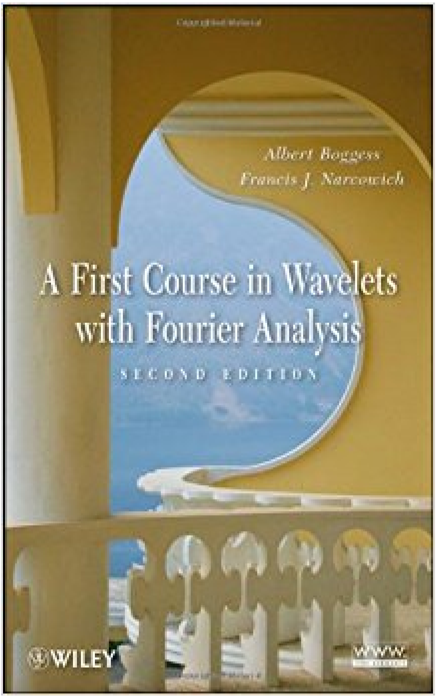
A First Course In Wavelets With Fourier Analysis



Synopsis

A comprehensive, self-contained treatment of Fourier analysis and waveletsÃ¢â ¬â •now in a new edition Through expansive coverage and easy-to-follow explanations, A First Course in Wavelets with Fourier Analysis, Second Edition provides a self-contained mathematical treatment of Fourier analysis and wavelets, while uniquely presenting signal analysis applications and problems. Essential and fundamental ideas are presented in an effort to make the book accessible to a broad audience, and, in addition, their applications to signal processing are kept at an elementary level. The book begins with an introduction to vector spaces, inner product spaces, and other preliminary topics in analysis. Subsequent chapters feature: The development of a Fourier series, Fourier transform, and discrete Fourier analysis Improved sections devoted to continuous wavelets and two-dimensional wavelets The analysis of Haar, Shannon, and linear spline wavelets The general theory of multi-resolution analysis Updated MATLAB code and expanded applications to signal processing The construction, smoothness, and computation of Daubechies' wavelets Advanced topics such as wavelets in higher dimensions, decomposition and reconstruction, and wavelet transform Applications to signal processing are provided throughout the book, most involving the filtering and compression of signals from audio or video. Some of these applications are presented first in the context of Fourier analysis and are later explored in the chapters on wavelets. New exercises introduce additional applications, and complete proofs accompany the discussion of each presented theory. Extensive appendices outline more advanced proofs and partial solutions to exercises as well as updated MATLAB routines that supplement the presented examples. A First Course in Wavelets with Fourier Analysis, Second Edition is an excellent book for courses in mathematics and engineering at the upper-undergraduate and graduate levels. It is also a valuable resource for mathematicians, signal processing engineers, and scientists who wish to learn about wavelet theory and Fourier analysis on an elementary level.

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Customer Reviews

"A first course in wavelets with Fourier analysis, second edition is an excellent book for courses in mathematics and engineering at the upper-undergraduate and graduate levels. It is also a valuable resource for mathematicians, signal processing engineers, and scientists who wish to learn about wavelet theory and Fourier analysis on an elementary level." (Mathematical Reviews, 2011) "The discussions of applications avoid the deep jargon of signal processing Ã¢â ¬Â| accessible to a wider audience." (Book News, December 2009)

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This is a great introduction to wavelet theory for someone that has a strong calculus background and a basic understanding of analysis. I only skimmed the first four chapters which cover Fourier because I already had a strong Fourier background so I can only attest to the second half of the book.The motivation for wavelets via Haar decomposition is easy to follow and enlightening. Chapter 5 covers the mathematical nitty gritty and takes a bit more to work through but the proofs are annotated quite nicely. My only grief is chapter 7. It’s written in a way that makes you think the author didn’t feel like writing it but one of the technical editors said they should include it last minute. Overall, a great first read on wavelets. I would highly recommend for beginning grad students / upperclass undergrads in STEM disciplines.

I have had 5 students use this book to learn about wavelets in independent study courses. The students range from very good undergraduates to beginning graduate students. They were all able to make progress on their own and work all of the problems in the book with some help from me. I think the book is a great introduction to the subject of wavelets and MRA’s. I will continue to use this book for individual students who are interested in learning about wavelets and relationships to Fourier transform methods.

