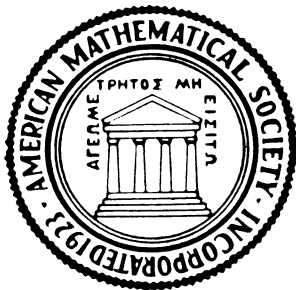


Mathematics of Computation



EDITED BY

James H. Bramble
Bille C. Carlson
Walter Gautschi, *Managing Editor*
Donald Goldfarb
Eugene Isaacson
Heinz-Otto Kreiss
James N. Lyness
Morris Newman
Frank W. J. Olver
John E. Osborn
Stanley Osher
Beresford Parlett
Philip Rabinowitz
Ridgway Scott
Daniel Shanks
Frank Stenger
Hans J. Stetter
G. W. Stewart
Vidar C. Thomée
Lars B. Wahlbin
Hugh C. Williams
John W. Wrench, Jr.

October 1984

Volume 43, Number 168, Pages 349–632

**Published by the American Mathematical Society
Providence, Rhode Island USA**

ISSN 0025-5718

Editorial Committee

WALTER GAUTSCHI, Chairman, Dept. of Computer Sciences, Purdue Univ., West Lafayette, IN 47907
JOHN E. OSBORN, Dept. of Mathematics, Univ. of Maryland, College Park, MD 20742
DANIEL SHANKS, Dept. of Mathematics, Univ. of Maryland, College Park, MD 20742
HUGH C. WILLIAMS, Dept. of Computer Science, Univ. of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2

Technical Editor

MIRIAM E. PORILE, Dept. of Computer Sciences, Purdue Univ., West Lafayette, IN 47907

Board of Associate Editors

JAMES H. BRAMBLE, Dept. of Mathematics, Cornell Univ., Ithaca, NY 14853
BILLE C. CARLSON, Dept. of Mathematics, Iowa State Univ., Ames, IA 50011
DONALD GOLDFARB, Dept. of Industrial Engineering and Operations Research, Seely W. Mudd Building,
Columbia Univ. in the City of New York, New York, NY 10027
EUGENE ISAACSON, Courant Institute of Mathematical Sciences, New York Univ., 251 Mercer Street, New
York, NY 10012
HEINZ-OTTO KREISS, Dept. of Applied Mathematics, California Institute of Technology, Pasadena, CA
91125
JAMES N. LYNESS, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439
MORRIS NEWMAN, Dept. of Mathematics, Univ. of California, Santa Barbara, CA 93106
FRANK W. J. OLVER, Inst. for Physical Science and Technology, Univ. of Maryland, College Park, MD 20742
STANLEY OSHER, Dept. of Mathematics, Univ. of California, Los Angeles, CA 90024
BERESFORD PARLETT, Dept. of Mathematics, Univ. of California, Berkeley, CA 94720
PHILIP RABINOWITZ, Dept. of Applied Mathematics, The Weizmann Institute of Science, Rehovot, Israel
RIDGWAY SCOTT, Dept. of Mathematics, Univ. of Michigan, Ann Arbor, MI 48109
FRANK STENGER, Dept. of Mathematics, Univ. of Utah, Salt Lake City, UT 84112
HANS J. STETTER, Institut für Numerische Mathematik, Technische Universität Wien, Karlsplatz 13, A-1040,
Wien, Austria
G. W. STEWART, Dept. of Computer Science, Univ. of Maryland, College Park, MD 20742
VIDAR C. THOMÉE, Mathematics Dept., Chalmers Univ. of Technology, Göteborg, Sweden
LARS B. WAHLBIN, Dept. of Mathematics, Cornell Univ., Ithaca, NY 14853
JOHN W. WRENCH, JR., 6310 Jefferson Blvd., Frederick, MD 21701

