be reconfirmed and rediscovered by using the frequency domain methods, is also explained. The description of how the frequency domain approach can be used to obtain several types of standard bifurcation conditions for general nonlinear dynamical systems is given as well as demonstrated a very rich pictorial gallery of local bifurcation diagrams for nonlinear systems under simultaneous variations of several system parameters. In conjunction with this graphical analysis of local bifurcation diagrams, the defining and nondegeneracy conditions for several degenerate Hopf bifurcations is presented. With a great deal of algebraic computation, some higher-order harmonic balance approximation formulas are derived, for analyzing the dynamical behavior in small neighborhoods of certain types of degenerate Hopf bifurcations that involve multiple limit cycles and multiple limit points of periodic solutions. In addition, applications in chemical, mechanical and electrical engineering as well as in biology are discussed. This book is designed and written in a style of research monographs rather than classroom textbooks, so that the most recent contributions to the field can be included with references.

Offers Both Standard and Novel Approaches for the Modeling of Systems Examines the Interesting Behavior of Particular Classes of Models Assumes a comprehensive coverage of Chaotic Modelling and Simulation: Analysis of Chaotic Models, Attractors and Forms presents the main models developed by pioneers of chaos theory, along with new extensions and variations of these models. Using more than 500 graphs and illustrations, the authors show how to design, estimate, and test an array of models. Requiring little prior knowledge of mathematics, the book focuses on classical forms and attractors as well as new simulation methods and techniques. Ideas clearly progress from the most elementary to the most advanced. The authors cover deterministic, stochastic, logistic, Gaussian, delay, Hénon, Holmes, Lorenz, Rössler, and rotation models. They also look at chaotic analysis as a tool to design forms that appear in physical systems; simulate complicated and chaotic orbits and paths in the solar system; explore the Hénon-Heiles, Contopoulos, and Hamiltonian systems; and provide a compilation of interesting systems and variations of systems, including the very intriguing Lotha-Voltaire system. Making a complex topic accessible through a visual and geometric style, this book should inspire new developments in the field of chaotic models and encourage more readers to become involved in this rapidly developing area.

The interrelated essays in this book explore the coming together of ethics and poetics in literatures that engage with their contemporary moments to become wagers on the future of meaning. The central concern of The Poetical Wager is the relation of poetics to agency in a chaotic world.

How do scientists look at chance, or randomness, and chaos in physical systems? In answering this question for a general audience, Ruelle writes in the best French tradition: he has produced an authoritative and elegant book—a model of clarity, succinctness, and a humor bordering at times on the sardonic.
This book offers a unique multidisciplinary integration of the physics of turbulence and remote sensing technology. Remote Sensing of Turbulence provides a new vision on the research of turbulence and summarizes the current and future challenges of monitoring turbulence remotely. The book emphasizes sophisticated geophysical applications, detection, and recognition of complex turbulent flows in oceans and the atmosphere. Through several techniques based on microwave and optical/IR observations, the text explores the technological capabilities and tools for the detection of turbulence, their signatures, and variability. FEATURES: Covers the fundamental aspects of turbulence problems with a broad geographical scope for a wide audience of readers Provides a complete description of remote-sensing capabilities for observing turbulence in the earth’s environment Establishes the state-of-the-art in remote-sensing techniques and methods of data analysis for turbulence detection, measurement, and evaluation summarizes their properties, and variability Provides cutting-edge remote-sensing applications for space-based monitoring and forecasts of turbulence in oceans and the atmosphere This book is a great resource for applied physicists, the professional remote sensing community, ecologists, geophysicists, and earth scientists.

The growing interest in prepositions is reflected by this impressive collection of papers from leading scholars of various fields. The selected contributions of Prepositions in their Syntactic, Semantic and Pragmatic Context focus on the local and temporal semantics of prepositions in relation to their context, too. Following an introduction which puts this new approach into a thematic and historical perspective, the volume presents fifteen studies in the following areas: The semantics of space dynamics (mainly on French prepositions). Language acquisition (applying: Artificial intelligence (mainly of English prepositions)); Specific languages: Hebrew (from a number of perspectives — syntax, semiotics, and sociolinguistic impact on morphology), Maltese, the Melanesian English-based Creole Bislama, and Biblical translations into Judeo-Greek.

Written by three leaders in the field, Strange Attractors explains how the principles of chaos theory can help mental health professionals arrive at a more profound understanding of the dynamics of one of the most complicated non-linear systems - the family. Both a general introduction to chaos theory and a guide to its clinical applications, Strange Attractors details various chaos-based approaches to the assessment and treatment of families.

