

# Mathematics of Computation

**Coden: MCMPAF**

**Pages 685-1028**

**Volume 27, Number 124**

**October 1973**

*Published by the American Mathematical Society*

PROVIDENCE, RHODE ISLAND

### Editorial Committee

- EUGENE ISAACSON, Chairman, New York University, Courant Institute of Mathematical Sciences, 251 Mercer Street, New York, New York 10012  
Assistant to the Chairman: CHARLOTTE W. JOHN
- JAMES H. BRAMBLE, Department of Mathematics, Cornell University, Ithaca, New York 14850
- ALSTON S. HOUSEHOLDER, Department of Mathematics, Ayres Hall, The University of Tennessee, Knoxville, Tennessee 37916
- JOHN W. WRENCH, JR., Naval Ship Research and Development Center, Bethesda, Maryland 20034

### Board of Associate Editors

- JAMES W. DANIEL, Department of Mathematics, University of Texas at Austin, Austin, Texas 78712
- WALTER GAUTSCHI, Computer Sciences Department, Purdue University, Lafayette, Indiana 47907
- DONALD GOLDFARB, Department of Computer Sciences, School of Engineering, The City College of the City University of New York, 139th Street & Convent Avenue, New York, New York 10031
- HEINZ-OTTO KREISS, Computer Science Department, University of Uppsala, Uppsala, Sturegaten 4, Sweden
- YUDELL L. LUKE, Department of Mathematics, University of Missouri at Kansas City, Kansas City, Missouri 64110
- JAMES N. LYNES, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439
- BERESFORD PARLETT, Department of Computer Science, University of California, Berkeley, California 94720
- PHILIP RABINOWITZ, Department of Applied Mathematics, The Weizmann Institute of Science, Rehovot, Israel
- JOHN R. RICE, Division of Mathematical Sciences, Purdue University, Lafayette, Indiana 47907
- DANIEL SHANKS, Naval Ship Research and Development Center, Bethesda, Maryland 20034
- HANS J. STETTER, Institut für Numerische Mathematik, Technische Hochschule Wien, Karlsplatz 13, A-1040 Wien, Austria

### Information for Subscribers

The journal is published quarterly in one volume per year, with issues numbered serially since Volume 1, Number 1. The subscription price is \$24.00. All back volumes are available. For Volumes 1–19 (1943–1965), prices are \$20.00 per volume; for Volumes 20–23 (1966–1969), \$24.00 per volume and Volumes 24–26 (1970–1972), \$30.00 per volume.

### Unpublished Mathematical Tables

The editorial office of the journal maintains a repository of Unpublished Mathematical Tables (UMT).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, address changes, business communications and payments should be sent to:

AMERICAN MATHEMATICAL SOCIETY  
P. O. Box 6248  
Providence, Rhode Island 02904

Copyright © 1973, American Mathematical Society  
Second-class postage paid at Providence, Rhode Island, and at additional mailing offices

