An Extended Finite Element Method For The Analysis Of

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Enriched Finite Element Methods John Wiley & Sons
While the theory and application of finite elements methods can be extended to incompatible, hybrid, and mixed element methods, important issues, such as determining the reliability of the solution of incompatible multivariable elements, along with a common perception of impracticality, have hindered the widespread implementation of these methods.
The Finite Element Method in Heat Transfer and Fluid Dynamics, Third Edition John Wiley & Sons
Extended Finite Element MethodJohn Wiley & Sons
Large Strain Finite Element Method Springer-Verlag
The Finite Element Method: Its Basis and Fundamentals offers a complete introduction to the basis of the finite element method, covering fundamental theory and worked examples in the detail required for readers to apply the knowledge to their own engineering problems and understand more advanced applications. This edition sees a significant rearrangement of the book's content to enable clearer development of the finite element method, with major new chapters and sections added to cover: Weak forms Variational forms Multi-dimensional field problems Automatic mesh generation Plate bending and shells Developments in meshless techniques Focusing on the core knowledge, mathematical and analytical tools needed for successful application, The Finite Element Method: Its Basis and Fundamentals is the authoritative resource of choice for graduate level students, researchers and professional engineers involved in finite element-based engineering analysis. A proven keystone reference in the library of any engineer needing to understand and apply the finite element method in design and development. Founded by an influential pioneer in the field and updated in this seventh edition by an author team incorporating academic authority and industrial simulation experience. Features reworked and reordered contents for clearer development of the theory, plus new chapters and sections on mesh generation, plate bending, shells, weak forms and variational forms.
The Finite Element Method: Its Basis and Fundamentals CRC Press
Nonlinear Finite Elements for Continua and Structures p>Nonlinear Finite Elements for Continua and Structures 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.

Introduction to Finite Element Analysis and Design Academic Press

The Finite Element Method in Engineering, Sixth Edition, provides a thorough grounding in the mathematical principles behind the Finite Element Analysis technique—an analytical engineering tool originated in the 1960's by the aerospace and nuclear power industries to find usable, approximate solutions to problems with many complex variables. Rao shows how to set up finite element solutions in civil, mechanical and aerospace engineering applications. The new edition features updated real-world examples from MATLAB, Ansys and Abaqus, and a new chapter on additional FEM topics including extended FEM (X-FEM). Professional engineers will benefit from the introduction to the many useful applications of finite element analysis. Includes revised and updated chapters on MATLAB, Ansys and Abaqus Offers a new chapter, Additional Topics in Finite Element Method Includes discussion of practical considerations, errors and pitfalls in FEM singularity elements Features a brief presentation of recent developments in FEM including extended FEM (X-FEM), augmented FEM (A-FEM) and partition of unity FEM (POUFEM) Features improved pedagogy, including the addition of more design-oriented and practical examples and problems Covers real-life applications, sample review questions at the end of most chapters, and updated references

XFEM Fracture Analysis of Composites John Wiley & Sons

Nonlinear Mechanics for Composite Heterogeneous Structures applies both classical and multi-scale finite element analysis to the non-linear, failure response of composite structures. These traditional and modern computational approaches are holistically presented, providing insight into a range of non-linear structural analysis problems. The classical methods include geometric and material non-linearity, plasticity, damage and contact mechanics. The cutting-edge formulations include cohesive zone models, the Extended Finite Element Method (XFEM), multi-scale computational homogenization, localization of damage, neural networks and data-driven techniques. This presentation is simple but efficient, enabling the reader to understand, select and apply appropriate methods through programming code or commercial finite element software. The book is suitable for undergraduate studies as a final year textbook and for MSc and PhD studies in structural, mechanical, aerospace engineering and material science, among others. Professionals in these fields will also be strongly benefited. An accompanying website provides MATLAB codes for two-dimensional finite element problems with contact, multi-scale (FE2) and non-linear XFEM analysis, data-driven and machine learning simulations.

