it an invaluable source of convincing industrial and business applications of fuzzy set theory.

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**5[41-06, 65-06, 42-06, 46-06]**—*Advances in computational mathematics: New Delhi, India*, H. P. Dikshit and C. A. Micchelli (Editors), Series in Approximations and Decompositions, Vol. 4, World Scientific, Singapore, 1994, xvi + 319 pp., $22\frac{1}{2}$ cm, $75.00

Twenty years ago, relatively little was known about the approximation, representation and analysis of functions of several variables. Since then the theoretical aspects, and more recently the computational development, have evolved quite nicely. In particular, the representation of curves, surfaces and functions has been enhanced by subdivision algorithms, neural network theory and radial basis functions, the analysis of functions by wavelet theory and the numerical solution of equations by multigrid techniques. Many of these computational developments are highlighted in the Proceedings volume under review. It includes 20 articles by many leaders of their fields. For the reader's convenience, the book is subdivided into four main areas: Finite element methods for PDE's, Geometric modeling for curves and surfaces, Wavelets, and Approximation.

The first section contains three papers which report on current numerical approaches to solving certain partial differential and integral equations. Both multigrid and multiscale techniques are utilized in these articles. The next section contains four papers. These articles illustrate the importance of rational splines for geometric modeling of curves and surfaces. Section 3 contains five papers related to wavelets and frames. The articles also include applications of wavelets to compressed representation and reconstruction of curves and images. The final section deals with the representation and approximation of functions of several variables with applications to Neural Networks.

In summary, I believe that the main contribution of this book is that it gives the reader a good feel for several directions of progress made in computational mathematics over the last 15 or 20 years.

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**6[01A70, 65-06, 65F10, 65T20, 76W05, 83-06, 83C05, 85-06]**—*Proceedings of the Cornelius Lanczos international centenary conference*, J. David Brown, Moody T. Chu, Donald C. Ellison, and Robert J. Plemmons (Editors), SIAM Proceedings Series, Society for Industrial and Applied Mathematics, Philadelphia, PA, 1994, 1xvi + 644 pp., $25\frac{1}{2}$ cm, softcover, $78.50

The conference was held during December 12–17, 1993 at North Carolina State University and had about 600 attendees. This scholarly volume describes Lanczos'

life (1893-1974) and presents a clear development of the many fields he opened. The material is presented in five parts:

(1) The Life and Works of Cornelius Lanczos;

(2) Plenary Presentations: Computational Mathematics;

(3) Plenary Presentations: Theoretical Physics and Astrophysics;

(4) Mathematics Minisymposia;

(5) Physics Minisymposia.

Part (1) begins with a collection of seven photographs of Lanczos from 1910 to 1972. This is followed by a fascinating twenty-eight page annotated story, "Cornelius Lanczos: A Biographical Essay", by Barbara Gellai. The fortuitous inclusion of this excellent biography makes the Proceedings a more complete and desirable volume!

Peter D. Lax, mathematician, presents the first symposium essay, a four-page insightful and pithy description, "Cornelius Lanczos (1893-1974), and the Hungarian Phenomenon in Science and Mathematics". Lax describes how Lanczos developed therein, flourished thereafter, and ends with, "In the end there is no explanation for superior achievement. All we can do is accept gratefully the brilliant contributions of this remarkable man".

This is followed by an analogous four plus page study, "The Roots of Cornelius Lanczos", by George Marx, physicist, who describes the development and significance of Lanczos' early work in Physics and the remarkable way that Lanczos returned to the subject in his final years. Marx concludes with, "In the name of the Roland Eotvos Physical Society of Hungary, I express my deepest thanks to North Carolina State University and to the organizers and speakers of the Lanczos Centenary Symposium in Raleigh NC, for keeping the memory of the Hungarian-American-Irish-Jewish Cornelius Lanczos alive, and for transferring his human message to the incoming generations . . . ".

John Todd, mathematician, concludes the essays in Part (1) with "Reminiscences of Cornelius Lanczos". In a self-deprecating (now humorous) story, he tells of the first time they met. Todd then presents an interesting fantasy that describes how Bloom might have been replaced by Lanczos as the central character in Joyce's "Ulysses", since Joyce and Lanczos would have "surely met" in Dublin, had they been there at the same time!

Part (1) concludes with a six-page list: "Published Papers and Books of Cornelius Lanczos".

The 140-page Part (2) contains eleven papers that describe Lanczos' discoveries of numerical algorithms. The authors present careful analyses of these methods and their latest refinements, which are extremely useful in current computing practice even though they were developed by Lanczos when he worked with electric-mechanical desktop calculators. The reader of these articles will get a complete understanding of the history of the numerical methods and their underlying mathematical structure. Lanczos would have enjoyed seeing what he had spawned:

James W. Cooley, "Lanczos and the FFT: A Discovery Before its Time";

Jane K. Cullum, "Lanczos Algorithms for Large Scale Symmetric and Nonsymmetric Matrix Eigenvalue Problems";

Roland W. Freund, "The Look-Ahead Lanczos Process for Nonsymmetric Matrices and its Applications";

Anne Greenbaum, "The Lanczos and Conjugate Gradient Algorithms in Finite Precision Arithmetic";

Martin H. Gutknecht, "The Lanczos Process and Padé Approximation";

