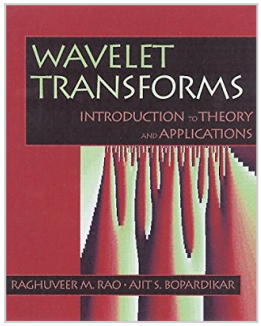


# Wavelet Transforms: Introduction to Theory & Applications

*By Raghuveer M. Rao, Ajit S. Bopardikar*



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*Written by researchers Raghuveer M. Rao and Ajit S. Bopardikar, Wavelet Transforms provides engineers, scientists, and students with a practical understanding of wavelet transforms and their properties. The authors introduce the underlying theory of the transform by presenting a wide range of applications, such as signal processing, image processing, and communications. *This book identifies problems for which wavelet transform techniques are well-suited, shows how to implement wavelet transforms efficiently, and explains how to choose or design appropriate wavelets for a given application. In Chapter 1, basic linear filtering principles are utilized to introduce the reader to continuous wavelet transform. In Chapter 2, the basics of discrete wavelet transforms and multiresolution analysis are presented. Multiresolution analysis is then further explored in Chapter 3. Chapter 4 contains alternative wavelet representations, such as biorthogonal bases, wavelet packets, and multiresolution analysis of images. Chapter 5 provides a detailed treatment of the use of wavelet transform techniques in signal and image compression.In Chapter 6, applications to areas such as denoising, object isolation, and detection are presented. Chapter 7 addresses several more advanced topics, including: choice or design of wavelets for a given application, projection relations for the continuous wavelet transform, biorthogonal bandlimited wavelets, matched wavelet construction, self-similar signals, and linear scale-invariant systems. The supporting disk contains MATLAB routines that enable the reader to experiment with various algorithms and techniques presented in the book. *Practical in their approach, Rao and Bopardikar present the material in a visual and comprehensive manner, using geometric analogies and filtering concepts. The book is written in a language familiar to readers with a basic undergraduate engineering degree.

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## Editorial Review

From the Inside Flap
The wavelet transform has been perhaps the most exciting development in the last decade to bring together researchers in several different fields such as signal processing, image processing, communications, computer science, and mathematics--to name a few. This book provides an introduction to wavelet transform theory and applications for engineers. The subject has been taught previously as part of several of our graduate courses in the Electrical Engineering Department at the Rochester Institute of Technology and is now being taught as a complete course. Most of the students who take the course are working engineers from local industries such as Eastman Kodak Company, Xerox Corporation, Harris, RF Communications, and so on. A challenge in teaching this audience has been to cast the material in a language familiar to engineers with a basic undergraduate degree while maintaining accuracy and rigor. Over the years we have been able to develop an approach using geometric analogies and filtering concepts to meet this challenge successfully. Our students and colleagues have been urging us to write a book that adopts such an approach because they find the material in the mathematically oriented books to be daunting and inaccessible. We have endeavored to keep the presentation in line with their exhortations.

Application of the wavelet transform has almost come to be regarded as being synonymous with data compression. So it should come as no surprise that we have an extensive chapter on this application. However, there are properties of the wavelet transform that make it naturally suited for application in many other areas. It has been our desire for some time to bring out this fact. The reader will find a detailed chapter devoted to such applications.

The book starts off with a discussion of the continuous wavelet transform. This is in keeping with the teaching approach in our classes. Rather than starting with one or two chapters devoted to notation and basic material such as Fourier analysis, the reader is led directly into the subject using basic linear filtering principles. The wavelet transform is introduced in the context of reconstructing a signal from the outputs of filters with impulse responses that are generated by dilation of a single function. Chapter 2 introduces the basics of discrete wavelet transforms and multiresolution analysis. The latter concept is first developed in the familiar setting of linear vector spaces and Fourier series. The role of wavelets is then introduced through the Haar wavelet and piecewise constant approximations of signals. Chapter 3 considers multiresolution analysis based on orthogonal wavelet basis functions in greater detail. Subband filter bank implementations for signals and images as well as efficient implementation are discussed. Chapter 4 looks at alternative wavelet representations such as biorthogonal bases, wavelet packets, and multiresolution analysis of images. Chapter 5 provides a detailed treatment of the use of wavelet transform techniques in signal and image compression. In Chapter 6, wavelet transform application to areas such as denoising, object isolation, and detection are explained. Lastly, Chapter 7 treats several advanced topics. A question that arises often is which wavelet to choose in an application. Chapter 7 addresses this issue. It also deals with some of the latest research on generating wavelets and decompositions that are tailored specifically to meet certain objectives. Throughout the text, the presentation is patterned after what is usually found in electrical engineering texts and generally stays away from the "theorem-proof" model. The readers do not have to be familiar with real analysis or functional analysis. The concept of integration as dealt with traditionally in undergraduate engineering courses should suffice for understanding the material, and because it serves perfectly well in most applications, the attendant sacrifice in mathematical rigor should be of minor importance from a practical viewpoint. Problem sets are provided at the ends of Chapters 1 through 4. We also provide a disk with (MATLAB) routines that illustrate the concepts developed in the text.

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From the Back Cover

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About the Author
Raghuveer M. Rao is a Professor of Electrical Engineering and a member of the graduate faculty of the Center for Imaging Science at the Rochester Institute of Technology. He is an active researcher in the areas of signal/image processing and digital communications. Ajit S. Bopardikar obtained his BE degree from the University of Bombay and his MSc(Engg) degree in Electrical Communication Engineering from the Indian Institute of Science. He is a doctoral candidate at the Center for Imaging Science at the Rochester Institute of Technology, and has been an active researcher in the areas of wavelet transforms and filter banks.
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**Ruth Brinkman:**

The feeling that you get from Wavelet Transforms: Introduction to Theory & Applications could be the more deep you looking the information that hide inside the words the more you get thinking about reading it. It doesn't mean that this book is hard to recognise but Wavelet Transforms: Introduction to Theory & Applications giving you buzz feeling of reading. The writer conveys their point in particular way that can be understood by anyone who read it because the author of this book is well-known enough. This book also makes your current vocabulary increase well. That makes it easy to understand then can go along, both in printed or e-book style are available. We propose you for having this kind of Wavelet Transforms: Introduction to Theory & Applications instantly.

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**Pauline Jones:**

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