A Meshfree Splitting Method For Soliton Dynamics In

This book is a collection of the papers from the proceedings of the 1st Asian Workshop on Meshfree Methods held in conjunction with the 2nd International Conference on Structural Stability & Dynamics (ICSSD02) on 16-18 December 2002 in Singapore. It contains 36 articles covering most of the topics in the rapidly developing areas of meshfree methods and extended finite element methods (X-FEM). These topics include domain discretization, boundary discretization, combined domain/boundary discretization, meshfree particle methods, collocation methods, X-FEM, etc. Papers on issues related to implementation and coding of meshfree methods are also presented. The areas of applications of meshfree methods include solving general partial differential equations, the mechanics of solids and structures, smart material/structures, soil-structures, fracture mechanics, fluid dynamics, impact, penetration, micro-fluidics, etc. In addition, techniques for field variable interpolation, such as the moving least squares (MLS) approximation, the point interpolation method (PIM), and radial PIM are reported. Contents:Meshfree FormulationsMeshfree Methods for Smart Materials/StructuresMeshfree Methods for Fracture AnalysisMeshfree Methods for Membranes, Plates & ShellsMeshfree Methods for SoilMeshfree Methods for CFDBoundary Meshfree MethodsCoding, Error Estimation, ParallisationMeshfree Particle MethodsX-FEM Readership: Graduate and undergraduate students, researchers, academics, lecturers and engineers in civil engineering, engineering mechanics and mechanical engineering. Keywords:Meshfree Method;Meshless Method;SPH;X-FEM;Computational Mechanics;Computational Science;Fluid Dynamics;Modified Variational Principle;Smart Materials

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

This book discusses the basic formulations of fluid mechanics and their computer modelling, as well as the relationship between experimental and analytical results. Containing papers from the Ninth International Conference on Advances in Fluid Mechanics, this book discusses the basic formulations of fluid mechanics and their computer modelling, as well as the relationship between experimental and analytical results. Scientists, engineers, and other professionals interested in the latest developments in theoretical and computational fluid mechanics will find the book a useful addition to the literature. The book covers a wide range of topics, with emphasis on new applications and research currently in progress, including: Computational Methods in Fluid Mechanics, Environmental Fluid Mechanics; Experimental Versus Simulation Methods; Multiphase Flow; Hydraulics and Hydrodynamics; Heat and Mass Transfer; Industrial Applications; Wave Studies; Biofluids; Fluid Structure Interaction.

Containing the latest in a long line of conferences covering the most recent advances in Boundary Elements and Mesh Reduction Methods (BEM/MRM), this book contains an important chapter in the history of this important method used in science and engineering. The BEM/MRM conference has long been recognised as THE international forum on the technique. The proceedings of the conference therefore constitute a record of the development of the method, running from the initial successful development of boundary integral techniques into the BEM, a method that eliminates the need for an internal mesh, to the recent and most sophisticated Mesh Reduction and even Meshless Methods. Since the boundary elements, mesh reduction, and meshless methods are used in many engineering and scientific fields, the book will be of great interest to all engineers and scientists working within the areas of numerical analysis, boundary elements and meshless methods. Topics covered include: Advanced formulations; Advanced meshless and mesh reduction methods; Structural mechanics applications; Solid mechanics; Heat and mass transfer, Electrical engineering and electromagnetics; Computational methods; Fluid flow modelling; Damage mechanics and fracture; Dynamics and Vibrations Engineering applications.

Structural Integrity and Durability of Advanced Composites

A Parallel Multilevel Partition of Unity Method for Elliptic Partial Differential Equations

Advances in Visual Computing

Computational Science – ICCS 2020

Meshfree Methods for Partial Differential Equations VI

Structural Integrity and Durability of Advanced Composites: Innovative Modelling Methods and Intelligent Design presents scientific and technological research from leading composite materials scientists and engineers that showcase the fundamental issues and practical problems that affect the development and exploitation of large composite structures. As predicting precisely where cracks may develop in materials under stress is an age old mystery in the design and building of large-scale engineering structures, the burden of testing to provide "fracture safe design" is imperative. Readers will learn to transfer key ideas from research and development to both the design engineer and end-user of composite materials. This comprehensive text provides the information users need to understand deformation and fracture phenomena resulting from impact, fatigue, creep, and stress corrosion cracking and how these phenomena can affect reliability, life expectancy, and the durability of structures. Presents scientific and technological research from leading composite materials scientists and engineers that showcase fundamental issues and practical problems Provides the information users need to understand deformation and fracture phenomena resulting from impact, fatigue, creep, and stress corrosion cracking Enables readers to transfer key ideas from research and development to both the design engineer and end-user of composite materials

