An Extended Finite Element Method For The Analysis Of

Provides an introduction to the concepts of extended finite element method (XFEM) for fracture analysis of structures, as well as for other related engineering applications. The book is self contained, with summaries of both classical and modern computational techniques. It also includes numerical examples describing various features of XFEM.

Non-standard finite element methods, in particular mixed methods, are central to many applications. In this text the authors, Boffi, Brezzi and Fortin present a general framework, starting with a finite dimensional presentation, then moving on to formulation in Hilbert spaces and finally considering approximations, including stabilized methods and eigenvalue problems. This book also provides an introduction to standard finite element approximations, followed by the construction of elements for the approximation of mixed formulations in H(div) and H(curl). The general theory is applied to some classical examples: Dirichlet's problem, Stokes' problem, plate problems, elasticity and electromagnetism.

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

In the years since the fourth edition of this seminal work was published, active research has developed the Finite Element Method into the pre-eminent tool for the modelling of physical systems. Written by the pre-eminent professors in their fields, this new edition of the Finite Element Method maintains the comprehensive style of the earlier editions and authoritatively incorporates the latest developments of this dynamic field. Expanded to three volumes the book now covers the basis of the method and its application to advanced solid mechanics and also advanced fluid dynamics. Volume Two: Solid and Structural Mechanics is intended for readers studying structural mechanics at a higher level. Although it is an ideal companion volume to Volume One: The Basis, this advanced text also functions as a "stand-alone" volume, accessible to those who have been introduced to the Finite Element Method through a different route. Volume 1 of the Finite Element Method provides a complete introduction to the method and is essential reading for undergraduates, postgraduates and professional engineers. Volume 3 covers the whole range of fluid dynamics and is ideal reading for postgraduate students and professional engineers working in this discipline. Coverage of the concepts necessary to model behaviour, such as viscoelasticity, plasticity and creep, as well as shells and plates.Up-to-date coverage of new linked interpolation methods for shell and plate formations.New material on non-linear geometry, stability and buckling of structures and large deformations.

Theory and Applications

An Extended Finite Element Method with Discontinuous Enrichment for Applied Mechanics

Introduction to the Explicit Finite Element Method for Nonlinear Transient Dynamics

for Fracture Analysis of Structures

The Extended Finite Element Method

Novel techniques for modeling 3D cracks and their evolution in solids are presented. Cracks are modeled in terms of signed distance functions (level sets). Stress, strain and displacement field are determined using the extended finite elements method (X-FEM). Non-linear constitutive behavior for the crack tip region are developed within this framework to account for non-linear effect in crack propagation. Applications for static or dynamics case are provided.

The aim of this monograph is to describe the main concepts and recent − vances in multiscale ?nite element methods. This monograph is intended for thebroaderaudienceincludingengineers,appliedscientists,andforthosewho are interested in multiscale simulations. The book is intended for graduate students in applied mathematics and those interested in multiscale compu− tions. It combines a practical introduction, numerical results, and analysis of multiscale ?nite element methods. Due to the page limitation, the material has been condensed. Each chapter of the book starts with an introduction and description of the proposed methods and motivating examples. Some new techniques are introduced using formal arguments that are justi?ed later in the last chapter. Numerical examples demonstrating the signi?cance of the proposed methods are presented in each chapter following the description of the methods. In the last chapter, we analyze a few representative cases with the objective of demonstrating the main error sources and the convergence of the proposed methods. A brief outline of the book is as follows. The ?rst chapter gives a general introductiontomultiscalemethodsandanoutlineofeachchapter.Thesecond chapter discusses the main idea of the multiscale ?nite element method and its extensions. This chapter also gives an overview of multiscale ?nite element methods and other related methods. The third chapter discusses the ext− sion of multiscale ?nite element methods to nonlinear problems. The fourth chapter focuses on multiscale methods that use limited global information.

