Explorations In Harmonic Analysis With Applications To Complex Function Theory And The Heisenberg Group Applied And Numerical Harmonic Analysis

This self-contained text provides an introduction to modern harmonic analysis in the context in which it is actually applied, in particular, through complex function theory and partial differential equations. It takes the novice mathematical reader from the rudiments of harmonic analysis (Fourier series) to the Fourier transform, pseudodifferential operators, and finally to Heisenberg analysis.

A sweeping exploration of the development and far-reaching applications of harmonic analysis such as signal processing, digital music, Fourier optics, radio astronomy, crystallography, medical imaging, spectroscopy, and more. Featuring a wealth of illustrations, examples, and material not found in other harmonic analysis books, this unique monograph skillfully blends together historical narrative with scientific exposition to create a comprehensive yet accessible work. While only an understanding of calculus is required to appreciate it, there are more technical sections that will charm even specialists in harmonic analysis. From undergraduates to professional scientists, engineers, and mathematicians, there is something for everyone here. The second edition of The Evolution of Applied Harmonic Analysis contains a new chapter on atmospheric physics and climate change, making it more relevant for today’s audience. Praise for the first edition: "...can be thoroughly recommended to any reader who is

curious about the physical world and the intellectual underpinnings that have lead to our expanding understanding of our physical environment and to our halting steps to control it. Everyone who uses instruments that are based on harmonic analysis will benefit from the clear verbal descriptions that are supplied." — R.N. Bracewell, Stanford University “The book under review is a unique and splendid telling of the triumphs of the fast Fourier transform. I can recommend it unconditionally... Elena Prestini... has taken one major mathematical idea, that of Fourier analysis, and chased down and described a half dozen varied areas in which Fourier analysis and the FFT are now in place. Her book is much to be applauded.” — Society for Industrial and Applied Mathematics “This is not simply a book about mathematics, or even the history of mathematics; it is a story about how the discipline has been applied (to borrow Fourier’s expression) to ‘the public good and the explanation of natural phenomena.’ ... This book constitutes a significant addition to the library of popular mathematical works, and a valuable resource for students of mathematics.” — Mathematical Association of America Reviews

* Presented from a geometric analytical viewpoint, this work addresses advanced topics in complex analysis that verge on modern areas of research * Methodically designed with individual chapters containing a rich collection of exercises, examples, and illustrations

This volume consists of contributions spanning a wide spectrum of harmonic analysis and its applications written by speakers at the February Fourier Talks from 2002 – 2013. Containing cutting-edge results by an impressive array of mathematicians, engineers, and scientists in academia, industry, and government, it will be an excellent reference for graduate students, researchers, and professionals in pure and applied mathematics, physics, and engineering.

Topics covered include · spectral analysis and correlation; · radar and communications: design, theory, and applications; · sparsity · special topics in harmonic analysis. The February Fourier Talks are held annually at the Norbert Wiener Center for Harmonic Analysis and Applications. Located at the University of Maryland, College Park, the Norbert Wiener Center provides a state-of- the-art research venue for the broad emerging area of mathematical engineering.
This contributed volume contains articles written by the plenary and invited speakers from the second international MATHEON Workshop 2015 that focus on applications of compressed sensing. Article authors address their techniques for solving the problems of compressed sensing, as well as connections to related areas like detecting community-like structures in graphs, curbatures on Grassmanians, and randomized tensor train singular value decompositions. Some of the novel applications covered include dimensionality reduction, information theory, random matrices, sparse approximation, and sparse recovery. This book is aimed at both graduate students and researchers in the areas of applied mathematics, computer science, and engineering, as well as other applied scientists exploring the potential applications for the novel methodology of compressed sensing. An introduction to the subject of compressed sensing is also provided for researchers interested in the field who are not as familiar with it.
This book has two main objectives, the first of which is to extend the power of numerical Fourier analysis and to show by means of theoretical examples and numerous concrete applications that when computing discrete Fourier transforms of periodic and non periodic functions, the usual kernel matrix of the Fourier transform, the discrete Fourier transform (DFT), should be replaced by another kernel matrix, the eXtended Fourier transform (XFT),

since the XFT matrix appears as a convergent quadrature of a more general transform, the fractional Fourier transform. In turn, the book's second goal is to present the XFT matrix as a finite-dimensional transformation that links certain discrete operators in the same way that the corresponding continuous operators are related by the Fourier transform, and to show that the XFT matrix accordingly generates sequences of matrix operators that represent continuum operators, and which allow these operators to be studied from another perspective.