Meshfree methods, particle methods, and generalized finite element methods have witnessed substantial development since the mid 1990s. The growing interest in these methods is due in part to the fact that they are extremely flexible numerical tools and can be interpreted in a number of ways. For instance, meshfree methods can be viewed as a natural extension of classical finite element and finite difference methods to scattered node configurations with no fixed connectivity. Furthermore, meshfree methods offer a number of advantageous features which are especially attractive when dealing with multiscale phenomena: a priori knowledge about particular local behavior of the solution can easily be introduced in the meshfree approximation space, and coarse-scale approximations can be seamlessly refined with fine-scale information. This volume collects selected papers presented at the Seventh International Workshop on Meshfree Methods, held in Bonn, Germany in September 2013. They address various aspects of this highly dynamic research field and cover topics from applied mathematics, physics and engineering.

The two volume set LNCS 8887 and 8888 constitutes the refereed proceedings of the 10th International Symposium on Visual Computing, ISVC 2014, held in Las Vegas, NV, USA. The 74 revised full papers and 55 poster papers presented together with 39 special track papers were carefully reviewed and selected from more than 280 submissions. The papers are organized in topical sections: Part I (LNCS 8887) comprises computational bioimaging, computer graphics; motion, tracking, feature extraction and matching, segmentation, visualization, mapping, modeling and surface reconstruction, unmanned autonomous systems, medical imaging, tracking for human activity monitoring, intelligent transportation systems, visual perception and robotic systems. Part II (LNCS 8888) comprises topics such as computational bioimaging , recognition, computer vision, applications, face processing and recognition, virtual reality, and the poster sessions.

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

A Partial Differential Equation Approach

Current Trends in Mathematical Analysis and Its Interdisciplinary Applications

Issues in Mechanical Engineering: 2013 Edition

Moving Beyond the Finite Element Method

Domain Decomposition Methods in Science and Engineering XXI

Smoothed Particle Hydrodynamics

This book contains 36 articles covering most of the topics in the rapidly developing areas of meshfree methods and extended finite element methods (X-FEM). These topics include domain discretization, boundary discretization, combined domain/boundary discretization, meshfree particle methods, collocation methods, X-FEM, etc. Papers on issues related to implementation and coding of meshfree methods are also presented. The areas of applications of meshfree methods include solving general partial differential equations, the mechanics of solids and structures, smart material/structures, soil-structures, fracture mechanics, fluid dynamics, impact, penetration, micro-fluidics, etc. In addition, techniques for field variable interpolation, such as the moving least squares (MLS) approximation, the point interpolation method (PIM), and radial PIM are reported. Contents: Meshfree Shape Functions for Weak Formulation, Strong Formulation; Meshfree Methods for Smart Materials/Structures; Meshfree Methods for Fracture Analysis; Meshfree Methods for Membranes, Plates & Shells; Meshfree Methods for Soil; Meshfree Methods for CFD; Boundary Meshfree Methods; Coding, Error Estimation, Parallisation; Meshfree Particle Methods; X-FEM. Readership: Graduate and undergraduate students, reserchers, academics, lecturers and engineers in civil engineering, engineering mechanics and mechanical engineering.

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 numerical treatment of partial differential equations with particle methods and meshfree discretization techniques is an extremely active research field, both in the mathematics and engineering communities. Meshfree methods are becoming increasingly mainstream in various applications. Due to their independence of a mesh, particle schemes and meshfree methods can deal with large geometric changes of the domain more easily than classical discretization techniques. Furthermore, meshfree methods offer a promising approach for the coupling of particle models to continuous models. This volume of LNCSE is a collection of the papers from the proceedings of the Fifth International Workshop on Meshfree Methods, held in Bonn in August 2009. The articles address the different meshfree methods and their use in applied mathematics, physics and engineering. The volume is intended to foster this highly active and exciting area of interdisciplinary research and to present recent advances and findings in this field.