SUBSCRIPTION INFORMATION: MATHEMATICS OF COMPUTATION is published quarterly, with issues numbered serially since Volume 1, Number 1. Subscription prices for Volumes 42 and 43 (1984) are \$100.00 list; \$75.00 institutional member; \$50.00 member of CBMS organizations; \$40.00 individual AMS member. A late charge of 10% of the subscription price will be imposed upon orders received from nonmembers after January 1 of the subscription year. Subscribers outside the United States and India must pay a postage surcharge of \$5.00; subscribers in India must pay a postage surcharge of \$8.00. Combination paper and microfiche subscription prices are \$133.00 list; \$100.00 institutional member; \$67.00 member of CBMS organizations; \$53.00 individual AMS member. Microfiche of each issue will be mailed the fastest way before the issue is mailed by the printer.

BACK NUMBER INFORMATION: Back number prices *per volume* are for Volumes 1–21, \$80.00 list, \$60.00 member; for Volumes 22–33, \$120.00 list, \$90.00 member; for Volumes 34–41, \$80.00 list, \$60.00 member. Back volumes may be purchased on microfilm or microfiche from University Microfilms International, 300 North Zeeb Road, Ann Arbor, MI 48106.

UNPUBLISHED MATHEMATICAL TABLES: The editorial office of the journal maintains a repository of Unpublished Mathematical Tables (UMT). When a table is deposited in the UMT repository a brief summary of its contents is published in the section *Reviews and Descriptions of Tables and Books*. Upon request, the chairman of the editorial committee will supply copies of any table for a nominal cost per page. All tables and correspondence concerning the UMT should be sent to Walter Gautschi, Chairman, Editorial Committee, Mathematics of Computation, Department of Computer Sciences, Purdue University, West Lafayette, IN 47907.

Orders for subscriptions and publications of the American Mathematical Society should be addressed to the AMS, P.O. Box 1571, Annex Station, Providence, RI 02901. *All orders must be accompanied by payment.* Other correspondence should be addressed to P.O. Box 6248, Providence, RI 02940.

MATHEMATICS OF COMPUTATION is published quarterly by the American Mathematical Society, 201 Charles Street, Providence, RI 02904. Second-class postage is paid at Providence, Rhode Island, and additional mailing offices. Postmaster: Send address changes to Mathematics of Computation, American Mathematical Society, P.O. Box 6248, Providence, RI 02940.

Copyright © 1984, American Mathematical Society
Printed in the United States of America

The paper used in this journal is acid-free and falls within the guidelines
established to ensure permanence and durability.

MATHEMATICS OF COMPUTATION

TABLE OF CONTENTS

October 1984

Obituary — Yudell L. Luke 1918–1983	349
Eitan Tadmor , The Large-Time Behavior of the Scalar, Genuinely Nonlinear Lax-Friedrichs Scheme	353
Eitan Tadmor , Numerical Viscosity and the Entropy Condition for Conservative Difference Schemes	369
Laurence A. Bales , Semidiscrete and Single Step Fully Discrete Approximations for Second Order Hyperbolic Equations With Time-Dependent Coefficients	383
Mark J. Friedman , Finite Element Formulation of the General Magnetostatic Problem in the Space of Solenoidal Vector Functions	415
Joseph E. Pasciak , A New Scalar Potential Formulation of the Magnetostatic Field Problem	433
Mark J. Friedman and Joseph E. Pasciak , Spectral Properties for the Magnetization Integral Operator	447
P. P. B. Eggermont , Approximation Properties of Quadrature Methods for Volterra Integral Equations of the First Kind	455
Werner C. Rheinboldt , Differential-Algebraic Systems as Differential Equations on Manifolds	473
G. W. Stewart , On the Asymptotic Behavior of Scaled Singular Value and QR Decompositions	483
Stephen Demko, William F. Moss and Philip W. Smith , Decay Rates for Inverses of Band Matrices	491
A. McCurdy, K. C. Ng and B. N. Parlett , Accurate Computation of Divided Differences of the Exponential Function	501
B. L. R. Shawyer , Best Approximation of Positive Power Series	529
Nira Dyn , Composite Hermite-Birkhoff Quadrature Formulas of Gaussian Type	535
J. Kautsky and S. Elhay , Gauss Quadratures and Jacobi Matrices for Weight Functions Not of One Sign	543
J. N. Newman , Approximations for the Bessel and Struve Functions	551
Henry E. Fettis , More Trigonometric Integrals	557
Enrico Spoletini , Generation of Permutations Following Lehmer and Howell	565
W. Plesken and W. Hanrath , The Lattices of Six-Dimensional Euclidean Space	573
Robert Grone and Russell Merris , An Algorithm for the Second Immanant	589
David W. Boyd , Pisot Numbers in the Neighborhood of a Limit Point. II....	593