This book offers a unified presentation of Fourier theory and corresponding algorithms emerging from new developments in function approximation using Fourier methods. It starts with a detailed discussion of classical Fourier theory to enable readers to grasp the construction and analysis of advanced fast Fourier algorithms introduced in the second part, such as nonequispaced and sparse FFTs in higher dimensions. Lastly, it contains a selection of numerical applications, including recent research results on nonlinear function approximation by exponential sums. The code of most of the presented algorithms is available in the authors' public domain software packages. Students and researchers alike benefit from this unified presentation of Fourier theory and corresponding algorithms.

This text is a self-contained introduction to the three main families that we encounter in analysis – metric spaces, normed spaces, and inner product spaces – and to the operators that transform objects in one into objects in another. With an emphasis on the fundamental properties defining the spaces, this book guides readers to a deeper understanding of analysis and an appreciation of the field as the "science of functions." Many important topics that are rarely presented in an accessible way to undergraduate students are included, such as unconditional convergence of series, Schauder bases for Banach spaces, the dual of lp

topological isomorphisms, the Spectral Theorem, the Baire Category Theorem, and the Uniform Boundedness Principle. The text is constructed in such a way that instructors have the option whether to include more advanced topics. Written in an appealing and accessible style, Metrics, Norms, Inner Products, and Operator Theory is suitable for independent study or as the basis for an undergraduate-level course. Instructors have several options for building a course around the text depending on the level and interests of their students. Key features: Aimed at students who have a basic knowledge of undergraduate real analysis. All of the required background material is reviewed in the first chapter. Suitable for undergraduate-level courses; no familiarity with measure theory is required. Extensive exercises complement the text and provide opportunities for learning by doing. A separate solutions manual is available for instructors via the Birkhäuser website (www.springer.com/978-3-319-65321-1). Unique text providing an undergraduate-level introduction to metrics, norms, inner products, and their associated operator theory.

This monograph serves as a much-needed, self-contained reference on the topic of modulation spaces. By gathering together state-of-the-art developments and previously unexplored applications, readers will be motivated to make effective use of this topic in future research. Because modulation spaces have historically only received a cursory treatment, this book will fill a gap in time-frequency analysis literature, and offer readers a convenient and timely resource. Foundational concepts and definitions in functional, harmonic, and real analysis are reviewed in the first chapter, which is then followed by introducing modulation spaces. The focus then expands to the many valuable applications of modulation spaces, such as linear and multilinear pseudodifferential operators, and dispersive partial differential equations.

Because it is almost entirely self-contained, these insights will be accessible to a wide audience of interested readers. Modulation Spaces will be an ideal reference for researchers in time-frequency analysis and nonlinear partial differential equations. It will also appeal to graduate students and seasoned researchers who seek an introduction to the time-frequency analysis of nonlinear dispersive partial differential equations.

Lectures on Constructive Approximation: Fourier, Spline, and Wavelet Methods on the Real Line, the Sphere, and the Ball focuses on spherical problems as they occur in the geosciences and medical imaging. It comprises the author's lectures on classical approximation methods based on orthogonal polynomials and selected modern tools such as splines and wavelets. Methods for approximating functions on the real line are treated first, as they provide the foundations for the methods on the sphere and the ball and are useful for the analysis of time-dependent (spherical) problems. The author then examines the transfer of these spherical methods to problems on the ball, such as the modeling of the Earth's or the brain's interior. Specific topics covered include: * the advantages and disadvantages of Fourier, spline, and wavelet methods * theory and numerics of orthogonal polynomials on intervals, spheres, and balls * cubic splines and splines based on reproducing kernels * multiresolution analysis using wavelets and scaling functions This textbook is written for students in mathematics, physics, engineering, and the geosciences who have a basic background in analysis and linear algebra. The work may also be suitable as a self-study resource for researchers in the above-mentioned fields.