This book explores several important aspects of recent developments in the interdisciplinary applications of mathematical analysis (MA), and highlights how MA is now being employed in many areas of scientific research. Each of the 23 carefully reviewed chapters was written by experienced expert(s) in respective field, and will enrich readers' understanding of the respective research problems, providing them with sufficient background to understand the theories, methods and applications discussed. The book's main goal is to highlight the latest trends and advances, equipping interested readers to pursue further research of their own. Given its scope, the book will especially benefit graduate and PhD students, researchers in the applied sciences, educators, and engineers with an interest in recent developments in the interdisciplinary applications of mathematical analysis.

Meshless methods for volume visualization

Computational Modelling of Fracture with Local Maximum Entropy Approximations

Mesh Reduction Methods

A Conservative Meshless Framework for Conservation Laws with Applications in Computational Fluid Dynamics

A Meshfree Particle Method

Error Estimates for Advanced Galerkin Methods

The seven-volume set LNCS 12137, 12138, 12139, 12140, 12141, 12142, and 12143 constitutes the proceedings of the 20th International Conference on Computational Science, ICCS 2020, held in Amsterdam, The Netherlands, in June 2020.* The total of 101 papers and 248 workshop papers presented in this book set were carefully reviewed and selected from 719 submissions (230 submissions to the main track and 489 submissions to the workshops). The papers were organized in topical sections named: Part I: ICCS Main Track Part II: ICCS Main Track Part III: Advances in High-Performance Computational Earth Sciences: Applications and Frameworks; Agent-Based Simulations, Adaptive Algorithms and Solvers; Applications of Computational Methods in Artificial Intelligence and Machine Learning; Biomedical and Bioinformatics Challenges for Computer Science Part IV: Classifier Learning from Difficult Data; Complex Social Systems through the Lens of Computational Science; Computational Health; Computational Methods for Emerging Problems in (Dis-)Information Analysis Part V: Computational Optimization, Modelling and Simulation; Computational Science in IoT and Smart Systems; Computer Graphics, Image Processing and Artificial Intelligence Part VI: Data Driven Computational Sciences; Machine Learning and Data Assimilation for Dynamical Systems; Meshfree Methods in Computational Sciences; Multiscale Modelling and Simulation; Quantum Computing Workshop Part VII: Simulations of Flow and Transport: Modeling, Algorithms and Computation; Smart Systems: Bringing Together Computer Vision, Sensor Networks and Machine Learning; Software Engineering for Computational Science; Solving Problems with Uncertainties; Teaching Computational Science; UNcErtainty QUantIficatiOn for ComputationAl modeLs *The conference was canceled due to the COVID-19 pandemic.

This proceedings volume contains over 300 papers on rock mechanics and engineering with contributors from all over Asia and many other parts of the world. Seven keynote papers summarize the state-of-the-art in rock engineering including topics such as underground rock caverns. The technical papers cover a wide range of rock mechanics and engineering topics: rock tunnels, caverns, mining, rock slopes and dams, rock blasting, rock burst and failure, rock properties, rock mass, rock joints, and block theory. Numerous valuable rock engineering case studies are also reported. This volume should serve as a useful reference for the engineers and researchers in rock mechanics and rock engineering. Sample Chapter(s). Chapter 1: Forensic Engineering for Underground Construction (244 KB). Contents: Tunnelling; Rock Caverns; Mining; Blasting and Dynamics; Support and Reinforcement; Rock Mass; Rock Properties; Discontinuities; Block Theory and DDA; Failure, Fracture and Burst; Dams and Slopes; Other Applications. Readership: Graduate students, academics and researchers in civil engineering and engineering mechanics.

Meshfree methods for the solution of partial differential equations gained much attention in recent years, not only in the engineering but also in the mathematics community. One of the reasons for this development is the fact that meshfree discretizations and particle models are often better suited to cope with geometric changes of the domain of interest, e.g. free surfaces and large deformations, than classical discretization techniques such as finite differences, finite elements or finite volumes. Another obvious advantage of meshfree discretizations is their independence of a mesh so that the costs of mesh generation are eliminated. Also, the treatment of time-dependent PDEs from a Lagrangian point of view and the coupling of particle models and continuous models gained enormous interest in recent years from a theoretical as well as from a practial point of view. This volume consists of articles which address the different meshfree methods (SPH, PUM, GFEM, EFGM, RKPM etc.) and their application in applied mathematics, physics and engineering.

