An Extended Finite Element Method For The Analysis Of

for Fracture Analysis of Structures
TEXTBOOK OF FINITE ELEMENT ANALYSIS
Finite Element Analysis for Biomedical Engineering Applications
A First Course in the Finite Element Method, SI Version
The Extended Finite Element Method
Selected Papers from the ICOSAHOM Conference, London, UK, July 9-13, 2018
Bearing Capacity of Roads, Railways and Airfields
Linear Finite Element Analysis
A Continuum-Based Particle Method for Extreme Loading Cases
Finite Element Methods for Flow Problems
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Xfem
Advanced Finite Element Method in Structural Engineering
Finite Element Methods and Their Applications
Tsinghua University Press Computational Mechanics Series
An Extended Finite Element Method Applied to Levitated Droplet Problems
An Extended Finite Element Method with Discontinuous Enrichment for Applied Mechanics
Extended Finite Element and Meshfree Methods
Micro-scale Crack Propagation Using the EXtended Finite Element Method (XFEM)
The Material Point Method
Extended Finite Element Method
Strength Prediction of Adhesively-Bonded Joints

Proceedings of the 10th International Conference on the Bearing Capacity of Roads, Railways and Airfields (BCRRA 2017), June 28-30, 2017, Athens, Greece
Fundamentals of Finite Element Analysis
The Finite Element Method: Solid mechanics

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for Fracture Analysis of Structures Academic Press
This work describes the implementation of the eXtended Finite Element Method (XFEM) in the Abaqus software package. A user-defined element was developed containing the analytical functions relating to homogeneous and interface fracture mechanics. The long-term goal of such work is to increase the ability to analyze fractures and other imperfections in multimaterial systems containing large elastic mismatches, such as flexible electronics. A review of XFEM-related literature is presented, as well as an overview of fracture mechanics for both homogeneous and interface systems. The theoretical basis of the XFEM is then covered, including the concepts of Partition of Unity and stress intensity factor evaluation. Finally, numerical results of the implementation are compared to several benchmark cases, along with conclusions and suggestions for future work.
TEXTBOOK OF FINITE ELEMENT ANALYSIS John Wiley & Sons
In the extended finite element method (XFEM), a standard displacement based finite element approximation is enriched by additional (special) functions using the framework of partition of unity. In the XFEM, the finite element mesh need not conform to the internal boundaries (cracks, material interfaces, voids, etc.), and hence a single mesh suffices for modeling as well as capturing the evolution of material interfaces and cracks. This book mainly focuses on the application of XFEM in modeling dynamic fracture in thin plates and shells. New crack tip enrichment functions are extracted from analytical solutions and several enrichment schemes are introduced for various elements. As an application, the problem of cracked thin tubes under gaseous detonation loading is simulated by the introduced Dynamic-XFEM formulation and the obtained response of the tube to moving detonation loading is compared with ANSYS-LS DYNA results.
Finite Element Analysis for Biomedical Engineering Applications Courier Corporation
This important textbook provides an introduction to the concepts of the newly developed extended finite element method (XFEM) for fracture analysis of structures, as well as for other related engineering applications. One of the main advantages of the method is that it avoids any need for remeshing or geometric crack modelling in numerical simulation, while generating discontinuous fields along a crack and around its tip. The second major advantage of the method is that by a small increase in number of degrees of freedom, far more accurate solutions can be obtained. The method has recently been extended to nonlinear materials and other disciplines such as modelling contact and interface, simulation of inclusions and holes, moving and changing phase problems, and even to multiscale analyses. The book is self

contained, with summaries of both classical and modern computational techniques. The main chapters include a comprehensive range of numerical examples describing various features of XFEM.

A First Course in the Finite Element Method, SI Version John Wiley & Sons

Extended Finite Element and Meshfree Methods provides an overview of, and investigates, recent developments in extended finite elements with a focus on applications to material failure in statics and dynamics. This class of methods is ideally suited for applications, such as crack propagation, two-phase flow, fluid-structure-interaction, optimization and inverse analysis because they do not require any remeshing. These methods include the original extended finite element method, smoothed extended finite element method (XFEM), phantom node method, extended meshfree methods, numerical manifold method and extended isogeometric analysis. This book also addresses their implementation and provides small MATLAB codes on each sub-topic. Also discussed are the challenges and efficient algorithms for tracking the crack path which plays an important role for complex engineering applications. Explains all the important theory behind XFEM and meshfree methods Provides advice on how to implement XFEM for a range of practical purposes, along with helpful MATLAB codes Draws on the latest research to explore new topics, such as the applications of XFEM to shell formulations, and extended meshfree and extended isogeometric methods Introduces alternative modeling methods to help readers decide what is most appropriate for their work