The chapters in this volume are based on talks given at the inaugural Technology, Engineering and Mathematics Conference (TEM18), held from March 26 to 27, 2018 in Kenitra, Morocco.

Advances in mathematical modeling, optimization, numerical analysis, signal processing, and computer science are presented by leading experts in these fields. There is a particular emphasis on stochastic analysis, machine learning algorithms, and deep learning models, which are highly relevant to the state-of-the-art in augmented, virtual, and mixed realities. Topics include: Harmonic analysis Big data analytics and applications Biomathematics Computer engineering and applications Economics and financial engineering Medical imaging and non-destructive testing This volume is ideal for engineers and researchers working in technological fields that need to be modeled and simulated using the tools of modern mathematics.

A collection of invited chapters dedicated to Carlos Segovia, this unified and self-contained volume examines recent developments in real and harmonic analysis. The work begins with a chronological description of Segovia's mathematical life, highlighting his original ideas and their evolution. Also included are surveys dealing with Carlos' favorite topics, and PDE works written by students and colleagues close to Segovia whose careers were in some way influenced by him. Contributors: H. Aimar, A. Bonami, O. Blasco, L.A. Caffarelli, S. Chanillo, J. Feuto, L. Forzani, C.E. Gutíerrez, E. Harboure, A.L. Karakhanyan, C.E. Kenig, R.A. Macías, J.J. Manfredi, F.J. Martín-Reyes, P. Ortega, R. Scotto, A. de la Torre, J.L. Torrea.

This contributed volume collects papers based on courses and talks given at the 2017 CIMPA school Harmonic Analysis, Geometric Measure Theory and Applications, which took place at the University of Buenos Aires in August 2017. These articles highlight recent breakthroughs in both harmonic analysis and geometric measure theory, particularly focusing on their impact on image and signal processing. The wide range of expertise present in these articles will help

readers contextualize how these breakthroughs have been instrumental in resolving deep theoretical problems. Some topics covered include: Gabor frames Falconer distance problem Hausdorff dimension Sparse inequalities Fractional Brownian motion Fourier analysis in geometric measure theory This volume is ideal for applied and pure mathematicians interested in the areas of image and signal processing. Electrical engineers and statisticians studying these fields will also find this to be a valuable resource.

This unified, self-contained book examines the mathematical tools used for decomposing and analyzing functions, specifically, the application of the [discrete] Fourier transform to finite Abelian groups. With countless examples and unique exercise sets at the end of each section, Fourier Analysis on Finite Abelian Groups is a perfect companion to a first course in Fourier analysis. This text introduces mathematics students to subjects that are within their reach, but it also has powerful applications that may appeal to advanced researchers and mathematicians. The only prerequisites necessary are group theory, linear algebra, and complex analysis.

This contributed volume explores the connection between the theoretical aspects of harmonic analysis and the construction of advanced multiscale representations that have emerged in signal and image processing. It highlights some of the most promising mathematical developments in harmonic analysis in the last decade brought about by the interplay among different areas of abstract and applied mathematics. This intertwining of ideas is considered starting from the theory of unitary group representations and leading to the construction of very efficient schemes for the analysis of multidimensional data. After an introductory chapter surveying the scientific significance of classical and more advanced multiscale methods,

chapters cover such topics as An overview of Lie theory focused on common applications in signal analysis, including the wavelet representation of the affine group, the Schrödinger representation of the Heisenberg group, and the metaplectic representation of the symplectic group An introduction to coorbit theory and how it can be combined with the shearlet transform to establish shearlet coorbit spaces Microlocal properties of the shearlet transform and its ability to provide a precise geometric characterization of edges and interface boundaries in images and other multidimensional data Mathematical techniques to construct optimal data representations for a number of signal types, with a focus on the optimal approximation of functions governed by anisotropic singularities. A unified notation is used across all of the chapters to ensure consistency of the mathematical material presented. Harmonic and Applied Analysis: From Groups to Signals is aimed at graduate students and researchers in the areas of harmonic analysis and applied mathematics, as well as at other applied scientists interested in representations of multidimensional data. It can also be used as a textbook for graduate courses in applied harmonic analysis.?