The numerical treatment of partial differential equations with particle methods and meshfree discretization techniques is a very active research field both in the mathematics and engineering community. Due to their independence of a mesh, particle schemes and meshfree methods can deal with large geometric changes of the domain more easily than classical discretization techniques. Furthermore, meshfree methods offer a promising approach for the coupling of particle models to continuous models. This volume of LNCSE is a collection of the papers from the proceedings of the Second International Workshop on Meshfree Methods held in September 2003 in Bonn. The articles address the different meshfree methods (SPH, PUM, GFEM, EFGM, RKPM, etc.) and their application in applied mathematics, physics and engineering. The volume is intended to foster this new and exciting area of interdisciplinary research and to present recent advances and results in this field.

Wavelet Numerical Method and Its Applications in Nonlinear Problems

Boundary Elements and Other Mesh Reduction Methods XXXVI

Meshfree Methods for Partial Differential Equations II

Innovative Modelling Methods and Intelligent Design

With CD-ROM(Volume 2)

Progress on Meshless Methods

Methods of Fundamental Solutions in Solid Mechanics presents the fundamentals of continuum mechanics, the foundational concepts of the MFS, and methodologies and applications to various engineering problems. Eight chapters give an overview of meshless methods, the mechanics of solids and structures, the basics of fundamental solutions and radical basis functions, meshless analysis for thin beam bending, thin plate bending, two-dimensional elastic, plane piezoelectric problems, and heat transfer in heterogeneous media. The book presents a working knowledge of the MFS that is aimed at solving real-world engineering problems through an understanding of the physical and mathematical characteristics of the MFS and its applications. Explains foundational concepts for the method of fundamental solutions (MFS) for the advanced numerical analysis of solid mechanics and heat transfer Extends the application of the MFS for use with complex problems Considers the majority of engineering problems, including beam bending, plate bending, elasticity, piezoelectricity and heat transfer Gives detailed solution procedures for engineering problems Offers a practical guide, complete with engineering examples, for the application of the MFS to real-world physical and engineering challenges

This book summarizes the basic theory of wavelets and some related algorithms in an easy-to-understand language from the perspective of an engineer rather than a mathematician. In this book, the wavelet solution schemes are systematically established and introduced for solving general linear and nonlinear initial boundary value problems in engineering, including the technique of boundary extension in approximating interval-bounded functions, the calculation method for various connection coefficients, the single-point Gaussian integration method in calculating the coefficients of wavelet expansions and unique treatments on nonlinear terms in differential equations. At the same time, this book is supplemented by a large number of numerical examples to specifically explain procedures and characteristics of the method, as well as detailed treatments for specific problems. Different from most of the current monographs focusing on the basic theory of wavelets, it focuses on the use of wavelet-based numerical methods developed by the author over the years. Even for the necessary basic theory of wavelet in engineering applications, this book is based on the author's own understanding in plain language, instead of a relatively difficult professional mathematical description. This book is very suitable for students, researchers and technical personnel who only want to need the minimal knowledge of wavelet method to solve specific problems in engineering.

The world of quantitative finance (QF) is one of the fastest growing areas of research and its practical applications to derivatives pricing problem. Since the discovery of the famous Black-Scholes equation in the 1970's we have seen a surge in the number of models for a wide range of products such as plain and exotic options, interest rate derivatives, real options and many others. Gone are the days when it was possible to price these derivatives analytically. For most problems we must resort to some kind of approximate method. In this book we employ partial differential equations (PDE) to describe a range of one-factor and multi-factor derivatives products such as plain European and American options, multi-asset options, Asian options, interest rate options and real options. PDE techniques allow us to create a framework for modeling complex and interesting derivatives products. Having defined the PDE problem we then approximate it using the Finite Difference Method (FDM). This method has been used for many application areas such as fluid dynamics, heat transfer, semiconductor simulation and astrophysics, to name just a few. In this book we apply the same techniques to pricing real-life derivative products. We use both traditional (or well-known) methods as well as a number of advanced schemes that are making their way into the QF literature: Crank-Nicolson, exponentially fitted and higher-order schemes for one-factor and multi-factor options Early exercise features and approximation using front-fixing, penalty and variational methods Modelling stochastic volatility models using Splitting methods Critique of ADI and Crank-Nicolson schemes; when they work and when they don't work Modelling jumps using Partial Integro Differential Equations (PIDE) Free and moving boundary value problems in QF Included with the book is a CD containing information on how to set up FDM algorithms, how to map these algorithms to C++ as well as several working programs for one-factor and two-factor models. We also provide source code so that you can customize the applications to suit your own needs.

