The good performance of the method depends particularly on the fact that the number of particles in each box at the finest level is roughly constant. It is therefore important to derive adaptive methods in which the refinement process preserves that property even in the case of a highly nonuniform distribution of particles. Such an algorithm is given in great detail in the book, and numerical experiments are reported which prove its efficiency. Also the problem of boundary conditions is discussed, although the proposed method is limited to the case of a simple geometry, where image particles more or less reduce the problem to a free space problem.

The next part of the book is devoted to the 3D case. The basic idea is the same but the expansions involve spherical harmonics. This makes the translation and addition techniques much more involved.

Finally, the author mentions several important applications of these new algorithms, ranging from Astrophysics to numerical solutions of Integral Equations. In Fluid Mechanics those ideas have already led to a more systematic use of the so-called vortex methods: the reconstruction of the velocity field from the vorticity carried by the particles can now be achieved in $O(N)$ operations without using an intermediate grid. It can also be hoped that in Plasma Physics such grid-free methods will be used as an alternative to the usual particle-grid methods, overcoming, for instance, aliasing difficulties introduced by the grid.

It also seems that some other, related, ideas of Rokhlin concerning the fast solution of potential equations could be very helpful for solving integral equations arising in various fields.

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11[34A55, 15A18, 15A99].—G. M. L. GLADWELL, *Inverse Problems in Vibration*, Mechanics: Dynamical Systems, Martinus Nijhoff Publishers, Dordrecht, 1986, x + 263 pp., $24\frac{1}{4}$ cm. Price \$79.50/Dfl. 175.00.

Inverse problems are in fashion, so the appearance of Gladwell's book is well timed. The author is not concerned with inverse scattering nor does he ask whether you can hear the shape of a drum. He is interested in whether you could reconstruct the vocal chords of your favorite opera star if you listened well. Idealized sopranos have one-dimensional vocal chords.

Free from the difficulties associated with geometry, there has been considerable progress in discovering how to reconstruct one-dimensional systems that possess designated spectral properties. Half the problem is to elucidate what eigenvalue information is needed to specify uniquely the vibrating system. Eigenvalues are just natural frequencies, or overtones, in disguise.

Gladwell provides a user-friendly account of this body of work. He approaches the subject gently, since the book could be used as a text. There are exercises at the end of all the earlier sections. In fact, the student will learn several topics that most graduates in engineering and mathematics seem to miss these days: Perron's theorem on positive matrices, Gantmacher and Krein's theory of oscillation matrices, and the small transverse vibrations of a beam. The final chapters give an account of the Gelfand-Levitan method for reconstructing the potential (or density) in Sturm-Liouville systems. The material here would be heavy going for a student whose background was weak enough to warrant study of the first two chapters: elementary matrix analysis and vibration of masses connected by springs. So much for the end conditions; the middle of the book, nearly half of it, in fact, presents a nice exposition of oscillation matrices and their use. Gladwell shares the enthusiasm of Gantmacher and Krein for determinants.

A revealing clue that this book was conceived as a text rather than a research monograph is the absence of an index. It is not easy to dip into one of the later chapters. There is no pointer to where certain symbols (such as S_ν^+) are defined. The surprise here is that the author is in an engineering department and engineers are usually punctilious in collecting all their symbols in an obvious place. The complete absence for any numerical data to illustrate the efficacy of the reconstruction techniques for discrete problems makes me suspect that the author is an applied mathematician dressed in engineer's clothing. That possibility would be consistent with the author's interest in Pascal—the philosopher, not the language.

This well-focussed study presents material that is not easy to locate elsewhere. It provides a gateway to the world of inverse problems.

B.P.

12[65–06, 68–06].—J. S. KOWALIK & C. T. KITZMILLER (Editors), *Coupling Symbolic and Numerical Computing in Expert Systems*, II, North-Holland, Amsterdam, 1988, viii + 274 pp., 23 cm. Price $73.75/Dfl. 140.00.

This volume contains 19 papers presented at a second workshop on the subject held July 20–22, 1987 in Bellevue, Washington. For the first workshop, see [1]. The contributions reflect the interdisciplinary nature of the workshop, drawing from such fields as artificial intelligence, symbolic and numerical computation, and software development. About half of the papers address specific applications in science and engineering. The three papers with the strongest numerical analysis component discuss expert systems related issues in the stable evaluation of symbolically generated mathematical expressions and in finite difference methods and grid generation for partial differential equations.

W.G.

1. J. S. KOWALIK (ed.), *Coupling Symbolic and Numerical Computing in Expert Systems*, North-Holland, Amsterdam, 1986.