Book Review: *Wavelets: An Analysis Tool*

Wavelets: An Analysis Tool. Matthias Holschneider, Oxford Science Publications, Oxford, 1995.

The wavelet transform, in contrast to the Fourier transform, simultaneously provides information about a signal in both time and frequency. It is a widely applied tool in several fields of engineering and is somewhat more slowly being applied as an analytical tool for the solution of problems in the physical sciences.

Many books on the wavelet transform have been published within the past few years. In most the focus is on wavelets as either a purely mathematical construct or as a tool for signal analysis. Very few books are addressed to the physicist, in spite of many recent articles published on applications to physics. Holschneider's book partially fills this void, particularly in Chapter 4, which is devoted to applications of the wavelet transform to the analysis of fractals. Much of the material in that chapter was originally published in this journal. Nevertheless, the main thrust of the book is mathematical rather than physical. Many students and researchers with a background in the physical sciences might wish that the author had supplemented some of the heavier mathematical analysis with material providing more motivation. This, in spite of the author's statement that the book is designed to be "an easy-to-read, more or less self-contained introductory text to the theory of wavelets. It is intended for graduate students of mathematics and physics, as well as interested researchers from other fields, and engineers" and "only very elementary mathematics is needed." This last statement might be somewhat misleading when applied to the average graduate student in physics. If the author's aim was to make this book appeal to a wide audience, then more should have been done to provide illustrative examples. Additionally, one might have wished for a wider survey of applications. Another feature that might have improved the book's readability would have been an introductory listing of preliminary material and notation. There is only a limited list of symbols in the contents section.

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Here I give a brief and incomplete overview of the material in the book. The fourth chapter applies the wavelet methodology to fractal analysis and illustrates how various problems (theorems) can be solved (proved) in wavelet space. Among others it contains sections on Brownian motion, dynamical systems (as modeled by the iterated function systems), and fractal measures. Other chapters, although not specifically focused on physics, contain interesting and useful information. Chapter 1 introduces the continuous wavelet transform and its properties. The second chapter deals with partial reconstruction formulas in which only subsets of the half-plane are used to reconstruct the transformed function. Chapter 3 discusses the construction of orthonormal wavelet bases and multiresolution analysis. The fifth chapter deals with group theory as a unifying language, while the sixth contains a brief introduction to functional analysis and wavelets.

To summarize, Holschneider's book is not a particularly intuitive introduction to wavelet transforms, but has a heavy emphasis on the rigorous mathematical underpinnings of the subject. I do not recommend it to physicists as an introductory text on wavelets; however, scientists with a mathematical bent who already have an introductory knowledge will find it a valuable source of information. The book is self-contained, covers a lot of ground, has many interesting insights, and, considering its scope, is a significant achievement.

Sinisa Pajevic
Division of Computer Research and Technology
National Institutes of Health
Bethesda, Maryland 20892