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Divergence Operator and Related Inequalities

This Brief is mainly devoted to two classical and related results: the existence of a right inverse of the divergence operator and the so-called Korn Inequalities. It is well known that both results are fundamental tools in the analysis of some classic differential equations, particularly in those arising in fluid dynamics and elasticity. Several connections between these two topics and improved Poincaré inequalities are extensively treated. From simple key ideas the book is growing smoothly in complexity. Beginning with the study of these problems on star-shaped domains the arguments are extended first to John domains and then to Hölder α domains where the need of weighted spaces [...]

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Theory and Applications

This new and expanded monograph improves upon Mohan’s earlier book, Residue Number Systems (Springer, 2002) with a state of the art treatment of the subject. Replete with detailed illustrations and helpful examples, this book covers a host of cutting edge topics such as the core function, the quotient function, new Chinese Remainder theorems, and large integer operations. It also features many significant applications to practical communication systems and cryptography such as FIR filters and elliptic curve cryptography. Starting with a comprehensive
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Optimal Control

This book is based on lectures from a one-year course at the Far Eastern Federal University (Vladivostok, Russia) as well as on workshops on optimal control offered to students at various mathematical departments at the university level. The main themes of the theory of linear and nonlinear systems are considered, including the basic problem of establishing the necessary and sufficient conditions of optimal processes. In the first part of the course, the theory of linear control systems is constructed on the basis of the separation theorem and the concept of a reachability set.

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Moduli Spaces and Arithmetic

The contributions in this book explore various contexts in which the derived category of coherent sheaves on a variety determines some of its arithmetic. This setting provides new geometric tools for interpreting elements of the Brauer group. With a view towards future arithmetic applications, the book extends a number of powerful tools for analyzing rational points on elliptic curves, e.g., isogenies among curves, torsion points, modular curves, and the resulting descent techniques, as well as higher-dimensional varieties like K3 surfaces. Inspired by the rapid recent advances in our understanding of K3 surfaces, the book is intended to foster cross-pollination between the fields of[…]
Advances in Nonlinear Analysis via the Concept of Measure of Noncompactness

This book offers a comprehensive treatment of the theory of measures of noncompactness. It discusses various applications of the theory of measures of noncompactness, in particular, by addressing the results and methods of fixed-point theory. The concept of a measure of noncompactness is very useful for the mathematical community working in nonlinear analysis. Both these theories are especially useful in investigations connected with differential equations, integral equations, functional integral equations and optimization theory. Thus, one of the book’s central goals is to collect and present sufficient conditions for the solvability of such equations. The results are established in [...] More on www.springer.com/978-3-319-46978-2

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Nice Numbers
In this intriguing book, John Barnes takes us on a journey through aspects of numbers much as he took us on a geometrical journey in Gems of Geometry. Similarly originating from a series of lectures for adult students at Reading and Oxford University, this book touches a variety of amusing and fascinating topics regarding numbers and their uses both ancient and modern. The author informs and intrigues his audience with both fundamental number topics such as prime numbers and cryptography, and themes of daily needs and pleasures such as counting one’s assets, keeping track of time, and enjoying music. Puzzles and exercises at the end of each lecture offer additional inspiration, and [...] More on www.springer.com/978-3-319-15427-5

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Asymptotic Analysis for Functional Stochastic Differential Equations
This brief treats dynamical systems that involve delays and random disturbances. The study is motivated by a wide variety of systems in real life in which random noise has to be taken into consideration and the effect of delays cannot be ignored. Concentrating on such systems that are described by functional stochastic differential equations, this work focuses on the study of large time behavior, in particular, ergodicity. This brief is written for probabilists, applied mathematicians, engineers, and scientists who need to use delay systems and functional stochastic differential equations in their work. Selected topics from the brief can also be used in a graduate level topics course [...] More on www.springer.com/978-3-319-46830-3

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Building Bridges: Connections and Challenges in Modern Approaches to Numerical Partial Differential Equations
This volume contains contributed survey papers from the main speakers at the LMS/EPSRC Symposium “Building bridges: connections and challenges in modern approaches to numerical partial differential equations”. This meeting took place in July 8-16, 2014, and its main purpose was to gather specialists in emerging areas of numerical PDEs, and explore the connections between the different approaches. The type of contributions ranges from the theoretical
foundations of these new techniques, to the applications of them, to new general frameworks and unified approaches that can cover one, or more than one, of these emerging techniques.

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Combinatorics and Complexity of Partition Functions
Partition functions arise in combinatorics and related problems of statistical physics as they encode in a succinct way the combinatorial structure of complicated systems. The main focus of the book is on efficient ways to compute (approximate) various partition functions, such as permanents, hafnians and their higher-dimensional versions, graph and hypergraph matching polynomials, the independence polynomial of a graph and partition functions enumerating 0-1 and integer points in polyhedra, which allows one to make algorithmic advances in otherwise intractable problems. The book unifies various, often quite recent, results scattered in the literature, concentrating on the three main [...]

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R. Pardini, G.P. Pirola (Eds.)

Rationality Problems in Algebraic Geometry
Levico Terme, Italy 2015
Providing an overview of the state of the art on rationality questions in algebraic geometry, this volume gives an update on the most recent developments. It offers a comprehensive introduction to this fascinating topic, and will certainly become an essential reference for anybody working in the field. Rationality problems are of fundamental importance both in algebra and algebraic geometry. Historically, rationality problems motivated significant developments in the theory of abelian integrals, Riemann surfaces and the Abel–Jacobi map, among other areas, and they have strong links with modern notions such as moduli spaces, Hodge theory, algebraic cycles and derived categories. This[...]

