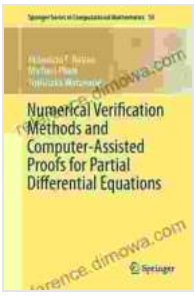
Numerical Verification Methods and Computer-Assisted Proofs for Partial Differential Equations: Unlocking the Secrets of Mathematical Models

Partial differential equations (PDEs) are mathematical equations that describe the behavior of physical phenomena such as fluid flow, heat transfer, and wave propagation. They play a crucial role in various scientific and engineering disciplines, enabling researchers to model and predict complex systems. However, due to their inherent complexity, solving PDEs can be a challenging task.

Numerical verification methods and computer-assisted proofs offer powerful tools for tackling this challenge. These techniques allow researchers to verify the correctness of numerical solutions to PDEs and to prove mathematical properties of these solutions. This book provides a comprehensive guide to these methods, presenting a wealth of theoretical foundations, practical algorithms, and real-world applications.

Numerical verification methods are designed to assess the accuracy and reliability of numerical solutions to PDEs. These methods involve comparing the numerical solution to an exact solution or to a solution obtained using a different numerical method. By quantifying the differences between these solutions, researchers can gain confidence in the reliability of their numerical results.

Numerical Verification Methods and Computer-Assisted Proofs for Partial Differential Equations (Springer



Series in Computational Mathematics Book 53)

by Yanhua Shih

4.7 out of 5

Language : English
File size : 11960 KB
Screen Reader : Supported
Print length : 480 pages

This book covers a wide range of numerical verification methods, including:

- **A posteriori error estimation**: Techniques for estimating the error in a numerical solution without knowing the exact solution.
- **Adaptive mesh refinement**: Algorithms for automatically adapting the computational grid to reduce the error in regions where the solution is rapidly changing.
- **Verification by interval arithmetic**: Methods for bounding the error in a numerical solution using interval arithmetic, which represents numbers as intervals rather than single values.

Computer-assisted proofs are techniques for using computers to verify mathematical proofs. These techniques can be applied to prove the correctness of numerical methods for solving PDEs, as well as to prove mathematical properties of the solutions themselves.

This book presents a range of computer-assisted proof techniques, including:

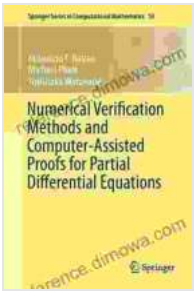
- **Interactive theorem proving**: Systems that allow researchers to interactively construct and verify mathematical proofs.
- **Automated theorem proving**: Systems that can automatically search for proofs of mathematical conjectures.
- **Formal verification of numerical software**: Techniques for verifying the correctness of software implementations of numerical methods.

The methods presented in this book have a wide range of applications in scientific and engineering disciplines, including:

- **Computational fluid dynamics**: Modeling and simulating the flow of fluids, such as air and water.
- **Computational heat transfer**: Modeling and simulating the transfer of heat, such as in buildings and industrial processes.
- **Computational wave propagation**: Modeling and simulating the propagation of waves, such as sound and electromagnetic waves.
- **Mathematical modeling of biological systems**: Modeling and simulating the behavior of biological systems, such as cells and tissues.
- **Verification and validation of scientific software**: Ensuring the correctness and reliability of software used for scientific research and engineering design.

Numerical verification methods and computer-assisted proofs are essential tools for advancing the understanding and application of PDEs. This book provides a comprehensive guide to these methods, empowering

researchers and engineers with the knowledge and techniques they need to tackle the challenges of mathematical modeling and scientific computing. By leveraging the power of numerical verification and computer-assisted proofs, we can unlock the secrets of partial differential equations and gain deeper insights into the behavior of the physical world.

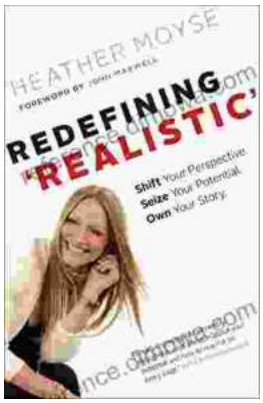


Numerical Verification Methods and Computer-Assisted Proofs for Partial Differential Equations (Springer Series in Computational Mathematics Book 53)

by Yanhua Shih

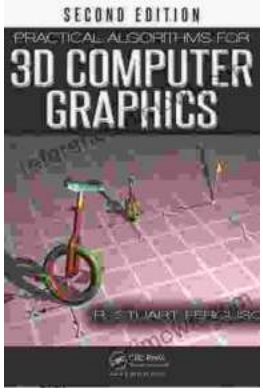
4.7 out of 5

Language	: English
File size	: 11960 KB
Screen Reader	: Supported
Print length	: 480 pages



Shift Your Perspective, Seize Your Potential, Own Your Story

A Transformative Guide to Living a Life of Purpose and Meaning Are you ready to unleash your true potential and live a life of purpose and meaning? Shift...



Practical Algorithms For 3d Computer Graphics: Unlocking the Secrets of 3D Visuals

In the realm of digital artistry, 3D computer graphics stands as a towering force, shaping our virtual worlds and captivating our imaginations. Whether you're an aspiring game...