John J. Benedetto has had a profound influence not only on the direction of harmonic analysis and its applications, but also on the entire community of people involved in the field. The chapters in this volume-- compiled on the occasion of his 80th birthday-- are written by leading researchers in the field and pay tribute to John's many significant and lasting achievements. Covering a wide range of topics in harmonic analysis and related areas, these chapters are organized into four main parts: harmonic analysis, wavelets and frames, sampling and signal processing, and compressed sensing and optimization. An introductory chapter also provides a brief overview of John's life and mathematical career. This volume will be an excellent

reference for graduate students, researchers, and professionals in pure and applied mathematics, engineering, and physics.

This landmark monograph presents the most recent mathematical developments in the analysis of ionospheric distortions of SAR images and offers innovative new strategies for their mitigation. As a prerequisite to addressing these topics, the book also discusses the radar ambiguity theory as it applies to synthetic aperture imaging and the propagation of radio waves through the ionospheric plasma, including the anisotropic and turbulent cases. In addition, it covers a host of related subjects, such as the mathematical modeling of extended radar targets (as opposed to point-wise targets) and the scattering of radio waves off those targets, as well as the theoretical analysis of the start-stop approximation, which is used routinely in SAR signal processing but often without proper justification. The mathematics in this volume is clean and rigorous – no assumptions are hidden or ambiguously stated. The resulting work is truly interdisciplinary, providing both a comprehensive and thorough exposition of the field, as well as an accurate account of a range of relevant physical processes and phenomena. The book is intended for applied mathematicians interested in the area of radar imaging or, more generally, remote sensing, as well as physicists and electrical/electronic engineers who develop/operate spaceborne SAR sensors and perform the data processing. The methods in the book are also useful for researchers and practitioners working on other types of imaging. Moreover, the book is accessible

to graduate students in applied mathematics, physics, engineering, and related disciplines. Praise for Transionospheric Synthetic Aperture Imaging: “I perceive that this text will mark a turning point in the field of synthetic aperture radar research and practice. I believe this text will instigate a new era of more rigorous image formation relieving the research, development and practitioner communities of inconsistent physical assumptions and numerical approaches.” – Richard Albanese, Senior Scientist, Albanese Defense and Energy Development LLC

This volume consists of contributions spanning a wide spectrum of harmonic analysis and its applications written by speakers at the February Fourier Talks from 2002 – 2016. Containing cutting-edge results by an impressive array of mathematicians, engineers, and scientists in academia, industry and government, it will be an excellent reference for graduate students, researchers, and professionals in pure and applied mathematics, physics, and engineering. Topics covered include: Theoretical harmonic analysis Image and signal processing Quantization Algorithms and representations The February Fourier Talks are held annually at the Norbert Wiener Center for Harmonic Analysis and Applications. Located at the University of Maryland, College Park, the Norbert Wiener Center provides a state-of- the-art research venue for the broad emerging area of mathematical engineering.