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Y. Benoist, J.-F. Quint

Random Walks on Reductive Groups
The classical theory of Random Walks describes the asymptotic behavior of sums of independent identically distributed random variables. This book explains the generalization of this theory to products of independent identically distributed random matrices with real coefficients. Under the assumption that the action of the matrices is semisimple – or, equivalently, that the Zariski closure of the group generated by these matrices is reductive - and under suitable moment assumptions, it is shown that the norm of the products of such random matrices satisfies a number of classical probabilistic laws. This book includes necessary background on the theory of reductive algebraic groups, [...]

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J.L. Berggren

Episodes in the Mathematics of Medieval Islam
This book presents an account of selected topics from key mathematical works of medieval Islam, based on the Arabic texts themselves. Many of these works had a great influence on mathematics in Western Europe. Topics covered in the first edition include arithmetic, algebra, geometry, trigonometry, and numerical approximation; this second edition adds number theory and combinatorics. Additionally, the author has included selections from the western regions of medieval Islam—both North Africa and Spain. The author puts the works into their historical context and includes numerous examples of how mathematics interacted with Islamic society.

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A. Bolsinov, J.J. Morales-Ruiz, N.T. Zung

Geometry and Dynamics of Integrable Systems
Based on lectures given at an advanced course on integrable systems at the Centre de Recerca Matemàtica in Barcelona, these lecture notes address three major aspects of integrable systems: obstructions to integrability from differential Galois theory; the description of singularities of integrable systems on the basis of their relation to bi-Hamiltonian systems; and the generalization of integrable systems to the non-Hamiltonian settings. All three sections were written by top experts in their respective fields. Native to actual problem-solving challenges in mechanics, the topic of integrable systems is cur-
rently at the crossroads of several disciplines in pure and applied [...] More on www.springer.com/978-3-319-33502-5

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**Introduction to Partial Differential Equations**

This modern take on partial differential equations does not require knowledge beyond vector calculus and linear algebra. The author focuses on the most important classical partial differential equations, including conservation equations and their characteristics, the wave equation, the heat equation, function spaces, and Fourier series, drawing on tools from analysis only as they arise. Within each section the author creates a narrative that answers the five questions: What is the scientific problem we are trying to understand? How do we model that with PDE? What techniques can we use to analyze the PDE? How do those techniques apply to this equation? What information or insight did we [...] More on www.springer.com/978-3-319-48934-6

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**Asymptotic Expansion of a Partition Function Related to the Sinh-model**

This book elaborates on the asymptotic behaviour, when N is large, of certain N-dimensional integrals which typically occur in random matrices, or in 1+1 dimensional quantum integrable models solvable by the quantum separation of variables. The introduction presents the underpinning motivations for this problem, a historical overview, and a summary of the strategy, which is applicable in greater generality. The core aims at proving an expansion up to o(1) for the logarithm of the partition function of the sinh-model. This is achieved by a combination of potential theory and large deviation theory so as to grasp the leading asymptotics described by an equilibrium measure, the [...] More on www.springer.com/978-3-319-33378-6

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This is a first book to show that the theory of the Gaussian random matrix is essential to understand the universal correlations with random fluctuations and to demonstrate that it is useful to evaluate topological universal quantities. We consider Gaussian random matrix models in the presence of a deterministic matrix source. In such models the correlation functions are known exactly for an arbitrary source and for any size of the matrices. The freedom given by the external source allows for various tunings to different classes of universality. The main interest is to use this freedom to compute various topological invariants for surfaces such as the intersection numbers for curves [...] More on www.springer.com/978-981-10-3315-5

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**Positive Operator Semigroups**

From Finite to Infinite Dimensions

This book gives a gentle but up-to-date introduction into the theory of operator semigroups (or linear dynamical systems), which can be used with great success to describe the dynamics of complicated phenomena arising in many applications. Positivity is a property which naturally appears in physical, chemical, biological or economic processes. It adds a beautiful and far reaching mathematical structure to the dynamical systems and operators describing these processes. In the first part, the finite dimensional theory in a coordinate-free way is developed, which is difficult to find in literature. This is a good opportunity to present the main ideas of the Perron-Frobenius theory in a [...] More on www.springer.com/978-3-319-42811-6

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C. Börgers

**An Introduction to Modeling Neuronal Dynamics**

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R. Camporesi

**An Introduction to Linear Ordinary Differential Equations Using the Impulsive Response Method and Factorization**

This book presents a method for solving linear ordinary differential equations based on the factorization of the differential operator. The approach for the case of constant coefficients is elementary, and only requires a basic knowledge of calculus and linear algebra. In particular, the book avoids the use of distribution theory, as well as the other more advanced approaches: Laplace transform, linear systems, the general theory of linear equations with variable coefficients and variation of parameters. The case of variable coefficients is addressed using Mammana’s result for the factorization of a real linear differential operator into a product of first-order (complex) [...]

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S. CHANILLO, B. Franchi, G. Lu, C. Perez, E.T. Sawyer (Eds.)

**Harmonic Analysis, Partial Differential Equations and Applications**

In Honor of Richard L. Wheeden

This collection of articles and surveys is devoted to Harmonic Analysis, related Partial Differential Equations and Applications and in particular to the fields of research to which Richard L. Wheeden made profound contributions. The papers deal with Weighted Norm inequalities for classical operators like Singular integrals, fractional integrals and maximal functions that arise in Harmonic Analysis. Other papers deal with applications of Harmonic Analysis to Degenerate Elliptic equations, variational problems, Several Complex variables, Potential theory, free boundaries and boundary behavior of functions.

