Spectral Theory Of Dynamical Systems

#spectral theory #dynamical systems #mathematical analysis #nonlinear dynamics #operator theory

Explore the intricate world where Spectral Theory meets Dynamical Systems, a fundamental area in mathematical analysis. This field utilizes spectral properties, such as eigenvalues and eigenvectors, to understand the long-term behavior and stability of systems that evolve over time. It's crucial for insights into phenomena ranging from chaos theory to quantum mechanics, providing tools to predict and describe complex system evolution.

Spectral Theory of Dynamical Systems

This book discusses basic topics in the spectral theory of dynamical systems. It also includes two advanced theorems, one by H. Helson and W. Parry, and another by B. Host. Moreover, Ornstein’s family of mixing rank-one automorphisms is given with construction and proof. Systems of imprimitivity and their relevance to ergodic theory are also examined. Baire category theorems of ergodic theory, scattered in literature, are discussed in a unified way in the book. Riesz products are introduced and applied to describe the spectral types and eigenvalues of rank-one automorphisms. Lastly, the second edition includes a new chapter “Calculus of Generalized Riesz Products”, which discusses the recent work connecting generalized Riesz products, Hardy classes, Banach's problem of simple Lebesgue spectrum in ergodic theory and flat polynomials.

Spectral Theory of Dynamical Systems

This book treats some basic topics in the spectral theory of dynamical systems, where by a dynamical system we mean a measure space on which a group of automorphisms acts preserving the sets of measure zero. The treatment is at a general level, but even here, two theorems which are not on the surface, one due to H. Helson and W. Parry and the other due to B. Host are presented. Moreover non singular automorphisms are considered and systems ofimprimitivity are discussed. and they are used to describe Riesz products, suitably generalised, are considered the spectral types and eigenvalues of rank one automorphisms. On the other hand topics such as spectral characterisations of various mixing conditions, which can be found in most texts on ergodic theory, and also the spectral theory of Gauss Dynamical Systems, which is very well presented in Cornfeld, Fomin, and Sinai's book on Ergodic Theory, are not treated in this book. A number of discussions and correspondence on email with El Abdalaoui El Houcein made possible the presentation of mixing rank one construction of D. S. Ornstein. Iam deeply indebted to G. R. Goodson. He has edited the book and suggested a number of corrections and improvements in both content and language.

Spectral Theory of Dynamical Systems

This volume mainly deals with the dynamics of finitely valued sequences, and more specifically, of sequences generated by substitutions and automata. Those sequences demonstrate fairly simple combinatorical and arithmetical properties and naturally appear in various domains. As the title suggests, the aim of the initial version of this book was the spectral study of the associated dynamical systems: the first chapters consisted in a detailed introduction to the mathematical notions involved, and the description of the spectral invariants followed in the closing chapters. This approach, combined with new material added to the new edition, results in a nearly self-contained book on the subject. New tools - which have also proven helpful in other contexts - had to be developed for this study. Moreover, its findings can be concretely applied, the method providing an algorithm to exhibit the spectral measures and the spectral multiplicity, as is demonstrated in several examples. Beyond this advanced analysis, many readers will benefit from the introductory chapters on the spectral theory of dynamical systems; others will find complements on the spectral study of bounded sequences; finally, a very basic presentation of substitutions, together with some recent findings and questions, rounds out the book.

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Substitution Dynamical Systems - Spectral Analysis

This book presents in a concise and accessible way, as well as in a common setting, various tools and methods arising from spectral theory, ergodic theory and stochastic processes theory, which form the basis of and contribute interactively a great deal to the current research on almost-everywhere convergence problems. Researchers working in dynamical systems and at the crossroads of spectral theory, ergodic theory and stochastic processes will find the tools, methods, and results presented in this book of great interest. It is written in a style accessible to graduate students.

Substitution Dynamical Systems - Spectral Analysis

The first part of this work gives an introduction into aperiodic order in general and the lines of research pursued. The second part consists of eight manuscripts.

