Journal of Sound and Vibration (2001) **242**(5), 929–937
doi:10.1006/jsvi.2001.3438, available online at http://www.idealibrary.com on IDEAL®

BOOK REVIEWS

FINITE ELEMENT ANALYSIS OF ACOUSTIC SCATTERING, 1998, by F. Ihlenburg. New York: Springer. xiv + 224 pp. Price DM 118.00; £45.50; US$ 59.95. ISBN 0-387-98319-8

This book deals with some of the mathematical issues arising in the computational simulation of wave propagation and fluid–structure interaction. The main interest is in the numerical solution of exterior boundary value problems for the Helmholtz equation.

The first two chapters are introductory chapters which set the stage for finite element analysis. In Chapter 1 the equations of motion for acoustic waves, elastic waves, fluid–solid interaction and electromagnetic waves are derived. In the first part of Chapter 2 analytical solutions for various radiation, scattering and fluid–solid interaction problems are obtained using Cartesian, spherical and cylindrical co-ordinates. The remainder of this chapter is devoted to the derivation of variational formulations for Helmholtz problems in bounded and unbounded domains and for solid–fluid interaction using weighted residual techniques. The existence, uniqueness and stability of solutions of variational methods is then discussed. Finally, details of the Galerkin and Ritz variational methods are given. All this is in preparation for finite element analysis presented later in the book.

Chapter 3 is the heart of the book where finite element analysis methods for the Helmholtz equation in unbounded domains are dealt with. The radiating/scattering surface is surrounded by a fictitious surface which may be spherical or ellipsoidal. The volume between the specified and fictitious surfaces is then represented by an assemblage of finite elements. The h, p and h–p versions are all referred to. Various methods are then described which ensure that the Sommerfeld radiation condition is satisfied. Four methods of specifying absorbing boundary conditions on the artificial surface are reviewed. They incorporate (exactly or approximately) the farfield behaviour into the finite element model. Also one method of partitioning the domain exterior to the artificial surface into infinite elements is described.

Chapter 4 is devoted to the finite element analysis of Helmholtz problems on bounded domains for large wavenumbers. It is known from computational experience that the "rule of thumb" to resolve a wavelength by a certain fixed number of mesh points is not sufficient in such cases. This topic is addressed and new estimates presented that precisely characterize the error behaviour in the range of engineering computations. These are illustrated using three model problems whose analytical solutions are given.

In Chapter 5 two elastic scattering problems are analyzed using a combination of finite and infinite elements. In one case an analytical solution is available and in the other experimental measurements were made. Convergence with increased number of elements is studied.

The book is addressed to mathematicians as well as to physicists and computational engineers working on scattering problems. It is assumed that the reader is familiar with the basic physical and mathematical concepts of fluid–structure interaction and/or finite element analysis. Many numerical examples are included for a better understanding of the theory.

M. PETYT

0022-460X/01/200929 + 09 $35.00/0