

MATHEMATICS OF COMPUTATION

AMERICAN MATHEMATICAL SOCIETY

EDITED BY

David W. Boyd

James H. Bramble

Susanne C. Brenner

Richard P. Brent

Joe P. Buhler

Carsten Carstensen

Arjeh M. Cohen

Ronald F. A. Cools

Howard Elman

Richard S. Falk

Andrew J. Granville

Daniel W. Lozier

Zhi-Quan Luo

Roswitha März

Harald Niederreiter

Ricardo Horacio Nochetto

Stanley Osher

Haesun Park

Joseph E. Pasciak

Lothar Reichel

René Schoof

Chi-Wang Shu

Frank Stenger

Denis Talay

Nico M. Temme

Vidar Thomée

Lars B. Wahlbin, Managing Editor

Joseph D. Ward

Hugh C. Williams

PROVIDENCE, RHODE ISLAND USA

ISSN 0025-5718

Mathematics of Computation

This journal publishes research articles in computational mathematics. Areas covered include numerical analysis, with emphasis on the mathematical analysis and development of methods, computational number theory and algebra, and related fields. Table errata and reviews of books in areas related to computational mathematics are also included.

Submission information. See Information for Authors at the end of this issue.

Publisher Item Identifier. The Publisher Item Identifier (PII) appears at the top of the first page of each article published in this journal. This alphanumeric string of characters uniquely identifies each article and can be used for future cataloging, searching, and electronic retrieval.

Postings to e-MATH. Articles are posted to e-MATH individually soon after proof is returned from authors and before appearing in an issue.

Subscription information. Mathematics of Computation is published quarterly. Beginning in January 1996 Mathematics of Computation is accessible from e-MATH via the World Wide Web at the URL http://www.ams.org/publications/. Subscription prices for Volume 69 (2000) are as follows: for paper delivery, \$345 list, \$276 institutional member, \$311 corporate member, \$224 member of CBMS organizations; \$207 individual member; for electronic delivery, \$311 list, \$249 institutional member, \$280 corporate member, \$202 member of CBMS organizations, \$187 individual member. Upon request, subscribers to paper delivery of this journal are also entitled to receive electronic delivery. If ordering the paper version, add \$12 for surface delivery outside the United States and India; \$18 to India. Expedited delivery to destinations in North America is \$17; elsewhere \$56.

Back number information. For back issues see the AMS Catalog of Publications. Subscriptions and orders should be addressed to the American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904. All orders must be accompanied by payment. Other correspondence should be addressed to P.O. Box 6248, Providence, RI 02940-6248.

Copying and reprinting. Material in this journal may be reproduced by any means for educational and scientific purposes without fee or permission with the exception of reproduction by services that collect fees for delivery of documents and provided that the customary acknowledgment of the source is given. This consent does not extend to other kinds of copying for general distribution, for advertising or promotional purposes, or for resale. Requests for permission for commercial use of material should be addressed to the Assistant to the Publisher, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248. Requests can also be made by e-mail to reprint-permission@ams.org.

Excluded from these provisions is material in articles for which the author holds copyright. In such cases, requests for permission to use or reprint should be addressed directly to the author(s). (Copyright ownership is indicated in the notice in the lower right-hand corner of the first page of each article.)

Mathematics of Computation is published quarterly by the American Mathematical Society at 201 Charles Street, Providence, RI 02904-2213. Periodicals postage is paid at Providence, Rhode Island. Postmaster: Send address changes to Mathematics of Computation, American Mathematical Society, P. O. Box 6248, Providence, RI 02940-6248.

^{© 2000} by the American Mathematical Society. All rights reserved. This journal is indexed in Science Citation Index[®], Science Citation IndexTM–Expanded, ISI Alerting ServicesSM, CompuMath Citation Index[®], and Current Contents[®]/Physical, Chemical & Earth Sciences.

[⊗] The paper used in this book is acid-free and falls within the guidelines established to ensure permanence and durability.