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T. Caraballo, X. Han

**Applied Nonautonomous and Random Dynamical Systems**

Applied Dynamical Systems

This book offers an introduction to the theory of non-autonomous and stochastic dynamical systems, with a focus on the importance of the theory in the Applied Sciences. It starts by discussing the basic concepts from the theory of autonomous dynamical systems, which are easier to understand and can be used as the motivation for the non-autonomous and stochastic situations. The book subsequently establishes a framework for non-autonomous dynamical systems, and in particular describes the various approaches currently available for analysing the long-term behaviour of non-autonomous problems. Here, the major focus is on the novel theory of pullback attractors, which is still under [...] More on www.springer.com/978-3-319-49246-9

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F. Colombini, D. Del Santo, D. Lannes (Eds.)

**Shocks, Singularities and Oscillations in Nonlinear Optics and Fluid Mechanics**

The book collects the most relevant results from the INdAM Workshop “Shocks, Singularities and Oscillations in Nonlinear Optics and Fluid Mechanics” held in Rome, September 14-18, 2015. The contributions discuss recent major advances in the study of nonlinear hyperbolic systems, addressing general theoretical issues such as symmetrizability, singularities, low regularity or dispersive perturbations. It also investigates several physical phenomena where such systems are relevant, such as nonlinear optics, shock theory (stability, relaxation) and fluid mechanics (boundary layers, water waves, Euler equations, geophysical flows, etc.). It is a valuable resource for researchers in these [...] More on www.springer.com/978-3-319-52041-4

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Entire Slice Regular Functions

This Briefs volume develops the theory of entire slice regular functions. It is the first self-contained, monographic work on the subject, offering all the necessary background information and detailed studies on several central topics, including estimates on the maximum modulus of regular functions, relations between Taylor coefficients and the growth of entire functions, density of their zeros, and the universality properties. The proofs presented here shed new light on the nature of the quaternionic setting and provide inspiration for further research directions. Also featuring an exhaustive reference list, the book offers a valuable resource for graduate students, postgraduate students, and any researcher in the field.

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Banach Spaces of Continuous Functions as Dual Spaces

This book gives a coherent account of the theory of Banach spaces and Banach lattices, using the spaces C_0(K) of continuous functions on a locally compact space K as the main example. The study of C_0(K) has been an important area of functional analysis for many years. It gives several new constructions, some involving Boolean rings, of this space as well as many results on the Stonean space of Boolean rings. The book also discusses when Banach spaces of continuous functions are dual spaces and when they are bidual spaces.

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Operations Research, Engineering, and Cyber Security

This book gives an introduction to the field of Incidence Geometry by discussing the basic families of point-line geometries and introducing some of the mathematical techniques that are essential for their study. The families of geometries covered in this book include among others the generalized polygons, near polygons, polar spaces, dual polar spaces and designs. Also the various relationships between these geometries are investigated. Ovals and ovoids of projective spaces are studied and some applications to particular geometries will be given. A separate chapter introduces the necessary mathematical tools and techniques from graph theory. This chapter itself can be regarded as a reference for future research directions.

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Many in the mathematics community in the U.S. are involved in mathematics education in various capacities. This book highlights the breadth of the work in K-16 mathematics education done by members of US departments of mathematical sciences. It contains contributions by mathematicians and mathematics educators who do work in areas such as teacher education, quantitative literacy, informal education, writing and communication, social justice, outreach and mentoring, tactile learning, art and mathematics, ethnomathematics, scholarship of teaching and learning, and mathematics education research. Contributors describe their work, its impact, and how it is perceived and valued. In [...] More on www.springer.com/978-3-319-44949-4

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Dirac Matter
This fifteenth volume of the Poincare Seminar Series, Dirac Matter, describes the surprising resurgence, as a low-energy effective theory of conducting electrons in many condensed matter systems, including graphene and topological insulators, of the famous equation originally invented by P.A.M. Dirac for relativistic quantum mechanics. In five highly pedagogical articles, as befits their origin in lectures to a broad scientific audience, this book explains why Dirac matters. Highlights include the detailed "Graphene and Relativistic Quantum Physics", written by the experimental pioneer, Philip Kim, and devoted to graphene, a form of carbon crystallized in a two-dimensional hexagonal [...] More on www.springer.com/978-3-319-32535-4

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Fundamentals of Functional Analysis
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G. Fasano, J.D. Pintér (Eds.)

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Y. Fedorov, V.V. Kozlov

A Memoir on Integrable Systems

Integrable dynamical systems are usually associated with Hamiltonian ones. The present book considers the bigger class of systems which are not (at least a priori) Hamiltonian but possess tensor invariants, in particular, an invariant measure. Such systems are as rare as Hamiltonian ones that have additional first integrals and therefore must be considered as number one candidates for integrable problems. Several integrability theorems related to the existence of tensor invariants are formulated. The authors display the geometrical background of some classical and new hierarchies of integrable systems and give their explicit solution in terms of theta-functions. Most of the results[...]

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E. Feireisl, T.G. Karper, M. Pokorný

Mathematical Theory of Compressible Viscous Fluids
Analysis and Numerics

This book offers an essential introduction to the mathematical theory of compressible viscous fluids. The main goal is to present analytical methods from the perspective of their numerical applications. Accordingly, we introduce the principal theoretical tools needed to handle well-posedness of the underlying Navier-Stokes system, study the problems of sequential stability, and, lastly, construct solutions by means of an implicit numerical scheme. Offering a unique contribution – by exploring in detail the “synergy” of analytical and numerical methods – the book offers a valuable resource for graduate students in mathematics and researchers working in mathematical fluid[...]