# Mathematics of Computation

## TABLE OF CONTENTS

OCTOBER 1973

Generalized Local Maximum Principles for Finite-Difference Operators ACHI BRANDT	685
Convergence for a Vortex Method for Solving Euler's Equation THEODORE E. DUSHANE	719
Symmetrization of the Fluid Dynamic Matrices with Applications ELI TURKEL	729
Stability and Convergence of Difference Approximations to Pseudo-Parabolic Partial Differential Equations . . . . . WILLIAM H. FORD & T. W. TING	737
Mesh Refinements for Parabolic Equations of Second Order STEWART VENIT	745
Eigenfrequencies of an Elliptic Membrane B. A. TROESCH & H. R. TROESCH	755
Elliptical Membranes with Smallest Second Eigenvalue B. ANDREAS TROESCH	767
A Posteriori Error Bounds for Numerical Solutions of the Neutron Transport Equation . . . . . NIEL K. MADSEN	773
A Modified Bairstow Method for Multiple Zeros of a Polynomial F. M. CARRANO	781
The Order of Numerical Methods for Ordinary Differential Equations J. C. BUTCHER	793
Approximate Solution of the Differential Equation $y'' = f(x, y)$ with Spline Functions . . . . . G. MICULA	807
Polynomial Approximation of a Function and Its First Derivative in Near Minimax Norms . . . . . EDGAR A. COHEN, JR.	817
Boundary Expansions for Spline Interpolation . . . . . W. D. HOSKINS	829
Integration Formulas and Schemes Based on $g$ -Splines GEORGE D. ANDRIA, GEORGE D. BYRNE & DAVID R. HILL	831
An Elliptic Integral Identity . . . . . H. S. WRIGGE	839
Rational Approximants Defined from Double Power Series J. S. R. CHISHOLM	841
Error Analysis for Direct Linear Integral Equation Methods JAMES L. PHILLIPS	849
Numerical Construction of Gaussian Quadrature Formulas for $\int_0^1 (-\log x) \cdot x^\alpha \cdot f(x) \cdot dx$ and $\int_0^\infty E_m(x) \cdot f(x) \cdot dx$ . . BERNARD DANLOY	861
A Note on the Computation of Integrals Involving Products of Trigonometric and Bessel Functions . . . . . PETER LINZ & T. E. KROPP	871
Self-Scaling Variable Metric Algorithms Without Line Search for Uncon- strained Minimization . . . . . SHMUEL S. OREN	873
An Algorithm for the Exact Reduction of a Matrix to Frobenius Form Using Modular Arithmetic. I . . . . . JO ANN HOWELL	887
An Algorithm for the Exact Reduction of a Matrix to Frobenius Form Using Modular Arithmetic. II . . . . . JO ANN HOWELL	905
An Extrapolated Gauss-Seidel Iteration for Hessenberg Matrices L. J. LARDY	921
Extensions of Forsythe's Method for Random Sampling from the Normal Distribution . . . . . J. H. AHRENS & U. DIETER	927

New Approximations to Familiar Functions	J. E. DUTT, T. K. LIN & L. C. TAO	939
A Search Procedure and Lower Bound for Odd Perfect Numbers	BRYANT TUCKERMAN	943
A Lower Bound for the Set of Odd Perfect Numbers . . .	PETER HAGIS, JR.	951
On the Largest Prime Divisor of an Odd Perfect Number	PETER HAGIS, JR. & WAYNE L. MCDANIEL	955
The First Occurrence of Large Gaps Between Successive Primes	RICHARD P. BRENT	959
Computational Problems in S-Function Theory . . . . .	P. A. MORRIS	965
A Note on Dirichlet Characters . . . . .	RICHARD H. HUDSON	973
Primitive Binary Polynomials . . . . .	WAYNE STAHNKE	977
The Determination of Galois Groups . . . . .	RICHARD STAUDUHAR	981
REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS . . . . .		997
BULINGTON <b>43</b> , CHERKASOVA <b>45</b> , DAY <b>55</b> , FETTIS, CASLIN & CRAMER <b>49</b> , FETTIS & CASLIN <b>50</b> , HAGIS <b>53</b> , JACOBY, KOWALIK & PIZZO <b>46</b> , KARMAZINA <b>48</b> , MORRIS <b>54</b> , ROBINSON <b>44</b> , SCHATZ <b>42</b> , TUCKERMAN <b>51</b> , TUCKERMAN <b>52</b> , YOUNG <b>47</b> .		
TABLE ERRATA . . . . .		1009
FLETCHER, MILLER, ROSENHEAD & COMRIE <b>506</b> , SLAVIC <b>507</b> .		
CORRIGENDA . . . . .		1011
CHORIN, TE RIELE, SHANKS & SERAFIN		
MICROFICHE SUPPLEMENT		
Integration Formulas and Schemes Based on $g$ -Splines		
GEORGE D. ANDRIA, GEORGE D. BYRNE & DAVID R. HILL		
INDICES TO VOLUME XXVII . . . . .		1013

### 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 "Information for Contributors to Mathematics of Computation" and "Manual for Authors," both of which are available upon request from the American Mathematical Society. All contributions intended for publication and all books for review should be addressed to Eugene Isaacson, Chairman, Editorial Committee, Mathematics of Computation, New York University, Courant Institute of Mathematical Sciences, 251 Mercer Street, New York, New York 10012. 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).

### Microcard Edition

Volumes 1–14 (1943–1960) are available on Microcards at \$39.00 for the complete set and may be purchased from Microcard Editions, Inc., 901 26th Street, N. W., Washington, D.C. 20037.