Editorial Information

As of March 31, 2000, the backlog for this journal was approximately 4 issues. This estimate is the result of dividing the number of manuscripts for this journal in the Providence office that have not yet gone to the printer on the above date by the average number of articles per issue over the previous twelve months, reduced by the number of issues published in six months (the time necessary for editing and composing a typical issue). In an effort to make articles available as quickly as possible, articles are posted to to e-MATH individually soon after proof is returned from authors and before appearing in an issue.

A Consent to Publish and Copyright Agreement is required before a paper will be published in this journal. After a paper is accepted for publication, the Providence office will send out a Consent to Publish and Copyright Agreement to all authors of the paper. By submitting a paper to this journal, authors certify that the results have not been submitted to nor are they under consideration for publication by another journal, conference proceedings, or similar publication.

Information for Authors

Initial submission. An author should submit three paper copies of the manuscript. Initial submission by email is not allowed. The author may suggest an appropriate editor for his paper. All contributions intended for publication and all books for review should be addressed to Lars B. Wahlbin, Managing Editor, Mathematics of Computation, Center for Applied Mathematics, 657 Frank H. T. Rhodes Hall, Cornell University, Ithaca, NY 14853-3801. The date received, which is published with the final version of an accepted paper, is the date received in the office of the Managing Editor, and it is the responsibility of the author to submit manuscripts directly to this office.

The first page must consist of a descriptive title, followed by an abstract that summarizes the article in language suitable for workers in the general field (algebra, analysis, etc.). The descriptive title should be short, but informative; useless or vague phrases such as "some remarks about" or "concerning" should be avoided. The abstract must be brief and reasonably self-contained. Included with the footnotes to the paper should be the 2000 Mathematics Subject Classification representing the primary and secondary subjects of the article. The classifications are accessible from www.ams.org/msc/. The list of classifications is also available in print starting with the 1999 annual index of Mathematical Reviews. The Mathematics Subject Classification footnote may be followed by a list of key words and phrases describing the subject matter of the article and taken from it. Journal abbreviations used in bibliographies are listed in the latest Mathematical Reviews annual index. The series abbreviations are also accessible from www.ams.org/publications/. To help in preparing and verifying references, the AMS offers MR Lookup, a Reference Tool for Linking, at www.ams.org/mrlookup/. When the manuscript is submitted, authors should supply the editor with electronic addresses if available. These will be printed after the postal address at the end of each article.

Electronically prepared manuscripts. For the final submission of accepted papers, the AMS encourages use of electronically prepared manuscripts, with a strong preference for $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ -IATEX. To this end, the Society has prepared $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ -IATEX author packages for each AMS publication. Author packages include instructions for preparing electronic manuscripts, the $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ -IATEX style file that generates the particular design specifications of that publication series. Articles properly prepared using the $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ -IATEX style file and the \label and \ref commands automatically enable extensive intra-document linking to the bibliography and other elements of the article for searching electronically on the Web. Because linking must often be added manually to electronically prepared manuscripts in other forms of TEX, using $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ -IATEX also reduces the amount of technical intervention once the files are received by the AMS. This results in fewer errors in processing and saves the author proofreading time. $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ -IATEX papers also move more efficiently through the production stream, helping to minimize publishing costs.

 $\mathcal{A}_{\mathcal{M}}S$ -ETEX is the highly preferred format of TEX, but author packages are also available in $\mathcal{A}_{\mathcal{M}}S$ -TEX. Those authors who make use of these style files from the beginning of the

Authors may retrieve an author package from e-MATH starting from www.ams.org/tex/or via FTP to ftp.ams.org (login as anonymous and enter username as password). The author package can also be obtained free of charge by sending email to pub@ams.org (Internet) or from the Publication Division, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248. When requesting an author package, please specify AMS-IFIX or AMS-TEX, Macintosh or IBM (3.5) format, and the publication in which your paper will appear. Please be sure to include your complete mailing address.

The final version of the electronic manuscript should be sent to the Providence office immediately after the paper has been accepted for publication. The author should also send the final version of the paper manuscript to the Managing Editor, who will forward a copy to the Providence office. Editors will require authors to send their electronically prepared manuscripts to the Providence office in a timely fashion. Electronically prepared manuscripts can be sent via email to pub-submit@ams.org (Internet) or on diskette to the Electronic Prepress Department, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248. When sending a manuscript electronically, please be sure to include a message indicating in which publication the paper has been accepted. No corrections will be accepted electronically. Authors must mark their changes on their proof copies and return them to the Providence office. Complete instructions on how to send files are included in the author package.