Richard H. Hudson , Products and Sums of Powers of Binomial Coefficients mod p and Solutions of Certain Quaternary Diophantine Systems	603
Reviews and Descriptions of Tables and Books	615
Churchhouse, Editor 8 , Vichnevetsky and Bowles 9 , Morris 10 , Chvátal 11 , Lakshmikantham, Editor 12 , van Hulzen, Editor 13 , Uspensky 14	
Corrigenda	621
Vaughan, Godwin	
Indices to Volumes XLII and XLIII	623
Supplement to “Semidiscrete and Single Step Fully Discrete Approximations for Second Order Hyperbolic Equations with Time-Dependent Coefficients” by Laurence A. Bales	S1
Microfiche Supplement	
W. Plesken and W. Hanrath , The Lattices of Six-Dimensional Euclidean Space	

Information for Contributors

Manuscripts should be typewritten double-spaced in the format used by the journal. For journal abbreviations, see the latest *Mathematical Reviews* volume index. An author should submit the original and two copies of the manuscript and retain one copy. The author may suggest an appropriate editor for his paper. It is recommended that the author acquaint himself with the pertinent material contained in “A Manual for Authors of Mathematical Papers,” which is available from the American Mathematical Society. All contributions intended for publication and all books for review should be addressed to Walter Gautschi, Chairman, Editorial Committee, Mathematics of Computation, Department of Computer Sciences, Purdue University, West Lafayette, Indiana 47907. The date received, which is published with the final version of an accepted paper, is the date received in the office of the Chairman of the Editorial Committee, and it is the responsibility of the author to submit manuscripts directly to this office. Institutions sponsoring research reported in the journal are assessed page and microfiche charges.

Each article submitted for publication must be accompanied by a brief and reasonably self-contained abstract, and by 1980 *Mathematics Subject Classification* numbers. If a list of key words and phrases is included, it will be printed as a footnote on the first page. A list of the classification numbers may be found in the 1978 Subject Index to Mathematical Reviews.

The research journals of the American Mathematical Society carry a page charge of \$50.00 per page to help defray the cost of publication. This amount is charged to the institution or to a contract supporting the research reported in the published paper. The publication charge policy of the United States Federal Council for Science and Technology (FCST) is reported on page 112 of the February, 1975 issue of the NOTICES of the American Mathematical Society. In no case is the author personally responsible for paying the page charge, nor is acceptance of the author’s paper for publication dependent upon payment of the page charge.

Copying and Reprinting

Individual readers of this publication, and nonprofit libraries acting for them, are permitted to make fair use of the material, such as to copy an article for use in teaching or research. Permission is granted to quote brief passages from this publication in reviews provided the customary acknowledgement of the source is given.

Republication, systematic copying, or multiple reproduction of any material in this publication (including abstracts) is permitted only under license from the American Mathematical Society. Requests for such permission should be addressed to the Executive Director, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940.

The appearance of the code on the first page of an article in this journal indicates the copyright owner’s consent for copying beyond that permitted by Sections 107 or 108 of the U. S. Copyright Law, provided that the fee of \$1.00 plus \$.25 per page for each copy be paid directly to Copyright Clearance Center, Inc., 21 Congress Street, Salem, Massachusetts 01970. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotion purposes, for creating new collective works, or for resale.