Designed for a one-semester course in Finite Element Method, this compact and well-organized text presents FEM as a tool to find approximate solutions to differential equations. This provides the student a better perspective on the technique and its wide range of applications. This approach reflects the current trend as the present-day applications range from structures to biomechanics to electromagnetics, unlike in conventional texts that view FEM primarily as an extension of matrix methods of structural analysis. After an introduction and a review of mathematical preliminaries, the book gives a detailed discussion on FEM as a technique for solving differential equations and variational formulation of FEM. This is followed by a lucid presentation of one−dimensional and two−dimensional finite elements and finite element formulation for dynamics. The book concludes with some case studies that focus on industrial problems and Appendices that include mini−project topics based on near−real−life problems. Postgraduate/Senior undergraduate students of civil, mechanical and aeronautical engineering will find this text extremely useful; it will also appeal to the practising engineers and the teaching community.

This book offers an in−depth presentation of the finite element method, aimed at engineers, students and researchers in applied sciences. The description of the method is presented in such a way as to be usable in any domain of application. The level of mathematical expertise required is limited to differential and matrix calculus. The various stages necessary for the implementation of the method are clearly identified, with a chapter given over to each one: approximation, construction of the integral forms, matrix organization, solution of the algebraic systems and architecture of programs. The final chapter lays the foundations for a general program, written in Matlab, which can be used to solve problems that are linear or otherwise, stationary or transient, presented in relation to applications stemming from the domains of structural mechanics, fluid mechanics and heat transfer.

The EXtended Finite Element Method (XFEM) with Adaptive Mesh Refinement for Fracture Mechanics

Multiscale Modeling of Heterogeneous Structures

Advanced Finite Element Method in Structural Engineering

Micro-scale Crack Propagation Using the EXtended Finite Element Method (XFEM)

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 modelling methods to help readers decide what is most appropriate for their work

A comprehensive review of the Finite Element Method (FEM), this book provides the fundamentals together with a wide range of applications in civil, mechanical and aeronautical engineering. It addresses both the theoretical and numerical implementation aspects of the FEM, providing examples in several important topics such as solid mechanics, fluid mechanics and heat transfer, appealing to a wide range of engineering disciplines. Written by a renowned author and academician with the Chinese Academy of Engineering, The Finite Element Method would appeal to researchers looking to understand how the fundamentals of the FEM can be applied in other disciplines. Researchers and graduate students studying hydraulic, mechanical and civil engineering will find it a practical reference text.

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.

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.

The Finite Element Method for Elliptic Problems

Partial Differential Equations and the Finite Element Method

The FEniCS Book

Multiscale Finite Element Methods

Spectral and High Order Methods for Partial Differential Equations ICOSAHOM 2018

This publication includes 82 technical papers presented at Rocscience International Conference (RIC) 2021, held online on April 20 and 21, 2021. Rocscience created this event to bring geotechnical academics, researchers and practitioners together to exchange ideas as part of celebrating 25 years of the company's existence. The papers in these proceedings were from keynotes, panel discussions and papers, selected after careful review of over 100 technical submissions delivered at RIC 2021. The technical papers were grouped into sessions based on their subject areas. The conference aimed to stimulate discussions that could help the industry work towards overcoming geotechnical engineering limitations today. It also sought to foster creative thinking that will advance the current states of the art and practice. The keynote addresses, panel discussions and technical presentations tried to examine geotechnical problems and situations from fresh perspectives. RIC 2021 hopes that the proceedings will continue to enrich our thinking and contribute to achieving a critical mass of change in our practices and approaches. We look forward to significant improvements in our industry.

A systematic introduction to partial differential equations and modern finite element methods for their efficientnumerical solution Partial Differential Equations and the Finite Element Methodprovides a much-needed, clear, and systematic introduction tomodern theory of partial differential equations (PDEs) and finiteelement methods (FEM). Both nodal and hierachic concepts of the FEMare examined. Reflecting the growing complexity and multiscalenature of current engineering and scientific problems, the authoremphasizes higher-order finite element methods such as the spectralor hp-FEM. A solid introduction to the theory of PDEs and FEM contained inChapters 1-4 serves as the core and foundation of the publication.Chapter 5 is devoted to modern higher-order methods for thenumerical solution of ordinary differential equations (ODEs) thatarise in the semidiscretization of time-dependent PDEs by theMethod of Lines (MOL). Chapter 6 discusses fourth-order PDEs rootedin the bending of elastic beams and plates and approximates theirsolution by means of higher-order Hermite and Argyris elements.Finally, Chapter 7 introduces the reader to various PDEs governingcomputational electromagnetics and describes their finite elementapproximation, including modern higher-order edge elements forMaxwell's equations. The understanding of many theoretical and practical aspects of bothPDEs and FEM requires a solid knowledge of linear algebra andelementary functional analysis, such as functions and linearoperators in the Lebesgue, Hilbert, and Sobolev spaces. Thesetopics are discussed with the help of many illustrative examples inAppendix A, which is provided as a service for those readers whoneed to gain the necessary background or require a refreshertutorial. Appendix B presents several finite element computationsrooted in practical engineering problems and demonstrates thebenefits of using higher-order FEM. Numerous finite element algorithms are written out in detailalongside implementation discussions. Exercises, including manythat involve programming the FEM, are designed to assist the readerin solving typical problems in engineering and science. Specifically designed as a coursebook, this student-testedpublication is geared to upper-level undergraduates and graduatestudents in all disciplines of computational engineeringandscience. It is also a practical problem-solving reference forresearchers, engineers, and physicists.