Electronic graphics. Comprehensive instructions on preparing graphics are available at www.ams.org/jourhtml/graphics.html. A few of the major requirements are given here.

Submit files for graphics as EPS (Encapsulated PostScript) files. This includes graphics originated via a graphics application as well as scanned photographs or other computer-generated images. If this is not possible, TIFF files are acceptable as long as they can be opened in Adobe Photoshop or Illustrator. No matter what method was used to produce the graphic, it is necessary to provide a paper copy to the AMS.

Authors using graphics packages for the creation of electronic art should also avoid the use of any lines thinner than 0.5 points in width. Many graphics packages allow the user to specify a "hairline" for a very thin line. Hairlines often look acceptable when proofed on a typical laser printer. However, when produced on a high-resolution laser imagesetter, hairlines become nearly invisible and will be lost entirely in the final printing process.

Screens should be set to values between 15% and 85%. Screens which fall outside of this range are too light or too dark to print correctly. Variations of screens within a graphic should be no less than 10%.

Secure manuscript tracking on the Web and via email. Authors can track their manuscripts through the AMS journal production process using the personal AMS ID and Article ID printed in the upper right-hand corner of the Consent to Publish form sent to each author who publishes in AMS journals. Access to the tracking system is available from www.ams.org/mstrack/ or via email sent to mstrack-query@ams.org. To access by email, on the subject line of the message simply enter the AMS ID and Article ID. To track more than one manuscript by email, choose one of the Article IDs and enter the AMS ID and the Article ID followed by the word all on the subject line. An explanation of each production step is provided on the web through links from the manuscript tracking screen. Questions can be sent to mcom-query@ams.org.

TeX files available. Beginning with the January 1992 issue of the *Bulletin* and the January 1996 issues of *Transactions, Proceedings, Mathematics of Computation*, and the *Journal of the AMS*, TeX files can be downloaded from e-MATH, starting from

www.ams.org/journals/. Authors without Web access may request their files at the address given below after the article has been published. For Bulletin papers published in 1987 through 1991 and for Transactions, Proceedings, Mathematics of Computation, and the Journal of the AMS papers published in 1987 through 1995, TFX files are available upon request for authors without Web access by sending email to file-request@ams.org or by contacting the Electronic Prepress Department, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248. The request should include the title of the paper, the name(s) of the author(s), the name of the publication in which the paper has or will appear, and the volume and issue numbers if known. The TFX file will be sent to the author making the request after the article goes to the printer. If the requestor can receive Internet email, please include the email address to which the file should be sent. Otherwise please indicate a diskette format and postal address to which a disk should be mailed. Note: Because T_FX production at the AMS sometimes requires extra fonts and macros that are not yet publicly available, TEX files cannot be guaranteed to run through the author's version of T_FX without errors. The AMS regrets that it cannot provide support to eliminate such errors in the author's TFX environment.

Inquiries. Any inquiries concerning a paper that has been accepted for publication that cannot be answered via the manuscript tracking system mentioned above should be sent to mcom-query@ams.org or directly to the Electronic Prepress Department, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248.

Editorial Committee

STANLEY OSHER, Department of Mathematics, University of California, P. O. Box 951555, Los Angeles, CA 90095-1555; *E-mail*: sjo@math.ucla.edu

RENÉ SCHOOF, Dipartimento di Matematica, 2a Università di Roma "Tor Vergata", I-00133 Roma, Italy; E-mail: schoof@wins.uva.nl

DENIS TALAY, INRIA, 2004 Route des Lucioles, BP 93, 06902 Sophia Antipolis Cedex, France; E-mail: talay@sophia.inria.fr

LARS B. WAHLBIN, Chairman. Center for Applied Mathematics, 657 Frank H. T. Rhodes Hall, Cornell University, Ithaca, NY 14853-3801; *E-mail*: awahlbin@cam.cornell.edu