The first of a two volume set on novel methods in harmonic analysis, this book draws on a number of original research and survey papers from well-known specialists

detailing the latest innovations and recently discovered links between various fields. Along with many deep theoretical results, these volumes contain numerous applications to problems in signal processing, medical imaging, geodesy, statistics, and data science. The chapters within cover an impressive range of ideas from both traditional and modern harmonic analysis, such as: the Fourier transform, Shannon sampling, frames, wavelets, functions on Euclidean spaces, analysis on function spaces of Riemannian and sub-Riemannian manifolds, Fourier analysis on manifolds and Lie groups, analysis on combinatorial graphs, sheaves, co-sheaves, and persistent homologies on topological spaces. Volume I is organized around the theme of frames and other bases in abstract and function spaces, covering topics such as: The advanced development of frames, including Sigma-Delta quantization for fusion frames, localization of frames, and frame conditioning, as well as applications to distributed sensor networks, Galerkin-like representation of operators, scaling on graphs, and dynamical sampling. A systematic approach to shearlets with applications to wavefront sets and function spaces. Prolate and generalized prolate functions, spherical Gauss-Laguerre basis functions, and radial basis functions. Kernel methods, wavelets, and frames on compact and non-compact manifolds.

The Applied and Numerical Harmonic Analysis (ANHA) book series aims to provide the engineering, mathematical, and scienti?c communities with s- ni?cant developments in harmonic analysis, ranging from abstract harmonic analysis to basic applications. The

title of the series re?ects the importance of applications and numerical implementation, but richness and relevance of applications and implementation depend fundamentally on the structure and depth of theoretical underpinnings. Thus, from our point of view, the int- leaving of theory and applications and their creative symbiotic evolution is axiomatic. Harmonic analysis is a wellspring of ideas and applicability that has ?o- ished, developed, and deepened over time within many disciplines and by means of creative cross-fertilizationwith diverse areas. The intricate and f- damental relationship between harmonic analysis and ?elds such as signal processing, partial di?erential equations (PDEs), and image processing is - ?ected in our state-of-the-art ANHA series. Our vision of modern harmonic analysis includes mathematical areas such as wavelet theory, Banach algebras, classical Fourier analysis, time-frequency analysis, and fractal geometry, as well as the diverse topics that impinge on them.

This book investigates the convergence and summability of both one-dimensional and multi-dimensional Fourier transforms, as well as the theory of Hardy spaces. To do so, it studies a general summability method known as theta-summation, which encompasses all the well-known summability methods, such as the Fejér, Riesz, Weierstrass, Abel, Picard, Bessel and Rogosinski summations. Following on the classic books by Bary (1964) and Zygmund (1968), this is the first book that considers strong summability introduced by current methodology. A further unique aspect is that the Lebesgue points are also studied in the theory of multi-dimensional summability. In

addition to classical results, results from the past 20-30 years – normally only found in scattered research papers – are also gathered and discussed, offering readers a convenient “one-stop” source to support their work. As such, the book will be useful for researchers, graduate and postgraduate students alike.

This volume is a selection of written notes corresponding to courses taught at the CIMPA School: "New Trends in Applied Harmonic Analysis: Sparse Representations, Compressed Sensing and Multifractal Analysis". New interactions between harmonic analysis and signal and image processing have seen striking development in the last 10 years, and several technological deadlocks have been solved through the resolution of deep theoretical problems in harmonic analysis. New Trends in Applied Harmonic Analysis focuses on two particularly active areas that are representative of such advances: multifractal analysis, and sparse representation and compressed sensing. The contributions are written by leaders in these areas, and cover both theoretical aspects and applications. This work should prove useful not only to PhD students and postdocs in mathematics and signal and image processing, but also to researchers working in related topics.

Reconstructing or approximating objects from seemingly incomplete information is a frequent challenge in mathematics, science, and engineering. A multitude of tools designed to recover hidden information are based on Shannon’s classical sampling theorem, a central pillar of Sampling Theory. The growing need to efficiently obtain

precise and tailored digital representations of complex objects and phenomena requires the maturation of available tools in Sampling Theory as well as the development of complementary, novel mathematical theories. Today, research themes such as Compressed Sensing and Frame Theory re-energize the broad area of Sampling Theory. This volume illustrates the renaissance that the area of Sampling Theory is currently experiencing. It touches upon trendsetting areas such as Compressed Sensing, Finite Frames, Parametric Partial Differential Equations, Quantization, Finite Rate of Innovation, System Theory, as well as sampling in Geometry and Algebraic Topology.

