1. Record Nr. UNINA9910254348603321

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Titolo	Finite Element and Discontinuous Galerkin Methods for Transient Wave Equations / / by Gary Cohen, Sébastien Pernet
Pubbl/distr/stampa	Dordrecht : , : Springer Netherlands : , : Imprint : Springer, , 2017
ISBN	94-017-7761-6
Edizione	[1st ed. 2017.]
Descrizione fisica	1 online resource (XVII, 381 p. 79 illus., 39 illus. in color.)
Collana	Scientific Computation, , 1434-8322
Disciplina	519
Soggetti	Applied mathematics Engineering mathematics Physics Mathematical physics Continuum physics Mechanics Mechanics, Applied Computer mathematics Mathematical and Computational Engineering Numerical and Computational Physics, Simulation Mathematical Applications in the Physical Sciences Classical and Continuum Physics Solid Mechanics Computational Science and Engineering
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references at the end of each chapters.
Nota di contenuto	Classical Continuous Models and their Analysis -- The Basic Equations -- Functional Issues -- Plane Wave Solutions -- Definition of Different Types of Finite Elements -- 1D Mass-Lumping and Spectral Elements -- Quadrilaterals and Hexahedra -- Triangles and Tetrahedra -- Purely 3D Elements -- Tetrahedral and Triangular Edge Elements -- Hexahedral and Quadrilateral Edge Elements -- H(div) Finite Elements -- Other Mixed Elements -- Hexahedral and Quadrilateral Spectral Elements for Acoustic Waves -- Second Order Formulation of the Acoustics Equation -- First Order Formulation of the Acoustics

Equation -- Comparison of the Methods -- Dispersion Relation -- Reflection-Transmission by a Discontinuous Interface -- hp-a priori Error Estimates -- The Linear Elastodynamics System -- Discontinuous Galerkin Methods -- General Formulation for Linear Hyperbolic Problems -- Approximation by Triangles and Tetrahedra -- Approximation by Quadrilaterals and Hexahedra -- Comparison of the DG Methods for Maxwell's Equations -- Plane Wave Analysis -- Interior Penalty Discontinuous Galerkin Methods -- The Maxwell's System and Spurious Modes.-A First Model and its Approximation -- A Second Model and its Approximations -- Suppressing Spurious Modes -- Error Estimates for DGM -- Approximating Unbounded Domains -- Absorbing Boundary Conditions (ABC) -- Perfectly Matched Layers (PML) -- Time Approximation -- Schemes with a Constant Time-Step -- Local Time Stepping -- Some Complex Models -- The Linearized Euler Equations -- The Linear Cauchy-Poisson Problem -- Vibrating Thin Plates -- References -- Bibliography.

Sommario/riassunto

This monograph presents numerical methods for solving transient wave equations (i.e. in time domain). More precisely, it provides an overview of continuous and discontinuous finite element methods for these equations, including their implementation in physical models, an extensive description of 2D and 3D elements with different shapes, such as prisms or pyramids, an analysis of the accuracy of the methods and the study of the Maxwell's system and the important problem of its spurious free approximations. After recalling the classical models, i.e. acoustics, linear elastodynamics and electromagnetism and their variational formulations, the authors present a wide variety of finite elements of different shapes useful for the numerical resolution of wave equations. Then, they focus on the construction of efficient continuous and discontinuous Galerkin methods and study their accuracy by plane wave techniques and a priori error estimates. A chapter is devoted to the Maxwell's system and the important problem of its spurious-free approximations. Treatment of unbounded domains by Absorbing Boundary Conditions (ABC) and Perfectly Matched Layers (PML) is described and analyzed in a separate chapter. The two last chapters deal with time approximation including local time-stepping and with the study of some complex models, i.e. acoustics in flow, gravity waves and vibrating thin plates. Throughout, emphasis is put on the accuracy and computational efficiency of the methods, with attention brought to their practical aspects. This monograph also covers in details the theoretical foundations and numerical analysis of these methods. As a result, this monograph will be of interest to practitioners, researchers, engineers and graduate students involved in the numerical simulation of waves.