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Quantum Quadratic Operators and Processes Jun 12 2022 Covering both classical and quantum approaches, this unique and self-contained book presents the most recent developments in the theory of quadratic stochastic operators and their Markov and related processes. The asymptotic behavior of dynamical systems generated by classical and quantum quadratic operators is investigated and various properties of quantum quadratic operators are studied, providing an insight into the construction of quantum channels. This book is suitable as a textbook for an advanced undergraduate/graduate level course or summer school in quantum dynamical systems. It can also be used as a reference book by researchers looking for interesting problems to work on, or useful techniques and discussions of particular problems. Since it includes the latest developments in the fields of quadratic dynamical systems, Markov processes and quantum stochastic processes, researchers at all levels are likely to find the book inspiring and useful.
Noncommutative Symmetric Functions and Laplace Operators for Classical Lie Algebras Apr 29 2021
The algebra of non-classical singular integral operators on IR+n+1 Oct 12 2019
A Mathematical Primer on Quantum Mechanics Apr 10 2022 This book offers a rigorous yet elementary approach to quantum mechanics that will meet the needs of Master's-level Mathematics students and is equally suitable for Physics students who are interested in gaining a deeper understanding of the mathematical structure of the theory. Throughout the coverage, which is limited to single-particle quantum mechanics, the focus is on formulating theory and developing applications in a mathematically precise manner. Following a review of selected key concepts in classical physics and the historical background, the basic elements of the theory of operators in Hilbert spaces are presented and used to formulate the rules of quantum mechanics. The discussion then turns to free particles, harmonic oscillators, delta potential, and hydrogen atoms, providing rigorous proofs of the corresponding dynamical properties. Starting from an analysis of these applications, readers are subsequently introduced to more advanced topics such as the classical limit, scattering theory, and spectral analysis of Schrödinger operators. The main content is complemented by numerous exercises that stimulate interactive learning and help readers check their progress.
Classical Banach-Lie Algebras and Banach-Lie Groups of Operators in Hilbert Space Aug 02 2021
The Ruelle-Araki Transfer Operator in Classical Statistical Mechanics Jul 13 2022
Operator Theoretic Aspects of Ergodic Theory Jan 15 2020 Stunning recent results by Host–Kra, Green–Tao, and others, highlight the timeliness of this systematic introduction to classical ergodic theory using the tools of operator theory. Assuming no prior exposure to ergodic theory, this book provides a modern foundation for introductory courses on ergodic theory, especially for students or researchers with an interest in functional analysis. While basic analytic notions and results are reviewed in several appendices, more advanced operator theoretic topics are developed in detail, even beyond their immediate connection with ergodic theory. As a consequence, the book is also suitable for advanced or special-topic courses on functional analysis with applications to ergodic theory. Topics include: • an intuitive introduction to ergodic theory • an introduction to the basic notions, constructions, and standard examples of topological dynamical systems • Koopman operators, Banach lattices, lattice and algebra homomorphisms, and the Gelfand–Naimark theorem • measure-preserving dynamical systems • von Neumann's Mean Ergodic Theorem and Birkhoff's Pointwise Ergodic Theorem • strongly and weakly mixing systems • an examination of notions of isomorphism for measure-preserving systems • Markov operators, and the related concept of a factor of a measure preserving system • compact groups and semigroups, and a powerful tool in their study, the Jacobs–de Leeuw–Glicksberg decomposition • an introduction to the spectral theory of dynamical systems, the theorems of Furstenberg and Weiss on multiple recurrence, and applications of dynamical systems to combinatorics (theorems of van der Waerden, Gallai,and Hindman, Furstenberg's Correspondence Principle, theorems of Roth and Furstenberg–Sárközy) Beyond its use in the classroom, Operator Theoretic Aspects of Ergodic Theory can serve as a valuable foundation for doing research at the intersection of ergodic theory and operator theory
Unbounded Linear Operators Feb 14 2020 This volume presents a systematic treatment of the theory of unbounded linear operators in normed linear spaces with applications to differential equations. Largely self-contained, it is suitable for advanced undergraduates and graduate students, and it only requires a familiarity with metric spaces and real variable theory. After introducing the elementary theory of normed linear spaces--

