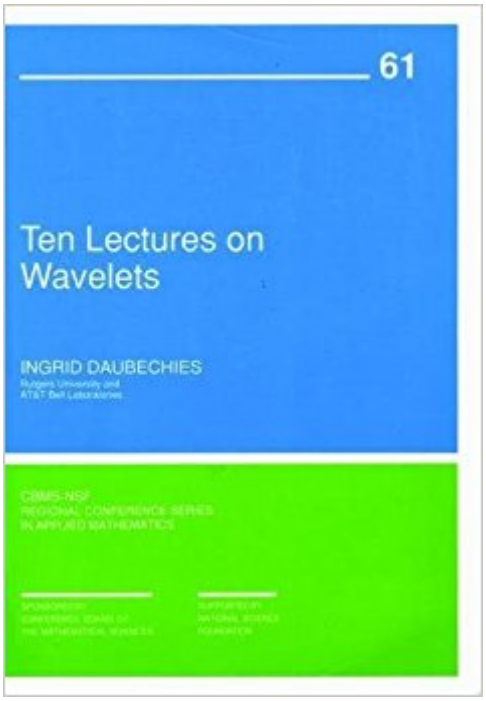
Ten Lectures On Wavelets (CBMS-NSF Regional Conference Series In Applied Mathematics)



Synopsis

This monograph contains 10 lectures presented by Dr. Daubechies as the principal speaker at the 1990 CBMS-NSF Conference on Wavelets and Applications. Wavelets are a mathematical development that many experts think may revolutionize the world of information storage and retrieval. They are a fairly simple mathematical tool now being applied to the compression of data, such as fingerprints, weather satellite photographs, and medical x-rays - that were previously thought to be impossible to condense without losing crucial details. The opening chapter provides an overview of the main problems presented in the book. Following chapters discuss the theoretical and practical aspects of wavelet theory, including wavelet transforms, orthonormal bases of wavelets, and characterization of functional spaces by means of wavelets. The last chapter presents several topics under active research, as multidimensional wavelets, wavelet packet bases, and a construction of wavelets tailored to decompose functions defined in a finite interval.

Book Information

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Customer Reviews

'This is a marvellous book written by one of the principal contributors to the field. ... a great part of the volume under review is dedicated to the engineering and physical origins of wavelets. ... The book style is alert and the interest of the potential reader is continuously kept alive. I think that this book is very useful to mathematicians as well as to people interested in the wavelets applications (engineers, physicists, etc.).' Nicolae Popa, Romanian Journal of Pure and Applied Mathematics'Ingrid Daubechies is a leading wavelet theorist; this book gives a clear and systematic

treatment of the mathematics. Applications are kept in mind all the time, but the main focus of attention is a rigorous development of the theory. ... The book is carefully written; proofs are given in detail for the benefit of non-expert readers yet there is plenty of broad-brush explanation to balance the rigorous mathematical detail.' D. H. Griffel, The Mathematical Gazette' ... this is a clearly written introduction to the mathematics of wavelets that provides solid background material on most of the major aspects of the current theory. Especially appealing is the way in which the relationships between wavelets and other areas are pointed out. ... I feel certain that this will be the major introductory text on wavelets for some time to come. It will definitely be a welcome addition to the library of anyone interested in learning the basics of wavelets.' Christopher Heil, SIAM Review'This book is both a tutorial on wavelets and a review of the most advanced research in this domain ... it also gives many practical examples and describes several applications (in particular, in signal processing, image coding and numerical analysis).' Mathematical Reviews' ... I heartily recommend this book to anyone who seriously wants to know the state of the art in wavelets. The modest ... is a real bargain for the wealth of information it contains ... I have changed from one who is skeptical because of wavelets being fashionable to one who has the opinion that wavelets are here to stay and will become a standard tool in many applications. This book is likely to become a classic text in mathematics and a reference to those seriously using wavelets. It is exciting to read a soon-to-be classic.' Journal of Electronic Imaging"The book by Daubechies, who is one of the main developers of the (wavelet) theory, is the result of an intensive short course. The presentation is completely engrossing; it is like reading a good, thick Russian novel. Daubechies has a real knack for making the material appealing and lively, and there is a definite 'slowing down for details' at the points that require further elucidation. ...This book can be used for many different purposes, from individual reading to graduate-level course-work, and it will likely become a classic." -- F. Alberto GrÃƒÂ nbaum, Science, August 7, 1992.

This monograph contains 10 lectures presented by Dr. Daubechies at the 1990 CBMS-NSF Conference on Wavelets and Applications. The opening chapter outlines the main problems presented in the book; following chapters discuss the theoretical and practical aspects of wavelet theory, whilst the last chapter presents several topics under active research.