Nonlinear Mechanics for Composite Heterogeneous Structures Butterworth-Heinemann

Aus den Besprechungen: "Mit der gelungenen Übersetzung wird dem deutschen Studenten, Dozenten und Ingenieur ein schon seit 1982 in den USA verbreitetes und bewährtes Standardwerk zugängig gemacht. Dieses Buch besticht zunächst dadurch, daß die Finite-Element-Methode in großer Breite abgehandelt wird. ... Dabei fehlt es nicht an Tiefe der Durchdringung und mathematischer Strenge. Didaktisch wird geschickt von jeweils einführenden Abschnitten und vielen Berechnungsbeispielen ausgegangen. ... Dieses hervorragende Lehrbuch und Nachschlagewerk dürfte auch den deutschen Fachleuten ein unentbehrlicher Begleiter werden." Schweissen & Schneiden#1 "... Im Anhang werden anhand des abgedruckten Programs STAP alle wesentlichen Aspekte, die die Implementierung der Verfahren betreffen, erörtert. Zahlreiche Zahlenbeispiele sorgen dafür, daß auch Leser mit nur geringen Vorkenntnissen den "roten Faden" nicht verlieren. Das Buch dokumentiert auf eindrucksvolle Weise den hohen Entwicklungsstandard der Methode der Finiten Elemente. Es ist ein sehr gutes Hilfsmittel für die Ausbildung von Studenten der Ingenieurwissenschaften in höheren Semestern. Darüber hinaus kann es aber auch allen interessierten Ingenieuren als Grundlagenwerk sehr empfohlen werden." Bautechnik#2

The Finite Element Method in Engineering Elsevier

Designed for students without in-depth mathematical training, this text includes a comprehensive presentation and analysis of algorithms of time-dependent phenomena plus beam, plate, and shell theories. Solution guide available upon request.

An Extended Finite Element Method with Discontinuous Enrichment for Applied Mechanics Academic Press

PARTITION OF UNITY METHODS Master the latest tool in computational mechanics with this brand-new resource from distinguished leaders in the field While it is the number one tool for computer aided design and engineering, the finite element method (FEM) has difficulties with discontinuities, singularities, and moving boundaries. Partition of unity methods addresses these challenges and is now increasingly implemented in commercially available software. Partition of Unity Methods delivers a detailed overview of its fundamentals, in particular the extended finite element method for applications in solving moving boundary problems. The distinguished academics and authors introduce the XFEM as a natural extension of the traditional finite element method (FEM), through straightforward one-dimensional examples which form the basis for the subsequent introduction of higher dimensional problems. This book allows readers to fully understand and utilize XFEM just as it becomes ever more crucial to industry practice. Partition of Unity Methods explores all essential topics on this key new technology, including: Coverage of the difficulties faced by the finite element method and the impetus behind the development of XFEM The basics of the finite element method, with discussions of finite element formulation of linear elasticity and the calculation of the force vector An introduction to the fundamentals of enrichment A revisitation of the partition of unity enrichment A description of the geometry of enrichment features, with discussions of level sets for stationary interfaces Application of XFEM to bio-film, gradient theories, and three dimensional crack propagation Perfect for researchers and postdoctoral candidates working in the field of computational mechanics, Partition of Unity Methods also has a place in the libraries of senior undergraduate and graduate students working in the field. Finite element and CFD analysts and developers in private industry will also greatly benefit from this book.

Hybrid and Incompatible Finite Element Methods CRC Press

Introduce every concept in the simplest setting and to maintain a level of treatment that is as rigorous as possible without being unnecessarily abstract. Contains unique recent developments of various finite elements such as nonconforming, mixed, discontinuous, characteristic, and adaptive finite elements, along with their applications. Describes unique recent applications of finite element methods to important fields such as multiphase flows in porous media and semiconductor modelling. Treats the three major types of partial differential equations, i.e., elliptic, parabolic, and hyperbolic equations.

Static and Dynamic Crack Propagation in Brittle Materials with XFEM LAP Lambert Academic Publishing

This book describes the basics and developments of the new XFEM approach to fracture analysis of composite structures and materials. It provides state of the art techniques and algorithms for fracture analysis of structures including numeric examples at the end of each chapter as well as an accompanying website which will include MATLAB resources, executables, data files, and simulation procedures of XFEM. The first reference text for the extended finite element method (XFEM) for fracture analysis of structures and materials Includes theory and applications, with worked numerical problems and solutions, and MATLAB examples on an accompanying website with further XFEM resources Provides a comprehensive overview of this new area of research, including a review of Fracture Mechanics, basic through to advanced XFEM theory, as well as current problems and applications Includes a chapter on the future developments in the field, new research areas and possible future applications of the method

Extended Finite Element Method CRC Press

This book deals with the most recent numerical modeling of adhesive joints. Advances in damage mechanics and extended finite element method are described in the context of the Finite Element method with examples of application. The book also introduces the classical continuum mechanics and fracture mechanics approach and discusses the boundary element method and the finite difference method with indication of the cases they are most adapted to. At the moment there a no numerical technique that can solve any problem and the analyst needs to be aware of the limitations involved in each case.