Volume is indexed by Thomson Reuters CPCI-S (WoS). This collection of peer-reviewed papers covers a wide range of topics: Fracture Mechanics, Failure analysis, corrosion, Creep, Non-linear problems, Dynamic Fracture, Residual Stress, Environmental effects, Crack Propagation, Repair Techniques, Composites, Ceramics, Polymers, Metallic and concrete materials, Probabilistic Aspects, Risk

Analysis, Damage Tolerance, Fracture Control, Computer Modelling Methods (Finite Elements, Boundary Elements and Meshless), Microstructural and Multiscale Aspects. The work thus offers a timely survey of these subjects.
Methods of Fundamental Solutions in Solid Mechanics
Extended Finite Element and Meshfree Methods
Meshfree Methods for Partial Differential Equations VIII
Shock capturing and high-order methods for hyperbolic conservation laws
Meshfree Methods for Partial Differential Equations
20th International Conference, Amsterdam, The Netherlands, June 3–5, 2020, Proceedings, Part VI

In recent years meshless/meshfree methods have gained considerable attention in engineering and applied mathematics. The variety of problems that are now being addressed by these techniques continues to expand and the quality of the results obtained demonstrates the effectiveness of many of the methods currently available. The book presents a significant sample of the state of the art in the field with methods that have reached a certain level of maturity while also addressing many open issues. The book collects extended original contributions presented at the Second ECCOMAS Conference on Meshless Methods held in 2007 in Porto. The list of contributors reveals a fortunate mix of highly distinguished authors as well as quite young but very active and promising researchers, thus giving the reader an interesting and updated view of different meshless approximation methods and their range of applications. The material presented is appropriate for researchers, engineers, physicists, applied mathematicians and graduate students interested in this active research area.

There have been substantial developments in meshfree methods, particle methods, and generalized finite element methods since the mid 1990s. The growing interest in these methods is in part due to the fact that they offer extremely flexible numerical tools and can be interpreted in a number of ways. For instance, meshfree methods can be viewed as a natural extension of classical finite element and finite difference methods to scattered node configurations with no fixed connectivity. Furthermore, meshfree methods have a number of advantageous features that are especially attractive when dealing with multiscale phenomena: A-priori knowledge about the solution's particular local behavior can easily be introduced into the meshfree approximation space, and coarse scale approximations can be seamlessly refined by adding fine scale information. However, the implementation of meshfree methods and their parallelization also requires special attention, for instance with respect to numerical integration.

A high-impact factor, prestigious annual publication containing invited surveys by subject leaders: essential reading for all practitioners and researchers.

Proceedings of the 31st World Conference on Boundary Elements and Other Mesh Reduction Methods, held Sept. 2-4, 2009, Wessex Institute of Technology.

Current Trends and Open Problems in Computational Mechanics
Programming the Finite Element Method
Modeling in Engineering Using Innovative Numerical Methods for Solids and Fluids
Rock Mechanics in Underground Construction
10th International Symposium, ISVC 2014, Las Vegas, NV, USA, December 8-10, 2014, Proceedings, Part I
Advances in Fracture and Damage Mechanics X

The book examines innovative numerical methods for computational solid and fluid mechanics that can be used to model complex problems in engineering. It also presents innovative and promising simulation methods, including the fundamentals of these methods, as well as advanced topics and complex applications. Further, the book explores how numerical simulations can significantly reduce the number of time-consuming and expensive experiments required, and can support engineering decisions by providing data that would be very difficult, if not impossible, to obtain experimentally. It also includes chapters covering topics such as particle methods addressing particle-based materials and numerical methods that are based on discrete element formulations; fictitious domain methods; phase field models; computational fluid dynamics based on modern finite volume schemes; hybridizable discontinuous Galerkin methods; and non-intrusive coupling methods for structural models.

the solution or its gradient. These new discretization techniques are promising approaches to overcome the severe problem of mesh-generation. Furthermore, the easy coupling of meshfree discretizations of continuous phenomena to dis crete particle models and the straightforward Lagrangian treatment of PDEs via these techniques make them very interesting from a practical as well as a theoretical point of view. Generally speaking, there are two different types of meshfree approaches; first, the classical particle methods [104, 105, 107, 108] and second, meshfree discretizations based on data fitting techniques [13, 39]. Traditional parti cle methods stem from physics applications like Boltzmann equations [3, 50] and are also of great interest in the mathematical modeling community since many applications nowadays require the use of molecular and atomistic mod els (for instance in semi-conductor design). Note however that these methods are Lagrangian methods; i. e. , they are based On a time-dependent formulation or conservation law and can be applied only within this context. In a particle method we use a discrete set of points to discretize the domain of interest and the solution at a certain time. The PDE is then transformed into equa tions of motion for the discrete particles such that the particles can be moved via these equations. After time discretization of the equations of motion we obtain a certain particle distribution for every time step.