particularly Hilbert space, which is used throughout the book--the author develops the basic theory of unbounded linear operators with normed linear spaces assumed complete, employing operators assumed closed only when needed. Other topics include strictly singular operators; operators with closed range; perturbation theory, including some of the main theorems that are later applied to ordinary differential operators; and the Dirichlet operator, in which the author outlines the interplay between functional analysis and "hard" classical analysis in the study of elliptic partial differential equations. In addition to its readable style, this book's appeal includes numerous examples and motivations for certain definitions and proofs. Moreover, it employs simple notation, eliminating the need to refer to a list of symbols.

Operator Theory and Conditions for Quantum Local Operations and Classical Communication Nov 12 2019 We study the finite dimensional C^{*}-algebras and their representation theory. The physical description of quantum local operations and classical communication (LOCC) and its schematics are presented. Focusing on the mathematical description of one-way LOCC, we give detailed analysis of recently derived operator relations in quantum information theory. We also show how functional analytic tools such as operatorx systems, operator algebras, and Hilbert C^{*}-modules all naturally emerge in this setting. We make use of these structures to derive some key results in one-way LOCC. Perfect distinguishability of one-way LOCC versus arbitrary quantum operations is analyzed. It turns out that they are equivalent for several families of operators that appear jointly in matrix and operator theory and quantum information theory. The main results of this work are contained in the paper \citep{comfort}.

Infinite Dimensional Laplace Operators in Classical and Quantum Calculus May 31 2021

Linear Operators for Quantum Mechanics Dec 26 2020 Suitable for advanced undergraduates and graduate students, this compact treatment examines linear space, functionals, and operators; diagonalizing operators; operator algebras; and equations of motion. 1969 edition.

Unbounded Operators and the Classical Moment Problem Apr 17 2020

Rings of Differential Operators on Classical Rings of Invariants Oct 16 2022

Classical Propositional Operators Sep 15 2022

An Introduction to Classical and P-adic Theory of Linear Operators and Applications Feb 08 2022 This book provides the reader with a self-contained treatment of the classical operator theory with significant applications to abstract differential equations, and an elegant introduction to basic concepts and methods of the rapidly growing theory of the so-called p-adic operator theory.

Hook length products and Cayley operators of classical invariant theory Oct 04 2021

Lectures on Gaussian Integral Operators and Classical Groups Feb 25 2021 This book is an elementary self-contained introduction to some constructions of representation theory and related topics of differential geometry and analysis. Topics covered include the theory of various Fourier-like integral operators as Segal-Bargmann transforms, Gaussian integral operators in L^2 and in the Fock space, integral operators with theta-kernels, the geometry of real and p-adic classical groups and symmetric spaces. The heart of the book is the Weil representation of the symplectic group (real and complex realizations, relations with theta-functions and modular forms, p-adic and adelic constructions) and representations in Hilbert spaces of holomorphic functions of several complex variables. The book is addressed to graduate students and researchers in representation theory, differential geometry, and operator theory. The reader is supposed to be familiar with standard university courses in linear algebra, functional analysis, and complex analysis.

On Operators on Classical Banach Spaces Sep 03 2021

Introduction to Spectral Theory Jul 21 2020 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.

Functional Equations with Causal Operators Jan 27 2021 Functional equations encompass most of the equations used in applied science and engineering: ordinary differential equations, integral equations of the Volterra type, equations with delayed argument, and integro-differential equations of the Volterra type. The basic theory of functional equations includes functional differential equations with cau

Quantum Dynamics for Classical Systems Nov 17 2022 Introduces number operators with a focus on the relationshipbetween quantum mechanics and social science Mathematics is increasingly applied to classical problems infinance, biology, economics, and elsewhere. Quantum Dynamics forClassical Systems describes how quantum tools—the numberoperator in particular—can be used to create dynamicalsystems in which the variables are operator-valued functions andwhose results explain the presented model. The book presentsmathematical results and their applications to concrete systems anddiscusses the methods used, results obtained, and techniquesdeveloped for the proofs of the results. The central ideas of number operators are