Partition of Unity Methods kassel university press GmbH

Introduces the basic concepts of FEM in an easy-to-use format so that students and professionals can use the method efficiently and interpret results properly Finite element method (FEM) is a powerful tool for solving engineering problems both in solid structural mechanics and fluid mechanics. This book presents all of the theoretical aspects of FEM that students of engineering will need. It eliminates overlong math equations in favour of basic concepts, and reviews of the mathematics and mechanics of materials in order to illustrate the concepts of FEM. It introduces these concepts by including examples using six different commercial programs online. The all-new, second edition of Introduction to Finite Element Analysis and Design provides many more exercise problems than the first edition. It includes a significant amount of material in modelling issues by using several practical examples from engineering applications. The book features new coverage of buckling of beams and frames and extends heat transfer analyses from 1D (in the previous edition) to 2D. It also covers 3D solid element and its application, as well as 2D. Additionally, readers will find an increase in coverage of finite element analysis of dynamic problems. There is also a companion website with examples that are concurrent with the most recent version of the commercial programs. Offers elaborate explanations of basic finite element procedures Delivers clear explanations of the capabilities and limitations of finite element analysis Includes application examples and tutorials for commercial finite element software, such as MATLAB, ANSYS, ABAQUS and NASTRAN Provides numerous examples and exercise problems Comes with a complete solution manual and results of several engineering design projects Introduction to Finite Element Analysis and Design, 2nd Edition is an excellent text for junior and senior level undergraduate students and beginning graduate students in mechanical, civil, aerospace, biomedical engineering, industrial engineering and engineering mechanics.

Extended Finite Element Method Springer Science & Business Media

As Computational Fluid Dynamics (CFD) and Computational Heat Transfer (CHT) evolve and become increasingly important in standard engineering design and analysis practice, users require a solid understanding of mechanics and numerical methods to make optimal use of available software. The Finite Element Method in Heat Transfer and Fluid Dynamics, Third Edition illustrates what a user must know to ensure the optimal application of computational procedures—particularly the Finite Element Method (FEM)—to important problems associated with heat conduction, incompressible viscous flows, and convection heat transfer. This book follows the tradition of the bestselling previous editions, noted for their concise explanation and powerful presentation of useful methodology tailored for use in simulating CFD and CHT. The authors update research developments while retaining the previous editions' key material and popular style in regard to text organization, equation numbering, references, and symbols. This updated third edition features new or extended coverage of: Coupled problems and parallel processing Mathematical preliminaries and low-speed compressible flows Mode superposition methods and a more detailed account of radiation solution methods Variational multi-scale methods (VMM) and least-squares finite element models (LSFEM) Application of the finite element method to non-isothermal flows Formulation of low-speed, compressible flows With its presentation of realistic, applied examples of FEM in thermal and fluid design analysis, this proven masterwork is an invaluable tool for mastering basic methodology, competently using existing simulation software, and developing simpler special-purpose computer codes. It remains one of the very best resources for understanding numerical methods used in the study of fluid mechanics and heat transfer phenomena.

The EXtended Finite Element Method (XFEM) with Adaptive Mesh Refinement for Fracture Mechanics Springer Science & Business Media

Echte Ingenieursprobleme sind intrinsisch nichtlinear. Kennnisse der nichtlinearen Finiten-Elemente-Analyse sind für Maschinenbauer, Bauingenieure und Werkstofftechniker daher unabdingbar. Mit ihrer Hilfe lassen sich mechanische Festigkeitsberechnungen durchführen, zeit- und kostenintensive Tests bei der Produktentwicklung werden so reduziert. Didaktisch schlüssig vom Modell und dessen theoretischer Durchdringung bis zum Algorithmus und dessen praktischer Implementierung bietet dieses Buch eine Einführung in die nichtlineare Finite-Elemente-Analyse ? leicht zugänglich, kompakt und auf die technische Ausrichtung fokussiert: - mathematische und kontinuumsmechanische Grundlagen, Lösungstechniken für nichtlineare Probleme in der statischen und dynamischen Analyse - erste Einblicke in geometrische Nichtlinearitäten - Schädigung, Plastizität und zeitabhängige Nichtlinearitäten - Plastizität von Balken, Bögen und Schalen - elastische und elastoplastische Finite-Elemente-Analyse großer Dehnungen - Einführung in moderne Diskretisierungskonzepte Hilfreich fürs Bestehen von Prüfungen sind die Beispiele im frei erhältlichen Finite-Elemente-Code auf Python?-Basis. Das dazugehörige Hintergrundwissen macht den User mit den Möglichkeiten und Grenzen moderner Finite-Elemente-Software vertraut. Der ideale Einstieg in die nichtlineare Finite-Elemente-Analyse für Studenten und Praktiker ? mit so viel Mathematik wie nötig und so vielen realen Ingenieursproblemen wie möglich. Mit Beispielen im Finite-Elemente-Code auf Python?-Basis unter: www.wiley-vch.de

