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The Mimetic Finite Element Method and the Virtual Element Method for Elliptic Problems with Arbitrary Regularity - 2012


This is the only book available that fully analyses the mathematical foundations of the finite element method. Not only is it valuable reference and introduction to current research, it is also a working textbook for graduate courses in numerical analysis, including useful figures and exercises of varying difficulty.


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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 method 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.


Mathematical Aspects of Finite Element Methods - I. Gallipoli - 2006-11-15

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Numerical Approximation Methods for Elliptic Boundary Value Problems - Olaf Steinbach - 2007-12-22

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Finite-element Method for Elliptic-type Differential Equations - 1978

The finite-element method is a powerful tool which can be described by elliptic differential-boundary value problems. A finite-element solution for such problems is outlined. The mathematical background of converting the differential form into an integral form is discussed. For simplicity, the trial function employed to illustrate the discrete solution process and the error source is limited to a linear one. Finally, the solvability of such a discretized system is reviewed.

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A New Finite Element Method for Elliptic Interface Problems - 2006

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Partial Differential Equations with Numerical Methods - Stig Larsson - 2008-12-05

The main theme is the integration of the theory of linear PDE and the theory of finite difference and finite element methods. For each type of PDE, elliptic, parabolic, and hyperbolic, the text contains one chapter on the mathematical theory of the differential equation, followed by one chapter on finite difference methods and one on finite element methods. The chapters are self-contained and written at an advanced undergraduate level. The emphasis is on ordinary boundary value problems for ordinary differential equations. Similarly, the chapters on time-dependent problems are preceded by a chapter on the initial-value problem for ordinary differential equations. There is also one chapter in the elliptic superspace problem and eigenfunction expansions. The presentation does not presume a deep knowledge of mathematical and functional analysis. The required background on linear functional analysis and Sobolev spaces is reviewed in an appendix. The book is suitable for advanced undergraduate and beginning graduate students of applied mathematics and engineering.

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Discontinuous Galerkin Methods - Erdoğan Cockburn - 2012-11-26

A class of finite element methods, the Discontinuous Galerkin Methods (DGM), has been under rapid development recently and has found its use very quickly in such diverse applications as aeroacoustics, semiconductor device simulation, turbulence, turbineflow, fluid materials processing, MHD and plasma simulations, and image processing. While there has been a lot of interest from mathematicians, physicists and engineers in DGM, only scattered information is available and there has been no prior effort in organizing and publishing the existing scattered information. Available information is organized and published in this book. The book gives an introduction to the theory of discontinuous Galerkin methods, which are high order methods, easily parallelizable, and very robust. It is also shown that the development of these methods is close to that of the other methods such as finite difference, finite volume and finite element methods. This book will be useful for graduate students in applied mathematics and engineering.
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.
