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Book Reviews

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# BOOK REVIEWS

*Yorick Hardy and Willi-Hans Steeb*: CLASSICAL AND QUANTUM COMPUTING. Birkhäuser Verlag, Basel-Boston-Berlin, 2001, 612 pages, ISBN 3-7643-6610-9, price EUR 58.–.

This book attempts to cover scientific computing from its basics to currently fashionable and developing areas as quantum computing. This is of course impossible to achieve in one book. The authors chose, in my opinion, somewhat unfortunate selection of topics. First part is an introduction into discrete mathematics and terminology concerning algorithms and computability. I write "terminology" since the treatment is mostly very shallow (and with errors even in basic definitions such as NP-completeness); the book does not even attempt to explain basic methods of design of efficient algorithms (according to the cover promising "comprehensive coverage of theory", one would expect this to be the main topic of the book). Much of the material is illustrated by code segments, which seems to make this part a useful introduction for programmers; unfortunately, this material does not seem to be available in an electronic form. The part on classical computing continues by a comparatively long treatment of neural networks and genetic algorithms. Due to the above mentioned omission of the mainstream areas of algorithm design, it may give an unfortunate and very misleading impression that this is the basic way to approach algorithmic problems. The last third of the book is devoted to quantum computing. In contrast to the previous part, the treatment is much more advanced. Given that quantum computing is so far an unimplemented theoretical creation, it does not seem to fit well with the very practitioner-oriented first two thirds of the book. Nevertheless, I found this to be the interesting part of the book.

*Jiří Sgall*

*E. B. Corrochano and G. Sobczyk, eds.*: GEOMETRIC ALGEBRA WITH APPLICATIONS IN SCIENCE AND ENGINEERING. Birkhäuser Verlag, Boston, 2001, 592 pages, ISBN 0-8176-4199-8, price DM 196,–.

Geometric algebra invented in 1878 by W. K. Clifford turned out to be a mighty tool that unified treatment of various problems in mathematics, physics, computer science and engineering. The book under review consists of contributions presented at the 5th International Conference on Clifford Algebras and Their Applications held in Mexico in July 1999. It is divided into 7 parts whose names illustrate the broadness of the scope of applications of geometric algebra—I. Advances in geometric algebra, II. Theorem proving, III. Computer vision, IV. Robotics, V. Quantum and neural computing, and wavelets, VI. Applications to engineering and physics and, finally, VII. Computational methods in Clifford algebra.

The book aims at presenting this rich, general mathematical framework for expressing ideas of linear and multilinear algebra, projective and affine geometry, calculus on manifolds, representation theory of Lie groups and Lie algebras, and many other areas to an audience of applied mathematicians, physicists, computer scientists and engineers.

*Martin Markl*

*H. M. Antia*: NUMERICAL METHODS FOR SCIENTISTS AND ENGINEERS. Birkhäuser Verlag, Basel-Boston-Berlin, 2nd edition, 2002, xxii+842 pages and one CD, ISBN 3-7643-6715-6, price EUR 48.60.

This comprehensive book is intended to cover all elementary topics in numerical computations. Its 13 chapters can be naturally divided into three parts:

The first part includes two chapters which give an introduction to errors in numerical computations. Different types of errors, as well as techniques for estimating them are described in these chapters. In particular, the concepts of condition and stability of a numerical method are introduced and discussed here.

In the second part which includes Chapters 3 to 8 basic topics of numerical methods, such as interpolation, linear and nonlinear equations systems, numerical differentiation and integration, and optimization, are studied in detail. The advantages and limitations of various numerical solutions are explained by means of comparable studies in which the different algorithms are applied to handle the same problem.

The last part—Chapters 9 to 13—gives a brief introduction to some special topics, such as functional approximations, algebraic eigenvalue problem, integral equations, ordinary and partial differential equations. Though the choice of the topics may not satisfy the demands of all readers (the extremely important method for solving boundary value problems—the finite element method—is, e.g., treated only on six pages) this part can still be considered as a helpful guide to advanced numerical methods for scientists and engineers.

The enclosed CD disk which contains over two hundred subprograms implementing some of the numerical methods of the book (in Fortran and C) may be very useful for not too much experienced self-learners who would like to use numerical methods for their own work.

*Emil Vitásek*

*P. K. Kythe, P. Puri*: COMPUTATIONAL METHODS FOR LINEAR INTEGRAL EQUATIONS. Birkhäuser Verlag, Boston, 2002, 508 pages, ISBN 0-8176-4192-0, price EUR 120.56.

In Chapter 1 the concept of the Nyström method is introduced. Eigenvalue problems are discussed in Chapter 2. Fredholm and Volterra equations of the second kind are studied in Chapter 3. In Chapter 4 expansions methods for the computation of the approximate solution of Fredholm equations of the second kind are explained. Chapter 5 is devoted to Riesz-Galerkin methods. In Chapter 6 the authors concentrate on iteration methods. Singular equations are introduced in Chapter 7, and various methods and iteration schemes of solving them are presented. Weakly singular equations are discussed in Chapter 8. Singular equations of the Cauchy type are studied in Chapter 9. Chapter 10 deals with the application of Whittaker's cardinal function, and the sinc-Galerkin method is presented for solving singular equations. Chapter 11 covers equations of the first kind. Chapter 12 deals with numerical inversion of the Laplace transform.

*Dagmar Medková*

*G. Israel, A. Millán Gasca, eds.*: THE BIOLOGY OF NUMBERS. THE CORRESPONDENCE OF VITO VOLTERRA ON MATHEMATICAL BIOLOGY. Birkhäuser Verlag, Basel-Berlin-Boston, 2002, x + 406 pages, ISBN 3-7643-6514-5, price EUR 74.–.