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V. Feray, P.-L. Meliot, A. Nikeghbali

Mod-ϕ Convergence
Normality Zones and Precise Deviations

The canonical way to establish the central limit theorem for i.i.d. random variables is to use characteristic functions and Lévy’s continuity theorem. This monograph focuses on this characteristic function approach and presents a renormalization theory called mod-ϕ convergence. This type of convergence is a relatively new concept with many deep ramifications, and has not previously been published in a single accessible volume. The authors construct an extremely flexible framework using this concept in order to study limit theorems and large deviations for a number of probabilistic models related to classical probability, combinatorics, non-commutative random variables, as well as[...]

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Hölder and locally Hölder Continuous Functions, and Open Sets of Class $C^k, C^{k,\lambda}$

This book offers a systematic treatment of a classic topic in Analysis. It fills a gap in the existing literature by presenting in detail the classic $\lambda$-Hölder condition and introducing the notion of locally Hölder-continuous function in an open set $\Omega$ in $\mathbb{R}^n$. Further, it provides the essential notions of multidimensional geometry applied to analysis. Written in an accessible style and with proofs given as clearly as possible, it is a valuable resource for graduate students in Mathematical Analysis and researchers dealing with Hölder-continuous functions and their applications.

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Playing Around Resonance
An Invitation to the Search of Periodic Solutions for Second Order Ordinary Differential Equations

This book provides an up-to-date description of the methods needed to face the existence of solutions to some nonlinear boundary value problems. All important and interesting aspects of the theory of periodic solutions of ordinary differential equations related to the physical and mathematical question of resonance are treated. The author has chosen as a model example the periodic problem for a second order scalar differential equation. In a pedagogical style the author takes the reader step by step from the basics to the most advanced existence results in the field.

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Recollections of a Jewish Mathematician in Germany

Abraham A. Fraenkel was a world-renowned mathematician in pre–Second World War Germany, whose work on set theory was fundamental to the development of modern mathematics. A friend of Albert Einstein, he knew many of the era’s acclaimed mathematicians personally. He moved to Israel (then Palestine under the British Mandate) in the early 1930s. In his autobiography Fraenkel describes his early years growing up as an Orthodox Jew in Germany and his development as a mathematician at the beginning of the twentieth century. This memoir, originally written in German in the 1960s, has now been translated into English, with an additional chapter covering the period from 1933 until his death.

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S.G. Georgiev

Integral Equations on Time Scales

This book offers the reader an overview of recent developments of integral equations on time scales. It also contains elegant analytical and numerical methods. This book is primarily intended for senior undergraduate students and beginning graduate students of engineering and science courses. The students in mathematical and physical sciences will find many sections of direct relevance. The book contains nine chapters and each chapter is pedagogically organized. This book is specially designed for those who wish to understand integral equations on time scales without having extensive mathematical background.

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S.L. Gavrilyuk, N.I. Makarenko, S.V. Sukhinin

Waves in Continuous Media

Starting with the basic notions and facts of the mathematical theory of waves illustrated by numerous examples, exercises, and methods of solving typical problems Chapters 1 & 2 show e.g. how to recognize the hyperbolicity property, find characteristics, Riemann invariants and conservation laws for quasi-linear systems of equations, construct and analyze solutions with weak or strong discontinuities, and how to investigate equations with dispersion and to construct travelling wave solutions for models reducible to nonlinear evolution equations. Chapter 3 deals with surface and internal waves in an incompressible fluid. The efficiency of mathematical methods is demonstrated on a...
radio waves off those targets, as well as the theoretical analysis of the [...]

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**Quantum Isometry Groups**

This book offers an up-to-date overview of the recently proposed theory of quantum isometry groups. Written by the founders, it is the first book to present the research on the "quantum isometry group", highlighting the interaction of noncommutative geometry and quantum groups, which is a non-commutative generalization of the notion of group of isometry of a classical Riemannian manifold. The motivation for this generalization is the importance of isometry groups in both mathematics and physics. The framework consists of Alain Connes' "noncommutative geometry" and the operator-algebraic theory of "quantum groups". The authors prove the existence of quantum isometry group[...]

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**Yosida Approximations of Stochastic Differential Equations in Infinite Dimensions and Applications**

This research monograph brings together, for the first time, the varied literature on Yosida approximations of stochastic differential equations (SDEs) in infinite dimensions and their applications into a single cohesive work. The author provides a clear and systematic introduction to the Yosida approximation method and justifies its power by presenting its applications in some practical topics such as stochastic stability and stochastic optimal control. The theory assimilated spans more than 35 years of mathematics, but is developed slowly and methodically in digestible pieces. The book begins with a motivational chapter that introduces the reader to several different models that play[...]

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This book aims to dispel the mystery and fear experienced by students surrounding sequences, series, convergence, and their applications. The author, an accomplished female mathematician, achieves this by taking a problem solving approach, starting with fascinating problems and solving them step by step with clear explanations and illuminating diagrams. The reader will find the problems interesting, unusual, and fun, yet solved with the rigor expected in a competi-
modeling approaches as partial differential equations, cellular automata are straightforward to simulate but hard to analyze. In this book we present a review of approaches and theories that allow the reader to understand the behavior of cellular automata beyond simulations. The first part consists of an introduction of cellular automata on Cayley graphs, and their characterization via the fundamental Cutis-Hedlund-Lyndon theorems in the context of different topological concepts [...] 