Dynamical Systems and Processes

Nobel prize winner Ilya Prigogine writes in his preface: "Irreversibility is a challenge to mathematics...[which] leads to generalized functions and to an extension of spectral analysis beyond the conventional Hilbert space theory." Meeting this challenge required new mathematical formulations-obstacles met and largely overcome thanks primarily to the contributors to this volume." This compilation of works grew out of material presented at the "Hyperfunctions, Operator Theory and Dynamical Systems" symposium at the International Solvay Institutes for Physics and Chemistry in 1997. The result is a coherently organized collective work that moves from general, widely applicable mathematical methods to ever more specialized physical applications. Presented in two sections, part one describes Generalized Functions and Operator Theory, part two addresses Operator Theory and Dynamical Systems. The interplay between mathematics and physics is now more necessary than ever-and more difficult than ever, given the increasing complexity of theories and methods.

Aspects of Aperiodic Order: Spectral Theory Via Dynamical Systems

The series is devoted to the publication of monographs and high-level textbooks in mathematics, mathematical methods and their applications. Apart from covering important areas of current interest, a major aim is to make topics of an interdisciplinary nature accessible to the non-specialist. The works in this series are addressed to advanced students and researchers in mathematics and theoretical physics. In addition, it can serve as a guide for lectures and seminars on a graduate level. The series de Gruyter Studies in Mathematics was founded ca. 35 years ago by the late Professor Heinz Bauer and Professor Peter Gabriel with the aim to establish a series of monographs and textbooks of high standard, written by scholars with an international reputation presenting current fields of research in pure and applied mathematics. While the editorial board of the Studies has changed with the years, the aspirations of the Studies are unchanged. In times of rapid growth of mathematical knowledge carefully written monographs and textbooks written by experts are needed more than ever, not least to pave the way for the next generation of mathematicians. In this sense the editorial board and the publisher of the Studies are devoted to continue the Studies as a service to the mathematical community. Please submit any book proposals to Niels Jacob. Titles in planning include Flavia Smarazzo and Alberto Tesei, Measure Theory: Radon Measures, Young Measures, and Applications to Parabolic Problems (2019) Elena Cordero and Luigi Rodino, Time-Frequency Analysis of Operators (2019) Mark M. Meerschaert, Alla Sikorskii, and Mohsen Zayernouri, Stochastic and Computational Models for Fractional Calculus, second edition (2020) Mariusz LemaDczyk, Ergodic Theory: Spectral Theory, Joinings, and Their Applications (2020) Marco Abate, Holomorphic Dynamics on Hyperbolic Complex Manifolds (2021) Miroslava Anti , Joeri Van der Veken, and Luc Vrancken, Differential Geometry of Submanifolds: Submanifolds of Almost Complex Spaces and Almost Product Spaces (2021) Kai Liu, Ilpo Laine, and Lianzhong Yang, Complex Differential-Difference Equations (2021) Rajendra Vasant Gurjar, Kayo Masuda, and Masayoshi Miyanishi, Affine Space Fibrations (2022)

Generalized Functions, Operator Theory, and Dynamical Systems

This monograph contains an in-depth analysis of the dynamics given by a linear Hamiltonian system of general dimension with nonautonomous bounded and uniformly continuous coefficients, without other initial assumptions on time-recurrence. Particular attention is given to the oscillation properties of the solutions as well as to a spectral theory appropriate for such systems. The book contains extensions of results which are well known when the coefficients are autonomous or periodic, as well as in the nonautonomous two-dimensional case. However, a substantial part of the theory presented here is new even in those much simpler situations. The authors make systematic use of basic facts concerning Lagrange planes and symplectic matrices, and apply some fundamental methods of topological dynamics and ergodic theory. Among the tools used in the analysis, which include Lyapunov exponents, Weyl matrices, exponential dichotomy, and weak disconjugacy, a fundamental role is played by the rotation number for linear Hamiltonian systems of general dimension. The properties of all these objects form the basis for the study of several themes concerning linear-quadratic control problems, including the linear regulator property, the Kalman-Bucy filter, the infinite-horizon optimization problem, the nonautonomous version of the Yakubovich Frequency Theorem, and dissipativity in the Willems sense. The book will be useful for graduate students and researchers interested in nonautonomous differential equations; dynamical systems and ergodic theory; spectral theory of differential operators; and control theory.