JOSEPH D. WARD, Department of Mathematics, Texas A&M University, College Station, TX 77843-3368; *E-mail*: jward@math.tamu.edu

Board of Associate Editors

DAVID W. BOYD, Department of Mathematics, University of British Columbia, Vancouver, BC Canada V6T 1Z2; *E-mail*: boyd@math.ubc.ca

JAMES H. BRAMBLE, Department of Mathematics, Texas A & M University, College Station, TX 77843-3368; *E-mail*: bramble@math.tamu.edu

SUSANNE C. BRENNER, Department of Mathematics, University of South Carolina, Columbia, SC 29208; *E-mail*: brenner@math.sc.edu

RICHARD P. BRENT, Oxford University Computing Laboratory, Wolfson Building, Parks Road, Oxford OX1 3QD, England; *E-mail*: Richard.Brent@comlab.ox.ac.uk

JOE P. BUHLER, Mathematical Sciences, Research Institute, 1000 Centennial Drive, Berkeley, CA 94720; *E-mail*: jpb@msri.org

CARSTEN CARSTENSEN, Mathematisches Seminar, Christian-Albrechts-Universität zu Kiel, Ludewig-Meyn-Straße 4, D-24098 Kiel, Germany; *E-mail*: cc@numerik.uni-kiel.de

ARJEH M. COHEN, Faculteit Wiskunde en Informatica, TU Eindhoven, Postbus 513, 5600 MB Eindhoven, The Netherlands: *E-mail*: amc@win.tue.nl

RONALD F. A. COOLS, Department of Computer Science, Katholieke Universiteit Leuven, Celestijnenlaan 200A, B-3001 Reverlee, Belgium; *E-mail*: ronald.cools@cs.kuleuven.ac.be

HOWARD ELMAN, Department of Computer Science, University of Maryland, College Park, MD 20742-0001; E-mail: elman@cs.umd.edu

RICHARD S. FALK, Department of Mathematics, Rutgers University, Hill Center, 110 Frelinghuysen Road, Piscataway, NJ 08854-8019; E-mail: falk@math.rutgers.edu

ANDREW J. GRANVILLE, Department of Mathematics, University of Georgia, Athens, GA 30602-7403; E-mail: andrew@math.uga.edu

DANIEL W. LOZIER, Applied and Computational Mathematics Division, National Institute of Standards and Technology, 100 Bureau Drive, Gaithersburg, MD 20899-8901; *E-mail*: dlozier@nist.gov

ZHI-QUAN LUO, Department of Electrical and Computer Engineering, McMaster University, Room CRL/225, Hamilton, ON Canada L8S 4K1; *E-mail*: luozq@mcmail.cis.mcmaster.ca

ROSWITHA MÄRZ, Institut für Mathematik, Humboldt-Universität zu Berlin, Unter den Linden 6, D-10099 Berlin, Germany; E-mail: maerz@mathematik.hu-berlin.de

HARALD NIEDERREITER, Director, Institute of Discrete Mathematics, Austrian Academy of Sciences, Sonnenfelsgaße 19, A-1010 Vienna, Austria; *E-mail*: niederreiter@oeaw.ac.at

RICARDO HORACIO NOCHETTO, Department of Mathematics, University of Maryland, Mathematics Building 084, College Park, MD 20742-0001; *E-mail*: rhn@math.umd.edu

HAESUN PARK, Department of Computer Science, University of Minnesota, 4-192 EE/CS, 200 Union Street, Minneapolis, MN 55455; E-mail: hpark@cs.umn.edu

JOSEPH E. PASCIAK, Department of Mathematics, Texas A&M University, 507B Blocker Hall, MS 3368, College Station, TX 77843; E-mail: pasciak@math.tamu.edu

LOTHAR REICHEL, Department of Mathematics & Computer Science, Kent State University, P.O. Box 5190, Kent, OH 44242; *E-mail*: reichel@mcs.kent.edu

CHI-WANG SHU, Applied Mathematics Division, Brown University, P.O. Box F, 182 George St., Providence, RI 02912-0001; E-mail: shu@cfm.brown.edu

FRANK STENGER, Department of Computer Science, University of Utah, Salt Lake City, UT 84112-1102; E-mail: stenger@cs.utah.edu