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Erscheinungstermin: April 11, 2017

J. Hofrichter, J. Jost, T.D. Tran

Information Geometry and Population Genetics
The mathematical structure of the Wright-Fisher model

The present monograph develops a versatile and profound mathematical perspective of the Wright–Fisher model of population genetics. This well-known and intensively studied model carries a rich and beautiful mathematical structure, which is uncovered here in a systematic manner. In addition to approaches by means of analysis, combinatorics and PDE, a geometric perspective is brought in through Amari’s and Chentsov’s information geometry. This concept allows us to calculate many quantities of interest systematically; likewise, the employed global perspective elucidates the stratification of the model in an unprecedented manner. Furthermore, the links to statistical mechanics and large [...] 

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2017. XIV, 322 p. illus., 2 illus. in color. (Understanding Complex Systems)
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A. Hora

The Limit Shape Problem for Ensembles of Young Diagrams

This book treats ensembles of Young diagrams originating from group-theoretical contexts and investigates what statistical properties are observed there in a large-scale limit. The focus is mainly on analyzing the interesting phenomenon that specific curves appear in the appropriate scaling limit for the profiles of Young diagrams. This problem is regarded as an important origin of recent vital studies on harmonic analysis of huge symmetry structures. As mathematics, an asymptotic theory of representations is develop-
op ed of the symmetric groups of degree \( n \) as \( n \) goes to infinity. The framework of rigorous limit theorems (especially the law of large numbers) in probability theory is [...] More on www.springer.com/978-4-31-56485-0

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Forthcoming
A. Huber, S. Müller-Stach

Periods and Nori Motives
This book casts the theory of periods of algebraic varieties in the natural setting of Madhav Nori’s abelian category of mixed motives. It develops Nori’s approach to mixed motives from scratch, thereby filling an important gap in the literature, and then explains the connection of mixed motives to periods, including a detailed account of the theory of period numbers in the sense of Kontsevich-Zagier and their structural properties. Period numbers are central to number theory and algebraic geometry, and also play an important role in other fields such as mathematical physics. There are long-standing conjectures about their transcendence properties, best understood in the language of [...] More on www.springer.com/978-3-31-9-49111-0

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A. Itkin

Pricing Derivatives Under Lévy Models
Modern Finite-Difference and Pseudo-Differential Operators Approach
This monograph presents a novel numerical approach to solving partial integro-differential equations arising in asset pricing models with jumps, which greatly exceeds the efficiency of existing approaches. The method, based on pseudo-differential operators and several original contributions to the theory of finite-difference schemes, is new as applied to the Lévy processes in finance, and is herein presented for the first time in a single volume. The results within, developed in a series of research papers, are collected and arranged together with the necessary background material from Lévy processes, the modern theory of finite-difference schemes, the theory of M-matrices and [...] More on www.springer.com/978-1-4939-6790-2

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M. Jevtic, D. Vukotic, M. Arsenovic

Taylor Coefficients and Coefficient Multipliers of Hardy and Bergman-Type Spaces
This book provides a systematic overview of the theory of Taylor coefficients of functions in some classical spaces of analytic functions and especially of the coefficient multipliers between spaces of Hardy type. Offering a comprehensive reference guide to the subject, it is the first of its kind in this area. After several introductory chapters covering the basic material, a large variety of results obtained over the past 80 years, including the most recent ones, are treated in detail. Several chapters end with discussions of practical applications and related topics that graduate students and experts in other subjects may find useful for their own purposes. Thus, a further aim of [...] More on www.springer.com/978-3-31-9-4563-0

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Forthcoming
E.B.V. Jensen, M. Kiderlen (Eds.)

Tensor Valuations and Their Applications in Stochastic Geometry and Imaging
The purpose of this volume is to give an up-to-date introduction to tensor valuations and their applications. Starting with classical results concerning scalar-valued valuations on the families of convex bodies and convex polytopes, it proceeds to the modern theory of tensor valuations. Product and Fourier-type transforms are introduced and various integral formulae are derived. New and well-known results are presented, together with generalizations in several directions, including extensions to the non-Euclidean setting and to non-convex sets. A variety of applications of tensor valuations to models in stochastic geometry, to local stereology and to imaging are also discussed. More on www.springer.com/978-3-31-9-51950-0

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A. Iksanov

Renewal Theory for Perturbed Random Walks and Similar Processes
This book offers a detailed review of perturbed random walks, perpetuities, and random processes with immigration. Being of major importance in modern probability theory, both theoretical and applied, these objects have been used to model various phenomena in the natural sciences as well as in insurance and finance. The book also presents the many significant results and efficient techniques and methods that have been worked out in the last decade. The first chapter is devoted to perturbed random walks and discusses their asymptotic behavior and various functional perturbations pertaining to them, including supremum and first-passage time. The second chapter examines perpetuities, presenting [...] More on www.springer.com/978-4-31-56485-0

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Forthcoming
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A. Itkin

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totic and the perturbative in its comprehensive highlights the complementary roles of the asymptotic and probabilistic and combinatorial independence, and able groups. It is organized around the theme of theory and topological dynamics of actions of countable groups. This book provides an introduction to the ergodic concepts to... more technical difficulties than nonlinear systems. Part II extends all of the concepts, as LTI systems pose fewer technical difficulties than nonlinear systems. Part II extends all of the concepts to... [...]

