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Volume Method"; "8.1 Introduction"; "8.2 Elliptic Equations"; "8.3 Parabolic Equations"; "8.4 Hyperbolic Equations"; "8.5 Heat Conduction: A Case Study"; "9. Finite Element Method"; "9.1 Finite Element Formulation"; "9.1.1 Weak Formulation"; "9.1.2 Shape Functions"; "9.2 Elasticity"; "9.2.1 Plane Stress and Plane Strain"; "9.2.2 Plane Stress and Plane Strain"; "9.2.3 Implementation"; "10. Heat Conduction"; "10.1 Basic Formulation"; "10.2 Element-by-Element Assembly"; "10.3 Application of Boundary Conditions"; "10.4 A Simple Program: 1-D Heat Conduction"; "10.5 2-D Heat Transfer"; "11. Time-Dependent Problems"; "11.1 The Time Dimension"; "11.2 Time-Stepping"; "11.3 1-D Transient Heat Transfer"; "11.4 Wave Equation"; "12. Optimization in Engineering"; "12.1 Introduction"; "12.2 Bioinspired Algorithms"; "12.2.1 Genetic Algorithms"; "12.2.2 Neural Networks"; "12.2.3 Virtual Bee Algorithms"; "12.2.4 Cellular Automata"; "12.2.5 Optimization"; "12.2.6 No Free Lunch Theorems"; "12.3 Engineering Optimization"; "12.3.1 Function and Multilevel Optimization"; "12.3.2 Multi-Peaked Functions"; "12.3.3 Inverse Analysis"; "13. Cellular Automata"; "13.1 Introduction"; "13.2 Cellular Automata"; "13.2.1 Fundamentals of Cellular Automaton"; "13.2.2 Finite State Cellular Automata"; "13.2.3 Stochastic Cellular Automata"; "13.2.4 Reversible Cellular Automata"; "13.3 Cellular Automata and PDEs"; "13.3.1 Rule-Based and Equation-Based ?"

Sommario/riassunto

This book strives to provide a concise introduction to computational engineering by introducing a wider range of numerical methods commonly used in computational modelling and scientific computing. These methods include finite difference methods, finite volume methods, finite element methods, virtual bee algorithms, and cellular automata. It also covers a wide spectrum of advanced topics in engineering applications, and these advanced topics include elasticity, heat conduction, reaction-diffusion system, optimisation, stochastic cellular automata, combustion, consolidation, heat transfer of carbon nanotubes, and pattern formation. The accompanied concise Matlab programs, no more than 100 lines each, demonstrate how each numerical method works. The animation and visualization of the results provide a first hand experience to the readers, especially for undergraduates and graduates, to master the fundamentals of the numerical methods. These Matlab programs can also be modified