Anh-Vu Vuong

# Adaptive Hierarchical Isogeometric Finite Element Methods

RESEARCH



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# **Adaptive Hierarchical Isogeometric Finite Element Methods**

Gernot Beer, Benjamin Marussig, Christian Duenser

#### **Adaptive Hierarchical Isogeometric Finite Element Methods:**

Adaptive Hierarchical Isogeometric Finite Element Methods Anh-Vu Vuong, 2012-05-01 Isogeometric finite elements combine the numerical solution of partial differential equations and the description of the computational domain given by rational splines from computer aided geometric design This work gives a well founded introduction to this topic and then extends isogeometric finite elements by a local refinement technique which is essential for an efficient adaptive simulation Thereby a hierarchical approach is adapted to the numerical requirements and the relevant theoretical properties of the basis are ensured The computational results suggest the increased efficiency and the potential of this local refinement Isogeometric Analysis and Applications 2014 Bert Jüttler, Bernd Simeon, 2015-12-21 Isogeometric Analysis is method a groundbreaking computational approach that promises the possibility of integrating the finite element method into conventional spline based CAD design tools It thus bridges the gap between numerical analysis and geometry and moreover it allows to tackle new cutting edge applications at the frontiers of research in science and engineering This proceedings volume contains a selection of outstanding research papers presented at the second International Workshop on Isogeometric Analysis and Applications held at Annweiler Germany in April 2014 Curves and Surfaces Jean-Daniel Boissonnat, Albert Cohen, Olivier Gibaru, Christian Gout, Tom Lyche, Marie-Laurence Mazure, Larry L. Schumaker, 2015-08-13 This volume constitutes the thoroughly refereed post conference proceedings of the 8th International Conference on Curves and Surfaces held in Paris France in June 2014 The conference had the overall theme Representation and Approximation of Curves and Surfaces and Applications The 32 revised full papers presented were carefully reviewed and selected from 39 submissions The scope of the conference was on following topics approximation theory computer aided geometric design computer graphics and visualization computational geometry and topology geometry processing image and signal processing interpolation and smoothing mesh generation finite elements and splines scattered data processing and learning theory sparse and high dimensional approximation subdivision wavelets and multi resolution method Proceedings of the International Conference on Advances in Computational Mechanics 2017 Hung Nguyen-Xuan, Phuc Phung-Van, Timon Rabczuk, 2018-02-20 This book provides an overview of state of the art methods in computational engineering for modeling and simulation This proceedings volume includes a selection of refereed papers presented at the International Conference on Advances in Computational Mechanics ACOME 2017 which took place on Phu Quoc Island Vietnam on August 2 4 2017 The contributions highlight recent advances in and innovative applications of computational mechanics Subjects covered include biological systems damage fracture and failure flow problems multiscale multiphysics problems composites and hybrid structures optimization and inverse problems lightweight structures computational mechatronics computational dynamics numerical methods and high performance computing The book is intended for academics including graduate students and experienced researchers interested in state of the art computational methods for solving challenging problems in engineering Fast Solvers for Mesh-Based Computations Maciej Paszynski,2016-01-05 Fast Solvers for Mesh Based Computations presents an alternative way of constructing multi frontal direct solver algorithms for mesh based computations. It also describes how to design and implement those algorithms The book is structure follows those of the matrices starting from tri diagonal matrices resulting from one dimensional mesh based meth. IGA: Non-Invasive Coupling with FEM and Regularization of Digital Image Correlation Problems, Volume 2 Robin Bouclier, Jean-Charles Passieux, 2023-07-26 Isogeometric analysis IGA consists of using the same higher order and smooth spline functions for the representation of geometry in Computer Aided Design as for the approximation of solution fields in Finite Element Analysis Now almost twenty years after its creation substantial works are being reported in IGA making it very competitive in scientific computing This book proposes to use IGA jointly with standard finite element methods FEM presenting IGA as a projection of FEM on a more regular reduced basis By shedding new light on how IGA relates to FEM we can see how IGA can be implemented on top of an FE code in order to improve the solution of problems that require more regularity This is illustrated by using IGA with FEM in a non invasive fashion to perform efficient and robust multiscale global local simulations in solid mechanics Furthermore we show that IGA can regularize the inverse problem of FE digital image correlation in experimental mechanics