The theory of several complex variables can be studied from several different perspectives. In this book, Steven Krantz approaches the subject from the point of view of a classical analyst, emphasizing its function-theoretic aspects. He has taken particular care to write the book with the student in mind, with uniformly extensive and helpful explanations, numerous examples, and plentiful exercises of varying difficulty. In the spirit of a student-oriented text, Krantz begins with an introduction to the subject, including an insightful comparison of analysis of several complex variables with the more familiar theory of one complex variable. The main topics in the book include integral formulas, convexity and pseudoconvexity, methods from harmonic analysis, and several aspects of the $\overline{\partial}$ problem. Some further topics are zero sets of holomorphic functions, estimates, partial differential equations, approximation

theory, the boundary behavior of holomorphic functions, inner functions, invariant metrics, and holomorphic mappings. While due attention is paid to algebraic aspects of several complex variables (sheaves, Cousin problems, etc.), the student with a background in real and complex variable theory, harmonic analysis, and differential equations will be most comfortable with this treatment. This book is suitable for a first graduate course in several complex variables.

Research topics in the book include complex dynamics, minimal surfaces, fluid flows, harmonic, conformal, and polygonal mappings, and discrete complex analysis via circle packing. The nature of this book is different from many mathematics texts: the focus is on student-driven and technology-enhanced investigation. Interlaced in the reading for each chapter are examples, exercises, explorations, and projects, nearly all linked explicitly with computer applets for visualization and hands-on manipulation.

Written by internationally renowned mathematicians, this state-of-the-art textbook examines four research directions in harmonic analysis and features some of the latest applications in the field. The work is the first one that combines spline theory, wavelets, frames, and time-frequency methods leading up to a construction of wavelets on manifolds other than Rn. Four Short Courses on Harmonic Analysis is intended as a graduate-level textbook for courses or seminars on harmonic analysis and its applications. The work is also an excellent reference or self-study guide for researchers and practitioners with diverse mathematical backgrounds working in different fields

such as pure and applied mathematics, image and signal processing engineering, mathematical physics, and communication theory.

Different aspects of harmonic analysis, complex analysis, sampling theory, approximation theory and related topics are covered in this volume. The topics included are Fourier analysis, Padè approximation, dynamical systems and difference operators, splines, Christoffel functions, best approximation, discrepancy theory and Jackson-type theorems of approximation. The articles of this collection were originated from the International Conference in Approximation Theory, held in Savannah, GA in 2017, and organized by the editors of this volume.

Real-Variable Methods in Harmonic Analysis deals with the unity of several areas in harmonic analysis, with emphasis on real-variable methods. Active areas of research in this field are discussed, from the Calderón-Zygmund theory of singular integral operators to the Muckenhoupt theory of Ap weights and the Burkholder-Gundy theory of good ? inequalities. The Calderón theory of commutators is also considered.

Comprised of 17 chapters, this volume begins with an introduction to the pointwise convergence of Fourier series of functions, followed by an analysis of Cesàro summability. The discussion then turns to norm convergence; the basic working principles of harmonic analysis, centered around the Calderón-Zygmund decomposition of locally integrable functions; and fractional integration. Subsequent chapters deal with harmonic and subharmonic functions; oscillation of functions; the Muckenhoupt theory

of Ap weights; and elliptic equations in divergence form. The book also explores the essentials of the Calderón-Zygmund theory of singular integral operators; the good ? inequalities of Burkholder-Gundy; the Fefferman-Stein theory of Hardy spaces of several real variables; Carleson measures; and Cauchy integrals on Lipschitz curves. The final chapter presents the solution to the Dirichlet and Neumann problems on C1-domains by means of the layer potential methods. This monograph is intended for graduate students with varied backgrounds and interests, ranging from operator theory to partial differential equations.