This is an excellent book, very lucid and rigorous. I took Daubechies' course on wavelet analysis while I was at Princeton some years ago, and her course essentially follows this book. So this book makes a lot of sense to me, after taking her class. But beware, this is a book on mathematical

analysis. It is not a book to learn about wavelets from a practical standpoint. If you are engineer, most likely you do not have the required mathematical background to understand anything from this book. This is really for math people, or engineers/physicists who are mathematically inclined. The pre-requisite are real analysis, complex analysis and analysis in several variable, and maybe a slight amount of functional analysis, although the latter is not really needed because most of the theorems are derived in this book. So to re-iterate, this is an excellent book, but it is not for learning about wavelets. Read Stephane Mallat's textbook instead, which was written to teach the topic from a more practical standpoint.

Thank you

Original papers ... a good starting point to learn about wavelets.

great book.

What can I say, Wavelets explained by Ingrid Daubechies! You can't go wrong.

As stated by the author in the first sentence of her redoubtable treatise (p.1), "The wavelet transform is a tool that cuts up data or functions or operators into different frequency components, and then studies each component with a resolution matched to its scale." She goes on to trace the evolution of this mathematical tool, that is seen to rely (in the case of Meyer wavelets, p.119) on "quasi-miraculous cancellations." Sigrid Daubechies' contribution was that of developing an algorithm for defining a wavelet function that did not suffer from the drawbacks of previously-defined analytical or digital functions. Analytical functions, while usually sufficiently smooth, are not truncated in temporal or configuration space--nor are the associated temporal or spacial frequencies commonly accessed by Fourier transforms (p.4). On the other hand, digital functions such as square waves or step functions (or the Haar wavelet, p.15) are often not sufficiently smooth. As the author observes on the first line of Chapter 6 (p.167) "Except for the Haar basis, all examples of orthonormal wavelet bases in the previous chapter consisted of infinitely supported functions." Daubechies, however, was able to unravel the Gordian knot by defining discrete/digital wavelets (pp.53-105) that are both sufficiently smooth and naturally truncated or "compact" (i.e. "compactly supported," pp.194-199).The author lucidly derives and proves the incredible properties of what have come to be called Daubechies wavelets--thereby convincing the reader that these amazing

mathematical entities actually exist! It is difficult, however, to digest every proof laid out by the author. I would therefore suggest that the reader begin with the most interesting proofs, which are found in the first section (5.1, pp.127-137) of Chapter 5: "Orthonormal bases of wavelets and multiresolution analysis." The reader should pay particular attention to p.132, which introduces the trigonometric polynomial m0(u), the properties of which are further detailed on pp.155, 168, and 216.For those of us who are not heavily involved in signal and image processing, however, Daubechies' book is a difficult place to begin one's study of wavelets. A better starting place for the novice would be an introductory textbook such as that of Burrus et al.:Ã Â Introduction to Wavelets and Wavelet Transforms: A Primer. In reading Burrus along with Daubechies, however, the reader needs to keep in mind that the two books use different notations for expressing wavelets and scaling functions (Daubechies p.130; Burrus p.15), such that scaling parameter as used in one book's notation is the reciprocal of that defined by the other.A good overview of the field is also provided by Hubbard'sÃ Â The World According to Wavelets: The Story of a Mathematical Technique in the Making, Second Edition. It is also necessary that the reader have an understanding of Fourier transforms at the level of Bracewell'sÃ Â The Fourier transform and its applications (McGraw-Hill electrical and electronic engineering series).I should also note that Daubechies' subject index spans only two pages--which is not nearly long enough! The shortcomings of the index and the detailed nature of this monograph limit its usefulness as a reference book. Therefore, the reader needs to buy his own copy of Daubechies and mark it up to his heart's content, including notes on the title page (and the pages immediately following it) that may supplement the subject index.

This book has become a classic,-- and a hit;-- for more than ten reasons. It is multilayered, and yet presents a unity of ideas: The material, and the writing is engaging for the beginner, and for the research mathematician alike. When I used it in my teaching, it was equally popular with the math students, and those from engineering. I don't know if I can say this about any other book I have taught from. The students could follow all the carefully presented proofs, and the engineer could generate algorithms from the applied chapters.

This is the document that started it all. It is by far a great mathematical and theoritical piece of work. HOWEVER, if you are just starting off and want to learn about wavelets and do not have an advanced math or engineering degree (and I do mean ADVANCED), do not pick up this book. At least not at the beginning. There are much better books written for explaining wavelets and to better

present the material. Ten Lectures is essentially one big proof. Try Mallat/Kovacevic or Strang...once you've got a solid understanding, come back to Daubechies and marvel at her work.

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