Substitution Dynamical Systems - Spectral Analysis

This book unifies the dynamical systems and functional analysis approaches to the linear and nonlinear stability of waves. It synthesizes fundamental ideas of the past 20+ years of research, carefully balancing theory and application. The book isolates and methodically develops key ideas by working through illustrative examples that are subsequently synthesized into general principles. Many of the seminal examples of stability theory, including orbital stability of the KdV solitary wave, and asymptotic stability of viscous shocks for scalar conservation laws, are treated in a textbook fashion for the first time. It presents spectral theory from a dynamical systems and functional analytic point of view, including essential and absolute spectra, and develops general nonlinear stability results for dissipative and Hamiltonian systems. The structure of the linear eigenvalue problem for Hamiltonian systems is carefully developed, including the Krein signature and related stability indices. The Evans function for the detection of point spectra is carefully developed through a series of frameworks of increasing complexity. Applications of the Evans function to the Orientation index, edge bifurcations, and large domain limits are developed through illustrative examples. The book is intended for first or second year graduate students in mathematics, or those with equivalent mathematical maturity. It is highly illustrated and there are many exercises scattered throughout the text that highlight and emphasize the key concepts. Upon completion of the book, the reader will be in an excellent position to understand and contribute to current research in nonlinear stability.

Spectral Theory of Canonical Systems

Heat Kernels and Spectral Theory investigates the theory of second-order elliptic operators.

Nonautonomous Linear Hamiltonian Systems: Oscillation, Spectral Theory and Control

Introduces the basic tools in spectral analysis using numerous examples from the Schrödinger operator theory and various branches of physics.

Spectral and Dynamical Stability of Nonlinear Waves

Bringing together 18 chapters written by leading experts indynamical systems, operator theory, partial differential equations,and solid and fluid mechanics, this book presents state-of-the-artapproaches to a wide spectrum of new and challenging stabilityproblems. Nonlinear Physical Systems: Spectral Analysis, Stability andBifurcations focuses on problems of spectral analysis, stabilityand bifurcations arising in the nonlinear partial differentialequations of modern physics. Bifurcations and stability of solitarywaves, geometrical optics stability analysis in hydro- andmagnetohydrodynamics, and dissi-pation-induced instabilities aretreated with the use of the theory of Krein and Pontryagin space,index theory, the theory of multi-parameter eigenvalue problems andmodern asymptotic and perturbative approaches. Each chapter contains mechanical and physical examples, and thecombination of ad-vanced material and more tutorial elements makesthis book attractive for both experts and non-spe-cialists keen toexpand their knowledge on modern methods and trends in stabilitytheory. Contents 1. Surprising Instabilities of Simple Elastic Structures, DavideBigoni, Diego Misseroni, Giovanni Noselli and DanieleZaccaria. 2. WKB Solutions Near an Unstable Equilibrium and Applications,Jean-François Bony, Setsuro Fujiié, Thierry Ramond andMaher Zerzeri, partially supported by French ANR pro-jectNOSEVOL. 3. The Sign Exchange Bifurcation in a Family of Linear HamiltonianSystems, Richard Cushman, Johnathan Robbins and DimitriiSadovskii. 4. Dissipation Effect on Local and Global Flu-id-ElasticInstabilities, Olivier Doaré. 5. Tunneling, Librations and Normal Forms in a Quantum Double Wellwith a Magnetic Field, Sergey Yu. Dobrokhotov and Anatoly Yu.Anikin. 6. Stability of Dipole Gap Solitons in Two-Dimensional LatticePotentials, Nir Dror and Boris A. Malomed. 7. Representation of Wave Energy of a Rotating Flow in Terms of theDispersion Relation, Yasuhide Fukumoto, Makoto Hirota and YouichiMie. 8. Determining the Stability Domain of Perturbed Four-DimensionalSystems in 1:1 Resonance, Igor Hoveijn and Oleg N. Kirillov. 9. Index Theorems for Polynomial Pencils, Richard Kollár andRadomír Bosák. 10. Investigating Stability and Finding New Solutions inConservative Fluid Flows Through Bifurcation Approaches, PaoloLuzzatto-Fegiz and Charles H.K. Williamson. 11. Evolution Equations for Finite Amplitude Waves in ParallelShear Flows, Sherwin A. Maslowe. 12. Continuum Hamiltonian Hopf Bifurcation I, Philip J. Morrisonand George I. Hagstrom. 13. Continuum Hamiltonian Hopf Bifurcation II, George I. Hagstromand Philip J. Morrison. 14. Energy Stability Analysis for a Hybrid Fluid-Kinetic PlasmaModel, Philip J. Morrison, Emanuele Tassi and Cesare Tronci. 15. Accurate Estimates for the Exponential Decay of Semigroups withNon-Self-Adjoint Generators, Francis Nier. 16.

