

Mathematics of Computation

Coden MCMPAF

Pages 969 – 1184

Volume 29, Number 132

October 1975

Published by the American Mathematical Society

PROVIDENCE, RHODE ISLAND

Editorial Committee

JAMES H. BRAMBLE, Chairman. Center for Applied Mathematics, 275 Olin Hall, Cornell Univ., Ithaca, NY 14853

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

ALSTON D. HOUSEHOLDER, Dept. of Mathematics, Ayres Hall, The Univ. of Tennessee, Knoxville, TN 37916

JOHN W. WRENCH, JR., Route 5, Box 237, Frederick, MD 21701

Technical Editor

CAROL A. HOLLAND, Center for Applied Mathematics, 275 Olin Hall, Cornell Univ., Ithaca, NY 14853

Board of Associate Editors

JAMES W. DANIEL, Dept. of Mathematics, Univ. of Texas at Austin, Austin, TX 78712

DONALD GOLDFARB, Dept. of Computer Sciences, School of Engineering, The City College of the City Univ. of New York, 139th Street & Convent Avenue, New York, NY 10031

EUGENE ISAACSON, New York Univ., Courant Institute of Mathematical Sciences, 251 Mercer Street, New York, NY 10012

HEINZ-OTTO KREISS, Computer Science Dept., Univ. of Uppsala, Uppsala, Sturegaten 4, Sweden

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

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

MORRIS NEWMAN, Mathematics Division, National Bureau of Standards, Washington, DC 20234

BERESFORD PARLETT, Dept. of Computer Science, Univ. of California, Berkeley, CA 94720

LAWRENCE E. PAYNE, Dept. of Mathematics, Cornell Univ., Ithaca, NY 14850

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

DANIEL SHANKS, Naval Ship Research and Development Center, Bethesda, MD 20084

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

VIDAR C. THOMÉE, Mathematics Dept., Chalmers Univ. of Technology, Göteborg, Sweden

Information for Subscribers

The journal is published quarterly in one volume per year, with issues numbered serially since Volume 1, Number 1. Subscription prices for Volume 29 (1975) are list \$36.00, institutional member \$24.00, individual AMS member \$10.00, member of CBMS organizations \$15.00. Subscription prices for Volume 30 (1976) are list \$48.00, institutional member \$32.00, individual AMS member \$13.00, member of CBMS organizations \$20.00. Back number prices *per volume* for Volumes 1–27 (1943–1973) are list \$36.00, AMS member \$27.00; Volume 28 (1974) list \$54.00, AMS member \$40.50. Volume 29 (1975), when sold at back number prices, will be list \$54.00, AMS member \$40.50.

Volumes 1–28 (1943–1974) are available on 16 mm microfilm either as negatives or positives and may be mounted either on spools or in Eastman or 3M cartridges. Prices are \$225.00 for spools and \$237.00 for cartridges. Only current subscribers will be eligible to purchase back volumes on microfilm.

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.

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

Mathematics of Computation

TABLE OF CONTENTS

OCTOBER 1975

Models of Difference Schemes for $u_t + u_x = 0$ by Partial Differential Equations	G. W. HEDSTROM	969
A Modified Galerkin Procedure with Hermite Cubics for Hyperbolic Problems	LARS WAHLBIN	978
Higher Order Compact Implicit Schemes for the Wave Equation MELVYN CIMENT & STEPHEN H. LEVENTHAL		985
A Finite Element Method for First Order Hyperbolic Equations GARTH A. BAKER		995
A Comparison of Global Methods for Linear Two-Point Boundary Value Problems	R. D. RUSSELL & J. M. VARAH	1007
Free Boundaries and Finite Elements in One Dimension WILLIAM W. HAGER & GILBERT STRANG		1020
A Curiosity of Low-Order Explicit Runge-Kutta Methods . . .	J. OLIVER	1032
Diagonalization and Simultaneous Symmetrization of the Gas-Dynamic Matrices	R. F. WARMING, RICHARD M. BEAM & B. J. HYETT	1037
Polynomial Evaluation Schemes	A. C. R. NEWBERY	1046
Methods for Computing and Modifying the <i>LDV</i> Factors of a Matrix PHILIP E. GILL, WALTER MURRAY & MICHAEL A. SAUNDERS		1051
Convergence of the Fraser-Hart Algorithm for Rational Chebyshev Approximation	CHARLES B. DUNHAM	1078
On Generalized Gaussian Quadrature YUDELL L. LUKE, BING YUAN TING & MARILYN J. KEMP		1083
Linear Filtering	RALPH SHAPIRO	1094
Cubatures of Precision $2k$ and $2k + 1$ for Hyperrectangles DALTON R. HUNKINS		1098
On Existence Criteria and Approximation Procedures for Integral Equations of the First Kind	C. W. GROETSCH	1105
Uniform Asymptotic Expansions of the Incomplete Gamma Functions and the Incomplete Beta Function	N. M. TEMME	1109
Some Analytic or Asymptotic Confluent Expansions for Functions of Several Variables	H. M. SRIVASTAVA & REKHA PANDA	1115
The Distribution of Ideal Class Numbers of Real Quadratic Fields M. D. HENDY		1129
A Note on l -Class Groups of Number Fields	FRANK GERTH III	1135
Zeros of p -Adic L -Functions	SAMUEL S. WAGSTAFF, JR.	1138
Sums of Distinct Elements from a Fixed Set	TORLEIV KLØVE	1144
Tables of Reductions of Symmetrized Inner Products ("Inner Plethysms") of Ordinary Irreducible Representations of Symmetric Groups	N. ESPER	1150

REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS	1152
BAILLIE 51, DELVES & WALSH, Editors 39, DINGLE 40, GREENBERGER, ARONOFSKY, MCKENNEY & MASSY 41, HOUSEHOLDER 42, KIRCH 43, O'MALLEY 44, ROBINSON 45, SCHAEFER 46, TEMPLEMAN, Editor 47, WEINTRAUB 48, WILLOUGHBY, Editor 49, YATES 50.	
TABLE ERRATA	1166
BRENT 520	
CORRIGENDA	1167
GOLDBERG & ABARBANEL, SHANKS	
INDICES TO VOLUME XXIX	1168
MICROFICHE SUPPLEMENTS	
Tables of Reductions of Symmetrized Inner Products ("Inner Plethysms") of Ordinary Irreducible Representations of Symmetric Groups N. ESPER	
Computer Program for Compact Prime List SOL WEINTRAUB	

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 one copy 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, Center for Applied Mathematics, 275 Olin Hall, Cornell University, Ithaca, New York 14853. 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 AMS (MOS) 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 Index to *Mathematical Reviews*, Volume 39 (June 1970).