This title demonstrates how to develop computer programmes which solve specific engineering problems using the finite element method. It enables students, scientists and engineers to assemble their own computer programmes to produce numerical results to solve these problems. The first three editions of Programming the Finite Element Method established themselves as an authority in this area. This fully revised 4th edition includes completely rewritten programmes with a unique description and list of parallel versions of programmes in Fortran 90. The Fortran programmes and subroutines described in the text will be made available on the Internet via anonymous ftp, further adding to the value of this title.

The modelling 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.

The Finite Element Method: Solid mechanics

Mixed Finite Element Methods and Applications

Dynamic Extended Finite Element Method (XFEM) Analysis of Discontinuous Media

Finite Element Method

TEXTBOOK OF FINITE ELEMENT ANALYSIS

Extended Finite Element MethodTheory and ApplicationsJohn Wiley & Sons

The eXtended Finite Element Method for special problems with moving interfaces.

In recent years there have been significant developments in the development of stable and accurate finite element procedures for the numerical approximation of a wide range of fluid mechanics problems. Taking an engineering rather than a mathematical bias, this valuable reference resource details the fundamentals of stabilised finite element methods for the analysis of steady and time-dependent fluid dynamics problems. Organised into six chapters, this text combines theoretical aspects and practical applications and offers coverage of the latest research in several areas of computational fluid dynamics. * Coverage includes new and advanced topics unavailable elsewhere in book form * Collection in one volume of the widely dispersed literature reporting recent progress in this field * Addresses the key problems and offers modern, practical solutions Due to the balance between the concise explanation of the theory and the detailed description of modern practical applications, this text is suitable for a wide audience including academics, research centres and government agencies in aerospace, automotive and environmental engineering.

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.

Application

Extended Finite Element and Meshfree Methods

Nonlinear Finite Elements for Continua and Structures

Finite Element Methods for Flow Problems

The Finite Element Method for Three-Dimensional Thermomechanical Applications

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 systematic introduction to the theories and formulations ofthe explicit finite element method As numerical technology continues to grow and evolve withindustrial applications, understanding the explicit finite elementmethod has become increasingly important, particularly in the areasof crashworthiness, metal forming, and impact engineering.Introduction to the Explicit Finite Element Method forNonlinear Transient Dynamics is the first book to addressspecifically what is now accepted as the most successful numericaltool for nonlinear transient dynamics. The book aids readers inmastering the explicit finite element method and programming codewithout requiring extensive background knowledge of the generalfinite element. The authors present topics relating to the variationalprinciple, numerical procedure, mechanical formulation, andfundamental achievements of the convergence theory. In addition,key topics and techniques are provided in four clearly organizedsections: • Fundamentals explores a framework of the explicitfinite element method for nonlinear transient dynamics andhighlights achievements related to the convergence theory • Element Technology discusses four-node,three-node, eight-node, and two-node element theories • Material Models outlines models of plasticity andother nonlinear materials as well as the mechanics model of ductiledamage • Contact and Constraint Conditions covers subjectsrelated to three-dimensional surface contact, with examples solvedanalytically, as well as discussions on kinematic constraintconditions Throughout the book, vivid figures illustrate the ideas and keyfeatures of the explicit finite element method. Examples clearlypresent results, featuring both theoretical assessments andindustrial applications. Introduction to the Explicit Finite Element Method forNonlinear Transient Dynamics is an ideal book for bothengineers who require more theoretical discussions and fortheoreticians searching for interesting and challenging researchtopics. The book also serves as an excellent resource for courseson applied mathematics, applied mechanics, and numerical methods atthe graduate level.

