

cent research by Tao, which could be a basis for a sequel.

LEON VASERSTEIN
The Pennsylvania State University

Generalized Collocation Methods: Solutions to Nonlinear Problems. By N. Bellomo, B. Lods, R. Revelli, and L. Ridolfi. Birkhäuser, Boston, 2008. \$69.95. xii+196 pp., hardcover. ISBN 978-0-8176-4525-0.

This is a textbook describing the application of what is called the generalized collocation method to time-dependent partial differential and integro-differential equations. The emphasis lies on problems in one and two space dimensions, the latter assuming applicable geometry which poses restrictions on the space domain. The idea behind collocation methods for a numerical approximation is attractive as it is conceptually easy. For time-dependent partial (integro-)differential equations, as applied in this textbook, it consists of the following main steps.

- (i) First, the space variables are discretized in the so-called collocation points in which the solution sought is to be approximated by interpolating functions, such as Lagrange polynomials, sinc functions, or splines.
- (ii) Then, the space derivatives of the interpolating functions are substituted into the differential equation and the boundary conditions are treated likewise. This second step turns the partial (integro-)differential equation into a continuous-time system of ordinary differential equations.
- (iii) Finally, the system of ordinary differential equations obtained is numerically integrated in time, e.g., by means of a Runge-Kutta method, so that at the chosen discrete time points a spatially continuous approximation to the solution sought is available through the interpolating function. In the literature the generalized collocation method is also called the differential quadrature method. In the book, however, it is not explained what is meant by the adjective “generalized.”

The book has been written primarily for scientists, engineers, and university students with a good knowledge of basic mathematics and differential equations at an elementary level who are interested in the application of mathematics to problems from application fields. The aim is to offer an easy-to-use handbook for the *Mathematica* implementation of the collocation method for the problem at hand. For that purpose a nice selection of example problems is discussed, accompanied by *Mathematica* software. The idea is that with some basic knowledge of *Mathematica*, interested readers are then readily capable of writing their own *Mathematica* code for their own problem. To achieve this aim, the text has been divided into six chapters and an appendix. The first chapter gives an introduction to the notion of a mathematical model and describes several interesting application examples, including solitary waves, river pollution, traffic flow, population dynamics, and pattern formation in chemistry. The second chapter is devoted to interpolation by means of Lagrange polynomials and sinc functions, which are used and explained in considerable detail in the remaining four chapters. These four chapters describe the collocation technique for various problem classes and provide many numerical examples illustrated with a great deal of solution and approximation plots. The appendix contains *Mathematica* code.

The material is well presented in a pleasant and easily readable style and covers a substantial number of topics. Being a numerical mathematician, however, I wish to note that the book contains very little numerical (error and stability) analysis and gives no easy insight into how the collocation method performs in terms of accuracy and efficiency in comparison to other well-developed powerful numerical techniques from the theory of numerical integration, finite differences, finite elements, and spectral methods. This means that, in my opinion, the book is somewhat outside the mainstream of modern scientific computing. Nevertheless, potential readers, in particular university students interested in applying mathematics who wish to become acquainted with the enormous power of scientific computing, are advised to read this

well-written textbook, certainly if they already possess *Mathematica* skills. However, for developing further and broader skills in scientific computing and in software, they are advised to learn more, for example, about COMSOL Multiphysics. This is a finite-element package (the former FEM-LAB initiated by students from KTH, Swe-

den) for various physics and engineering applications offering an interface to MATLAB and currently including various well-tested toolboxes; see Wikipedia and the official site <http://www.comsol.com/>.

JAN VERWER

Centrum Wiskunde & Informatica, Amsterdam