Stability Optimization for Polynomials and Matrices, Michael L.Overton. 17. Spectral Stability of Nonlinear Waves in KdV-Type EvolutionEquations, Dmitry E. Pelinovsky. 18. Unfreezing Casimir Invariants: Singular Perturbations GivingRise to Forbidden Instabilities, Zensho Yoshida and Philip J.Morrison. About the Authors Oleg N. Kirillov has been a Research Fellow at theMagneto-Hydrodynamics Division of the Helmholtz-ZentrumDresden-Rossendorf in Germany since 2011. His research interestsinclude non-conservative stability problems of structural mechanicsand physics, perturbation theory of non-self-adjoint boundaryeigenvalue problems, magnetohydrodynamics, friction-inducedoscillations, dissipation-induced instabilities and non-Hermitianproblems of optics and microwave physics. Since 2013 he has servedas an Associate Editor for the journal Frontiers in MathematicalPhysics. Dmitry E. Pelinovsky has been Professor at McMaster University inCanada since 2000. His research profile includes work withnonlinear partial differential equations, discrete dynamicalsystems, spectral theory, integrable systems, and numericalanalysis. He served as the guest editor of the special issue of thejournals Chaos in 2005 and Applicable Analysis in 2010. He is anAssociate Editor of the journal Communications in Nonlinear Scienceand Numerical Simulations. This book is devoted to the problems of spectral analysis,stability and bifurcations arising from the nonlinear partialdifferential equations of modern physics. Leading experts indynamical systems, operator theory, partial differential equations,and solid and fluid mechanics present state-of-the-art approachesto a wide spectrum of new challenging stability problems.Bifurcations and stability of solitary waves, geometrical opticsstability analysis in hydro- and magnetohydrodynamics anddissipation-induced instabilities will be treated with the use ofthe theory of Krein and Pontryagin space, index theory, the theoryof multi-parameter eigenvalue problems and modern asymptotic andperturbative approaches. All chapters contain mechanical andphysical examples and combine both tutorial and advanced sections,making them attractive both to experts in the field andnon-specialists interested in knowing more about modern methods andtrends in stability theory.

Heat Kernels and Spectral Theory

This revised edition corrects various errors, and adds extensive notes to the end of each chapter which describe the considerable progress that has been made on the topic in the last 30 years.--

