

**io-port 06043916****Najmi, Amir-Homayoon****Wavelets. A concise guide.**

Baltimore, MD: Johns Hopkins University Press (ISBN 978-1-4214-0496-7/pbk; 978-1-4214-0495-0/hbk). xxix, 270 p. \$ 90.00/hbk; \$ 45.00/pbk (2012).

Books have been written on the subject of wavelets since around 1990, with early textbooks beginning to appear in the mid-90s. By now there are literally hundreds of texts and monographs focusing largely or entirely on wavelets and their applications, and thousands of edited volumes. For the most part, the texts and monographs fall roughly into a handful of categories: indent=6mm

- (1) Popular introductions such as Hubbard's [*B. Burke Hubbard*, The world according to wavelets: the story of a mathematical technique in the making. 2nd ed. Wellesley, MA: A K Peters (1998; Zbl 0896.42019)] or [*S. Jaffard, Y. Meyer* and *R. D. Ryan*, Wavelets. Tools for science and technology. Philadelphia, PA: SIAM (2001; Zbl 0970.42020)];
- (2) true primers, with varying emphasis on mathematics and applications, such as [*J. S. Walker*, A primer on wavelets and their scientific applications. 2nd ed. Boca Raton, FL: Chapman & Hall/CRC (2008; Zbl 1138.94003)], [*Y. Nievergelt*, Wavelets made easy. Boston, MA: Birkhäuser (1999; Zbl 0929.42021)], [*M. J. Mohlenkamp* and *M. C. Pereyra*, Wavelets, their friends, and what they can do for you. Zürich: European Mathematical Society (EMS) (2008; Zbl 1153.42016)] or [*C. Blatter*, Wavelets. A primer. Natick, MA: AK Peters (1998; Zbl 0928.42016)];
- (3) mathematical introductions for upper division undergraduate courses or graduate courses with varying degrees of emphasis on Fourier analysis versus wavelets and theory versus general applications of wavelets, such as [*A. Boggess* and *F. J. Narcowich*, A first course in wavelets with Fourier analysis. Upper Saddle River, NJ: Prentice Hall (2001; Zbl 1177.42001)], [*M.A. Pinsky*, Introduction to Fourier analysis and wavelets. The Brooks/Cole Series in Advanced Mathematics. Pacific Grove, CA: Brooks/Cole (2002; Zbl 1065.42001)], [*D. F. Walnut*, An introduction to wavelet analysis. Basel: Birkhäuser (2002; Zbl 0989.42014)], or [*D. W. Kammler*, A first course in Fourier analysis. 2nd revised ed. Cambridge: Cambridge University Press (2007; Zbl 1144.42001)] just to name a few;
- (4) monographs on wavelets and subband coding ranging from nuts and bolts to specific cutting edge applications such as *G. Strang* and *T. Nguyen's* [Wavelets and filter banks, Wellesley, MA: Wellesley-Cambridge Press (1996; Zbl 06111018)], *M. Vetterli* and *J. Kovačević's* [Wavelets and subband coding. Prentice Hall Signal Processing Series. Hemel Hempstead: Prentice Hall (1995; Zbl 0885.94002)], [*L. Debnath*, Wavelet transforms and their applications. Boston, MA: Birkhäuser (2002; Zbl 1019.94003)], [*A. Abbate, C. M. DeCusatis* and *P. K. Das*, Wavelets and subbands. Fundamentals and applications. Applied and Numerical Harmonic Analysis. Basel: Birkhäuser (2002; Zbl 0999.94001)] or [*A. Teolis*, Computational signal processing with wavelets. Applied and Numerical Harmonic Analysis. Boston: Birkhäuser (1998; Zbl 0928.94002)] among many others; and
- (5) more comprehensive conceptual treatments with varying degrees of emphasis on techniques, including Daubechies' classic [*I. Daubechies*, Ten lectures on wavelets. CBMS-NSF Regional Conference Series in Applied Mathematics. 61. Philadelphia, PA: SIAM, Society for Industrial and Applied Mathematics (1992; Zbl 0776.42018)] or Mallat's revised classic [*S. Mallat*, A wavelet tour of signal processing. The sparse way. 3rd ed. Amsterdam: Elsevier/Academic Press (2009; Zbl 1170.94003)]. There are also monographs specializing in applications to PDEs such as [*H. L. Resnikoff* and *R. O. Wells jun.*, Wavelet analysis. The scalable structure of information. New York, NY: Springer (1998; Zbl 0922.42020)], Urban's more recent and complete [*K. Urban*, Wavelet methods for elliptic partial differential equations. Numerical Mathematics and Scientific Computation. Oxford: Oxford University Press (2009; Zbl 1158.65002)] or [*G. Aubert* and *P. Kornprobst*, Mathematical problems in image processing. Partial differential equations and the calculus of variations. Applied Mathematical Sciences 147. New York, NY: Springer (2006; Zbl 1110.35001)]; and finally monographs that focus on the use of wavelets in more advanced mathematical settings, including [*M. Holschneider*, Wavelets. An analysis tool. Oxford Mathematical Monographs. Oxford: Clarendon Press (1995; Zbl 0874.42020)] or the work of [*Y. Meyer* and *R. R. Coifman*, Wavelets and operators III: Multilinear operators. Actualités Mathématiques. Paris: Hermann, Éditeurs des Sciences et des Arts (1991; Zbl 0745.42012)]. To draw a broad analogy one might observe that, just as with calculus texts, there are enough books on wavelets already. Yet, just as with calculus texts, there are a variety of practitioners, and an instructor has to decide at what level to pitch the material, based on the variety of backgrounds and eventual needs of students that the instructor encounters. The book under review is intended as a course text. Each of the nine chapters has a few to several (at most ten) exercises, some true mathematical exercises – verifying identities, or computing values of filters – and others computational implementations intended to be performed in Matlab or a similar environment. There are about ten or so figures per chapter on average, ranging from

graphs of wavelet functions to illustrations of implementation steps of subband coding schemes, to time-scale plane representations, and finally to illustrations of outputs of numerical algorithms for signal and image processing. An overview of the layout of chapters reflects a conventional approach. The first chapter covers mathematical prerequisites, including function spaces, discrete and continuous, and Fourier analysis, as well as essential frame theory. The second chapter covers discrete and continuous linear, time-invariant systems. The third chapter introduces the time-frequency and time-scale planes and the continuous short-time Fourier and wavelet transforms. It finishes with the à trous algorithm. Chapter Four covers the Haar, Shannon, and Meyer wavelets. Chapter Five addresses multiresolution analysis and the generation of wavelets from MRAs. Chapter Six addresses discrete implementations of wavelet transforms. Chapter Seven covers Daubechies' fundamental theory of regularity of wavelet transforms. The last two chapters cover the theory and algorithms associated with wavelet packets and two-dimensional tensor product wavelets, respectively; the last chapter gives a broad outline of the use of wavelets in jpeg image compression. The treatment is focused. There is not much deviation from the main story line to address applications; in particular, the author has resisted the temptation to detour into his own work on applications. This maintained focus also allows for a fairly straightforward presentation. The illustrative figures are chosen judiciously. The notation used is fairly standard whenever possible, so someone who has used the text should have ready access to a lot of the literature on applications and advanced mathematical topics. In the introduction, the author explains that the book grew out of teaching a graduate course in wavelets to students with broad backgrounds over a period of several years. The exposition reflects the balance needed to pull this off: while mathematical expectations have to be set from the start, the mathematical treatment has to be kept simple while maintaining enough integrity to allow the student to handle a few subtleties that inevitably arise. *Joseph Lakey (Las Cruces)*

*Keywords:* wavelets