The Kindle version of this book is horrible. Some characters are replaced with squares, some formulas are hard to read with some font sizes. This is due to the fact that formulas are mixed images and text. Also, no page numbers.The content itself is okay. However, in my class we had to use supplementary texts because some concepts aren’t explained properly.

as described

the condition of the textbook was excellent. As expected, the book the one i needed and ordered. A satisfied customer

Good

... I’m not sure this stands well by itself. I started learning about wavelets fromÃ Â anotherÃ Â book, which I found strong on intuitive clarity and applications, but weak on mathematical underpinnings. This has the full mathematical depth I’m looking for, but weaknesses in that other book’s strengths.Even experienced readers should pay attention to chapter zero (yes, zero, before one), when Boggess lays out the basic tools used throughout this book. In particular, it presents the notation used throughout the book. I already had adequate grasp of this chapter’s material, but it uses notation I hadn’t seen before and uses familiar symbols in unfamiliar ways. And, like other reviewers, the material on Fourier transforms would have been review, and didn’t add much to the wavelet discussion. For me, the real meat of the material came in chapters 4 and 5 - chapter 6 added breadth (and some pragmatic points) to the topic. Chapter 7 was sort of a winding down, filling out the notebook with transform and inverse material that a diligent and prepared reader could have worked out, if not as elegantly.So, between these two books, I’ve done a lot to build up the intuition and technique needed to put wavelets to use. Now, I just need to find out whether this tool does the job I want done. If it doesn’t, that’s more a matter of my poor choice than of the technique’s inherent value.-- wiredweird

At the time of writing of this review (October 2001), a standard academic search procedureproduces about twenty references per week of scientific papers using wavelet analysis in a very wide spectrum of sciences. More than 160 english language books have been published on wavelets since the first books appeared around 1990. Yet even now it is rare to find a book on this subject which is aiming at undergraduate students and yet is mathematically responsible, without being heavy going. Boggess and Narcovich have tried to do just that, and to my mind have admirably succeeded. Assuming a standard background knowledge in calculus and linear algebra that many science and engineering students acquire in their first two years at university, they present the basics of Fourier analysis and wavelets in eight brief chapters. To prepare the way, they start in chapter 0 with an introduction to inner product spaces, without using advanced analysis, and building on the experience with ordinary vector spaces.Also a sniff of linear operator theory is offered. Chapter 1 introduces Fourier series in real and complex form. These originated in the eighteenth century study of vibrations and in the theory of heat, made famous by Fourier’s classic book of 1808: Analytical Theory of Heat. The mathematical claims Fourier made, but which he could not all prove himself, gave the impetus to an enormous development of both mathematical theory and applications in all fields of natural science, which is still going on today. The applications briefly mentioned here are denoising and compression of signals, and finding the solution of partial differential equations. Various aspects of the convergence of Fourier series are dealt with. All concepts are illustrated with a good set of clear figures, and the chapter finishes with exercises that are going from very elementary to a little more ambitious, sometimes involving the use of simple computer algebra tasks. This format is maintained thorugh the entire text, except for the last chapter. Chapter 2 proceeds with the Fourier Transform, including the important theory of linear time invariant filters. The existence of the impulse response function and its convolution character are shown. As an example the noise reducing Butterworth filter is presented. Sampling and the Nyquist frequency are touched upon, and a derivation of the uncertainty relations, originally coming from quantum mechanics, is given. To analyse discrete data, one needs the discrete Fourier Transform, which is the subject of chapter 3, including of course the Fast Fourier Transform. Also the z-transform is introduced. Examples given are elementary cases of parameter identification in vibration, numerical solution of ordinary differential equations, as well as in the exercises: noise reduction and data compression.These first 153 pages serve as a good undergraduate introduction to Fourier analysis.The second half of the book is devoted to wavelets. Chapter 4 deals exclusively with Haar wavelets which are the oldest wavelets because they date from 1910! These wavelets constitute an orthonormal basis of functions, which makes for fast calucation, a very important aspect for many applications. The core ideas of the central concept of a "multiresolution analysis" of a signal, can be demonstrated with these simple wavelets. All of this is already understandable without the machinery of the preceding Fourier analysis, so you could jump into the book here and start reading about wavelets right away, picking up the Fourier analysis from the first part bit by bit as the need arises. As applications denoising and compression are mentioned again, as is the detection of a discontinuity in a signal. The general case of a multiresolution analysis is the subject of chapter 5. Again a large part of the discussion can be swallowed without the need of the Fourier transform point of view. The explanation of the structure of a multiresolution analysis leading to an orhtonormal basis of wavelets is straightforward and clear. It is only when we want to go into more detail about the precise characteristics of the underlying wavelet and scaling function that the Fourier point of view is introduced. This then leads up to the presentation of the famous Daubechies wavelets in chapter 6. These wavelets revolutionised the field after their publication in 1988. Chapter 7 which closes the book, gives several short remarks about various other topics among which are two-dimensional wavelets, and the continuous wavelet transform.This chapter is more sketchy than the others, and left me much less satisfied. Also the motivation why these subjects are chosen was lacking almost completely, and there are no exercises. I was particularly disappointed not to find any discussion of the relative merits of the continuous versus the discrete wavelet transform, and there is no mention of any application of the continuous case. Yet the latter is also used frequently in many important scientific applications, and it started the modern wavelet endeavour in the early eighties in France.That being said I still think this is a very useful book for anybody wanting to start with wavelets at an undergraduate level. A few helpful Matlab Codes are collected in an appendix as well as the more difficult parts of some proofs. The exercises make this good course material, but as a text for self study it will also be quite satisfactory for many newcomers that find most of the existing books too demanding.