I. Karafyllis, M. Krstic

Predic tor Feedback for Delay Systems: Implementations and Approximations

This monograph bridges the gap between the nonlinear predictor as a concept and as a practical tool, presenting a complete theory of the application of predictor feedback to time-invariant, uncertain systems with constant input delays and/or measurement delays. It supplies several methods for generating the necessary real-time solutions to the systems’ nonlinear differential equations, which the authors refer to as approximate predictors. Predictor feedback for linear time-invariant (LTI) systems is presented in Part I to provide a solid foundation on the necessary concepts, as LTI systems pose fewer technical difficulties than nonlinear systems. Part II extends all of the concepts to...[...]

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D. Kerr, H. Li

Ergodic Theory

Independence and Dichotomies

This book provides an introduction to the ergodic theory and topological dynamics of actions of countable groups. It is organized around the theme of probabilistic and combinatorial independence, and highlights the complementary roles of the asymptotic and the perturbative in its comprehensive treatment of the core concepts of weak mixing, compactness, entropy, and amenability. The more advanced material includes Popa’s cocycle superrigidity, the Furstenberg-Zimmer structure theorem, and sofic entropy. The structure of the book is designed to be flexible enough to serve a variety of readers. The discussion of dynamics is developed from scratch assuming some rudimentary functional...[...]

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D. Khoshnevisan, R. Schilling
F. Utzet, L. Quer-Sardanyons (Eds.)

From Lévy-Type Processes to Parabolic SPDEs

This volume presents the lecture notes from two courses given by Davar Khoshnevisan and René Schilling, respectively, at the second Barcelona Summer School on Stochastic Analysis. René Schilling’s notes are an expanded version of his course on Lévy and Lévy-type processes, the purpose of which is two-fold: on the one hand, the course presents in detail selected properties of the Lévy processes, mainly as Markov processes, and their different constructions, eventually leading to the celebrated Lévy-Itô decomposition. On the other, it identifies the infinitesimal generator of the Lévy process as a pseudo-differential operator whose symbol is the characteristic exponent of the process, [...]

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I.Z. Kiss, J.C. Miller, P.L. Simon

Mathematics of Epidemics on Networks From Exact to Approximate Models

This textbook provides an exciting new addition to the area of network science featuring a stronger and more methodical link of models to their mathematical origin and explains how these relate to each other with special focus on epidemic spread on networks. The content of the book is at the interface of graph theory, stochastic processes and dynamical systems. The authors set out to make a significant contribution to closing the gap between model development and the supporting mathematics. This is done by: Summarising and presenting the state-of-the-heart in modeling epidemics on networks with results and readily usable models signposted throughout the book; Presenting different...[...]

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R. Kossak, P. Ording (Eds.)

Simplicity: Ideals of Practice in Mathematics and the Arts

The recommendation to find a criterion of simplicity in mathematics, Hilbert’s (recently discovered) 24th question on his renowned list of open problems given in mathematics, Hilbert’s (recently discovered) 24th question on his renowned list of open problems given at the meeting of the International Congress of Mathematicians in Paris in 1900, places the aesthetic of simplicity at the heart of mathematical practice. At the same time, simplicity and economy of means are powerful impulses in the creation of architecture and artworks. The conference and this volume represents an attempt to probe the mathematical aspects of the phenomenon of simplicity, in the context of an attitude which sees the aesthetic of simplicity as an irreducible part of the core practice of mathematics and the making...[...]

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Formal Matrices

This monograph is a comprehensive account of formal matrices, examining homological properties of modules over formal matrix rings and summarizing the interplay between Morita contexts and K theory. While various special types of formal matrix rings have been studied for a long time from several points of view and appear in various textbooks, for instance to examine equivalences of module categories and to illustrate rings with one-sided non-symmetric properties, this particular class of rings has, so far, not been treated systematically. Exploring formal matrix rings of order 2 and introducing the notion of the determinant of a formal matrix over a commutative ring, this monograph [...] More on www.springer.com/978-3-319-53906-5

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Modern Solvers for Helmholtz Problems

This edited volume offers a state of the art overview of fast and robust solvers for the Helmholtz equation. The book consists of three parts: new developments and analysis in Helmholtz solvers, practical methods and implementations of Helmholtz solvers, and industrial applications. The Helmholtz equation appears in a wide range of science and engineering disciplines in which wave propagation is modeled. Examples are: seismic inversion, ultrasound medical imaging, sonar detection of submarines, waves in harbours and many more. The partial differential equation looks simple but is hard to solve. In order to approximate the solution of the problem numerical methods are needed. First [...] More on www.springer.com/978-3-319-28831-4

Stochastic Modeling

Three coherent parts form the material covered in this text, portions of which have not been widely covered in traditional textbooks. In this coverage the reader is quickly introduced to several different topics enriched with 175 exercises which focus on real-world problems. Exercises range from the classics of probability theory to more exotic research-oriented problems based on numerical simulations. Intended for graduate students in mathematics and applied sciences, the text provides the tools and training needed to write and use programs for research purposes. The first part of the text begins with a brief review of measure theory and revisits the main concepts of probability [...] More on www.springer.com/978-3-319-50037-9

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Exact Boundary Controllability of Nodal Profile for Quasilinear Hyperbolic Systems

