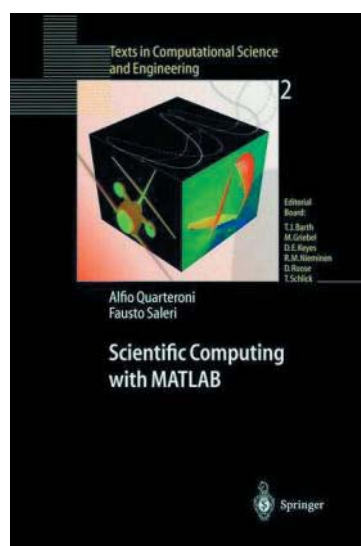


Anselm H. C. Horn

**Alfio Quarteroni, Fausto Saleri: Scientific Computing with MATLAB. Volume 2 of the series Timothy J. Barth, Michael Griebel, David E. Keyes, Risto M. Nieminen, Dirk Roose, Tamar Schlick (Eds): Texts in Computational Science and Engineering**

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Textbooks about numerical methods in mathematics are often unable to stimulate the reader's imagination. Problems are described, methods and algorithms for their solution are presented in a more or less detailed way, but very often the reader is reluctant to do the recommended (programming) exercises that would further deepen and solidify the new knowledge because of the unpleasant programming overhead for "trivial" tasks (e.g. input/output, basic vector and matrix transformations). On the other hand, mathematical expert systems like Maple, MATHEMATICA or MATLAB have been becoming more widespread over the past years and their user community is still growing. However, many students and

scientists eschew the effort of making themselves familiar with such tools. With their book *Scientific Computing with MATLAB* the authors now intend to provide the missing link, targeting undergraduate and graduate students in computational science, mathematics and sciences as well as any other researcher interested in the given topic.

All the book's chapters follow the same general structure: after a short introduction, two or three real-world problems with tables and figures are presented; then different methods for the solution of the underlying common problem are given, each complemented with examples and MATLAB programs. The chapter closes with an outlook, entitled "What we haven't told you", and the exercise section—the solutions are given all together at the end of the book.

The first chapter (35 pages) is a review of numbers and their representation in computers, basic matrix algebra and the properties of real functions. It simultaneously provides a nice introduction to using MATLAB. Chapter 2 (18 pages) deals with nonlinear equations and their solutions (bisection and Newton method, fixed-point iterations). The following chapter (25 pages) covers approximation of functions and data, including interpolation and least-squares methods as well as the spline algorithm. Chapter 4 gives a 19-page overview of numerical differentiation and integration. The fifth chapter (33 pages) introduces the solutions of linear systems (LU factorization, Richardson and iterative methods). Eigenvalues and eigenvectors are the topics of the next chapter (15 pages), where, besides the power method and standard matrix diagonalization, a method for locating the eigenvalues of a matrix is presented (Gershgorin circles). Chapter 7 (33 pages) covers ordinary differential equations and provides several methods for their solution: Euler, Crank–Nicolson, high-order (AB3, AM4, BDF3) and predictor–corrector. The last chapter (19 pages) gives an introduction into numerical solutions for boundary-

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value problems, namely approximation by finite-differences and finite-elements. Finally, the solutions of all exercises are given on 43 pages. The book closes with a short bibliography (4 pages), an index of all MATLAB programs developed throughout the chapters (2 pages) and a general index (7 pages) containing topics from the text as well as predefined MATLAB functions.

*Scientific Computing with MATLAB* is written in a clear and concise style, figures, tables and formula boxes complement the explanations. New MATLAB functions are given at the border of the text, thus allowing for fast relocation. The whole book is an invitation, if not a request, of the authors to the reader to play with MATLAB, apply its powerful menagerie of functions to solve the given (or own) problems—in brief: supervised learning by doing. Very comfortable is the fact that all programs are freely available for download over the internet. However, because the source is not a publisher's website the question of longevity of such "external" links may be raised.

Nevertheless, the authors impressively demonstrate the wide applicability of mathematical methods by presenting problems from different scientific areas that are then all treated with the same family of methods. For example, in

Chapter 2 the introductory problems are taken from finance (investment fund), thermodynamics (state equation of a gas) and statics (four rigid rod system). For researchers in computational chemistry and bioinformatics the section about numerical integration schemes is certainly of interest because these methods are often used in molecular dynamics simulations.

There are only a few critical but mostly formal remarks to be made: firstly, there are several disturbing typographical errors—"iff" (instead of "if") occurs more than half a dozen times throughout the book. Next, the different font types used for MATLAB functions within the text and the program examples are somehow confusing. The icons at the border indicating the presence of exercises, MATLAB programs, display panel etc. suffer from a rather low pixel resolution. Finally, the authors did not include a reference to the "Numerical Recipes" (Press et al.) in their bibliographic section, one of the classic text books for applied numerical mathematics.

All in all *Scientific Computing with MATLAB* is a stimulating introductory text book about numerical methods that successfully combines mathematical theory with programming experience.