The period 1920–1940 is called the Golden Age of Theoretical Biology. Statistical approach replacing causation by correlation was forwarded by Fisher, Galton, Haldane, Pearson and represented by the journal Biometrika founded by the last one named. On the other hand, Vito Volterra, influenced by his previous involvement and results in mathematical physics and pure mathematics, tried to transfer conceptual approaches of mechanics to biology, and considered his "mathematical biology" a more advanced stage of biomathematics. Volterra's interest in biology was aroused by the detailed fishery statistics gathered by his son in law U. D'Ancona and showing an increase in population of predators during World War I. The proposed solution based on the "principle of encounters" (between predators and their preys) resulted in a system of two non-linear differential equations, which was supposed by its author to be a mathematical form of Darwin's principle of vital competition. Although nearly all Volterra's ideas are surpassed now, they initiated the attempts to establish a firm empirical basis of biological observations, and Volterra's work is still the primary reference in population dynamics.

The reviewed book presents transcripts of 356 letters written to Volterra or to his wife by 19 correspondents and 69 drafts of his letters to them. They are ordered by the name of the correspondent and preceded by his short biographic profile. The original language of letters, namely English, Italian and French, is in all cases preserved. Drafts of Volterra's letters are sometimes accompanied by English or French original translations. The whole correspondence is drawn from the Vito Volterra Archive conserved at the Academia Nazionale dei Lincei.

The book opens by a long (54 pages) introductory chapter written by the second editor and entitled Mathematical Theories versus Biological Facts: A Debate on Mathematical Population Dynamics in the 30s. It provides the reader with a deep overview of the period of biomathematical research to which Volterra's correspondence relates and presents many researchers of that time, frequently also by carefully selected citations from their papers. Particular attention is paid to Volterra's ideas and collaborators. Final remarks sketch shortly the history of biomathematics after Volterra's death.

The correspondence covers the period 1926–1940; the only exception are the letters exchanged between Volterra and J. Larmor during the period 1908–1926 and considering also physical problems. The most voluminous parts belong to D'Ancona, Brélot, Kostitzin and Régnier, and they are also the most interesting ones from the scientific point of view. D'Ancona was a zoologist and helped considerably his father in law in the development of the "struggle of life" mathematical theory. Their collaboration resulted in the book "Les associations biologiques au point de vue mathématique" published in 1935. M. E. Brélot used a Rockfeller scholarship in Rome in 1929–1930 under Volterra's direction and undertook later (1931) the editing of Volterra's first book on biomathematics "Leçons sur la théorie mathématique de la lutte pour la vie". V. A. Kostitzin was a prominent Russian mathematician and Director of the Moscow Geophysics Institute. After his moving into exile in Paris (1926?), he became acquainted with Volterra and considered himself his "pupil". Their close collaboration took place from 1933 till Volterra's death and resulted in publications on population dynamics and biological associations so much important in the contemporary ecology. J. Régnier's research was concerned with microbiology and pharmacodynamics. His experiments on the dynamics of bacterial growth led to the research on the bacterial antagonism carried out together with Volterra and Kostitzin. Between the remaining correspondents, the names of G. G. Gause, A. J. Lotka, Karl Pearson and D'Arcy W. Thompson can be found. All letters are accompanied by notes facilitating their understanding.

The book will certainly be much appreciated by all taking interest in the origin of biomathematics which has undergone such an astonishing development the witnesses of which we are nowadays. Last but not least, it is a monument to the life of an eminent scholar as well as a courageous man. As the member of Senate, Volterra opposed all fascistic legislative bills and was also one of the 13 (only!) university professors who refused to take the oath of loyalty to the fascist regime. After this event, he was expelled from all Italian cultural and scientific institutions and, after the promulgation of the racial laws, died in a state of complete isolation.

*Ivan Saxl*

*A. Abbate, C. M. DeCusatis, P. K. Das*: WAWELETS AND SUBBANDS. FUNDAMENTALS AND APPLICATIONS. Birkhäuser Verlag, Boston, 2002, 568 pages, ISBN 0-8176-4136-X, price EUR 98.13.

The book is an important contribution to the theory as well as practice of the wavelet transform. Wavelets are an important general tool for many applications of mathematics to different fields of human activities, i.e. primarily to science and technology. The book presents both the theory and the systematic description of applications of the subject chosen as a natural generalization of Fourier analysis.

The monograph consists of a preface, 9 chapters, an appendix, and bibliography. Following introductory Chapter 1, Chapter 2 starts with the insight into the Fourier transform, which is a prerequisite for further considerations, and the definition of the wavelet transform. Chapters 3 and 4 are devoted to the continuous and discrete wavelet transform including fast algorithms.

The notion of a subband and subband decomposition is introduced in the book for band-limited signals with the discrete time variable. Chapter 5 is concerned with this phenomenon and Chapter 6 with an interesting generalization to 2D.

The rest of the book is primarily devoted to applications. Chapter 7 describes applications to transient signals, Chapter 8 to communication systems, and Chapter 9 presents real time implementations of wavelet transforms. Appendix treats the fundamendal notions, their definitions and properties. The concluding bibliography is a union of references given in each chapter separately.

The book accents the logical development of basic ideas and the treatment of wavelet analysis and its applications to a wide variety of problems in various areas. I must remark that if the monograph was set in TEXthe formulae would look much better.

The material of the book is well structured. It provides a large number of figures and examples from the mathematical, physical, and engineering context to which the theory is applied. There is no doubt that the book will be very useful for a large audience with diverse background and interests.

*Karel Segeth*