mechanics

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mechanics

mechanics provides its readers with news in the field of theoretical and applied mechanics, and serves as a forum for the presentation and discussion of issues related to the development of the science and profession of mechanics. Opinions expressed are those of the authors and do not necessarily reflect official points of views of AAM or the institutions with which the authors are affiliated.

The *American Academy of Mechanics* is a non-profit corporation incorporated in 1969 under the laws of the Commonwealth of Pennsylvania. Its objective is to advance the science and profession of mechanics, with particular reference to the countries of North, South, and Central America. It aims to facilitate cooperation among mechanicists, to encourage recognition of achievements in mechanics, and to promote public understanding of the work of the mechanicist.

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American Academy of Mechanics
Academia Americana de Mecánica

LETTER FROM THE EDITOR

October 25, 2002

Dear AAM Member,

It is my pleasure to share with you more general articles written by AAM members with a mechanics audience in mind. The first article is an abstract of a paper by Luis A. Godoy, an AAM member since 1984, published in Spanish in the previous issue of *Mechanics* (Volume 31, Number 7-8, July-August 2002). The paper was very well received by the mechanics community and due to an overwhelming number of requests, Professor Godoy has graciously prepared an abstract in English. The second paper is by Mohamed Gad-el-Hak, AAM Fellow, of the Virginia Commonwealth University. Professor Gad-el-Hak's paper is excerpted from Chapter 4 of *The Handbook of MEMS* (M. Gad-el-Hak, Editor, CRC Press, Boca Raton, Florida, 2002). Additionally, I have reprinted an article on "Carbon Nanotubes – the Route Toward Applications," which I hope that you find informative and stimulating.

As the editor of *Mechanics*, it is my desire to ensure the success of the journal by establishing editorial policies that promote and advance the presentation of *Mechanics*. I would like to enhance the quality of the journal by implementing a few changes that will increase the relevancy of the journal to the members of AAM and that will offer greater substance to the mechanics community. One of these changes is to encourage AAM members to contribute essays on new teaching methodologies, new technologies, new research challenges, etc. This new series of articles written by AAM members has been very well received and I am glad to inform you that we have received commitments to contribute an article from Hassan Aref (University of Illinois at Urbana/Champaign), Stephen Cowin (The City University of New York), Marcelo Epstein (University of Calgary), Pablo Kittl (Universidad de Chile), and Patricio Laura (Universidad Nacional del Sur, Argentina).

I hope that you will give some thought to joining your colleagues in contributing an article for publication in the *Mechanics* magazine. Articles should be written for a *general audience* and discuss aspects of mechanics research and education, including neat derivations of didactic results, discussions of educational issues in mechanics, historical matters, and so on. We would like interesting, high quality articles for distribution to our colleagues and to libraries everywhere.

Together, we can promote a better American Academy of Mechanics, and we can promote higher standards that will be received by a greater audience and provide more relevant information to AAM members. It is with great enthusiasm that I share these ideas with you and I ask for you support in improving the American Academy of Mechanics. I look forward to your contribution.

Sincerely,

Horacio D. Espinosa, Ph.D.
Editor, *Mechanics*

POSITION OPENINGS

UNIVERSITY OF MINNESOTA

AEROSPACE ENGINEERING AND MECHANICS

The Department of Aerospace Engineering and Mechanics at the University of Minnesota anticipates filling a faculty position in the area of solid mechanics. The position is at the rank of assistant professor; exceptionally qualified candidates may be considered for appointment at the rank of associate professor without tenure.

We are searching for candidates whose research program will set promising new directions in solid mechanics. We are especially interested in candidates who use computational or experimental tools to bring fundamental atomic scale information to the study of the mechanical behavior of materials or structures. Candidates from any branch of mechanical science and engineering are encouraged to apply, as are candidates from physics, materials science, applied mathematics, biophysics, electrical engineering or solid state chemistry. The successful candidate must also be able to develop and teach undergraduate and graduate courses in aerospace engineering and mechanics.

Current research activities in the department include the study of active materials (such as shape memory and magnetostrictive materials), phase transformations, continuum mechanics, fracture mechanics and biomechanics.

Applicants must have earned a doctorate in a related field by the date of appointment; experience beyond the doctorate degree is desirable. The successful candidate will be expected to develop an independent, externally funded research program, and to participate in all aspects of the department's mission. Strong written and verbal communication skills are required.

It is anticipated that the appointment will begin fall, 2003.

Applicants should send a letter of application, detailed resume, and the names and addresses of three references to:

Solids Search Committee (IT1017)
Department of Aerospace Engineering and Mechanics
University of Minnesota
107 Akerman Hall
110 Union Street S. E.
Minneapolis, MN 55455

Application Deadline: The initial screening of applications will begin on January 1, 2003; applications will be accepted until the position is filled.

The University of Minnesota is an equal opportunity employer and educator and specifically invites and encourages applications from women and minorities.

Department Head
Department of Engineering Science and Mechanics
Virginia Polytechnic Institute and State University

The Department of Engineering Science and Mechanics at Virginia Tech invites applications and nominations for candidates for the position of department head. The Department of Engineering Science and Mechanics (ESM) is a unique department within the College of Engineering at Virginia Tech in that it views physical phenomena from a fundamental level rather than through specialization, as in other departments. The graduate program has an outstanding international reputation and stresses the classic disciplines of solid mechanics, fluid mechanics, and dynamics, and has been increasing course offerings in the biomechanics area. The department is also known for interdisciplinary research and educational activities with departments inside and outside the College of Engineering. The department offers Ph.D. and M.S. degrees in Engineering Mechanics, an accredited undergraduate degree in Engineering Science and Mechanics, and teaches core mechanics courses for the 10 other departments within the college. The department has 28 full-time faculty, an undergraduate enrollment of 70, a graduate enrollment of 90, and annual research expenditures of $6.5M. Screening of candidates will begin with the strictest of confidence on September 16, 2002 and will continue until the position is filled. A detailed description of the position and the nomination and application process can be found at **http://www.esm.vt.edu**.