This book provides a comprehensive overview of the exact boundary controllability of nodal profile, a new kind of exact boundary controllability stimulated by some practical applications. This kind of controllability is useful in practice as it does not require any precisely given final state to be attained at a suitable time t=T by means of boundary controls, instead it requires the state to exactly fit any given demand (profile) on one or more nodes after a suitable time t=T by means of boundary controls. In this book we present a general discussion of this kind of controllability for general 1-D first order quasilinear hyperbolic systems and for general 1-D quasi-linear wave [...] More on www.springer.com/978-981-10-2841-0

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**Ergodic Theory of Expanding Thurston Maps**

Thurston maps are topological generalizations of postcritically-finite rational maps. This book provides a comprehensive study of ergodic theory of expanding Thurston maps, focusing on the measure of maximal entropy, as well as a more general class of invariant measures, called equilibrium states, and certain weak expansion properties of such maps. In particular, we present equidistribution results for iterated preimages and periodic points with respect to the unique measure of maximal entropy by investigating the number and locations of fixed points. We then use the thermodynamical formalism to establish the existence, uniqueness, and various other properties of the equilibrium state.[…]

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**Infectious Disease Modeling**

**A Hybrid System Approach**

This volume presents infectious diseases modeled mathematically, taking seasonality and changes in population behavior into account, using a switched and hybrid systems framework. The scope of coverage includes background on mathematical epidemiology, including classical formulations and results; a motivation for seasonal effects and changes in population behavior, an investigation into term-time forced epidemic models with switching parameters, and a detailed account of several different control strategies. The main goal is to study these models theoretically and to establish conditions under which eradication or persistence of the disease is guaranteed. In doing so, the long-term[…]

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**Divergent Series, Summability and Resurgence II**

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**Facility Location Using Game Theory**

Facility location theory develops the idea of locating one or more facilities by optimizing suitable criteria such as minimizing transportation cost, or capturing the largest market share. The contributions in this book focus an approach to facility location theory through game theoretical tools highlighting situations where a location decision is faced by several decision makers and leading to a game theoretical framework in non-cooperative and cooperative methods. Models and methods regarding the facility location via game theory are explored and applications are illustrated through economics, engineering, and physics. Mathematicians, engineers, economists and computer scientists[…]

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Fourier-Malliavin Volatility Estimation
Theory and Practice

This is a user-friendly presentation of the main theoretical properties of the Fourier-Malliavin volatility estimation, allowing the readers to experience the potential of the approach and its application in various financial settings. Readers are given examples and instruments to implement this methodology in various financial settings and applications of real-life data. A detailed bibliographic reference is included to permit an in-depth study.

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Recent Trends in Operator Theory and Partial Differential Equations
The Roland Duduchava Anniversary Volume

This volume is dedicated to the eminent Georgian mathematician Roland Duduchava on the occasion of his 70th birthday. It presents recent results on Toeplitz, Wiener-Hopf, and pseudodifferential operators, boundary value problems, operator theory, approximation theory, and reflects the broad spectrum of Roland Duduchava’s research. The book is addressed to a wide audience of pure and applied mathematicians.

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Exploring Classical Greek Construction Problems with Interactive Geometry Software

In this book the classical Greek construction problems are explored in a didactical, enquiry based fashion using Interactive Geometry Software (IGS). The book traces the history of these problems, stating them in modern terminology. By focusing on constructions and the use of IGS the reader is confronted with the same problems that ancient mathematicians once faced. The reader can step into the footsteps of Euclid, Viète and Cusanus amongst others and then by experimenting and discovering geometric relationships far exceed their accomplishments. Exploring these problems with the neusis-method lets him discover a class of interesting curves. By experimenting he will gain a deeper[...]

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Free Probability and Random Matrices

This volume opens the world of free probability to a wide variety of readers. From its roots in the theory of operator algebras, free probability has intertwined with non-crossing partitions, random matrices, applications in wireless communications, representation
Stabilisation de la formule des traces tordue

Ce travail en deux volumes donne la preuve de la stabilitisation de la formule des traces tordue. Stabiliser la formule des traces tordue est la méthode la plus puissante connue actuellement pour comprendre l’action naturelle du groupe des points adéliques d’un groupe réductif, tordue par un automorphisme, sur les formes automorphes de carré intégrable de ce groupe. Cette compréhension se fait en réduisant le problème, suivant les idées de Langlands, à des groupes plus petits munis d’un certain nombre de données auxiliaires; c’est ce que l’on appelle les données endoscopiques. L’analogie non tordu a été résolue par J. Arthur et dans ce livre on suit la stratégie de celui-ci. Publier ce[...]

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Optimal Design through the Sub-Relaxation Method
Understanding the Basic Principles
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The First Experimental Study of the Camera Obscura
This book provides the first critical edition of Ibn al-Haytham’s On the Shape of the Eclipse with English translation and commentary, which records the first scientific analysis of the camera obscura. The Shape of the Eclipse includes pioneering research on the conditions of formation of the image, in a time
deemed to be committed to aniconism. It also provides an early attempt to merge the two branches of Ancient optics—the theory of light and theory of vision. What perhaps most strongly characterizes this treatise is the close interaction of a geometric analysis of light and experimental reasoning. Ibn al-Haytham conducted his experiments in a systematic way by varying all that[…]

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M.G.C. Resende, C.C. Ribeiro

Optimization by GRASP
Greedy Randomized Adaptive Search Procedures

This is the first book to cover GRASP (Greedy Randomized Adaptive Search Procedures), a metaheuristic that has enjoyed wide success in practice with a broad range of applications to real-world combinatorial optimization problems. The state-of-the-art coverage and carefully crafted pedagogical style lends this book highly accessible as an introductory text not only to GRASP, but also to combinatorial optimization, greedy algorithms, local search, and path-relinking, as well as to heuristics and metaheuristics, in general. The focus is on algorithmic and computational aspects of applied optimization with GRASP with emphasis given to the end-user, providing sufficient information on the[…]