The second of a two volume set on novel methods in harmonic analysis, this book draws on a number of original research and survey papers from well-known specialists detailing the latest innovations and recently discovered links between various fields. Along with many deep theoretical results, these volumes contain numerous applications to problems in signal processing, medical imaging, geodesy, statistics, and data science. The chapters within cover an impressive range of ideas from both traditional and modern harmonic analysis, such as: the Fourier transform, Shannon sampling, frames, wavelets, functions on Euclidean spaces, analysis on function spaces of Riemannian and sub-Riemannian manifolds, Fourier analysis on manifolds and Lie groups, analysis on combinatorial graphs, sheaves, co-sheaves, and persistent homologies on topological spaces. Volume II is organized around the theme of recent applications of harmonic analysis to function spaces, differential equations, and data

science, covering topics such as: The classical Fourier transform, the non-linear Fourier transform (FBI transform), cardinal sampling series and translation invariant linear systems. Recent results concerning harmonic analysis on non-Euclidean spaces such as graphs and partially ordered sets. Applications of harmonic analysis to data science and statistics Boundary-value problems for PDE's including the Runge–Walsh theorem for the oblique derivative problem of physical geodesy.

Understand the methods of modern non-stationary signal processing with authoritative insights from a leader in the field.

This textbook explores a selection of topics in complex analysis. From core material in the mainstream of complex analysis itself, to tools that are widely used in other areas of mathematics, this versatile compilation offers a selection of many different paths. Readers interested in complex analysis will appreciate the unique combination of topics and connections collected in this book. Beginning with a review of the main tools of complex analysis, harmonic analysis, and functional analysis, the authors go on to present multiple different, self-contained avenues to proceed. Chapters on linear fractional transformations, harmonic functions, and elliptic functions offer pathways to hyperbolic geometry, automorphic functions, and an intuitive introduction to the Schwarzian derivative. The gamma, beta, and zeta functions lead into L-functions, while a chapter on entire functions opens pathways to the Riemann hypothesis and Nevanlinna theory. Cauchy transforms give rise to Hilbert and Fourier transforms, with

an emphasis on the connection to complex analysis. Valuable additional topics include Riemann surfaces, steepest descent, tauberian theorems, and the Wiener–Hopf method. Showcasing an array of accessible excursions, Explorations in Complex Functions is an ideal companion for graduate students and researchers in analysis and number theory. Instructors will appreciate the many options for constructing a second course in complex analysis that builds on a first course prerequisite; exercises complement the results throughout.

The chapters of this volume are based on talks given at the eleventh international Sampling Theory and Applications conference held in 2015 at American University in Washington, D.C. The papers highlight state-of-the-art advances and trends in sampling theory and related areas of application, such as signal and image processing. Chapters have been written by prominent mathematicians, applied scientists, and engineers with an expertise in sampling theory. Claude Shannon's 100th birthday is also celebrated, including an introductory essay that highlights Shannon's profound influence on the field. The topics covered include both theory and applications, such as: • Compressed sensing• Non-uniform and wave sampling• A-to-D conversion• Finite rate of innovation• Time-frequency analysis• Operator theory• Mobile sampling issues Sampling: Theory and Applications is ideal for mathematicians, engineers, and applied scientists working in sampling theory or related areas.

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applications written by speakers at the February Fourier Talks from 2002 – 2013. Containing cutting-edge results by an impressive array of mathematicians, engineers and scientists in academia, industry and government, it will be an excellent reference for graduate students, researchers and professionals in pure and applied mathematics, physics and engineering. Topics covered include: Special Topics in Harmonic Analysis Applications and Algorithms in the Physical Sciences Gabor Theory RADAR and Communications: Design, Theory, and Applications The February Fourier Talks are held annually at the Norbert Wiener Center for Harmonic Analysis and Applications. Located at the University of Maryland, College Park, the Norbert Wiener Center provides a state-of- the-art research venue for the broad emerging area of mathematical engineering.