The Extended Finite Element Method Springer Science & Business Media

The eXtended Finite Element Method for special problems with moving interfaces. Selected Papers from the ICOSAHOM Conference, London, UK, July 9-13, 2018 John Wiley & Sons

Introduces the theory and applications of the extended finite element method (XFEM) in the linear and nonlinear problems of continua, structures and geomechanics Extended Finite Element Method: Theory and Applications introduces the theory and applications of the extended finite element method (XFEM) in the linear and nonlinear problems of continua, structures and geomechanics. The XFEM approach is based on an extension of standard finite element method based on the partition of unity method. Extended Finite Element Method: Theory and Applications begins by introducing the concept of partition of unity, various enrichment functions, and fundamentals of XFEM formulation. It then covers the theory and application of XFEM in large deformations, plasticity and contact problems. The implementation of XFEM in fracture mechanics, including the linear, cohesive, and ductile crack propagation is also covered. The theory and applications of the XFEM in multiphase fluid flow, including the hydraulic fracturing in soil saturated media and crack propagation in thermo-hydro-mechanical porous media, is also discussed in detail. Introduces the theory and applications of the extended finite element method (XFEM) in the linear and nonlinear problems of continua, structures and geomechanics Explores the concept of partition of unity, various enrichment functions, and fundamentals of XFEM formulation. Covers numerous applications of XFEM including fracture mechanics, large deformation, plasticity, multiphase flow, hydraulic fracturing and

contact problems Accompanied by a website hosting source code and examples

Bearing Capacity of Roads, Railways and Airfields SIAM

Bearing Capacity of Roads, Railways and Airfields includes the contributions to the 10th International Conference on the Bearing Capacity of Roads, Railways and Airfields (BCRRA 2017, 28-30 June 2017, Athens, Greece). The papers cover aspects related to materials, laboratory testing, design, construction, maintenance and management systems of transport infrastructure, and focus on roads, railways and airfields. Additional aspects that concern new materials and characterization, alternative rehabilitation techniques, technological advances as well as pavement and railway track substructure sustainability are included. The contributions discuss new concepts and innovative solutions, and are concentrated but not limited on the following topics: · Unbound aggregate materials and soil properties · Bound materials characteritics, mechanical properties and testing · Effect of traffic loading · In-situ measurements techniques and monitoring · Structural evaluation · Pavement serviceability condition · Rehabilitation and maintenance issues · Geophysical assessment · Stabilization and reinforcement · Performance modeling · Environmental challenges · Life cycle assessment and sustainability Bearing Capacity of Roads, Railways and Airfields is essential reading for academics and professionals involved or interested in transport infrastructure systems, in particular roads, railways and airfields.

Linear Finite Element Analysis Academic Press

Extended Finite Element Method provides an introduction to the extended finite element method (XFEM), a novel computational method which has been proposed to solve complex crack propagation problems. The book helps readers understand the method and make effective use of the XFEM code and software plugins now available to model and simulate these complex problems. The book explores the governing equation behind XFEM, including level set method and enrichment shape function. The authors outline a new XFEM algorithm based on the continuum-based shell and consider numerous practical problems, including planar discontinuities, arbitrary crack propagation in shells and dynamic response in 3D composite materials. Authored by an expert team from one of China's leading academic and research institutions Offers complete coverage of XFEM, from fundamentals to applications, with numerous examples Provides the understanding needed to effectively use the latest XFEM code and software tools to model and simulate dynamic crack problems

A Continuum-Based Particle Method for Extreme Loading Cases Springer Science & Business Media

This book provides an overview of multiscale approaches and homogenization procedures as well as damage evaluation and crack initiation, and addresses recent advances in the analysis and discretization of heterogeneous materials. It also highlights the state of the art in this research area with respect to different computational methods, software development and applications to engineering structures. The first part focuses on defects in composite materials including their numerical and experimental investigations; elastic as

well as elastoplastic constitutive models are considered, where the modeling has been performed at macro- and micro levels. The second part is devoted to novel computational schemes applied on different scales and discusses the validation of numerical results. The third part discusses gradient enhanced modeling, in particular quasi-brittle and ductile damage, using the gradient enhanced approach. The final part addresses thermoplasticity, solid-liquid mixtures and ferroelectric models. The contents are based on the international workshop “Multiscale Modeling of Heterogeneous Structures” (MUMO 2016), held in Dubrovnik, Croatia in September 2016.