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M. Rezaei, R. Klette

Computer Vision for Driver Assistance
Simultaneous Traffic and Driver Monitoring

This book summarises the state of the art in computer vision-based driver and road monitoring, focussing on monocular vision technology in particular, with the aim to address challenges of driver assistance and autonomous driving systems. While the systems designed for the assistance of drivers of on-road vehicles are currently converging to the design of autonomous vehicles, the research presented here focuses on scenarios where a driver is still assumed to pay attention to the traffic while operating a partially automated vehicle. Proposing various computer vision algorithms, techniques and methodologies, the authors also provide a general review of computer vision technologies that[…]

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M. Richter

Inverse Problems
Basics, Theory and Applications in Geophysics

The overall goal of the book is to provide access to the regularized solution of inverse problems relevant in geophysics without requiring more mathematical knowledge than is taught in undergraduate math courses for scientists and engineers. From abstract analysis only the concept of functions as vectors is needed. Function spaces are introduced informally in the course of the text, when needed. Additionally, a more detailed, but still condensed introduction is given in Appendix B. A second goal is to elaborate the single steps to be taken when solving an inverse prob-
symmetric spaces. Scientists and researchers will find the application of linear operators, ergodic theory, harmonic analysis and mathematical physics noteworthy and useful. This book is intended for graduate students and researchers in mathematics and may be used as a general reference for the theory of functions, measure theory, and functional analysis. This self-contained text is presented in four parts totaling seventeen [...]
scopic-scale heterogeneities (on the order of centimeters), [...]"

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P. Saramito

**Complex fluids**

**Modeling and Algorithms**

This book presents a comprehensive overview of the modeling of complex fluids, including many common substances, such as toothpaste, hair gel, mayonnaise, liquid foam, cement and blood, which cannot be described by Navier-Stokes equations. It also offers an up-to-date mathematical and numerical analysis of the corresponding equations, as well as several practical numerical algorithms and software solutions for the approximation of the solutions. It discusses industrial (molten plastics, forming process), geophysical (mud flows, volcanic lava, glaciers and snow avalanches), and biological (blood flows, tissues) modeling applications. This book is a valuable resource for undergraduate[...]

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M. Skopina, A. Krivoshein, V. Protasov

**Multivariate Wavelet Frames**

This book presents a systematic study of multivariate wavelet frames with matrix dilation, in particular, orthogonal and bi-orthogonal bases, which are a special case of frames. Further, it provides algorithmic methods for the construction of dual and tight wavelet frames with a desirable approximation order, namely compactly supported wavelet frames, which are commonly required by engineers. It particularly focuses on methods of constructing them. Wavelet bases and frames are actively used in numerous applications such as audio and graphic signal processing, compression and transmission of information. They are especially useful in image recovery from incomplete observed data due to[...]


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C. Soize

**Uncertainty Quantification**

An Accelerated Course with Advanced Applications in Computational Engineering

This book presents the fundamental notions and advanced mathematical tools in the stochastic modeling of uncertainties and their quantification for large-scale computational models in sciences and engineering. In particular, it focuses on parametric uncertainties, and non-parametric uncertainties with applications from the structural dynamics and vibroacoustics of complex mechanical systems, from micromechanics and multiscale mechanics of heterogeneous materials. Resulting from a course developed by the author, the book begins with a description of the fundamental mathematical tools of probability and statistics that are directly useful for uncertainty quantification. It proceeds[...]

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J. Sesiano

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Two Arabic Treatises by Anfākī and Būzjānī

This volume contains the texts and translations of two Arabic treatises on magic squares, which are undoubtedly the most important testimonies on the early history of that science. It is divided into the three parts: the first and most extensive is on tenth-century construction methods, the second is the translations of the texts, and the third contains the original Arabic texts, which date back to the tenth century.

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A. Soifer

**The Colorado Mathematical Olympiad: The Third Decade and Further Explorations**

From the Mountains of Colorado to the Peaks of Mathematics

Now in its third decade, the Colorado Mathematical Olympiad (CMO), founded by the author, has become an annual state-wide competition, hosting many hundreds of middle and high school contestants each year. This book presents a year-by-year history of the CMO from 2004–2013 with all the problems from the competitions and their solutions. Additionally, the book includes 10 further explorations, bridges from solved Olympiad problems to ‘real’ mathematics, bringing young readers to the forefront of various fields of mathematics. This book contains more than just problems, solutions, and event statistics — it tells a compelling story involving the lives of those who have been part of the[...]
Introduzione all’Analisi Qualitativa dei Sistemi Dinamici Discreti e Continui

Il testo è stato concepito per la struttura degli attuali corsi di laurea in Biologia, Matematica, Matematica Applicata, Ingegneria, Scienze Naturali e Mediche. Esso si concentra sugli aspetti qualitativi delle equazioni differenziali come limitatezza o illimitatezza delle soluzioni, esistenza o non esistenza di orbite periodiche, stabilità o instabilità dei punti di equilibrio, biforcazione del sistema al variare di un parametro, robustezza del sistema in presenza di perturbazioni. L’analisi qualitativa di sistemi dinamici discreti e continui è un argomento tecnicamente accessibile anche agli studenti di primo livello e consente di collegare, combinare ed esercitare nozioni che [...]
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