sonoluminescence, see Detlef Lohse's article in PHYSICS TODAY (February 2003, page 36).

A principal focus of the book is the physics and design of ultrasonic sensors. Typically of most texts, the first chapters cover reflection, refraction, and transmission through various media. But then Cheeke launches into detailed discussions of waves in different environments: on surfaces, in the bulk, in media sandwiched between two structures, trapped near surfaces, leaking away from surfaces, in films, in thin plates, and in cylinders. Those environments support such phenomena as surface acoustic waves, longitudinal and transverse bulk waves, trapped acoustic waves, cutoff modes, dispersion modes, and symmetric and antisymmetric modes. For the general case, he derives in detail the pertinent wave equations and dispersion relations. For special cases, he outlines advanced techniques for solving the equations and then presents the principal results. For the most specialized uses, he simply presents results and gives qualitative phenomenological discussions that make them plausible.

Because it relies on the knowledge acquired in the previous chapters, chapter 13 on sensors must have been the most difficult to organize, but Cheeke meets the challenge and continues to balance fundamentals with applications. In that chapter, he first derives general ultrasonic-wave sensitivity relations for such factors as mass loading, fluid viscosity, and temperature. He then uses the equations for reflections at intermediate boundaries to deduce the effectiveness of certain ultrasonic-wave modes as ultrasonic sensors. Through simple models based on sensitivity results derived from reflection and refraction relations, he conveys the physical processes that are important in sensor design. Finally, he discusses ultrasonic sensors used as mass detectors; as level, temperature, density, viscosity, and flow sensors; and in gas chromatography and in biosensing devices.

Each of the first 10 chapters ends with an excellent summary and provocative and instructive questions. Therefore, one is left at a loss when these summaries are absent from the last seven chapters. Perhaps Cheeke had some self-referential intent when he stated in the acknowledgments that authors are sometimes compelled by publishers' deadlines to abandon the full completion of their books. Even so, I think the outlines of the application chapters presented in the table of contents are enough to navigate through the engrossing topics within those chapters.

Moises Levy
University of Wisconsin–Milwaukee

Wavelet Transforms and Their Applications

Lokenath Debnath
Birkhäuser, Boston, 2002. $79.95 (565 pp.). ISBN 0-8176-4204-8

Wavelets are everywhere nowadays. Whether in signal or image processing, in astronomy, in fluid dynamics (turbulence), or in condensed matter physics, wavelets have found applications in almost every corner of physics. Furthermore, wavelet methods have become standard fare in applied mathematics, numerical analysis, and approximation theory. As a result, publishers strongly compete with each other to release new books at a sustained pace on the topic.

Some textbooks have a distinctly mathematical flavor, including Ingrid Daubechies's celebrated *Ten Lectures on Wavelets* (Society for Industrial and Applied Mathematics, 1992), the Yves Meyer volume *Wavelets, Algorithms and Applications* (Society for Industrial and Applied Mathematics, 1993), or the more popular *Wavelets: Tools for Science and Technology*, by Stéphane Jaffard, Yves Meyer, and Robert D. Ryan (Society for Industrial and Applied Mathematics, 2001). Among the texts more directly aimed at signal processing, we may cite Stéphane Mallat's *A Wavelet Tour of Signal Processing* (2nd ed., Academic Press, 1999). Finally, there are introductory textbooks suitable for a first contact with wavelets. *Wavelet Transforms and Their Applications*, by Lokenath Debnath, clearly belongs to the last category. Debnath has published several textbooks on turbulence, wavelets, and mathematical methods, and has also lectured extensively in the US and in India on wavelet analysis. The present volume results from his teaching experience.

Despite its title, *Wavelet Transforms and Their Applications* is not a textbook on wavelets. (Wavelets appear only on page 361!) Rather, the book is an overview of a class of integral transforms that generalize the Fourier transform to the time–frequency (or time–scale) domain: the short-time (or windowed) Fourier transform (also improperly called the Gabor transform), the Wigner–Ville transform, and the wavelet transform in both its continuous and discrete realizations. It is commendable to discuss such transforms as a class, because they have marked similarities that arise from their origin in group-representation theory. Debnath's treatment is essentially self-contained. For example, the first two chapters review Hilbert space and the Fourier transform in great detail. Many exercises, with hints and solutions, appear throughout the text. Altogether, this is a textbook suitable for a one-semester course at the senior or graduate level.

Unfortunately, the organization of the book is inexcusably sloppy. There are many typographical errors, some of which are mathematically confusing. Some statements are simply wrong. To give a few examples: on page 96, $\|Tx\|$ should replace $\|T\|$ in the definition of the operator norm; on page 181, "eigenfunctions" should replace "eigenvalues;" and on page 207, the Gaussian window is claimed to be the only minimal uncertainty state, whereas all coherent and squeezed states are also minimally uncertain.

Worse yet, the structure of the book is somewhat random. Ideas are sometimes used before they are properly defined. Frames are described twice—in sections 4.5 and 6.4—without cross-reference. Many mathematical assertions are inaccurate or missing. For instance, unbounded operators are never mentioned, and that omission creates a systematic confusion between Hermitian and self-adjoint operators. The definition of the support of a function on page 37 is not the accepted one. Chapter 2 discusses distributions at length but, curiously, does not describe the much simpler tempered distributions. Chapter 3 does not even mention Fourier transforms of tempered distributions.

Finally, the author propagates the terminology "Heisenberg uncertainty relations" in a classical signal-processing context, although only Fourier's theorem is involved. The term "Fourier uncertainty relations" would be more appropriate. This in no way minimizes Werner Heisenberg's achievement, which was to interpret quantum measurements probabilistically, not to discover the mathematical theorem that relates the width of a bump to that of its Fourier transform.

In conclusion, Debnath's book is certainly on the right track, but we can only hope that a second edition will alleviate its shortcomings.

Jean-Pierre Antoine
Catholic University of Louvain
Louvain-la-Neuve, Belgium