Spectral Theory and Its Applications

The main theme of the book is the spectral theory for evolution operators and evolution semigroups, a subject tracing its origins to the classical results of J. Mather on hyperbolic dynamical systems and J. Howland on nonautonomous Cauchy problems. The authors use a wide range of methods and offer a unique presentation. The authors give a unifying approach for a study of infinite-dimensional nonautonomous problems, which is based on the consistent use of evolution semigroups. This unifying idea connects various questions in stability of semigroups, infinite-dimensional hyperbolic linear skew-product flows, translation Banach algebras, transfer operators, stability radii in control theory, Lyapunov exponents, magneto-dynamics and hydro-dynamics. Thus the book is much broader in scope than existing books on asymptotic behavior of semigroups. Included is a solid collection of examples from different areas of analysis, PDEs, and dynamical systems. This is the first monograph where the spectral theory of infinite dimensional linear skew-product flows is described together with its connection to the multiplicative ergodic theorem; the same technique is used to study evolution semigroups, kinematic dynamos, and Ruelle operators; the theory of stability radii, an important concept in control theory, is also presented. Examples are included and non-traditional applications are provided.

Nonlinear Physical Systems

International Series of Monographs in Pure and Applied Mathematics, Volume 89: Applied Methods of the Theory of Random Functions presents methods of random functions analysis with their applications in various branches of technology, such as in the theory of ships, automatic regulation and control, and radio engineering. This book discusses the general properties of random functions, spectral theory of stationary random functions, and determination of optimal dynamical systems. The experimental methods for the determination of characteristics of random functions, method of envelopes, and some supplementary problems of the theory of random functions are also deliberated. This publication is intended for engineers and scientists who use the methods of the theory of probability in various branches of technology.

The Spectral Theory of Periodic Differential Equations

This textbook provides a careful treatment of functional analysis and some of its applications in analysis, number theory, and ergodic theory. In addition to discussing core material in functional analysis, the authors cover more recent and advanced topics, including Weyl's law for eigenfunctions of the Laplace operator, amenability and property (T), the measurable functional calculus, spectral theory for unbounded operators, and an account of Tao's approach to the prime number theorem using Banach algebras. The book further contains numerous examples and exercises, making it suitable for both lecture courses and self-study. Functional Analysis, Spectral Theory, and Applications is aimed at postgraduate and advanced undergraduate students with some background in analysis and algebra, but will also appeal to everyone with an interest in seeing how functional analysis can be applied to other parts of mathematics.

Spectral Theory and Differential Operators

Lively discussions and stimulating research were part of a five-day conference on Mathematical Methods in Nonlinear Wave Propagation sponsored by the NSF and CBMS. This volume is a collection of lectures and papers stemming from that event. Leading experts present dynamical systems and chaos, scattering and spectral theory, nonlinear wave equations, optimal control, optical waveguide design, and numerical simulation. The book is suitable for a diverse audience of mathematical specialists interested in fiber optic communications and other nonlinear phenomena. It is also suitable for engineers and other scientists interested in the mathematics of nonlinear wave propagation.

Evolution Semigroups in Dynamical Systems and Differential Equations

This EMS volume, the first edition of which was published as Dynamical Systems II, EMS 2, familiarizes the reader with the fundamental ideas and results of modern ergodic theory and its applications to dynamical systems and statistical mechanics. The enlarged and revised second edition adds two new contributions on ergodic theory of flows on homogeneous manifolds and on methods of algebraic geometry in the theory of interval exchange transformations.

Applied Methods of the Theory of Random Functions

Since the seminal work of P. Anderson in 1958, localization in disordered systems has been the object of intense investigations. Mathematically speaking, the phenomenon can be described as follows: the self-adjoint operators which are used as Hamiltonians for these systems have a ten dency to have pure point spectrum, especially in low dimension or for large disorder. A lot of effort has been devoted to the mathematical study of the random self-adjoint operators relevant to the theory of localization for disordered systems. It is fair to say that progress has been made and that the un derstanding of the phenomenon has improved. This does not mean that the subject is closed. Indeed, the number of important problems actually solved is not larger than the number of those remaining. Let us mention some of the latter: • A proof of localization at all energies is still missing for two dimen sional systems, though it should be within reachable range. In the case of the two dimensional lattice, this problem has been approached by the investigation of a finite discrete band, but the limiting pro cedure necessary to reach the full two-dimensional lattice has never been controlled. • The smoothness properties of the density of states seem to escape all attempts in dimension larger than one. This problem is particularly serious in the continuous case where one does not even know if it is continuous.

