
VOLUME 72 NUMBER 241



JANUARY 2003

MATHEMATICS OF COMPUTATION

A M E R I C A N M A T H E M A T I C A L S O C I E T Y

EDITED BY

Randolph E. Bank
David W. Boyd
Susanne C. Brenner
Richard P. Brent
Joe P. Buhler
Carsten Carstensen
Arjeh M. Cohen
Ronald F. A. Cools
Howard Elman
Richard S. Falk
Daniel W. Lozier
Zhi-Quan Luo
Roswitha März
Harald Niederreiter
Ricardo Horacio Nochetto
Stanley Osher
Haesun Park
Joseph E. Pasciak
Lothar Reichel
René Schoof
Igor E. Shparlinski
Chi-Wang Shu, *Managing Editor*
Frank Stenger
Denis Talay
Nico M. Temme
Lars B. Wahlbin
Joseph D. Ward
Hugh C. Williams
Jinchao Xu

PROVIDENCE, RHODE ISLAND USA

ISSN 0025-5718

Available electronically at
www.ams.org/mcom/

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 the AMS website. Articles are posted to the AMS website individually 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 www.ams.org/publications/. Subscription prices for Volume 72 (2003) are as follows: for paper delivery, \$411 list, \$329 institutional member, \$370 corporate member, \$267 member of CBMS organizations; \$247 individual member; for electronic delivery, \$370 list, \$296 institutional member, \$333 corporate member, \$241 member of CBMS organizations, \$222 individual member. Upon request, subscribers to paper delivery of this journal are also entitled to receive electronic delivery. If ordering the paper version, add \$13 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 www.ams.org/bookstore.

Subscriptions and orders should be addressed to the American Mathematical Society, P.O. Box 845904, Boston, MA 02284-5904 USA. *All orders must be accompanied by payment.* Other correspondence should be addressed to 201 Charles Street, Providence, RI 02904-2294 USA.

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 Acquisitions Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA. 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 02904-2294 USA. Periodicals postage is paid at Providence, Rhode Island. Postmaster: Send address changes to Mathematics of Computation, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA.

© 2003 by the American Mathematical Society. All rights reserved.

This journal is indexed in *Mathematical Reviews*, *Zentralblatt MATH*, *Science Citation Index*[®], *Science Citation Index*TM-*Expanded*, *ISI Alerting Services*SM, *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.

10 9 8 7 6 5 4 3 2 1 08 07 06 05 04 03

MATHEMATICS OF COMPUTATION

CONTENTS

Vol. 72, No. 241

January 2003

Jayadeep Gopalakrishnan and Joseph E. Pasciak , Overlapping Schwarz preconditioners for indefinite time harmonic Maxwell equations	1
Andrew Knyazev and Olof Widlund , Lavrentiev regularization + Ritz approximation = uniform finite element error estimates for differential equations with rough coefficients	17
Rob Stevenson , A stable, direct solver for the gradient equation	41
Rob Stevenson , An analysis of nonconforming multi-grid methods, leading to an improved method for the Morley element	55
Z. Belhachmi and F. Ben Belgacem , Quadratic finite element approximation of the Signorini problem	83
L. Vardapetyan and L. Demkowicz , Full-wave analysis of dielectric waveguides at a given frequency	105
Ramaz Botchorishvili, Benoit Perthame, and Alexis Vasseur , Equilibrium schemes for scalar conservation laws with stiff sources . . .	131
Yen-Hsi Richard Tsai, Yoshikazu Giga, and Stanley Osher , A level set approach for computing discontinuous solutions of Hamilton-Jacobi equations	159
Albert Cohen, Sidi Mahmoud Kaber, Siegfried Müller, and Marie Postel , Fully adaptive multiresolution finite volume schemes for conservation laws	183
Hailiang Liu , The l^1 global decay to discrete shocks for scalar monotone schemes	227
A. J. Roberts , A holistic finite difference approach models linear dynamics consistently	247
Howard C. Elman and Alison Ramage , A characterisation of oscillations in the discrete two-dimensional convection-diffusion equation	263
Othmar Koch and Ewa B. Weinmüller , The convergence of shooting methods for singular boundary value problems	289
Lung-An Ying , Convergence study of the Chorin-Marsden formula	307
Ming-Jun Lai and Larry L. Schumaker , Macro-elements and stable local bases for splines on Powell-Sabin triangulations	335
Marko Huhtanen , Orthogonal polyanalytic polynomials and normal matrices	355
Tai-Lin Wang and William B. Gragg , Convergence of the unitary QR algorithm with a unimodular Wilkinson shift	375
Colin Percival , Rapid multiplication modulo the sum and difference of highly composite numbers	387
Enrique González-Jiménez and Josep González , Modular curves of genus 2	397
Avram Sidi , A convergence and stability study of the iterated Lubkin transformation and the θ-algorithm	419
Annegret Weng , Constructing hyperelliptic curves of genus 2 suitable for cryptography	435
Reinhold Hübl and Irena Swanson , Normal cones of monomial primes	459

