Funaro, Daniele

Polynomial approximation of differential equations. (English) Zbl 0774.41010

Lecture Notes in Physics. New Series m: Monographs. 8. Berlin: Springer- Verlag. x, 305 p. (1992).

From the author's preface: This book is devoted to the analysis of approximate solution techniques for differential equations, based on classical orthogonal polynomials. These techniques are known as spectral methods. The book is divided into thirteen chapters. In the first chapter, the reader can find definitions and properties relative to different families of polynomials. Orthogonality, zeroes, Gaussian quadrature formulas, basic transformations, and many other algebraic relations are studied in chapters 2, 3, 4. With the help of the short introduction to functional analysis given in chapter 5, a survey of results in approximation theory is provided in chapter 6. Chapter 7 is devoted to the study of the discretization of derivative operators. The eigenvalues of the corresponding matrices are analyzed in chapter 8. The study of the differential equations begins in chapter 9. Ordinary differential equations and time-dependent partial differential equations in one space variable are examined in chapters 9 and 10 respectively. Domain-decomposition methods and related solution techniques are considered in chapter 11. Numerical experiments on four upgraded model problems in one dimension are presented in chapter 12. Finally, suggestions for the treatment of problems in two variables are presented in the last chapter.

Reviewer: M.Heilmann (Dortmund)

MSC:

41A10	Approximation by polynomials
41-01	Introductory exposition (textbooks, tutorial papers, etc.) pertaining to approximations and expansions
65T99	Numerical methods in Fourier analysis
65C10	Random number generation in numerical analysis
65M70	Spectral, collocation and related methods for initial value and initial-boundary value problems involving PDEs

Keywords:

domain-decomposition methods; orthogonal polynomials; spectral methods