illuminated whileavoiding excessive technicalities that are unnecessary forunderstanding and learning the various mathematical applications.The presented dynamical systems address a variety of contexts andoffer clear analyses and explanations of concluded results.Additional features in Quantum Dynamics for ClassicalSystems include: Applications across diverse fields including stock markets andpopulation migration as well as a unique quantum perspective onthese classes of models Illustrations of the use of creation and annihilation operatorsfor classical problems Examples of the recent increase in research and literature onthe many applications of quantum tools in applied mathematics Clarification on numerous misunderstandings and misnomers whileshedding light on new approaches in the field Quantum Dynamics for Classical Systems is an idealreference for researchers, professionals, and academics in appliedmathematics, economics, physics, biology, and sociology. The bookis also excellent for courses in dynamical systems, quantummechanics, and mathematical models.

Spectral Theory and Applications of Linear Operators and Block Operator Matrices Jul 01 2021 Examining recent mathematical developments in the study of Fredholm operators, spectral theory and block operator matrices, with a rigorous treatment of classical Riesz theory of polynomially-compact operators, this volume covers both abstract and applied developments in the study of spectral theory. These topics are intimately related to the stability of underlying physical systems and play a crucial role in many branches of mathematics as well as numerous interdisciplinary applications. By studying classical Riesz theory of polynomially compact operators in order to establish the existence results of the second kind operator equations, this volume will assist the reader working to describe the spectrum, multiplicities and localization of the eigenvalues of polynomially-compact operators.

Semi-Classical Analysis for the Schrödinger Operator and Applications Aug 14 2022 This introduction to semi-classical analysis is an extension of a course given by the author at the University of Nankai. It presents for some of the standard cases presented in quantum mechanics books a rigorous study of the tunneling effect, as an introduction to recent research work. The book may be read by a graduate student familiar with the classic book of Reed-Simon, and for some chapters basic notions in differential geometry. The mathematician will find here a nice application of PDE techniques and the physicist will discover the precise link between approximate solutions (B.K.W. constructions) and exact eigenfunctions (in every dimension). An application to Witten's approach for the proof of the Morse inequalities is given, as are recent results for the Schrödinger operator with periodic potentials.

Finite Mathematics as the Foundation of Classical Mathematics and Quantum Theory Dec 14 2019 This book delves into finite mathematics and its application in physics, particularly quantum theory. It is shown that quantum theory based on finite mathematics is more general than standard quantum theory, whilst finite mathematics is itself more general than standard mathematics.As a consequence, the mathematics describing nature at the most fundamental level involves only a finite number of numbers while the notions of limit, infinite/infinitesimal and continuity are needed only in calculations that describe nature approximately. It is also shown that the concepts of particle and antiparticle are likewise approximate notions, valid only in special situations, and that the electric charge and baryon- and lepton quantum numbers can be only approximately conserved.

Non-Self-Adjoint Differential Operators, Spectral Asymptotics and Random Perturbations Sep 22 2020 The asymptotic distribution of eigenvalues of self-adjoint differential operators in the high-energy limit, or the semi-classical limit, is a classical subject going back to H. Weyl of more than a century ago. In the last decades there has been a renewed interest in non-self-adjoint differential operators which have many subtle properties such as instability under small perturbations. Quite remarkably, when adding small random perturbations to such operators, the eigenvalues tend to distribute according to Weyl's law (quite differently from the distribution for the unperturbed operators in analytic cases). A first result in this direction was obtained by M. Hager in her thesis of 2005. Since then, further general results have been obtained, which are the main subject of the present book. Additional themes from the theory of non-self-adjoint operators are also treated. The methods are very much based on microlocal analysis and especially on pseudodifferential operators. The reader will find a broad field with plenty of open problems.

