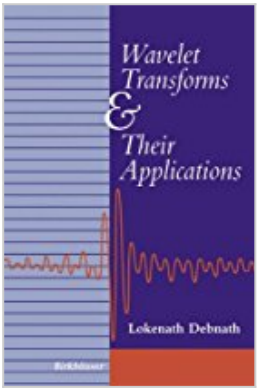

Wavelet Transforms and Their Applications

By Lokenath Debnath

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Overview Historically, the concept of "ondelettes" or "wavelets" originated from the study of time-frequency signal analysis, wave propagation, and sampling theory. One of the main reasons for the discovery of wavelets and wavelet transforms is that the Fourier transform analysis does not contain the local information of signals. So the Fourier transform cannot be used for analyzing signals in a joint time and frequency domain. In 1982, Jean MorIet, in collaboration with a group of French engineers, first introduced the idea of wavelets as a family of functions constructed by using translation and dilation of a single function, called the mother wavelet, for the analysis of nonstationary signals. However, this new concept can be viewed as the synthesis of various ideas originating from different disciplines including mathematics (Calder6n-Zygmund operators and Littlewood-Paley theory), physics (coherent states in quantum mechanics and the renormalization group), and engineering (quadratic mirror filters, sideband coding in signal processing, and pyramidal algorithms in image processing). Wavelet analysis is an exciting new method for solving difficult problems in mathematics, physics, and engineering, with modern applications as diverse as wave propagation, data compression, image processing, pattern recognition, computer graphics, the detection of aircraft and submarines, and improvement in CAT scans and other medical image technology. Wavelets allow complex information such as music, speech, images, and patterns to be decomposed into elementary forms, called the fundamental building blocks, at different positions and scales and subsequently reconstructed with high precision.

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Editorial Review

Review

"It contains a wealth of information that should make it useful in signal processing and perhaps some other areas of engineering . . . I like the book as a possible text for a beginning graduate course in, say, mathematical methods in engineering. It covers a number of topics that are quite useful but are rarely covered in mainstream mathematics courses . . . a lot of the proofs are short and computational, which is necessary in such a book that covers a large number of topics . . . it would serve as a good text, provided that the aim of the course is to present a variety of transforms useful in signal processing, as well as the wavelet transforms."

—Mathematical Reviews

"The last two decades have produced tremendous developments in the mathematical theory of wavelets and their great variety of applications. Since wavelet analysis is a relatively new subject, this monograph is intended to be self-contained. The book is designed as a modern and authoritative guide to wavelets, wavelet transform, time-frequency signal analysis and related topics.

It is known that some research workers look upon wavelets as a new basis for representing functions, others consider them as a technique for time-frequency analysis and some others think of them as a new mathematical subject. All these approaches are gathered in this book, which presents an accessible, introductory survey of new wavelet analysis tools and the way they can be applied to fundamental analysis problems. We point out the clear, intuitive style of [the] presentation, and the numerous examples demonstrated through[out] the book illustrate how methods work in a step-by-step manner.

This way, the book becomes ideal for a broad audience including advanced undergraduate students, graduate[s] and professionals in signal processing. Also, the book provides the reader with a thorough mathematical background, and the wide variety of applications cover the interdisciplinary collaborative research in applied mathematics."

—Revue D'Analyse Numérique et de Théorie de L'Approximation

From the Back Cover

This volume is designed as a new source for modern topics dealing with wavelets, wavelet transforms time-frequency signal analysis and other applications for future development of this new, important and useful subject for mathematics, science and engineering. Its main features include:
A broad coverage of recent material on wavelet analysis, and time-frequency signal analysis and other applications that are not usually covered in other recent reference books.
The material presented in this volume brings together a rich variety of ideas that blend most aspects of the subject mentioned above.
This volume brings together a detailed account of major recent developments in wavelets, wavelet transforms and time-frequency signal analysis.

This volume provides the reader with a thorough mathematical background and a wide variety of applications that are sufficient to do interdisciplinary collaborative research in applied mathematics. The book provides information that puts the reader at the forefront of the current resarch. An up-to-date bibliography is included at the end of each chapter to stimulate new interest in future study and research.

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