Nichtlineare Finite-Elemente-Analyse von Festkörpern und Strukturen John Wiley & Sons

The Finite Element Method for Fluid Dynamics offers a complete introduction the application of the

finite element method to fluid mechanics. The book begins with a useful summary of all relevant partial differential equations before moving on to discuss convection stabilization procedures, steady and transient state equations, and numerical solution of fluid dynamic equations. The character-based split (CBS) scheme is introduced and discussed in detail, followed by thorough coverage of incompressible and compressible fluid dynamics, flow through porous media, shallow water flow, and the numerical treatment of long and short waves. Updated throughout, this new edition includes new chapters on: Fluid-structure interaction, including discussion of one-dimensional and multidimensional problems Biofluid dynamics, covering flow throughout the human arterial system Focusing on the core knowledge, mathematical and analytical tools needed for successful computational fluid dynamics (CFD), The Finite Element Method for Fluid Dynamics is the authoritative introduction of choice for graduate level students, researchers and professional engineers. A proven keystone reference in the library of any engineer needing to understand and apply the finite element method to fluid mechanics Founded by an influential pioneer in the field and updated in this seventh edition by leading academics who worked closely with Olgierd C. Zienkiewicz Features new chapters on fluid-structure interaction and biofluid dynamics, including coverage of one-dimensional flow in flexible pipes and challenges in modeling systemic arterial circulation

Advances in Numerical Modeling of Adhesive Joints Butterworth-Heinemann

Fundamentals of Enriched Finite Element Methods provides an overview of the different enriched finite element methods, detailed instruction on their use, and also looks at their real-world applications, recommending in what situations they’re best implemented. It starts with a concise background on the theory required to understand the underlying functioning principles behind enriched finite element methods before outlining detailed instruction on implementation of the techniques in standard displacement-based finite element codes. The strengths and weaknesses of each are discussed, as are computer implementation details, including a standalone generalized finite element package, written in Python. The applications of the methods to a range of scenarios, including multi-phase, fracture, multiscale, and immersed boundary (fictitious domain) problems are covered, and readers can find ready-to-use code, simulation videos, and other useful resources on the companion website to the book. Reviews various enriched finite element methods, providing pros, cons, and scenarios for best use Provides step-by-step instruction on implementing these methods Covers the theory of general and enriched finite element methods Discusses the application of the methods to a range of scenarios including multi-phase, fracture, multiscale, and immerse boundary problems Includes access to a companion website featuring code, simulation examples, and other practical tools

Eindimensionale Finite Elemente John Wiley & Sons

Finite element method refers to the numerical method, which is used to solve problems in mathematical physics and engineering. The areas where finite element method is mostly applied are fluid flow, structural analysis, mass transport, heat transfer and electromagnetic potential problems. This method divides the problem into simpler and smaller parts called finite elements, in order to solve it. Algebraic equations are formulated for each element, which are then assembled into a larger set of equations that models the whole problem. Variational methods are then applied to find an approximate solution by minimizing the associated error function. The different finite element methods are applied element method (AEM), extended finite element method (XFEM), meshfree methods, Loubignac iteration, finite element limit analysis, spectral element method, etc. This book outlines the concepts and applications of finite element method in detail. It strives to provide a fair idea about this discipline and to help develop a better understanding of the latest advances within this area of mathematics. Those in search of information to further their knowledge will be greatly assisted by this book.

Extended Finite Element Method John Wiley & Sons

Computational Methods for Fracture in Porous Media: Isogeometric and Extended Finite Element Methods provides a self-contained presentation of new modeling techniques for simulating crack propagation in fluid-saturated porous materials. This book reviews the basic equations that govern fluid-saturated porous media. A multi-scale approach to modeling fluid transport in joins, cracks, and faults is described in such a way that the resulting formulation allows for a sub-grid representation of the crack and fluid flow in the crack. Interface elements are also analyzed with their extension to the hydromechanical case. The flexibility of Extended Finite Element Method for non-stationary cracks is also explored and their formulation for fracture in porous media described. This book introduces Isogeometric finite element methods and its basic features and properties. The rapidly evolving phase-field approach to fracture is also discussed. The applications of this book’s content cover various fields of engineering, making it a valuable resource for researchers in soil, rock and biomechanics. Teaches both new and upcoming computational techniques for simulating fracture in (partially) fluid-saturated porous media Helps readers learn how to couple modern computational methods with non-linear fracture mechanics and flow in porous media Presents tactics on how to simulate fracture propagation in hydraulic fracturing

Nonlinear Finite Elements for Continua and Structures Extended Finite Element Method 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

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