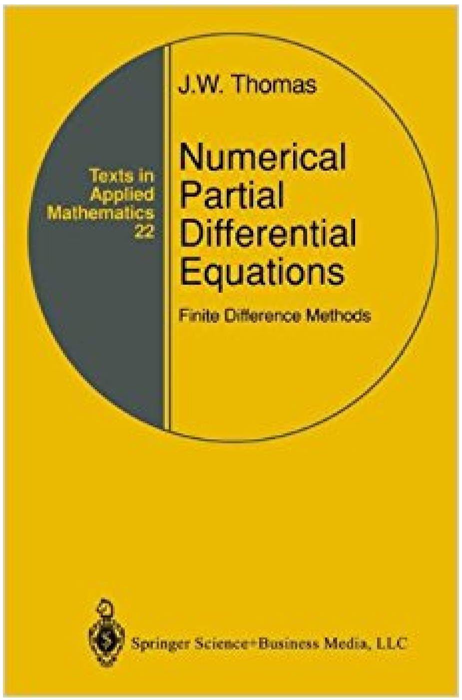
Numerical Partial Differential Equations: Finite Difference Methods (Texts In Applied Mathematics)



Synopsis

What makes this book stand out from the competition is that it is more computational. Once done with both volumes, readers will have the tools to attack a wider variety of problems than those worked out in the competitors' books. The author stresses the use of technology throughout the text, allowing students to utilize it as much as possible.

Book Information

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Customer Reviews

"This important volume is the first part of a two-part textbook (the second part is entitled Conservation laws and elliptic equations). The text includes interesting homework problems that implement different aspects of most of the schemes discussed. The implementation aspect of this text includes a large amount of computing. Other useful aspects of computing included in this volume are symbolic computing and the use of graphics for analysis. Prerequisites suggested for using this book might include one semester of partial differential equations and some programming capability. This book will be a good reference text for students." -- MATHEMATICAL REVIEWS

I had to read chapter 5 of this book for part of the comprehensive examination towards my PhD program. It is pretty easy to follow, except most of the steps in deriving equations are skipped. At times, this may be confusing for the reader. I went through the steps on my own to make sure I understood how one equation led to the other. For the most part, if one knows the fundamentals of numerical methods, it’s just writing down the steps to come to the same conclusion.What bothered me most was HW.5.6.8 (and 5.6.9). Basically, the problem is wrong. Such boundary conditions and initial conditions for the PDE given in the problem is not possible. I thought I was doing things wrong, so I took the problem to couple professors and other students and the conclusion was that the boundary condition that is given for that problem and the one after it can not be satisfied. Also, the given initial condition can only be thought of in imagination and not through analytical solution to the actual PDE. My three different numerical solutions match perfectly, but not the assumed anaylical solution f(x-at). So, I took one star off - also for a typo/mistake I found when stability of explicit FTCS method was discussed.

Great text for self-learning. Make the student apply the material from the very begining to the problems proposed. Be prepare to learn how to implement finite differences in PDE’s with perfect rigor.

It’s a very detailed book. But it has some errors. Some are printed errors, some statements are not accurate. Overall it’s a good guide for finite element methods.

This is textbook for FDM is especially good for self-study, mainly because most topics, even straightforward ones, are explained in quite detailed using quite many pages (that’s why the thickness the book; note the book has two volumes).In the preface the authors says the book comes from lectures to postgraduate students of math-major or engineering-major. I think the book is more tailored for those with engineering background (such as me) with limited (but non-zero) training in maths. The book uses very insignificant amount of topics in functional analysis, making it clearly different from numerical analysis texts for mathematicians. I think the prerequisite to read this book is one course in linear algebra (most physical science majors will have this), which is really light for those who are serious in learning FDM.The book comes with a large number of worked examples. Almost every concept presented is associated with one or more examples in one or more types of PDE. Although this is sometimes tedious (see how many times the book applies DFT for stability analysis), it maximizes the chance for a self-learner who has no background in FDM to understand the concepts.

This is a book that approximates the solution of parabolic, first order hyperbolic and systems of partial differential equations using standard finite difference schemes (FDM). The theory and practice of FDM is discussed in detail and numerous practical examples (heat equation, convection-diffusion) in one and two space variables are given. In particular, Alternating Direction Implicit (ADI) methods are the standard means of solving PDE in 2 and 3 dimensions.In almost all cases model problems are taken in order to show how the schemes work for initial value problems, initial boundary value problem with Dirichlet and Neumann boundary conditions.This book is a *must* for those in science, engineering and quantitative financial analysis. It digs into the nitty-gritty of mapping a PDE to a FDM scheme while taking nasty boundary conditions into consideration. The resulting algorithms are documented are are easily programmed in C++ or other language.The book does not cover topics that are also important: operator splitting (Marchuk/Janenko), non-constant coefficient PDEs, nonlinearities. Finally, the book uses von Neumann analysis as a means of proving stability (getting a bit long in the tooth). There are more robust methods that use monotone schemes, M-matrices and the maximum principle. You should consult other specialised references.This is Volume I of a two-volume set (Volume II deals with Conversation Laws and first-order hyperbolic as well as Elliptic problems.(...)

Thomas wrote a good book on a quite specialized subject. Although finite difference schemes have been traditionally viewed as a game field for physicists, they are given today much more commercial attention as financial option market evolves. Those who seek standard numerical recipes are advised to read this book. You will enjoy it (easy reading) and learn. But the book may not satisfy quests of a more rigorous readership. It abuses the Fourier method in stability analysis while considering only PDEs with constant coefficients. The bibliographical work has not been done at all. In addition, the cover does not state that this is the first book of two. I'd also advise to read G.Marchuk "Methods of Numerical Mathematics" (Springer, 1982) where a more general approach for stability of numerical schemes is developed.

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