Mathematics of Computation

THEMATICAL AMERICAN A

EDITED BY

James H. Bramble, Managing Editor

Todd Dupont

Walter Gautschi

Donald Goldfarb

Eugene Isaacson

Heinz-Otto Kreiss

Yudell L. Luke

James N. Lyness

Morris Newman

John E. Osborn

Beresford Parlett

Philip Rabinowitz

John R. Rice

Daniel Shanks

Charles C. Sims

Hans J. Stetter

Vidar C. Thomée

Hugh C. Williams

John W. Wrench, Jr.

July 1983

Volume 41, Number 163, Pages 1-308

Published by the American Mathematical Society Providence, Rhode Island USA

ISSN 0025-5718

Editorial Committee

JAMES H. BRAMBLE, Chairman. Dept. of Mathematics, White Hall, Cornell Univ., Ithaca, NY 14853 MORRIS NEWMAN, Dept. of Mathematics, Univ. of California, Santa Barbara, CA 93106 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

ANITA WAHLBIN, Dept. of Mathematics, White Hall, Cornell Univ., Ithaca, NY 14853

Board of Associate Editors

TODD DUPONT, Dept. of Mathematics, Univ. of Chicago, Chicago, IL 60637

WALTER GAUTSCHI, Computer Sciences Dept., Purdue Univ., West Lafayette, IN 47907

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,

YUDELL L. LUKE, Dept. of Mathematics, Univ. of Missouri at Kansas City, Kansas City, MO 64110

JAMES N. LYNESS, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439

JOHN E. OSBORN, Dept. of Mathematics, Univ. of Maryland, College Park, MD 20742

BERESFORD PARLETT, Dept. of Mathematics, Univ. of California, Berkeley, CA 94720

PHILIP RABINOWITZ, Dept. of Applied Mathematics, The Weizmann Institute of Science, Rehovot, Israel

JOHN R. RICE, Division of Mathematical Sciences, Purdue Univ., Lafayette, IN 47907

CHARLES C. SIMS, Dept. of Mathematics, Rutgers Univ., New Brunswick, NJ 08903

HANS J. STETTER, Institut für Numerische Mathematik, Technische Universität Wien, Karlsplatz 13, A-1040, Wien, Austria

VIDAR C. THOMÉE, Mathematics Dept., Chalmers Univ. of Technology, Göteborg, Sweden 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 40 and 41 (1983) are \$86.00 list; \$60.00 institutional member; \$43.00 member of CBMS organizations; \$34.00 individual AMS member. Combination paper and microform (microfiche or microfilm) subscription prices are \$115.00 list; \$81.00 institutional member; \$58.00 member of CBMS organizations; \$46.00 individual AMS member. Microfiche of each issue will be mailed the fastest way before the camera copy is sent to the printer.

BACK NUMBER INFORMATION: Back number prices *per volume* are for Volumes 1–29, \$64.00 list, \$48.00 member, for Volumes 30–33, \$100.00 list, \$75.00 member; for Volumes 34–39, \$60.00 list, \$45.00 member. Beginning with Volume 32, back volumes are also available on 16mm positive or negative microfilm or on microfiche; Volumes 1–31 are available on microfilm only, not microfiche. The microfilm may be mounted on spools or in Kodak or 3M catridges. Only current subscribers are eligible to purchase back volumes on microform. Write to the AMS for a detailed price list.

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 chariman 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 James H. Bramble, Chairman, Department of Mathematics, White Hall, Cornell University, Ithaca, NY 14853.

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.

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 James H. Bramble, Chairman, Editorial Committee, Mathematics of Computation, Department of Mathematics, White Hall, Cornell University, Ithaca, New York 14853. 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, 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 copier pay the stated per copy fee through the 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.

As of January 1, 1984

all material submitted to

MATHEMATICS OF COMPUTATION

should be sent to

Professor Walter Gautschi
Computer Sciences Department
Purdue University
West Lafayette, IN 47907

MATHEMATICS OF COMPUTATION TABLE OF CONTENTS

July 1983

Scheme	1
Zi-Cai Li and Guo-Ping Liang, On the Simplified Hybrid-Combined Method	13
M. R. Crisci and E. Russo, An Extension of Ortiz' Recursive Formulation of the Tau Method to Certain Linear Systems of Ordinary Differential Equations	27
S. F. McCormick and J. W. Ruge, Unigrid for Multigrid Simulation	43
Philip Rabinowitz, Gauss-Kronrod Integration Rules for Cauchy Principal Value Integrals	63
N. I. Ioakimidis, Further Convergence Results for the Weighted Galerkin Method of Numerical Solution of Cauchy-Type Singular Integral Equations	79
Ch. Lubich, Runge-Kutta Theory for Volterra and Abel Integral Equations of the Second Kind	87
John Lund, Sinc Function Quadrature Rules for the Fourier Integral	103
Seymour Haber, Parameters for Integrating Periodic Functions of Several Variables	115
Charles K. Chui and Ren-Hong Wang, On Smooth Multivariate Spline Functions	131
Wolfgang A. Dahmen and Charles A. Micchelli, On the Linear Independence of Multivariate B-Splines. II: Complete Configurations	143
Nira Dyn and Warren E. Ferguson, Jr., The Numerical Solution of Equality- Constrained Quadratic Programming Problems	165
K. S. Kölbig , On the Integral $\int_0^\infty e^{-\mu t} t^{\nu-1} \log^m t dt$	171
J. H. McCabe, The Quotient-Difference Algorithm and the Padé Table: An Alternative Form and a General Continued Fraction	183
D. S. Lubinsky and A. Sharif, On the Largest Zeroes of Orthogonal Polynomials for Certain Weights	199
T. C. Benton, Common Zeros of Two Bessel Functions. Part II. Approximations and Tables	203
L. B. Rall, Representations of Intervals and Optimal Error Bounds	219
Frank Gerth III, An Application of Matrices Over Finite Fields to Algebraic Number Theory	229
H. C. Williams, G. W. Dueck and B. K. Schmid, A Rapid Method of Evaluating the Regulator and Class Number of a Pure Cubic Field	235
Joseph L. Gerver, Factoring Large Numbers With a Quadratic Sieve	287

R. J. Schoof, Class Groups of Complex Quadratic Fields	295
Eric Seah, Lawrence C. Washington and Hugh C. Williams, The Calculation	
of a Large Cubic Class Number With an Application to Real Cyclotomic	
Fields	303
Reviews and Descriptions of Tables and Books	307
Axelsson, Frank and van der Sluis, Editors 13, Heath, Editor 14	