Authored by a ranking authority in harmonic analysis of several complex variables, this book embodies a state-of-the-art entrée at the intersection of two important fields of research: complex analysis and harmonic analysis. Written with the graduate student in mind, it is assumed that the reader has familiarity with the basics of complex analysis of one and several complex variables as well as with real and functional analysis. The monograph is largely self-contained and develops the harmonic analysis of several complex variables from the first principles. The text includes copious examples, explanations, an exhaustive bibliography for further reading, and figures that illustrate the geometric nature of the subject. Each chapter ends with an exercise set. Additionally, each chapter begins with a prologue, introducing the reader to the subject matter that follows; capsules presented in each section give perspective and a spirited launch to the segment; preludes help put ideas into context. Mathematicians and researchers in several applied disciplines will find the breadth and depth of the treatment of the

subject highly useful.

Functions of bounded variation represent an important class of functions. Studying their Fourier transforms is a valuable means of revealing their analytic properties. Moreover, it brings to light new interrelations between these functions and the real Hardy space and, correspondingly, between the Fourier transform and the Hilbert transform. This book is divided into two major parts, the first of which addresses several aspects of the behavior of the Fourier transform of a function of bounded variation in dimension one. In turn, the second part examines the Fourier transforms of multivariate functions with bounded Hardy variation. The results obtained are subsequently applicable to problems in approximation theory, summability of the Fourier series and integrability of trigonometric series.

This book addresses the mathematical aspects of modern image processing methods, with a special emphasis on the underlying ideas and concepts. It discusses a range of modern mathematical methods used to accomplish basic imaging tasks such as denoising, deblurring, enhancing, edge detection and inpainting. In addition to elementary methods like point operations, linear and morphological methods, and methods based on multiscale representations, the book also covers more recent methods based on partial differential equations and variational methods. Review of the German Edition: The overwhelming impression of the book is that of a very professional presentation of an appropriately developed and motivated textbook for a course like an introduction to fundamentals and modern theory of mathematical image processing. Additionally, it belongs to the bookcase of any office where someone is doing research/application in image processing. It has the virtues of a good and handy reference manual. (zbMATH, reviewer: Carl H. Rohwer, Stellenbosch)

????Describing novel mathematical concepts for recommendation engines, Realtime Data Mining: Self-Learning Techniques for Recommendation Engines features a sound mathematical framework unifying approaches based on control and learning theories, tensor factorization, and hierarchical methods. Furthermore, it presents promising results of numerous experiments on real-world data.? The area of realtime data mining is currently developing at an exceptionally dynamic pace, and realtime data mining systems are the counterpart of today's “classic” data mining systems. Whereas the latter learn from historical data and then use it to deduce necessary actions, realtime analytics systems learn and act continuously and autonomously. In the vanguard of these new analytics systems are recommendation engines. They are principally found on the Internet, where all information is available in realtime and an immediate feedback is guaranteed. This monograph appeals to computer scientists and specialists in machine learning, especially from the area of recommender systems, because it conveys a new way of realtime thinking by considering recommendation tasks as control-theoretic problems. Realtime Data Mining: Self-Learning Techniques for Recommendation Engines will also interest application-oriented mathematicians because it consistently combines some of the most promising mathematical areas, namely control theory, multilevel approximation, and tensor factorization.

Marking a distinct departure from the perspectives of frame theory and discrete transforms, this book provides a comprehensive mathematical and algorithmic introduction to wavelet theory. As such, it can be used as either a textbook or reference guide. As a textbook for graduate mathematics students and beginning researchers, it offers detailed information on the basic theory of framelets and wavelets, complemented by self-contained elementary proofs,

illustrative examples/figures, and supplementary exercises. Further, as an advanced reference guide for experienced researchers and practitioners in mathematics, physics, and engineering, the book addresses in detail a wide range of basic and advanced topics (such as multiwavelets/multiframelets in Sobolev spaces and directional framelets) in wavelet theory, together with systematic mathematical analysis, concrete algorithms, and recent developments in and applications of framelets and wavelets. Lastly, the book can also be used to teach on or study selected special topics in approximation theory, Fourier analysis, applied harmonic analysis, functional analysis, and wavelet-based signal/image processing.