Numerical Methods for Partial Differential Equations. An Introduction

Description: Numerical Methods for Partial Differential Equations: An Introduction

Vitoriano Ruas, Sorbonne Universités, UPMC – Université Paris 6, France

A comprehensive overview of techniques for the computational solution of PDE's

Numerical Methods for Partial Differential Equations: An Introduction covers the three most popular methods for solving partial differential equations: the finite difference method, the finite element method and the finite volume method. The book combines clear descriptions of the three methods, their reliability, and practical implementation aspects. Justifications for why numerical methods for the main classes of PDE's work or not, or how well they work, are supplied and exemplified.

Aimed primarily at students of Engineering, Mathematics, Computer Science, Physics and Chemistry among others this book offers a substantial insight into the principles numerical methods in this class of problems are based upon. The book can also be used as a reference for research work on numerical methods for PDE's.

Key features:

- A balanced emphasis is given to both practical considerations and a rigorous mathematical treatment.
- The reliability analyses for the three methods are carried out in a unified framework and in a structured and visible manner, for the basic types of PDE’s.
- Special attention is given to low order methods, as practitioner's overwhelming default options for everyday use.
- New techniques are employed to derive known results, thereby simplifying their proof.
- Supplementary material is available from a companion website.

Contents:

Preface by Eugenio Ònate xi

Preface by Larisa Beilina xiii

Acknowledgements xv

About the Companion Website xvii

Introduction xix

Key Reminders on Linear Algebra xxvii

1 Getting Started in One Space Variable 1

1.1 A Model Two–point Boundary Value Problem 2

1.2 The Basic FDM 7

1.3 The Piecewise Linear FEM (P 1 FEM) 12

1.4 The Basic FVM 17

1.4.1 The Vertex–centred FVM 17
7.1.3 Hermite FEM in Intervals and Rectangles 265
7.2 The Advection Diffusion Equation 272
7.2.1 A Model One-Dimensional Equation 272
7.2.2 Overcoming the Main Difficulties with the FDM 274
7.2.3 Example 7.1: Numerical Study of the Upwind FD Scheme 277
7.2.4 The SUPG Formulation 278
7.2.5 Example 7.2: Numerics of the SUPG Formulation for the P 1 FEM 281
7.2.6 An Upwind FV Scheme 282
7.2.7 A FE Scheme for the Time-Dependent Problem 286
7.2.8 Example 7.3: Numerical Study of the Weighted Mass FE Scheme 292
7.3 Basics of a Posteriori Error Estimates and Adaptivity 294
7.3.1 A Posteriori Error Estimates 295
7.3.2 Mesh Adaptivity: h, p and h p Methods 298
7.4 A Word about Non-linear PDEs 300
7.4.1 Example 7.4: Solving Non-linear Two-point Boundary Value Problems 301
7.4.2 Example 7.5: A Quasi-explicit Method for the Navier Stokes Equations 305
7.5 Exercises 309
Appendix 311
References 320
Index 331

Order by Fax - using the form below
Order by Post - print the order form below and send to
Research and Markets,
Guinness Centre,
Taylors Lane,
Dublin 8,
Ireland.
**Fax Order Form**
To place an order via fax simply print this form, fill in the information below and fax the completed form to 646-607-1907 (from USA) or +353-1-481-1716 (from Rest of World). If you have any questions please visit [http://www.researchandmarkets.com/contact/](http://www.researchandmarkets.com/contact/)

**Order Information**
Please verify that the product information is correct.

<table>
<thead>
<tr>
<th>Product Name:</th>
<th>Numerical Methods for Partial Differential Equations. An Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Address:</td>
<td><a href="http://www.researchandmarkets.com/reports/3623321/">http://www.researchandmarkets.com/reports/3623321/</a></td>
</tr>
<tr>
<td>Office Code:</td>
<td>SCBR1ING</td>
</tr>
</tbody>
</table>

**Product Format**
Please select the product format and quantity you require:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Hard Copy (Hard Back):</th>
<th>USD 98 + USD 29 Shipping/Handling</th>
</tr>
</thead>
</table>

* Shipping/Handling is only charged once per order.

**Contact Information**
Please enter all the information below in **BLOCK CAPITALS**

<table>
<thead>
<tr>
<th>Title:</th>
<th>Mr ☐</th>
<th>Mrs ☐</th>
<th>Dr ☐</th>
<th>Miss ☐</th>
<th>Ms ☐</th>
<th>Prof ☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Name:</td>
<td></td>
<td></td>
<td></td>
<td>Last Name:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Email Address: *</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Job Title:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organisation:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postal / Zip Code:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone Number:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fax Number:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Please refrain from using free email accounts when ordering (e.g. Yahoo, Hotmail, AOL)
Payment Information

Please indicate the payment method you would like to use by selecting the appropriate box.

☐ Pay by credit card: You will receive an email with a link to a secure webpage to enter your credit card details.

☐ Pay by check: Please post the check, accompanied by this form, to:
Research and Markets,
Guinness Center,
Taylors Lane,
Dublin 8,
Ireland.

☐ Pay by wire transfer: Please transfer funds to:
Account number 833 130 83
Sort code 98-53-30
Swift code ULSBIE2D
IBAN number IE78ULSB98533083313083
Bank Address Ulster Bank,
27-35 Main Street,
Blackrock,
Co. Dublin,
Ireland.

If you have a Marketing Code please enter it below:

Marketing Code: 

Please note that by ordering from Research and Markets you are agreeing to our Terms and Conditions at http://www.researchandmarkets.com/info/terms.asp

Please fax this form to:
(646) 607-1907 or (646) 964-6609 - From USA
+353-1-481-1716 or +353-1-653-1571 - From Rest of World