Functional Analysis, Spectral Theory, and Applications

In this fully-illustrated textbook, the author examines the spectral theory of self-adjoint elliptic operators. Chapters focus on the problems of convergence and summability of spectral decompositions about the fundamental functions of elliptic operators of the second order. The author's work offers a novel method for estimation of the remainder term of a spectral function and its Riesz means without recourse to the traditional Carleman technique and Tauberian theorem apparatus.

Mathematical Studies in Nonlinear Wave Propagation

Linear, Time-varying Approximations to Nonlinear Dynamical Systems introduces a new technique for analysing and controlling nonlinear systems. This method is general and requires only very mild conditions on the system nonlinearities, setting it apart from other techniques such as those – well-known – based on differential geometry. The authors cover many aspects of nonlinear systems including stability theory, control design and extensions to distributed parameter systems. Many of the classical and modern control design methods which can be applied to linear, time-varying systems can be extended to nonlinear systems by this technique. The implementation of the control is therefore simple and can be done with well-established classical methods. Many aspects of nonlinear systems, such as spectral theory which is important for the generalisation of frequency domain methods, can be approached by this method.

Dynamical Systems, Ergodic Theory and Applications

This volume contains the proceedings of the CRM Workshops on Probabilistic Methods in Spectral Geometry and PDE, held from August 22–26, 2016 and Probabilistic Methods in Topology, held from November 14–18, 2016 at the Centre de Recherches Mathématiques, Université de Montréal, Montréal, Quebec, Canada. Probabilistic methods have played an increasingly important role in many areas of mathematics, from the study of random groups and random simplicial complexes in topology, to the theory of random Schrödinger operators in mathematical physics. The workshop on Probabilistic Methods in Spectral Geometry and PDE brought together some of the leading researchers in quantum chaos, semi-classical theory, ergodic theory and dynamical systems, partial differential equations, probability, random matrix theory, mathematical physics, conformal field theory, and random graph theory. Its emphasis was on the use of ideas and methods from probability in different areas, such as quantum chaos (study of spectra and eigenstates of chaotic systems at high energy); geometry of random metrics and related problems in quantum gravity; solutions of partial differential equations with random initial conditions. The workshop Probabilistic Methods in Topology brought together researchers working on random simplicial complexes and geometry of spaces of triangulations (with connections to manifold learning); topological statistics, and geometric probability; theory of random groups and their properties; random knots; and other problems. This volume covers recent developments in several active research areas at the interface of Probability, Semiclassical Analysis, Mathematical Physics, Theory of Automorphic Forms and Graph Theory.

Spectral Theory of Random Schrödinger Operators

Analytic number theory and part of the spectral theory of operators (differential, pseudo-differential, elliptic, etc.) are being merged under amore general analytic theory of regularized products of certain sequences satisfying a few basic axioms. The most basic examples consist of the sequence of natural numbers, the sequence of zeros with positive imaginary part of the Riemann zeta function, and the sequence of eigenvalues, say of a positive Laplacian on a compact or certain cases of non-compact manifolds. The resulting theory is applicable to ergodic theory and dynamical systems; to the zeta and L-functions of number theory or representation theory and modular forms; to Selberg-like zeta functions; andto the theory of regularized determinants familiar in physics and other parts of mathematics. Aside from presenting a systematic account of widely scattered results, the theory also provides new results. One part of the theory deals with complex analytic properties, and another part deals with Fourier analysis. Typical examples are given. This LNM provides basic results which are and will be used in further papers, starting with a general formulation of Cram r's theorem and explicit formulas. The exposition is self-contained (except for far-reaching examples), requiring only standard knowledge of analysis.

