# Mathematics of Computation

Coden: MCMPAF

Volume 26, Number 118

Pages 311-604

**April 1972** 

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

### **Board of Associate Editors**

James H. Bramble, Department of Mathematics, Cornell University, Ithaca, New York 14850

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

ALSTON S. HOUSEHOLDER, Department of Mathematics, Ayres Hall, The University of Tennessee, Knoxville, Tennessee 37916

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. Lyness, 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

DANIEL SHANKS, Naval Ship Research and Development Center, Washington, D.C. 20034

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

JOHN W. WRENCH, JR., Naval Ship Research and Development Center, Washington, D.C. 20034

### **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 \$20.00. 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 24-25 (1970-1971), \$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### **Unpublished Mathematical Tables**

The editorial office of the journal maintains a repository of Unpublished Mathematical Tables (UMT).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 02940

## **Mathematics of Computation**

# TABLE OF CONTENTS APRIL 1972

Block Five Diagonal Matrices and the Fast Numerical Solution of the Biharmonic Equation Louis Bauer & Edward L. Reiss	311
An Improved Method for Numerical Conformal Mapping	311
JOHN K. HAYES, DAVID K. KAHANER & RICHARD G. KELLNER	327
Coupled Harmonic Equations, SOR, and Chebyshev Acceleration	
L. W. EHRLICH	335
Norms of the Successive Overrelaxation Method DAVID R. KINCAID	345
Existence and Error Estimates for Solutions of a Discrete Analog of Non-linear Eigenvalue Problems	359
The Numerical Solution of Hyperbolic Systems Using Bicharacteristics R. L. Johnston & S. K. Pal	377
Some Properties of a Class of Band Matrices	
W. D. Hoskins & P. J. Ponzo	393
Norms on Direct Sums and Tensor Products	
P. Lancaster & H. K. Farahat	401
One-Step Piecewise Polynomial Galerkin Methods for Initial Value Problems Bernie L. Hulme	415
On the Solution of Systems of Equations by the Epsilon Algorithm of Wynn	
E. Gekeler	427
Anharmonic Frequency Analysis A. K. PAUL	437
An Integral Analogue of Taylor's Series and Its Use in Computing Fourier Transforms	449
Monotonicity in Romberg Quadrature Torsten Ström	461
Minimal Error Constant Numerical Differentiation (N.D.) Formulas  A. Pelios & R. W. Klopfenstein	467
Minimum Norm Differentiation Formulas with Improved Roundoff Error Bounds David K. Kahaner	477
Uniform Approximation of Vector-Valued Functions with a Constraint	
Geneva G. Belford	487
Uniform Approximation Through Partitioning S. E. Weinstein	493
Best $L_p$ Approximation S. W. Kahng	505
A Method for Computing Bessel Function Integrals Peter Linz	509
The Asymptotic Expansions of Hankel Transforms and Related Integrals ROBERT F. MACKINNON	515
On Evaluation of Moments of $K_{\nu}(t)/I_{\nu}(t)$ Chih-Bing Ling & Jung Lin	529
A Note on the Evaluation of the Complementary Error Function D. B. Hunter & T. Regan	539
An Algorithm for Computing Logarithms and Arctangents B. C. CARLSON	543

Complex Zeros of Two Incomplete Riemann Zeta Functions K. S. KÖLBIG	551
Some Results for $k! \pm 1$ and $2 \cdot 3 \cdot 5 \cdots p \pm 1 \dots$ Alan Borning	567
On Thabit ibn Kurrah's Formula for Amicable Numbers WALTER BORHO	571
On the Equation $\phi(n) = \phi(n + k)$ M. Lal & P. GILLARD	579
Reviews and Descriptions of Tables and Books	585
TABLE ERRATA	597
Corrigendum Gradshteyn & Ryzhik	601
Notice	603

### **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.

### NOTICE

### ANNOUNCING A NEW JOURNAL

### **COMPUTERS & STRUCTURES**

Editor-in-Chief: Dr. HAROLD LIEBOWITZ
School of Engineering and Applied Science
George Washington University, Washington, D.C. 20006, USA

The object of this new journal is to provide a medium for the rapid and current communication of information concerning the applications of computers, (digital, analog, and hybrid) and computer programs to the solution of scientific and engineering problems related to hydrospace, aerospace and terrestrial structures.

Computers & Structures will be of interest and use to the scientist/engineer researcher and practitioner in the academic, governmental, and industrial communities in such relevant technical areas as structural mechanics, fluid mechanics and oceanography as utilized to establish structural loading, soil mechanics and foundation engineering, geology and geophysics, and materials science and engineering, including fatigue, creep, relaxation, fracture, stress corrosion, etc. Particular attention will be devoted to the practical engineering aspects of structural analysis, design and optimization.

COMPUTERS & STRUCTURES will publish authoritative papers on theoretical and experimental research and advanced applications of computer programs. When appropriate, it will also feature:

Tutorial papers reviewing a field or fields of computers and/or structures.

Descriptive type of papers showing what computers are and how they could be used to assist the scientist/engineer in designing structures.

Computer programs described in sufficient detail so as to be usable with minimum effort.

Contributions concerning computer-aided design of structures and structural elements.

Reviews of books and papers published elsewhere, meeting schedules, and other such information.

A section on Education Programs. Relatively short programs will be published to demonstrate or augment the material normally found in textbooks or other instructional material. Two types of programs will be emphasized: the first where the program itself is to be "read" by students and engineers not too well informed about computers in order to understand a particular concept or algorithm, or, more significantly, to understand the conversion of an informally stated procedure into a complete algorithm. The second is a program which may be used as a "black box" by students and engineers to produce results which either contribute to the students' understanding of a particular concept or trend, or reduce the amount of computation needed on his part to achieve a particular objective.

604 NOTICE

### Languages of papers

The language of the Journal is primarily English, but manuscripts submitted in other languages are considered at the discretion of the Editor.

### **Abstracts**

A summary of each paper is included in English.

### Frequency

Published quarterly, with four issues comprising one volume with Subject/Author index included with last issue in each volume.

Subscription rates

Annual subscription

£18.00

\$45.00

Pergamon Press Ltd., Headington Hill Hall Oxford OX3 0BW, England