Boundedness of Fractional Maximal Operators Between Classical and Weak-type Lorentz Spaces Jun 19 2020

A Calculus for Classical Pseudo-differential Operators with Non-smooth Symbols Mar 17 2020

Composition Operators Jan 19 2023 The study of composition operators links some of the most basic questions you can ask about linear operators with beautiful classical results from analytic-function theory. The process invests old theorems with new mean ings, and bestows upon functional analysis an intriguing class of concrete linear operators. Best of all, the subject can be appreciated by anyone with an interest in function theory or functional analysis, and a background roughly equivalent to the following twelve chapters of Rudin's textbook Real and Complex Analysis [Rdn '87]: Chapters 1-7 (measure and integra tion, LP spaces, basic Hilbert and Banach space theory), and 10-14 (basic function theory through the Riemann Mapping Theorem). In this book I introduce the reader to both the theory of composition operators, and the classical results that form its

infrastructure. I develop the subject in a way that emphasizes its geometric content, staying as much as possible within the prerequisites set out in the twelve fundamental chapters of Rudin's book. Although much of the material on operators is quite recent, this book is not intended to be an exhaustive survey. It is, quite simply, an invitation to join in the fun. The story goes something like this.

Sugawara Operators for Classical Lie Algebras Nov 05 2021 The celebrated Schur-Weyl duality gives rise to effective ways of constructing invariant polynomials on the classical Lie algebras. The emergence of the theory of quantum groups in the 1980s brought up special matrix techniques which allowed one to extend these constructions beyond polynomial invariants and produce new families of Casimir elements for finite-dimensional Lie algebras. Sugawara operators are analogs of Casimir elements for the affine Kac-Moody algebras. The goal of this book is to describe algebraic structures associated with the affine Lie algebras, including affine vertex algebras, Yangians, and classical -algebras, which have numerous ties with many areas of mathematics and mathematical physics, including modular forms, conformal field theory, and soliton equations. An affine version of the matrix technique is developed and used to explain the elegant constructions of Sugawara operators, which appeared in the last decade. An affine analogue of the Harish-Chandra isomorphism connects the Sugawara operators with the classical -algebras, which play the role of the Weyl group invariants in the finite-dimensional theory.

Classical Nonintegrability, Quantum Chaos Aug 22 2020 Our DMV Seminar on 'Classical Nonintegrability, Quantum Chaos' intended to introduce students and beginning researchers to the techniques applied in nonin tegrable classical and quantum dynamics. Several of these lectures are collected in this volume. The basic phenomenon of nonlinear dynamics is mixing in phase space, lead ing to a positive dynamical entropy and a loss of information about the initial state. The nonlinear motion in phase space gives rise to a linear action on phase space functions which in the case of iterated maps is given by a so-called transfer operator. Good mixing rates lead to a spectral gap for this operator. Similar to the use made of the Riemann zeta function in the investigation of the prime numbers, dynamical zeta functions are now being applied in nonlinear dynamics. In Chapter 2 V. Baladi first introduces dynamical zeta functions and transfer operators, illustrating and motivating these notions with a simple one-dimensional dynamical system. Then she presents a commented list of useful references, helping the newcomer to enter smoothly into this fast-developing field of research. Chapter 3 on irregular scattering and Chapter 4 on quantum chaos by A. Knauf deal with solutions of the Hamilton and the Schr6dinger equation. Scatter ing by a potential force tends to be irregular if three or more scattering centres are present, and a typical phenomenon is the occurrence of a Cantor set of bounded orbits. The presence of this set influences those scattering orbits which come close.

Semifredholm Operators and Semigroups Associated with Some Classical Operator Ideals May 19 2020

Fourier Integrals in Classical Analysis Jan 07 2022 An advanced monograph concerned with modern treatments of central problems in harmonic analysis.

D-bar and Dirac Type Operators on Classical and Quantum Domains May 11 2022 I study d-bar and Dirac operators on classical and quantum domains subject to the APS boundary conditions, APS like boundary conditions, and other types of global boundary conditions. Moreover, the inverse or inverse modulo compact operators to these operators are computed. These inverses/parametrices are also shown to be bounded and are also shown to be compact, if possible. Also the index of some of the d-bar operators are computed when it doesn't have trivial index. Finally a certain type of limit statement can be said between the classical and quantum d-bar operators on specialized complex domains.

Semigroups of Linear Operators and Applications to Partial Differential Equations Nov 24 2020 Since the characterization of generators of C0 semigroups was established in the 1940s, semigroups of linear operators and its neighboring areas have developed into an abstract theory that has become a necessary discipline in functional analysis and differential equations. This book presents that theory and its basic applications, and the last two chapters give a connected account of the applications to partial differential equations.