Finite Element Methods for Flow Problems Springer Science & Business Media

An exploration of the new weighted approximation techniques which result from the combination of the finite element method and B-splines.

Extended Finite Element Method for Crack Propagation LAP Lambert Academic Publishing

This book is a tutorial written by researchers and developers behind the FEniCS Project and explores an advanced, expressive approach to the development of mathematical software. The presentation spans mathematical background, software design and the use of FEniCS in applications. Theoretical aspects are complemented with computer code which is available as free/open source software. The book begins with a special introductory tutorial for beginners. Following are chapters in Part I addressing fundamental aspects of the approach to automating the creation of finite element solvers. Chapters in Part II address the design and implementation of the FEnicS software. Chapters in Part III present the application of FEniCS to a wide range of applications, including fluid flow, solid mechanics, electromagnetics and geophysics.

Mixed Finite Element Methods and Applications PHI Learning Pvt. Ltd.

Finite element analysis has been widely applied to study biomedical problems. This book aims to simulate some common medical problems using finite element advanced technologies, which establish a base for medical researchers to conduct further investigations. This book consists of four main parts: (1) bone, (2) soft tissues, (3) joints, and (4) implants. Each part starts with the structure and function of the biology and then follows the corresponding finite element advanced features, such as anisotropic nonlinear material, multidimensional interpolation, XFEM, fiber enhancement, UserHyper, porous media, wear, and crack growth fatigue analysis. The final section presents some specific biomedical problems, such as abdominal aortic aneurysm, intervertebral disc, head impact, knee contact, and SMA cardiovascular stent. All modeling files are attached in the appendixes of the book. This book will be helpful to graduate students and researchers in the biomedical field who engage in simulations of biomedical problems. The book also provides all readers with a better understanding of current advanced finite element technologies. Details finite element modeling of bone, soft tissues, joints, and implants Presents advanced finite element technologies, such as fiber enhancement, porous media, wear, and crack growth fatigue analysis Discusses specific biomedical problems, such as abdominal aortic aneurysm, intervertebral disc, head impact, knee

contact, and SMA cardiovascular stent Explains principles for modeling biology Provides various descriptive modeling files

Spectral and High Order Methods for Partial Differential Equations ICOSAHOM 2018 CRC Press

The Material Point Method: A Continuum-Based Particle Method for Extreme Loading Cases systematically introduces the theory, code design, and application of the material point method, covering subjects such as the spatial and temporal discretization of MPM, frequently-used strength models and equations of state of materials, contact algorithms in MPM, adaptive MPM, the hybrid/coupled material point finite element method, object-oriented programming of MPM, and the application of MPM in impact, explosion, and metal forming. Recent progresses are also stated in this monograph, including improvement of efficiency, memory storage, coupling/combination with the finite element method, the contact algorithm, and their application to problems. Provides a user's guide and several numerical examples of the MPM3D-F90 code that can be downloaded from a website Presents models that describe different types of material behaviors, with a focus on extreme events. Includes applications of MPM and its extensions in extreme events, such as transient crack propagation, impact/penetration, blast, fluid-structure interaction, and biomechanical responses to extreme loading

Extended Finite Element Method John Wiley & Sons

Advanced Finite Element Method in Structural Engineering systematically introduces the research work on the Finite Element Method (FEM), which was completed by Prof. Yu-qiu Long and his research group in the past 25 years. Seven original theoretical achievements - for instance, the Generalized Conforming Element method, to name one - and their applications in the fields of structural engineering and computational mechanics are discussed in detail. The book also shows the new strategies for avoiding five difficulties that exist in traditional FEM (shear-locking problem of thick plate elements; sensitivity problem to mesh distortion; non-convergence problem of non-conforming elements; accuracy loss problem of stress solutions by displacement-based elements; stress singular point problem) by utilizing foregoing achievements.