This thesis is concerned with the numerical treatment of hyperbolic conservation laws. These play an important role in describing many natural phenomena. Challenges in their theoretical as well as numerical study stem from the fact that spontaneous shock discontinuities can arise in their solutions, even in finite time and smooth initial states. Moreover, the numerical treatment of hyperbolic conservations laws involves many different fields from mathematics, physics, and computer science. As a consequence, this thesis also provides contributions to several different fields of research - which are still connected by numerical conservation laws, however. These contributions include, but are not limited to, the construction of stable high order quadrature rules for experimental data, the development of new stable numerical methods for conservation laws, and the investigation and design of shock capturing procedures as a means to stabilize high order numerical methods in the presence of (shock) discontinuities. Jan Glaubitz was born in Braunschweig, Germany, in 1990 and completed his mathematical studies (B.Sc., 2014, M.Sc., 2016, Dr. rer. nat., 2019) at TU Braunschweig. In 2016, he received awards from the German Mathematical Society (DMV) for his master's thesis as well as from the Society of Financial and Economic Mathematics of Braunschweig (VBFWM). In 2017, he was honored with the teaching award "LehrLEO" for the best tutorial at TU Braunschweig. Since 2020, he holds a position as a postdoctoral researcher at Dartmouth College, NH, USA.

Issues in Mechanical Engineering / 2013 Edition is a ScholarlyEditions™ book that delivers timely, authoritative, and comprehensive information about Additional Research. The editors have built Issues in Mechanical Engineering: 2013 Edition on the vast information databases of ScholarlyNews.™ You can expect the information about Additional Research in this book to be deeper than what you can access anywhere else, as well as consistently reliable, authoritative, informed, and relevant. The content of Issues in Mechanical Engineering: 2013 Edition has been produced by the world's leading scientists, engineers, analysts, research institutions, and companies. All of the content is from peer-reviewed sources, and all of it is written, assembled, and edited by the editors at ScholarlyEditions™ and available exclusively from us. You now have a source you can cite with authority, confidence, and credibility. More information is available at http://www.ScholarlyEditions.com/.

Advances in Meshfree and X-fem Methods
Meshfree Methods for Partial Differential Equations V
Finite Difference Methods in Financial Engineering
Acta Numerica 2006: Volume 15
Meshfree Methods for Partial Differential Equations VII
Deterministic Numerical Methods for Unstructured-Mesh Neutron Transport Calculation

This volume contains a selection of papers presented at the 21st international conference on domain decomposition methods in science and engineering held in Rennes, France, June 25-29, 2012. Domain decomposition is an active and interdisciplinary research discipline, focusing on the development, analysis and implementation of numerical methods for massively parallel computers. Domain decomposition methods are among the most efficient solvers for large scale applications in science and engineering. They are based on a solid theoretical foundation and shown to be scalable for many important applications. Domain decomposition techniques can also naturally take into account multiscale phenomena. This book contains the most recent results in this important field of research, both mathematically and algorithmically and allows the reader to get an overview of this exciting branch of numerical analysis and scientific computing.

Meshfree methods are a modern alternative to classical mesh-based discretization techniques such as finite differences or finite element methods. Especially in a time-dependent setting or in the treatment of problems with strongly singular solutions their independence of a mesh makes these methods highly attractive. This volume collects selected papers presented at the Sixth International Workshop on Meshfree Methods held in Bonn, Germany in October 2011. They address various aspects of this very active research field and cover topics from applied mathematics, physics and engineering. ?

The Conference on Boundary Elements and Mesh Reduction Methods (BEM/MRM) is recognised as the international forum for the latest advances in these techniques and their applications in science and engineering. Launched in 1978 the Conference continues to attract original contributions and has become the forum for their rapid dissemination throughout the international scientific community. Practically all new boundary element ideas have first appeared in the proceedings of these meetings.