The Isogeometric Boundary Element Method Gernot Beer, Benjamin Marussig, Christian Duenser, 2019-09-21 This book discusses the introduction of isogeometric technology to the boundary element method BEM in order to establish an improved link between simulation and computer aided design CAD that does not require mesh generation In the isogeometric BEM non uniform rational B splines replace the Lagrange polynomials used in conventional BEM This may seem a trivial exercise but if implemented rigorously it has profound implications for the programming resulting in software that is extremely user friendly and efficient The BEM is ideally suited for linking with CAD as both rely on the definition of objects by boundary representation The book shows how the isogeometric philosophy can be implemented and how its benefits can be maximised with a minimum of user effort Using several examples ranging from potential problems to elasticity it demonstrates that the isogeometric approach results in a drastic reduction in the number of unknowns and an increase in the quality of the results In some cases even exact solutions without refinement are possible The book also presents a number of practical applications demonstrating that the development is not only of academic interest It then elegantly addresses heterogeneous and non linear problems using isogeometric concepts and tests them on several examples including a severely non linear problem in viscous flow The book makes a significant contribution towards a seamless integration of CAD and simulation which eliminates the need for tedious mesh generation and provides high quality results with minimum user intervention and computing Isogeometric Methods for Numerical Simulation Gernot Beer, Stéphane Bordas, 2015-01-29 The book presents the state of the art in isogeometric modeling and shows how the method has advantaged First an introduction to geometric modeling with NURBS and T splines is given followed by the implementation

into computer software The implementation in both the FEM and BEM is discussed *Frontiers in Computational Fluid-Structure Interaction and Flow Simulation* Tayfun E. Tezduyar,2023-11-01 Computational fluid structure interaction FSI and flow simulation are challenging research areas that bring solution and analysis to many classes of problems in science engineering and technology Young investigators under the age of 40 are conducting much of the frontier research in these areas some of which is highlighted in this volume The first author of each chapter took the lead role in carrying out the research presented Some of the topics explored include Direct flow simulation of objects represented by point clouds Computational investigation of leaflet flutter in thinner biological heart valve tissues High fidelity simulation of hydrokinetic energy applications High resolution isogeometric analysis of car and tire aerodynamics Computational analysis of air blast structure interaction Heart valve computational flow analysis with boundary layer and leaflet contact representation Computational thermalmulti phase flow for metal additive manufacturing This volume will be a valuable resource for early career researchers and students not only those interested in computational FSI and flow simulation but also other fields of engineering and science including fluid mechanics solid mechanics and computational mathematics as it will provide them with inspiration and guidance for conducting their own successful research It will also be of interest to senior researchers looking to learn more about successful research led by those under 40 and possibly offer collaboration to these researchers

Non-standard Discretisation Methods in Solid Mechanics Jörg Schröder, Peter Wriggers, 2022-04-14 This edited volume summarizes research being pursued within the DFG Priority Programme 1748 Reliable Simulation Methods in Solid Mechanics Development of non standard discretisation methods mechanical and mathematical analysis the aim of which was to develop novel discretisation methods based e g on mixed finite element methods isogeometric approaches as well as discontinuous Galerkin formulations including a sound mathematical analysis for geometrically as well as physically nonlinear problems The Priority Programme has established an international framework for mechanical and applied mathematical research to pursue open challenges on an inter disciplinary level The compiled results can be understood as state of the art in the research field and show promising ways of further research in the respective areas The book is intended for doctoral and post doctoral students in civil engineering mechanical engineering applied mathematics and physics as well as industrial researchers interested in the field

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