The Finite Element Method for Three-Dimensional Thermomechanical Applications John Wiley & Sons

This open access book features a selection of high-quality papers from the presentations at the International Conference on Spectral and High-Order Methods 2018, offering an overview of the depth and breadth of the activities within this important research area. The carefully reviewed papers provide a snapshot of the state of the art, while the extensive bibliography helps initiate new research directions.

Fundamentals and Applications in Civil, Hydraulic, Mechanical and Aeronautical Engineering CRC Press

This book presents the proceedings of one of the major conferences in fatigue, fracture and structural integrity (NT2F). The papers are organized and divided in five different themes: fatigue and fracture mechanics of structures and advanced materials; fatigue and fracture in pressure vessels and pipelines: mechanical behavior and structural integrity of welded, bonded and bolted

joints; residual stress and environmental effects on the fatigue behavior; and simulation methods, analytical and computation models in fatigue and fracture.

Automated Solution of Differential Equations by the Finite Element Method John Wiley & Sons

This updated and expanded edition of the bestselling textbook provides a comprehensive introduction to the methods and theory of nonlinear finite element analysis. New material provides a concise introduction to some of the cutting-edge methods that have evolved in recent years in the field of nonlinear finite element modeling, and includes the eXtended finite element method (XFEM), multiresolution continuum theory for multiscale microstructures, and dislocation-density-based crystalline plasticity. Nonlinear Finite Elements for Continua and Structures, Second Edition focuses on the formulation and solution of discrete equations for various classes of problems that are of principal interest in applications to solid and structural mechanics. Topics covered include the discretization by finite elements of continua in one dimension and in multi-dimensions; the formulation of constitutive equations for nonlinear materials and large deformations; procedures for the solution of the discrete equations, including considerations of both numerical and multiscale physical instabilities; and the treatment of structural and contact-impact problems. Key features: Presents a detailed and rigorous treatment of nonlinear solid mechanics and how it can be implemented in finite element analysis Covers many of the material laws used in today's software and research Introduces advanced topics in nonlinear finite element modelling of continua Introduction of multiresolution continuum theory and XFEM Accompanied by a website hosting a solution manual and MATLAB® and FORTRAN code Nonlinear Finite Elements for Continua and Structures, Second Edition is a must have textbook for graduate students in mechanical engineering, civil engineering, applied mathematics, engineering mechanics, and materials science, and is also an excellent source of information for researchers and practitioners in industry.

A Practical Course Springer

An accessible introduction to the finite element method for solving numeric problems, this volume offers the keys to an important technique in computational mathematics. Suitable for advanced undergraduate and graduate courses, it outlines clear connections with applications and considers numerous examples from a variety of science- and engineering-related specialties.This text encompasses all varieties of the basic linear partial differential equations, including elliptic, parabolic and hyperbolic problems, as well as stationary and time-dependent problems. Additional topics include finite element methods for integral equations, an introduction to nonlinear problems, and considerations of unique developments of finite element techniques related to parabolic problems, including methods for automatic time step control. The relevant mathematics are expressed in non-technical terms whenever possible, in the interests of keeping the treatment accessible to a majority of students.

Implementation of the Extended Finite Element Method (XFEM) in the Abaqus Software Package CRC Press

A paradigm is developed for generating structured finite element models from

solid models by means of implicit surface definitions. The implicit surfaces are defined by radial basis functions. Internal features, such as material interfaces, sliding interfaces and cracks are treated by enrichment techniques developed in the extended finite element method (X-FEM). Methods for integrating the weak form for such models are proposed. These methods simplify the generation of finite element models. Results presented for several examples show that the accuracy of this method is comparable to standard unstructured finite element methods.
The Finite Element Method Springer Nature

The modeling of a discontinuous field with a standard finite element approximation presents unique challenges. The construction of an approximating space which is discontinuous across a given line or surface places strict restrictions on the finite element mesh. The simulation of an evolution of the discontinuity is in turn burdened by the requirement to remesh at each stage of the calculation. This work approaches the problem by locally enriching the standard element-based approximation with discontinuous functions. The enriched basis is formed from a union of the set of nodal shape functions with a set of products of nodal shape functions and enrichment functions. The construction of the approximating space in this fashion places the formulation in the class of partition of unity methods. By aligning the discontinuities in the enrichment functions with a specified geometry, a discontinuous field is represented independently of the finite element mesh. This capability is shown to significantly extend the standard method for a number of applications in applied mechanics.