As we attempt to solve engineering problems of ever increasing complexity, so must we develop and learn new methods for doing so. The Finite Difference Method used for centuries eventually gave way to Finite Element Methods (FEM), which better met the demands for flexibility, effectiveness, and accuracy in problems involving complex geometry. Now,

Boundary Elements and Other Mesh Reduction Methods XXXVIII
Proceedings of the 1 St Asian Workshop on Meshfree Methods, Singapore, 16-18 December, 2002
ISRM International Symposium 2006 : 4th Asian Rock Mechanics Symposium, 8 - 10 November 2006, Singapore
Mesh Free Methods
Advances in Meshfree and X-FEM Methods
Advances in Fluid Mechanics IX

Mesh generation, which is essential to most traditional numerical discretizations, often remains the bottleneck of the simulation process. Many researchers have developed meshless algorithms to circumvent mesh generation. Unfortunately, almost all existing meshless methods suffer from the lack of formal discrete conservation, which can lead to unpredictable numerical errors in the presence of discontinuities. This thesis addresses the issue of non-conservation in existing meshless methods. It focuses on the formulation and implementation of a novel conservative meshless scheme and its applications in computational fluid dynamics (CFD). The scheme, first of such nature documented in the literature, is formulated based on obtaining derivative approximations using function values and generated coefficients satisfying a set of reciprocity and polynomial consistency conditions. The required coefficients are generated by the solution of a global quadratic program. They minimize an upper bound of a representation of the global discretization error in addition to satisfying the necessary conditions. A generalization of the derivative approximation allows the use of arbitrary consistent interface values in the derivative operator while maintaining discrete conservation. This creates a flexible framework within which a wide variety of numerical flux schemes, such as those previously developed for finite volume discretization, can be used with no additional costs. The practicality of this new framework is demonstrated by solving compressible flow problems using, without modifications, a piece of software designed for finite volume discretization. The meshless numerical results show superconvergence and compare well with those obtained using meshed finite volume discretizations and other meshless schemes, highlighting the validity of the new framework and its potential to be applied to problems of greater complexity and scale.

' This is the first-ever book on smoothed particle hydrodynamics (SPH) and its variations, covering the theoretical background, numerical techniques, code implementation issues, and many novel and interesting applications. It contains many appealing and practical examples, including free surface flows, high explosive detonation and explosion, underwater explosion and water mitigation of explosive shocks, high velocity impact and penetration, and multiple scale simulations coupled with the molecular dynamics method. An SPH source code is provided, making this a friendly book for readers and SPH users. Supplementary Materials Software Contents:SPH Concept and Essential FormulationConstructing Smoothing FunctionsSPH for General Dynamic Fluid FlowsDiscontinuous SPH (DSPH)SPH for Simulating ExplosionsSPH for Underwater Explosion Shock SimulationSPH for Hydrodynamics with Material StrengthCoupling SPH with Molecular Dynamics for Multiple Scale SimulationsComputer Implementation of SPH and a 3D SPH Code Readership: Researchers, practitioners, upper-level undergraduates, graduate students, and academics in computational mechanics and engineering. Keywords:Meshfree Method;Meshless Method;SPH;Meshfree Particle Method;Computational Mechanics;Computational Science;Fluid Dynamics;Molecular Dynamics;Multi-Scale Simulations;Explosion;Detonation;High Velocity Impact;PenetrationReviews:"This is a readable book. The presentation of the book is friendly, straightforward, and application oriented … One of the unique features of the book is its emphasis on the computer implementation and coding of SPH method. Readers can easily learn from the examples illustrated in the book, write their own SPH codes, and test the validity of the numerical method. It may serve as a useful reference book in research and graduate study in computational engineering and science."Computational Mechanics "Numerical simulations using the SPH method are a new area of research, and are still under development. These problems offer ample opportunities for researchers to develop more advanced methods as next generation numerical methods. The book can serve as a good start to efficiently learn, test, practise and develop such new methods."Zentralblatt MATH '

The book collects extended original contributions presented at the first ECCOMAS Conference on Meshless Methods held in 2005 in Lisbon. The list of contributors is a mix of highly distinguished authors as well as promising young researchers. This means that the reader gets a varied and contemporary view on different mesh reduction methods and its range of applications. The material presented is appropriate for researchers, engineers, physicists, applied mathematicians and graduate students interested in this active research area.