Nonlinear Dynamical Systems of Mathematical Physics

This volume contains a collection of papers presented at the workshop on Spectrum and Dynamics held at the CRM in April 2008. In recent years. many new exciting connections have been established between the spectral theory of elliptic operators and the theory of dynamical systems. A number of articles in the proceedings highlight these discoveries. The volume features a diversity of topics. Such as quantum chaos, spectral geometry. Semiclassical analysis, number theory and ergodic theory. Apart from the research papers aimed at the experts, this book includes several survey articles accessible to a broad math ematical audience.

Spectral Theory of Differential Operators

The original zeta function was studied by Riemann as part of his investigation of the distribution of prime numbers. Other sorts of zeta functions were defined for number-theoretic purposes, such as the study of primes in arithmetic progressions. This led to the development of L-functions, which now have several guises. It eventually became clear that the basic construction used for number-theoretic zeta functions can also be used in other settings, such as dynamics, geometry, and spectral theory, with remarkable results. This volume grew out of the special session on dynamical, spectral, and arithmetic zeta functions held at the annual meeting of the American Mathematical Society in San Antonio, but also includes four articles that were invited to be part of the collection. The purpose of the meeting was to bring together leading researchers, to find links and analogies between their fields, and to explore new methods. The papers discuss dynamical systems, spectral geometry on hyperbolic manifolds, trace formulas in geometry and in arithmetic, as well as computational work on the Riemann zeta function. Each article employs techniques of zeta functions. The book unifies the application of these techniques in spectral geometry, fractal geometry, and number theory. It is a comprehensive volume, offering up-to-date research. It should be useful to both graduate students and confirmed researchers.

Spectral Theory and Nonlinear Analysis with Applications to Spatial Ecology

This book unifies the dynamical systems and functional analysis approaches to the linear and nonlinear stability of waves. It synthesizes fundamental ideas of the past 20+ years of research, carefully balancing theory and application. The book isolates and methodically develops key ideas by working through illustrative examples that are subsequently synthesized into general principles. Many of the seminal examples of stability theory, including orbital stability of the KdV solitary wave, and asymptotic stability of viscous shocks for scalar conservation laws, are treated in a textbook fashion for the first time. It presents spectral theory from a dynamical systems and functional analytic point of view, including essential and absolute spectra, and develops general nonlinear stability results for dissipative and Hamiltonian systems. The structure of the linear eigenvalue problem for Hamiltonian systems is carefully developed, including the Krein signature and related stability indices. The Evans function for the detection of point spectra is carefully developed through a series of frameworks of increasing complexity. Applications of the Evans function to the Orientation index, edge bifurcations, and large domain limits are developed through illustrative examples. The book is intended for first or second year graduate students in mathematics, or those with equivalent mathematical maturity. It is highly illustrated and there are many exercises scattered throughout the text that highlight and emphasize the key concepts. Upon completion of the book, the reader will be in an excellent position to understand and contribute to current research in nonlinear stability.

Linear, Time-varying Approximations to Nonlinear Dynamical Systems

This book presents the mathematical foundations of systems theory in a self-contained, comprehensive, detailed and mathematically rigorous way. It is devoted to the analysis of dynamical systems and combines features of a detailed introductory textbook with that of a reference source. The book contains many examples and figures illustrating the text which help to bring out the intuitive ideas behind the mathematical constructions.

Probabilistic Methods in Geometry, Topology and Spectral Theory

A ``quantum graph'' is a graph considered as a one-dimensional complex and equipped with a differential operator (``Hamiltonian''). Quantum graphs arise naturally as simplified models in mathematics, physics, chemistry, and engineering when one considers propagation of waves of various nature through a quasi-one-dimensional (e.g., ``meso-'' or ``nano-scale'') system that looks like a thin neighborhood of a graph. Works that currently would be classified as discussing quantum graphs have been appearing since at least the 1930s, and since then, quantum graphs techniques have been applied successfully in various areas of mathematical physics, mathematics in general and its applications. One can mention, for instance, dynamical systems theory, control theory, quantum chaos, Anderson localization, microelectronics, photonic crystals, physical chemistry, nano-sciences, superconductivity theory, etc. Quantum graphs present many non-trivial mathematical challenges, which makes them dear to a mathematician's heart. Work on quantum graphs has brought together tools and intuition coming from graph theory, combinatorics, mathematical physics, PDEs, and spectral theory. This book provides a comprehensive introduction to the topic, collecting the main notions and techniques. It also contains a survey of the current state of the quantum graph research and applications.