This book is essentially devoted to complex properties (Phase plane structure and bifurcations) of two-dimensional noninvertible maps, i.e. maps having either a nonunique inverse or no inverse at all. A different approach is taken in the study of discrete dynamical systems encountered in Engineering (Control, Signal Processing, Electronics), Physics, Economics, Life Sciences. Compared to the studies made in the one-dimensional case, the two-dimensional situation remained a long time in an underdeveloped state. It is only since these last years that the interest for this research has increased. Therefore the book purpose is to give a global presentation of a matter, available till now only in a partial form. Fundamental notions and tools (such as "critical manifolds"), as the most part of results, are accompanied by many examples and figures. Contents: Generalities on Dynamic Systems and MapsOne-Dimensional Noninvertible Maps: Properties of Critical CurvesAbsorbing Areas and Chaotic Areas of Two-Dimensional Noninvertible MapsBasins and Their BifurcationsOn Some Properties of Invariant Sets of Two-Dimensional Noninvertible Maps Readership: Nonlinear scientists, engineers and physicists. keywords:Noninvertible Maps;Multiple Preimages;Critical Curves;Plane Foliation;Absorbing Areas;Chaotic Areas;Invariant Sets;Disconnected Basins;Multiply connected Basins;Bifurcations involving Critical Sets

This volume includes contributions from diverse disciplines including electrical engineering, biomedical engineering, industrial engineering, and psychology, bridging a vital gap between the mathematical sciences and neuroscience research. Covering a wide range of research topics, this book demonstrates how various methods from data mining, signal processing, optimization and cutting-edge medical techniques can be used to tackle the most challenging problems in modern neuroscience.

Military conflicts, particularly land combat, possess the characteristics of complex adaptive systems: combat forces are composed of a large number of nonlinearly interacting parts and are organized in a dynamic command-and-control network; local action, which often appears disorganized, self-organizes into long-range order; military conflicts, by their nature, proceed far from equilibrium; military forces adapt to a changing combat environment; and there is no master voice that dictates the actions of every soldier (i)

Contents: General Description of Impulsive Differential SystemsLinear SystemsStability of SolutionsPeriodic and Almost Periodic Impulsive SystemsIntegral Sets of Impulsive SystemsOptimization Control in Impulsive SystemsAsymptotic Study of Oscillations in Impulsive SystemsA Periodic and Almost Periodic Impulsive SystemsBibliographySubject Index Readership: Researchers in nonlinear science. keywords:Differential Equations with Impulses;Linear Systems;Stability;Periodic and Quasi-Periodic Solutions;Integral Sets;Optimal Control...

This book is devoted to the frequency domain approach, for both regular and degenerate Hopf bifurcation analyses. Besides showing that the time and frequency domain approaches are in fact equivalent, the fact that many significant results and computational formulas obtained in the studies of regular and degenerate Hopf bifurcations from the time domain approach can be translated and reformulated into the corresponding frequency domain setting, and be reconfirmed and rediscovered by using the frequency domain methods, is also explained. The description of how the frequency domain approach can be used to obtain several types of standard bifurcation conditions for general dynamical systems is given as well as is demonstrated a very rich pictorial gallery of local bifurcation diagrams for nonlinear systems under simultaneous variations of several system parameters. In conjunction with this graphical analysis of local bifurcation diagrams, explicit formulas for so Hopf bifurcations frequency, amplitude, and phase are given. With the aid of computer aided symbolic-computations, some higher-order harmonic balance approximation formulas are derived, for analyzing the dynamical behavior in small neighborhoods of certain types of degenerate Hopf bifurcations that involve multiple limit cycles and multiple limit points of periodic solutions. In addition, applications in chemical, mechanical and electrical engineering as well as in biology are discussed. This book is designed and written in a style of research monographs rather than classroom textbooks, so that the most recent contributions to the field can be included with references. Contents: IntroductionThe Hopf Bifurcation TheoremContinuation of Bifurcation Curves on the Parameter PlaneDegenerate Bifurcations in the Space of System ParametersHigh-Order Hopf Bifurcation FormulasHopf Bifurcation in Nonlinear Systems with Time DelaysBirth of Multiple Limit CyclesAppendixReferencesArthur IndexSubject Index Readership: Nonlinear scientists, applied mathematicians, and systems engineers. keywords:Bifurcation;Harmonic Balance Approximation;Graphical Hopf Bifurcation;Degenerate Hopf Bifurcation;Multiple Limit Cycles;Hopf;Frequency;Harmonic Balance;Feedback;Oscillations;Nonlinear;Delay;Limit Cycles;Degenerate Bifurcations