The objective of this book is to analyze within reasonable limits (it is not a treatise) the basic mathematical aspects of the finite element method. The book should also serve as an introduction to current research on this subject. On the one hand, it is also intended to be a working textbook for advanced courses in Numerical Analysis, as typically taught in graduate courses in American and French universities. For example, it is the author's experience that a one-semester course (on a three-hour per week basis) can be taught from Chapters 1, 2 and 3 (with the exception of Section 3.3), while another one-semester course can be taught from Chapters 4 and 6. On the other hand, it is hoped that this book will prove to be useful for researchers interested in advanced aspects of the numerical analysis of the finite element method. In this respect, Section 3.3, Chapters 5, 7 and 8, and the sections on "Additional Bibliography and Comments should provide many suggestions for conducting seminars.

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

Tsinghua University Press Computational Mechanics Series

An EXtended Finite Element Method Formulation for Modeling the Response of Polycrystalline Materials to Dynamics Loading

Finite Element Analysis for Biomedical Engineering Applications

Programming the Finite Element Method

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

Though many 'finite element' books exist, this book provides a unique focus on developing the method for three-dimensional, industrial problems. This is significant as many methods which work well for small applications fail for large scale problems, which generally: are not so well posed introduce stringent computer time conditions require robust solution techniques. Starting from sound continuum mechanics principles, derivation in this book focuses only on proven methods. Coverage of all different aspects of linear and nonlinear thermal mechanical problems in solids are described, thereby avoiding distracting the reader with extraneous solutions paths. Emphasis is put on consistent representation and includes the examination of topics which are not frequently found in other texts, such as cyclic symmetry, rigid body motion and nonlinear multiple point constraints. Advanced material formulations include anisotropic hyperelasticity, large strain multiplicative viscoplasticity and single crystal viscoplasticity. Finally, the methods described in the book are implemented in the finite element software CalculiX, which is freely available (www.calculix.de; the GNU General Public License applies). Suited to industry practitioners and academic researchers alike, The Finite Element Method for Three-Dimensional Thermomechanical Applications expertly bridges the gap between continuum mechanics and the finite element method.

This book is not intended to be a text-book, delineating the full scope of finite element methodology, nor is it a comprehensive handbook of modern finite element practice for the finite element engineer. There are enough books that serve to do these and more. It is however intended as a monograph or treatise on a very specific area - the design of robust and accurate elements for applications in struc tural mechanics. It attempts to describe the epistemological conflict between the principles in finite element technology that can be described as Art and those that have a scientific basis invested in it and which can be admitted as science as the subject evolved and came to be accepted. The principles of structural mechanics as a branch of physics are well founded and have a sound scientific basis. The mathematical description of it has also a long history and is rigorously based on the infinitesimal and variational calculus. Of much more recent origin has been the branch of knowledge dealing with the numerical modelling of the beha viour of structural material. The most powerful method available to do this today is the finite element method. It is eminently suited to carry out the entire cycle of design and analysis of a structural configuration on a digital computer.

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.

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

Selected Papers from the ICOSAHOM Conference, London, UK, July 9-13, 2018

Extended Finite Element Method for Crack Propagation

For Fracture Analysis of Structures

Principles and Practice of Design of Field-consistent Elements for Structural and Solid Mechanics

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.

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.

An insight into the use of the finite method in geotechnical engineering. The first volume covers the theory and the second volume covers the applications of the subject. The work examines popular constitutive models, numerical techniques and case studies.

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.

Extended Finite Element Method

Automated Solution of Differential Equations by the Finite Element Method

Finite Element Analysis in Geotechnical Engineering

Proceedings of the 17th International Conference on New Trends in Fatigue and Fracture

Damage Tolerance Analysis Using the EXtended Finite Element Method

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.

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

Xfem

The EXtended Finite Element Method for Special Problems with Moving Interfaces

The Finite Element Method in Structural Mechanics

The Evolution of Geotech - 25 Years of Innovation