This monograph provides a compendium of established and novel error estimation procedures applied in the field of Computational Mechanics. It also includes detailed derivations of these procedures to offer insights into the concepts used to control the errors obtained from employing Galerkin methods in finite and linearized hyperelasticity. The Galerkin methods introduced are considered advanced methods because they remedy certain shortcomings of the well-established finite element method, which is the archetypal Galerkin (mesh-based) method. In particular, this monograph focuses on the systematical derivation of the shape functions used to construct both Galerkin mesh-based and meshfree methods. The mesh-based methods considered are the (conventional) displacement-based, (dual-)mixed, smoothed, and extended finite element methods. In addition, it introduces the element-free Galerkin and reproducing kernel particle methods as representatives of a class of Galerkin meshfree methods. Including illustrative numerical examples relevant to engineering with an emphasis on elastic fracture mechanics problems, this monograph is intended for students, researchers, and practitioners aiming to increase the reliability of their numerical simulations and wanting to better grasp the concepts of Galerkin methods and associated error estimation procedures.

Advances in Meshfree Techniques
BEM/MRM XXXI
The Finite Element Method for Fluid Dynamics

The key objective of this research is to study fracture with a meshfree method, local maximum entropy approximations, and model fracture in thin shell structures with complex geometry and topology. This topic is of high relevance for real-world applications, for example in the automotive industry and in aerospace engineering. The shell structure can be described efficiently by meshless methods which are capable of describing complex shapes as a collection of points instead of a structured mesh. In order to find the appropriate numerical method to achieve this goal, the first part of the work was development of a method based on local maximum entropy (LME) shape functions together with enrichment functions used in partition of unity methods to discretize problems in linear elastic fracture mechanics. We obtain improved accuracy relative to the standard extended finite element method (XFEM) at a comparable computational cost. In addition, we keep the advantages of the LME shape functions,such as smoothness and non-negativity. We show numerically that optimal convergence (same as in FEM) for energy norm and stress intensity factors can be obtained through the use of geometric (fixed area) enrichment with no special treatment of the nodes near the crack such as blending or shifting. As extension of this method to three dimensional problems and complex thin shell structures with arbitrary crack growth is cumbersome, we developed a phase field model for fracture using LME. Phase field models provide a powerful tool to tackle moving interface problems, and have been extensively used in physics and materials science. Phase methods are gaining popularity in a wide set of applications in applied science and engineering, recently a second order phase field approximation for brittle fracture has gathered significant interest in computational fracture such that sharp cracks discontinuities are modeled by a diffusive crack. By minimizing the system energy with respect to the mechanical displacements and the phase-field, subject to an irreversibility condition to avoid crack healing, this model can describe crack nucleation, propagation, branching and merging. One of the main advantages of the phase field modeling of fractures is the unified treatment of the interfacial tracking and mechanics, which potentially leads to simple, robust, scalable computer codes applicable to complex systems. In other words, this approximation reduces considerably the implementation complexity because the numerical *tracking of the fracture is not needed, at the expense of a high computational cost. We present a fourth-order phase field model for fracture based on local maximum entropy (LME) approximations. The higher order continuity of the meshfree LME approximation allows to directly solve the fourth-order phase field equations without splitting the fourth-order differential equation into two second order differential equations. Notably, in contrast to previous discretizations that use at least a quadratic basis, only linear completeness is needed in the LME approximation. We show that the crack surface can be captured more accurately in the fourth-order model than the second-order model. Furthermore, less nodes are needed for the fourth-order model to resolve the crack path. Finally, we demonstrate the performance of the proposed meshfree fourth order phase-field formulation for 5 representative numerical examples. Computational results will be compared to analytical solutions within linear elastic fracture mechanics and experimental data for three-dimensional crack propagation. In the last part of this research, we present a phase-field model for fracture in Kirchoff-Love thin shells using the local maximum-entropy (LME) meshfree method. Since the crack is a natural outcome of the analysis it does not require an explicit representation and tracking, which is advantageous over techniques as the extended finite element method that requires tracking of the crack paths. The geometric description of the shell is based on statistical learning techniques that allow dealing with general point set surfaces avoiding a global parametrization, which can be applied to tackle surfaces of complex geometry and topology. We show the flexibility and robustness of the present methodology for two examples: plate in tension and a set of open connected pipes.*

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