Eduardo L. Ortiz, "The Tau Method and the Numerical Solution of Differential Equations: Past and Recent Research";

C. C. Paige, "Krylov Subspace Processes, Krylov Subspace Methods, and Iteration Polynomials";

Beresford N. Parlett, "Do We Fully Understand the Symmetric Lanczos Algorithm Yet?";

Pál Rózsa, Francesco Romani, and Roberto Bevilacqua, "On Generalized Band Matrices and Their Inverses";

Yousef Saad, "Theoretical Error Bounds and General Analysis of a Few Lanczos-Type Algorithms";

G. W. Stewart, "Lanczos and Linear Systems".

The 98-page Part (3) contains seven papers which should be easily understood by physicists. This not so savvy reviewer did recognize that the technical articles were careful expositions, written mainly for physicists, concerning subjects that Lanczos thought and wrote about in his early career as a theoretical physicist! He was raised on the new Relativity Theory and Quantum Mechanics. By examining the list of Lanczos' publications, it is clear that he returned often to Einstein's quest for a unified field theory. So, I believe that Lanczos would have enjoyed learning about these current views of Physics, Astrophysics, and Cosmology:

Abbay Ashtekar, Donald Marolf, and José Mourão, "Integration on the Space of Connections Modulo Gauge Transformations";

James B. Hartle, "Quasiclassical Domains in a Quantum Universe";

D. Petiot and Y. Takahashi, "Gauge Invariant Energy-Momentum Tensor in Spinor Electrodynamics";

Tsvi Piran, "$\gamma$-Ray Bursts and Neutron Star Mergers";

John Stachel, "Lanczos's Early Contributions to Relativity and His Relationship with Einstein";

Claudio Teitelboim, "Topological Roots of Black Hole Entropy";

Robert M. Wald, "Variational Principles, Local Symmetries, and Black Hole Entropy".

The 190-page Part (4) consists of 48 brief papers that cover the analysis and evaluation of algorithms studied in these 12 Lanczos inspired minisymposia: Eigenvalue Computations: Theory and Algorithms; Eigenvalue Computations: Applications; Moments in Numerical Analysis; Iterative Methods for Linear Systems; Least Squares; Software for Lanczos-based Algorithms; Tau Method; Chebyshev Polynomials; Lanczos Methods in Control and Signal Processing; Development of the FFT; The FFT in Signal Processing; Wavelets.

The 213-page Part (5) consists of 56 brief papers that cover numerical and theoretical investigations that were specially chosen to encourage an active exchange of ideas across these 13 minisymposia: Computational Magnetohydrodynamics in Astrophysics; Numerical Simulations of Collisionless Space Plasmas; Detection of Gravitational Radiation from Astrophysical Sources; Lanczos $H$-tensor; Cosmic Censorship; Cauchy Problem of General Relativity; Black Hole Evaporation and Thermodynamics; The Problem of Time in Quantum Gravity; New Variables and Loop Quantization; Decoherence and the Foundations of Quantum Mechanics;

Open Questions in Particle Theory; Supercollider Physics; Symplectic Methods in Physics.

The concluding Author Index lists the 169 writers of the articles in Parts (2)–(5).

E. I.

**7[41-06, 41A15, 65-06, 65D07, 65D10]**—*Curves and surfaces in geometric design*, Pierre-Jean Laurent, Alain le Méhauté, and Larry L. Schumaker (Editors), A K Peters, Wellesley, MA, 1994, xvi + 490 pp., $23\frac{1}{2}$ cm, $69.95

*Curves and Surfaces in Geometric Design* is one of two books resulting from the June 1993 Conference on Curves and Surfaces held in Chamonix-Mont-Blanc, France. This book contains 58 research papers relating to Computer Aided Geometric Design. The other book, *Wavelets, Images, and Surface Fitting* [1], contains an additional 48 papers.

Computer Aided Geometric Design (CAGD) is the computer-assisted representation and analysis of shape. It draws upon such areas as approximation theory, differential geometry, optimization, mechanical CAD, and computer science. The 58 papers in this collection do a nice job in representing a large number of currently vital research topics. These range from theoretical concerns to properties of spline curves and surfaces to interpolation and approximation schemes to data structures and software approaches to use of CAGD techniques in specific applications. Although the papers are generally scattered throughout the subareas of CAGD, topics of current concern are well represented. For example, the book contains a number of research papers arising from minisymposia on software infrastructure, spline conversion, rational approximation, and constrained approximation.

While a few of the articles in *Curves and Surfaces in Geometric Design* are survey articles, the vast majority are research articles describing recent work. Most of the articles are fairly short—8 pages—so this is not a book for readers anticipating a detailed or leisurely exposition. Nor is it a book for readers desiring an introduction to CAGD, as most articles assume familiarity with terminology, basic results, and issues. What the book is, is a good collection of recent work by many of the foremost researchers in this area. Its strengths are its breadth, the generally high quality of the articles, and the important topics addressed. I recommend the book to anyone who is familiar with the basic issues in CAGD and desires to read about recent work.

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## REFERENCES

1. P.-J. Laurent, A. Le Méhauté and L. L. Schumaker (eds.), *Wavelets, images, and surface fitting*, A K Peters, Wellesley, MA, 1994. MR **95f:**65010