Lectures on Gaussian Integral Operators and Classical Groups Feb 20 2023 This book is an elementary self-contained introduction to some constructions of representation theory and related topics of differential geometry and analysis. Topics covered include the theory of various Fourier-like integral operators such as Segal-Bargmann transforms, Gaussian integral operators in L^2 and in the Fock space, integral operators with theta-kernels, the geometry of real and p-adic classical groups and symmetric spaces. The heart of the book is the Weil representation of the symplectic group (real and complex realizations, relations with theta-functions and modular forms, p-adic and adelic constructions) and representations in Hilbert spaces of holomorphic functions of several complex variables. This book is addressed to graduate students and researchers in representation theory, differential geometry, and operator theory. Prerequisites are standard university courses in linear algebra, functional analysis, and complex analysis.

Formulations of Classical and Quantum Dynamical Theory Oct 24 2020 In this book, we study theoretical and practical aspects of computing methods for mathematical modelling of nonlinear systems. A number of computing techniques are considered, such as methods of operator approximation with any given accuracy;

operator interpolation techniques including a non-Lagrange interpolation; methods of system representation subject to constraints associated with concepts of causality, memory and stationarity; methods of system representation with an accuracy that is the best within a given class of models; methods of covariance matrix estimation; methods for low-rank matrix approximations; hybrid methods based on a combination of iterative procedures and best operator approximation; and methods for information compression and filtering under condition that a filter model should satisfy restrictions associated with causality and different types of memory. As a result, the book represents a blend of new methods in general computational analysis, and specific, but also generic, techniques for study of systems theory ant its particular branches, such as optimal filtering and information compression. - Best operator approximation, - Non-Lagrange interpolation, - Generic Karhunen-Loeve transform - Generalised low-rank matrix approximation - Optimal data compression - Optimal nonlinear filtering

Weighted $ L^ P $ Estimates for Classical Operators Using Analytic Families of Operators Mar 29 2021

Symmetries and Recursion Operators for Classical and Supersymmetric Differential Equations Mar 09 2022 To our wives, Masha and Marian Interest in the so-called completely integrable systems with infinite num ber of degrees of freedom was aroused immediately after publication of the famous series of papers by Gardner, Greene, Kruskal, Miura, and Zabusky [75, 77, 96, 18, 66, 19J (see also [76]) on striking properties of the Korteweg-de Vries (KdV) equation. It soon became clear that systems of such a kind possess a number of characteristic properties, such as infinite series of symmetries and/or conservation laws, inverse scattering problem formulation, L - A pair representation, existence of prolongation structures, etc. And though no satisfactory definition of complete integrability was yet invented, a need of testing a particular system for these properties appeared. Probably one of the most efficient tests of this kind was first proposed by Lenard [19]' who constructed a recursion operator for symmetries of the KdV equation. It was a strange operator, in a sense: being formally integro-differential, its action on the first classical symmetry (x-translation) was well-defined and produced the entire series of higher KdV equations; but applied to the scaling symmetry, it gave expressions containing terms of the type J u dx which had no adequate interpretation in the framework of the existing theories. It is not surprising that P. Olver wrote "The de duction of the form of the recursion operator (if it exists) requires a certain amount of inspired guesswork. . . " [80, p.

Foundations of Quantum Theory Dec 06 2021 This book studies the foundations of quantum theory through its relationship to classical physics. This idea goes back to the Copenhagen Interpretation (in the original version due to Bohr and Heisenberg), which the author relates to the mathematical formalism of operator algebras originally created by von Neumann. The book therefore includes comprehensive appendices on functional analysis and C*-algebras, as well as a briefer one on logic, category theory, and topos theory. Matters of foundational as well as mathematical interest that are covered in detail include symmetry (and its "spontaneous" breaking), the measurement problem, the Kochen-Specker, Free Will, and Bell Theorems, the Kadison-Singer conjecture, quantization, indistinguishable particles, the quantum theory of large systems, and quantum logic, the latter in connection with the topos approach to quantum theory. This book is Open Access under a CC BY licence.

Quantum Operators Dec 18 2022

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