Berit Skjernaa , Satoh's algorithm in characteristic 2	477
Patrick J. Costello , New amicable pairs of type (2, 2) and type (3, 2)	489
Michael J. Jacobson, Jr. and Hugh C. Williams , New quadratic polynomials with high densities of prime values	499
A. J. van der Poorten, H. J. J. te Riele, and H. C. Williams , Corrigenda and addition to "Computer verification of the Ankeny-Artin-Chowla conjecture for all primes less than 100 000 000 000"	521

No microfiche supplement in this issue

Editorial Information

As of September 30, 2002, the backlog for this journal was approximately 3 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 the AMS website individually 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 the manuscript by e-mail to `mathcomp@dam.brown.edu`. The manuscript should be sent as a single postscript or pdf file. Files can be compressed using zip or gzip making the files smaller in size. If e-mail submission is not feasible, three paper copies should be submitted. If the office of the Managing Editor is not able to print the file received from an e-mail submission, the author will be contacted and asked to send three paper copies instead. The author may suggest an appropriate editor for his or her paper. All paper copies of contributions and all books for review should be addressed to Chi-Wang Shu, Managing Editor, Mathematics of Computation, Division of Applied Mathematics, Brown University, 182 George Street, Providence, RI 02912 USA. 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 $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\mathcal{L}\mathcal{T}\mathcal{E}\mathcal{X}$. To this end, the Society has prepared $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\mathcal{L}\mathcal{T}\mathcal{E}\mathcal{X}$ author packages for each AMS publication. Author packages include instructions for preparing electronic manuscripts, the *AMS Author Handbook*, samples, and a style file that generates the particular design specifications of that publication series. Articles properly prepared using the $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\mathcal{L}\mathcal{T}\mathcal{E}\mathcal{X}$ 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 $\mathcal{T}\mathcal{E}\mathcal{X}$, using $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\mathcal{L}\mathcal{T}\mathcal{E}\mathcal{X}$ 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. $\mathcal{A}\mathcal{M}\mathcal{S}$ - \LaTeX papers also move more efficiently through the production stream, helping to minimize publishing costs.

$\mathcal{A}\mathcal{M}\mathcal{S}$ - \LaTeX is the highly preferred format of \TeX , but author packages are also available in $\mathcal{A}\mathcal{M}\mathcal{S}$ - \TeX . Those authors who make use of these style files from the beginning of the writing process will further reduce their own efforts. Manuscripts prepared electronically in \LaTeX or plain \TeX are normally not acceptable due to the high amount of technical time required to insure that the file will run properly through the AMS in-house production system. \LaTeX users will find that $\mathcal{A}\mathcal{M}\mathcal{S}$ - \LaTeX is the same as \LaTeX with additional commands to simplify the typesetting of mathematics, and users of plain \TeX should have the foundation for learning $\mathcal{A}\mathcal{M}\mathcal{S}$ - \LaTeX .

Authors may retrieve an author package from the AMS website starting from www.ams.org/tex/ or via FTP to [ftp.ams.org](ftp://ftp.ams.org) (login as `anonymous`, enter username as password, and type `cd pub/author-info`). The *AMS Author Handbook* and the *Instruction Manual* are available in PDF format following the author packages link from www.ams.org/tex/. 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, 201 Charles Street, Providence, RI 02904-2294 USA. When requesting an author package, please specify $\mathcal{A}\mathcal{M}\mathcal{S}$ - \LaTeX or $\mathcal{A}\mathcal{M}\mathcal{S}$ - \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, 201 Charles Street, Providence, RI 02904-2294 USA. 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 starting from www.ams.org/jourhtml/authors.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%.

AMS policy on making changes to articles after posting. Articles are posted to the AMS website individually after proof is returned from authors and before appearing in an issue. To preserve the integrity of electronically published articles, once an article is individually posted to the AMS website but not yet in an issue, changes cannot be made in place in the paper. However, an “Added after posting” section may be added to the paper right before the References when there is a critical error in the content of the paper. The “Added after posting” section gives the author an opportunity to correct this type

of critical error before the article is put into an issue for printing and before it is then reposted with the issue. The “Added after posting” section remains a permanent part of the paper. The AMS does not keep author-related information, such as affiliation, current address, and email address, up to date after a paper is initially posted.

Once the article is assigned to an issue, even if the issue has not yet been posted to the AMS website, corrections may be made to the paper by submitting a traditional errata article to the Editor. The errata article will appear in a future print issue and will link back and forth on the web to the original article online.

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.

T_EX 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*, T_EX files can be downloaded from the AMS website, 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, T_EX 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, 201 Charles Street, Providence, RI 02904-2294 USA. 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 T_EX 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_EX production at the AMS sometimes requires extra fonts and macros that are not yet publicly available, T_EX files cannot be guaranteed to run through the author’s version of T_EX without errors. The AMS regrets that it cannot provide support to eliminate such errors in the author’s T_EX 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, 201 Charles Street, Providence, RI 02904-2294 USA.