Several turbulent and nonturbulent solutions of the Navier-Stokes equations are obtained. The unaveraged equations are used numerically in conjunction with tools and concepts from nonlinear dynamics, including time series, phase portraits, Poincare sections, Liapunov exponents, power spectra, and strange attractors. Initially neighboring solutions for a low-Reynolds-number fully developed turbulence are compared. The turbulence is sustained by a nonrandom time-independent external force. The solutions, on the average, separate exponentially with time, having a positive Liapunov exponent. Thus, the turbulence is characterized as chaotic. In a search for solutions which contrast with the turbulent ones, the Reynolds number (or strength of the forcing) is reduced. Several qualitatively different flows are noted. These are
respectively, fully chaotic, complex periodic, weakly chaotic, simple periodic, and fixed-point. Of these, we classify only the fully chaotic flows as turbulent. These flows have both a positive Liapunov exponent and Poincare sections without pattern. By contrast, the weakly chaotic flows, positive Liapunov exponents, have some pattern in their Poincare sections. The fixed-point and periodic flows are nonturbulent, since turbulence, as generally understood, is both time-dependent and aperiodic. Deissler, Robert G. Glenn Research Center RTOP 503-90-53

Cellular automata provide one of the most interesting avenues into the study of complex systems in general, as well as having an intrinsic interest of their own. Because of their mathematical simplicity and representational robustness they have been used to model economic, political, biological, ecological, chemical, and physical systems. Almost any system which can be treated in terms of a discrete representation space in which the dynamics is based on local interaction rules can be modelled by a cellular automata. The aim of this book is to give an introduction to the cellular automata (CA) in terms of an approach in which CA rules are viewed as elements of a nonlinear operation. The underlying rules can be expressed in terms of ordinary vectors in vector algebra. Although a variety of different topics are covered, this viewpoint provides the underlying theme. The actual mathematics used is not hard, and the material should be accessible to anyone with a junior level university background, and a certain degree of mathematical maturity.

Chaos: The Science of Predictable Random Motion bridges the gap between introductions for the layman and college-level texts with an account of chaos theory based on elementary mathematics. It develops the science of dynamics in terms of small time steps, describes the phenomenon of chaos through simple examples, and concludes with a close look at a homoclinic tangle, the mathematical monster at the heart of chaos. The presentation is enhanced by numerous figures, animations of chaotic motion (available on a companion CD), and biographical sketches of the pioneers of dynamics and chaos theory.

In the past hundred years investigators have learned the significance of chaos and randomness in biological and physical phenomena. This book pursues the ambitious goal to bring together an extensive body of knowledge regarding complex dynamics from various academic disciplines. Beyond its focus on economics and finance, including for instance the evolution of macroeconomic growth models towards nonlinear structures as well as signal processing applications to stock markets, fundamental parts of the book are devoted to the use of nonlinear dynamics in mathematics, statistics, signal theory and processing.

The equations which we are going to study in these notes were first presented in 1963 by E. N. Lorenz. They define a three-dimensional system of ordinary differential equations that depends on three real positive parameters. As we vary the parameters, we change the behaviour of the flow determined by the equations. For some parameter values, numerically computed solutions of the equations oscillate, apparently forever, in the pseudo-random way we now call “chaotic”; this is the main reason for the immense amount of interest generated by the equations in the eighteen years since Lorenz first presented them. In addition, there are some parameter values for which we see “preturbulence”, a phenomenon in which trajectories oscillate chaotically for long periods of time before finally settling down to stable stationary or stable periodic behaviour, others in which we see “intermittent chaos”, where trajectories alternate between chaotic and apparently stable periodic behaviour, and yet others in which we see “noisy periodicity”, where trajectories appear chaotic though they stay very close to a non-stable periodic orbit. Though the Lorenz equations were not much studied in the years between 1963 and 1975, the number of man, woman, and computer hours spent on them in recent years — since they came to the general attention of mathematicians and other researchers — must be truly immense.

Although multifractals are rooted in probability, much of the related literature comes from the physics and mathematics arena. Multifractals: Theory and Applications pulls together ideas from both these areas using a language that makes them accessible and useful to statistical scientists. It provides a framework, in particular, for the evaluation of results which are obtained by various authors.
side, the tool of choice is the qualitative theory of dynamical systems — most importantly bifurcation theory, which describes the dependence of a system on the parameters. This approach allows one to find general patterns of behavior that are expected to be observed in ecological models. Of special interest is the reaction of a given model to disturbances of its present state, as well as to changes in the external conditions. This leads to the general idea of “dangerous boundaries” in the state and parameter space of an ecological system. The study of these boundaries allows one to analyze and predict qualitative and often sudden changes of the dynamics — a much-needed tool, given the increasing anthropogenic load on the biosphere. As a spin-off from this approach, the book can be used as a guided tour of bifurcation theory from the viewpoint of application. The interested reader will find a wealth of intriguing examples of how known bifurcations occur in applications. The book can in fact be seen as bridging the gap between mathematical biology and bifurcation theory.