
REVIEWED BY P. BURGERS

This book is a review of many topics fundamental to dynamic numerical analysis, and in particular to finite elements, although some chapters do discuss finite difference methods. The areas covered, in order of presentation, are an overview of transient finite element and difference methods, a detailed compendium of transient algorithms with a heavy emphasis on their stability, techniques of performing partitioned analyses of coupled systems, dynamic boundary element methods, dynamic relaxation, dynamic and spatial dispersion of discretised systems, methods of modeling infinite bodies with finite meshes for dynamic transient problems, explicit dynamic finite difference methods, implicit finite element methods and finally combined Lagrangian-Eulerian (ALE) finite element methods. Each chapter has been written by different experts in the particular field but the editing has been thorough so that the cross referencing is quite good.

The introductory chapter was written by Belytschko and serves as very readable background material for the rest of the book, apart from a questionable statement on the most appropriate stress rate to use in finite elements. There is a brief but interesting presentation of 'hour-glass' control of finite elements and then short introductions to other topics in the book. The second chapter, by Hughes, discusses time integration algorithms and their stability in great detail, bringing together many results in dynamic numerical analysis in one place. The majority of the discussion is on linear symmetric systems, these being the ones that have received the most study. This chapter will serve very well as a starting point for anybody interested in getting a good background into the more theoretical side of numerical dynamics. The chapter on dispersion by discretised systems by Schreyer compliments this chapter very well and together they give a good all round review, although it would have been very interesting if the chapter on dispersion had continued in the detail that it started with. As with all the other chapters, there is a detailed reference list of recent work in the area so interested readers can pursue the subject further.

The history and current state of the art (as used by the authors) on the analysis of coupled systems by partitioning the system into a number of subsystems, each with degrees of freedom associated with a single system is presented by Park and Felippa. Examples of this are solid structures interacting with fluid systems or the pore fluid flow through soil. The suitability of the method with linear subsystems or even mildly nonlinear systems seems clear, but it is not obvious to the reviewer that this is true for highly nonlinear systems, e.g. if the problem involves large strains. This chapter is quite comprehensive (and lengthy) and will serve as a good starting point for a newcomer to the area. Modeling of infinite bodies by discretised methods always leads to difficulties. Chapter seven on 'silent boundary' methods in dynamics, by Cohen and Jennings, considers this problem in great detail. The difficulty is that the numerical problem must draw energy out of the mesh through the boundaries. A number of techniques are discussed with the advantages and disadvantages summarized.

The remaining chapters discuss implicit methods in dynamics, such as the BFGS algorithm, dynamic relaxation, explicit Lagrangian finite differences. In final chapter the problem of mesh distortion due to deformation or flow is considered using an arbitrary Lagrangian-Eulerian formulation. The concept is very attractive — use a mesh that models the deformation in the best manner for all times of interest and still retains the ease of modeling boundaries that comes with the Finite Element method. The example used to illustrate the technique (which gives an automatic mesh rezoning using the same number of elements) is for fluid-solid interaction. However the idea is possibly suitable for problems just involving a single material type with regions of large deformation, such as in forging and extrusion problems. The problem of determining a suitable mapping for the mesh as a function of time remains but the idea certainly has great potential.

In summary this first volume in the series Computational Methods in Mechanics published by North-Holland makes for a broad review of the area of numerical dynamics which would be of benefit to both novices and experts in the field.


REVIEWED BY S. H. CRANDALL

This masterly monograph on the theory of random vibration is a translation of the 1979 Russian edition. The author is the leading contributor to this theory in the Soviet Union. His book Statistical Methods in Structural Mechanics (Russian editions in 1961 and 1965, English translation in 1969) contained an excellent introduction to the subject at the time when activity in this field was just beginning to blossom.

Random vibration as the name of a technical discipline has come to mean the study of the random fields or processes which are the excitations and responses of deterministic dynamic systems. The discipline arose about thirty years ago out of the need to solve three distinct aerospace problems with the common thread of random excitation: turbulent buffeting...