

Mathematics of Computation

Coden MCMPAF

Volume 31, Number 139

Pages 619—808

July 1977

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

CARL-WILHELM R. DE BOOR, Mathematics Research Center, Univ. of Wisconsin, Madison, WI 53706

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

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, Courant Institute of Mathematical Sciences, New York Univ., 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. LYNES, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439

MORRIS NEWMAN, Dept. of Mathematics, Univ. of California, Santa Barbara, CA 93106

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

LAWRENCE E. PAYNE, Dept. of Mathematics, Cornell Univ., Ithaca, NY 14853

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

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 31 (1977) are list \$55.00, institutional member \$39.00, individual AMS member \$20.00, member of CBMS organizations \$27.00. Back number prices *per volume* for Volumes 1–27 (1943–1973) are list \$36.00, AMS member \$27.00; Volumes 28–29 (1974–1975) are list \$54.00, AMS member \$40.50; Volume 30 (1976) are list \$72.00, AMS member \$54.00.

Volumes 1–30 (1943–1976) 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 \$385.00 for spools and \$403.00 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

JULY 1977

An Error Estimate for the Truncation Method for the Solution of Parabolic Obstacle Variational Inequalities	ALAN E. BERGER & RICHARD S. FALK	619
Absorbing Boundary Conditions for the Numerical Simulation of Waves	BJORN ENGQUIST & ANDREW MAJDA	629
High Order Local Approximations to Derivatives in the Finite Element Method	VIDAR THOMÉE	652
On the Stability of Galerkin Methods for Initial-Boundary Value Problems for Hyperbolic Systems	MAX D. GUNZBURGER	661
The Application of Linear Multistep Methods to Singular Initial Value Problems	FRANK R. DE HOOG & RICHARD WEISS	676
Taylor Series Methods for the Solution of Volterra Integral and Integro-Differential Equations	ALAN GOLDFINE	691
Discretization of Volterra Integral Equations of the First Kind	HERMANN BRUNNER	708
Algorithms for Computing Shape Preserving Spline Interpolations to Data	DAVID F. MCALLISTER, ELI PASSOW & JOHN A. ROULIER	717
Inverse Iteration on Defective Matrices	NAI-FU CHEN	726
The Infinity Norm of a Certain Type of Symmetric Circulant Matrix	W. D. HOSKINS & D. S. MEEK	733
Uniqueness of Padé Approximants From Series of Orthogonal Polynomials	AVRAM SIDI	738
Computational Complexity of Fourier Transforms Over Finite Fields	F. P. PREPARATA & D. V. SARWATE	740
Roots of Two Transcendental Equations Involving Spherical Bessel Functions	ROBERT L. PEXTON & ARNO D. STEIGER	752
An Effective Number Geometric Method of Computing the Fundamental Units of an Algebraic Number Field	MICHAEL POHST & HANS ZASSENHAUS	754
Computation of the Regular Continued Fraction for Euler's Constant	RICHARD P. BRENT	771
Computation of the Solution of $x^3 + Dy^3 = 1$	H. C. WILLIAMS & R. HOLTE	778
Small Class Numbers and Extreme Values of L -Functions of Quadratic Fields	DUNCAN A. BUELL	786
Some New Primes of the Form $k \cdot 2^n + 1$	G. MATTHEW & H. C. WILLIAMS	797
REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS		799
BATHE & WILSON 9, BUNCH & ROSE, Editors 8, CRARY & ROSSER 11, HANSEN 10, SKOVGAARD, SVENDSEN, JONSSON & BRINK-KJAER 12		
TABLE ERRATA		806
ABRAMOWITZ & STEGUN, Editors 539, GRAY, MATHEWS & MACROBERT 540, JARDEN 541, LEVINE & DALTON 542, SELBY, Editor 543		

BOWND'S

MICROFICHE SUPPLEMENT

Roots of Two Transcendental Equations Involving Spherical Bessel Functions ROBERT L. PEXTON & ARNO D. STEIGER

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 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).

The research journals of the American Mathematical Society carry a page charge of \$40.00 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.

BOWNS

MICROFICHE SUPPLEMENT

Roots of Two Transcendental Equations Involving Spherical Bessel Functions ROBERT L. PEXTON & ARNO D. STEIGER

MATHEMATICS OF COMPUTATION

TABLE OF CONTENTS

JULY 1977

An Error Estimate for the Truncation Method for the Solution of Parabolic Obstacle Variational Inequalities	ALAN E. BERGER & RICHARD S. FALK	619
Absorbing Boundary Conditions for the Numerical Simulation of Waves	BJORN ENGQUIST & ANDREW MAJDA	629
High Order Local Approximations to Derivatives in the Finite Element Method	VIDAR THOMÉE	652
On the Stability of Galerkin Methods for Initial-Boundary Value Problems for Hyperbolic Systems	MAX D. GUNZBURGER	661
The Application of Linear Multistep Methods to Singular Initial Value Problems	FRANK R. DE HOOG & RICHARD WEISS	676
Taylor Series Methods for the Solution of Volterra Integral and Integro-Differential Equations	ALAN GOLDFINE	691
Discretization of Volterra Integral Equations of the First Kind	HERMANN BRUNNER	708
Algorithms for Computing Shape Preserving Spline Interpolations to Data	DAVID F. MCALLISTER, ELI PASSOW & JOHN A. ROULIER	717
Inverse Iteration on Defective Matrices	NAI-FU CHEN	726
The Infinity Norm of a Certain Type of Symmetric Circulant Matrix	W. D. HOSKINS & D. S. MEEK	733
Uniqueness of Padé Approximants From Series of Orthogonal Polynomials	AVRAM SIDI	738
Computational Complexity of Fourier Transforms Over Finite Fields	F. P. PREPARATA & D. V. SARWATE	740
Roots of Two Transcendental Equations Involving Spherical Bessel Functions	ROBERT L. PEXTON & ARNO D. STEIGER	752
An Effective Number Geometric Method of Computing the Fundamental Units of an Algebraic Number Field	MICHAEL POHST & HANS ZASSENHAUS	754
Computation of the Regular Continued Fraction for Euler's Constant	RICHARD P. BRENT	771
Computation of the Solution of $x^3 + Dy^3 = 1$	H. C. WILLIAMS & R. HOLTE	778
Small Class Numbers and Extreme Values of L -Functions of Quadratic Fields	DUNCAN A. BUELL	786
Some New Primes of the Form $k \cdot 2^n + 1$	G. MATTHEW & H. C. WILLIAMS	797
REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS		799
BATHE & WILSON 9, BUNCH & ROSE, Editors 8, CRARY & ROSSER 11, HANSEN 10, SKOVGAARD, SVENDSEN, JONSSON & BRINK-KJAER 12		
TABLE ERRATA		806
ABRAMOWITZ & STEGUN, Editors 539, GRAY, MATHEWS & MACROBERT 540, JARDEN 541, LEVINE & DALTON 542, SELBY, Editor 543		