Basic Analysis of Regularized Series and Products

The intention of this book is to introduce students to active areas of research in mathematical physics in a rather direct way minimizing the use of abstract mathematics. The main features are geometric methods in spectral analysis, exponential decay of eigenfunctions, semi-classical analysis of bound state problems, and semi-classical analysis of resonance. A new geometric point of view along with new techniques are brought out in this book which have both been discovered within the past decade. This book is designed to be used as a textbook, unlike the competitors which are either too fundamental in their approach or are too abstract in nature to be considered as texts. The authors' text fills a gap in the marketplace.

Spectrum and Dynamics

Ergodic theory is one of the few branches of mathematics which has changed radically during the last two decades. Before this period, with a small number of exceptions, ergodic theory dealt primarily with averaging problems and general qualitative questions, while now it is a powerful amalgam of methods used for the analysis of statistical properties of dyna mical systems. For this reason, the problems of ergodic theory now interest not only the mathematician, but also the research worker in physics, biology, chemistry, etc. The outline of this book became clear to us nearly ten years ago but, for various reasons, its writing demanded a long period of time. The main principle, which we adhered to from the beginning, was to develop the approaches and methods or ergodic theory in the study of numerous concrete examples. Because of this, Part I of the book contains the description of various classes of dynamical systems, and their elementary analysis on the basis of the fundamental notions of ergodicity, mixing, and spectra of dynamical systems. Here, as in many other cases, the adjective" elementary" i~ not synonymous with "simple. " Part II is devoted to "abstract ergodic theory. " It includes the construc tion of direct and skew products of dynamical systems, the Rohlin-Halmos lemma, and the theory of special representations of dynamical systems with continuous time. A considerable part deals with entropy.

Dynamical, Spectral, and Arithmetic Zeta Functions

Following the concept of the EMS series this volume sets out to familiarize the reader to the fundamental ideas and results of modern ergodic theory and to its applications to dynamical systems and statistical mechanics. The exposition starts from the basic of the subject, introducing ergodicity, mixing and entropy. Then the ergodic theory of smooth dynamical systems is presented - hyperbolic theory, billiards, one-dimensional systems and the elements of KAM theory. Numerous examples are presented carefully along with the ideas underlying the most important results. The last part of the book deals with the dynamical systems of statistical mechanics, and in particular with various kinetic equations. This book is compulsory reading for all mathematicians working in this field, or wanting to learn about it.

Spectral and Dynamical Stability of Nonlinear Waves

This book is the first systematic treatment of the theory of topological dynamics of random dynamical systems. A relatively new field, the theory of random dynamical systems unites and develops the classical deterministic theory of dynamical systems and probability theory, finding numerous applications in disciplines ranging from physics and biology to engineering, finance and economics. This book presents in detail the solutions to the most fundamental problems of topological dynamics: linearization of nonlinear smooth systems, classification, and structural stability of linear hyperbolic systems. Employing the tools and methods of algebraic ergodic theory, the theory presented in the book has surprisingly beautiful results showing the richness of random dynamical systems as well as giving a gentle generalization of the classical deterministic theory.

Mathematical Systems Theory I

In this fully-illustrated textbook, the author examines the spectral theory of self-adjoint elliptic operators. Chapters focus on the problems of convergence and summability of spectral decompositions about the fundamental functions of elliptic operators of the second order. The author's work offers a novel method for estimation of the remainder term of a spectral function and its Riesz means without recourse to the traditional Carleman technique and Tauberian theorem apparatus.

Introduction to Quantum Graphs

Introduction to Spectral Theory