NICO M. TEMME, Centrum voor Wiskunde en Informatica, P.O. Box 94079, 1090-GB Amsterdam, The Netherlands; *E-mail*: nicot@cwi.nl

VIDAR C. THOMÉE, Department of Mathematics, Chalmers University of Technology, 41296 Göteborg, Sweden; E-mail: thomee@math.chalmers.se

HUGH C. WILLIAMS, Department of Computer Science, University of Manitoba, Winnipeg, Manitoba R3T 2N2 Canada; *E-mail*: Hugh_Williams@csmail.cs.umanitoba.ca

R. Scheidler and A. Stein, Voronoi's algorithm in purely cubic congruence function fields of unit rank 1	1945
Oliver Schirokauer, Using number fields to compute logarithms in finite	1240
fields	1267
Carter Bays and Richard H. Hudson, A new bound for the smallest x	
with $\pi(x) > \operatorname{li}(x)$	1285
R. P. Brent, R. E. Crandall, K. Dilcher, and C. Van Halewyn, Three	
new factors of Fermat numbers	1297
Reviews and Descriptions of Tables and Books	1305
P. G. Ciarlet and J. L. Lions, Editors 2, Thierry Dubois, Francois	
Jauberteau, and Roger Temam 3, Jack J. Dongarra, Iain S. Duff,	
Danny C. Sorensen, and Henk A. van der Vorst 4, R. B. Lehoucq,	
D. C. Sorensen, and C. Yang 5, Arnold R. Krommer and Christoph	
W. Ueberhuber 6, Wolmer V. Vasconcelos 7, S. C. Coutinho 8	
Table Errata	1317
Landon Curt Noll and David I. Bell 635	
Supplement to "Almost periodic factorization of certain block triangular	
matrix functions" by Ilya M. Spitkovsky and Darryl Yong	S1

No microfiche supplement in this issue

MATHEMATICS OF COMPUTATION CONTENTS

Vol. 69, No. 231 July	2000
Jinchao Xu and Aihui Zhou, Local and parallel finite element algorithms	
based on two-grid discretizations	881
Richard S. Falk and Tong Tu, Locking-free finite elements for the Reissner-	
Mindlin plate	911
Dan-Ping Yang, Analysis of least-squares mixed finite element methods for	000
nonlinear nonstationary convection-diffusion problems	929
M. Farhloul, S. Nicaise, and L. Paquet, A mixed formulation of	
Boussinesq equations: Analysis of nonsingular solutions	965
Laurent Gosse and François James, Numerical approximations of	
one-dimensional linear conservation equations with discontinuous	
coefficients	987
Norbert Hofmann, Thomas Müller-Gronbach, and Klaus Ritter,	
Optimal approximation of stochastic differential equations by adaptive	
step-size control	1017
D. Calvetti, G. H. Golub, W. B. Gragg, and L. Reichel, Computation	
of Gauss-Kronrod quadrature rules	1035
Ilya M. Spitkovsky and Darryl Yong, Almost periodic factorization of	
certain block triangular matrix functions	1053
Jean-Pierre Dedieu and Mike Shub, Multihomogeneous Newton	
methods	1071
J. P. Dedieu and M. Shub, Newton's method for overdetermined systems	
of equations	1099
Andreas Griewank, Jean Utke, and Andrea Walther, Evaluating	
higher derivative tensors by forward propagation of univariate Taylor	
series	1117
Divakar Viswanath, Random Fibonacci sequences and the number	
1.13198824	1131
Peter Borwein and Michael Mossinghoff, Rudin-Shapiro-like polynomi-	
als in L_4	1157
P. G. Walsh, A polynomial-time complexity bound for the computation of	
the singular part of a Puiseux expansion of an algebraic function	1167
P. G. Walsh, Irreducibility testing over local fields	1183
Emmanuel Halberstadt and Alain Kraus, On the modular curves	
$Y_E(7)$	1193
T. Fukuda and K. Komatsu, On a unit group generated by special values	
of Siegel modular functions	1207
Christian Friesen, Class group frequencies of real quadratic function fields:	
The degree 4 case	1213
(Continued on inside back c	over)