Editorial Committee

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

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

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

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

Board of Associate Editors

RANDOLPH E. BANK, Department of Mathematics, University of California San Diego, C-012, La Jolla, CA 92093-0001 USA; *E-mail:* reb@sdna2.ucsd.edu

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

SUSANNE C. BRENNER, Department of Mathematics, University of South Carolina, Columbia, SC 29208 USA; *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 94720-5070 USA; *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, Netherlands; *E-mail*: amc@win.tue.nl

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

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

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

DANIEL W. LOZIER, National Institute of Standards and Technology, 100 Bureau Drive, Mail Stop 8910, Gaithersburg, MD 20899-8910 USA; *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@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, Department of Mathematics, National University of Singapore, 2 Science Drive 2, Singapore 117543, Republic of Singapore; *E-mail*: nied@math.nus.edu.sg

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

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

HAESUN PARK, Department of Computer Science, University of Minnesota, 4-192 EE/CS, 200 Union Street, Minneapolis, MN 55455 USA; *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 USA; *E-mail*: pasciak@math.tamu.edu

LOTHAR REICHEL, Department of Mathematics & Computer Science, Kent State University, P.O. Box 5190, Kent, OH 44242-0001 USA; *E-mail*: reichel@mcs.kent.edu

IGOR E. SHPARLINSKI, Department of Computing, Macquarie University, Sydney, New South Wales 2109, Australia; *E-mail*: igor@comp.mq.edu.au

FRANK STENGER, School of Computing, University of Utah, Salt Lake City, UT 84112-1102 USA; *E-mail*: stenger@cs.utah.edu

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

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

HUGH C. WILLIAMS, Department of Mathematics and Statistics, University of Calgary, Calgary AB, Canada T2N 1N4; *E-mail*: williams@math.ucalgary.ca

JINCHAO XU, Department of Mathematics, Pennsylvania State University, McAllister Building, University Park, PA 16802-6401 USA; *E-mail*: xu@math.psu.edu

(Continued from back cover)

Avram Sidi , A convergence and stability study of the iterated Lubkin transformation and the θ -algorithm	419
Annegret Weng , Constructing hyperelliptic curves of genus 2 suitable for cryptography	435
Reinhold Hübl and Irena Swanson , Normal cones of monomial primes	459
Berit Skjernaas , Satoh's algorithm in characteristic 2	477
Patrick J. Costello , New amicable pairs of type (2, 2) and type (3, 2)	489
Michael J. Jacobson, Jr. and Hugh C. Williams , New quadratic polynomials with high densities of prime values	499
A. J. van der Poorten, H. J. J. te Riele, and H. C. Williams , Corrigenda and addition to "Computer verification of the Ankeny-Artin- Chowla conjecture for all primes less than 100 000 000 000"	521

No microfiche supplement in this issue

MATHEMATICS OF COMPUTATION
CONTENTS

Vol. 72, No. 241

January 2003

Jayadeep Gopalakrishnan and Joseph E. Pasciak , Overlapping Schwarz preconditioners for indefinite time harmonic Maxwell equations	1
Andrew Knyazev and Olof Widlund , Lavrentiev regularization + Ritz approximation = uniform finite element error estimates for differential equations with rough coefficients	17
Rob Stevenson , A stable, direct solver for the gradient equation	41
Rob Stevenson , An analysis of nonconforming multi-grid methods, leading to an improved method for the Morley element	55
Z. Belhachmi and F. Ben Belgacem , Quadratic finite element approximation of the Signorini problem	83
L. Vardapetyan and L. Demkowicz , Full-wave analysis of dielectric waveguides at a given frequency	105
Ramaz Botchorishvili, Benoit Perthame, and Alexis Vasseur , Equilibrium schemes for scalar conservation laws with stiff sources . . .	131
Yen-Hsi Richard Tsai, Yoshikazu Giga, and Stanley Osher , A level set approach for computing discontinuous solutions of Hamilton-Jacobi equations	159
Albert Cohen, Sidi Mahmoud Kaber, Siegfried Müller, and Marie Postel , Fully adaptive multiresolution finite volume schemes for conservation laws	183
Hailiang Liu , The l^1 global decay to discrete shocks for scalar monotone schemes	227
A. J. Roberts , A holistic finite difference approach models linear dynamics consistently	247
Howard C. Elman and Alison Ramage , A characterisation of oscillations in the discrete two-dimensional convection-diffusion equation	263
Othmar Koch and Ewa B. Weinmüller , The convergence of shooting methods for singular boundary value problems	289
Lung-An Ying , Convergence study of the Chorin-Marsden formula	307
Ming-Jun Lai and Larry L. Schumaker , Macro-elements and stable local bases for splines on Powell-Sabin triangulations	335
Marko Huhtanen , Orthogonal polyanalytic polynomials and normal matrices	355
Tai-Lin Wang and William B. Gragg , Convergence of the unitary QR algorithm with a unimodular Wilkinson shift	375
Colin Percival , Rapid multiplication modulo the sum and difference of highly composite numbers	387
Enrique González-Jiménez and Josep González , Modular curves of genus 2	397

(Continued on inside back cover)



0025-5718(200301)72:241;1-M