Virginia Tech has a strong commitment to the principle of diversity, and in that spirit, seeks a broad spectrum of candidates including women, minorities, and people with disabilities. Individuals with disabilities desiring accommodations in the application process should notify Nancy Linkous, 540-231-3243(V), or by way of the Telecommunication Relay Service number, 711, 8 am – 5 pm Eastern US Time.

ANNOUNCEMENTS

Minutes of the 64th Meeting of the Board of Directors, Meeting of the Fellows, and Open Meeting of the Members

The **14th US National Congress of Theoretical and Applied Mechanics was held at Virginia Polytechnic Institute and State University, Blacksburg, Virginia**. In conjunction with this conference, **the 64th Meeting of the Board of Directors, the Fellows Meeting, and the Members Meeting** were held in Room 231 Norris Hall, on the campus of Virginia Tech on Thursday, June 27, 2002.

1. A quorum was not present, so no voting action by the Board was taken. President Beatty called the meeting to order at 11:30 EDT. The following were in attendance: M. Beatty (res0guxi@verizon.net), C. Bert (cbert@ou.edu), J. Dally (jimdally@aol.com), E. Dowell (dowell@mail.ee.duke.edu), H. Espinosa (espinosa@nwu.edu), D. Frederick (dfundfff@ vt.edu), R. Haythornthwaite (rmh@y.astro.edu), R. Heller (rheller@vt.edu), Q. Jiang (gjiang@engr.ucr.edu), M. Johnson (millard@engr.wisc.edu), W. Knauss (wgk@caltech.edu), M. Ostoja-Starzewski (martin.ostoja@mcgill.ca), S. Shrader (sallys@vt.edu), C. Taylor (cet@aero.ufl.edu), L. Virgin (lvirgin@duke.edu), L. Wheeler (lwheeler@uh.edu).

2. **Minutes of the Previous Meeting**. There was no report on previous Minutes of the Board Meeting in NY scheduled for 12 November 2001, due to its cancellation following the air tragedy. Meeting of the Fellows was held 12 November and 4 new Fellows were elected – information attached. An AAM Awards luncheon on 13 November was conducted by C. Bert. Professor A. Leissa received the Outstanding Service Award for 2001; and previous award recipients C. Taylor for the Outstanding Service Award (1998) and V. Gupta for the Junior Achievement Award (1998), were recognized. Thanks went to C. Bert for a job well done under these unusual circumstances.

3. **AAM Activities Report**. Beatty distributed a summary report on AAM activities for the period 1 June 2001 to 31 May 2002, and several additional documents on previous revisions to the Bylaws and on Rules of Policy and Procedure, for discussion. See attachments.

4. **Awards Committee**. Beatty, reporting for Committee Chair S. Ostrach, noted that Junior Achievement Award nominations have been received. Members need to stimulate interest in these Awards. New members of the Awards Committee were announced – J.T. Oden, W. Knauss, and R. Batra. Knauss suggested a conference call to finalize the selection of awards by the Committee. Hardcopy paperwork would still need to go to all members. S. Shrader (acting on behalf of D. Mook, AAM Secretary) reported that only 6-8 medals currently are on hand. The Board will need to discuss in the future having new medals made, which may require a new mold.

5. **Adjudication Committee**. R. Haythornthwaite reported that no nominations have yet been received for the Founders Prize and Grant, deadline July 1, 2002.

6. **Director Reports**. L. Virgin, Director for Region IA, Eastern U.S., had no news to report.

7. **PACAM VII**. Thanks went to the Chair, Professor P. Kittl, and Co-Chairs, G. Diaz and D. Mook, of the Organizing Committee for the PACAM VII Conference, held at Temuco, Chile, January 2-4, 2001. The proceedings were published in *Applied Mechanics in the Americas* Volume 9, edited by P. Kittl, G. Diaz, D. Mook and J. Geer, to whom thanks was extended.

8. **PACAM VIII**. Co-Chairs are Professors R. Rodriguez-Ramos and M. Ostoja-Starzewski. The latter reported on the proposal for PACAM VIII to be held at Havana, Cuba in January 2004 (see

attachment). In view of current U.S. policy on trade restrictions, some concern was expressed over the distribution of the proceedings and its publication. Treasurer Heller asked where the residual money from PACAM VIII would go. Publisher R. Haythornthwaite indicated that PACAM VIII in Cuba might create some publishing problems and cautioned AAM's involvement with the proceedings publication. The proposal was discussed but no specific decisions were made. Ostoja -Starzewski will develop further information and report at the November meeting on these several issues.

9. **Discussion of Bylaws**. Beatty remarked that the Bylaws need to be updated and amended to make sure everything is clear, to revise some typographical slips, and to include previously approved revisions. It was noted, for example, that Rules of Policy and Procedure mentioned in the Bylaws do not exist. Beatty prepared some established Rules of Policy and Procedure related to Regional Directors and AAM Awards (see attached). These additions and some previously approved revisions to the Bylaws will be included in a new edition of the Bylaws. Beatty will work on this and append the currently established Rules of Policy and Procedure. Espinosa will add the Rules of Policy and Procedure to the web site documentation.

10. **Treasurer's Report**. R. Heller reported on the current financial status of AAM (see attached). There was discussion on how the Founders Prize and Grant is reported. R. Haythornthwaite remarked that it is reported separately through a non-profit foundation handled directly by Haythornthwaite and does not need to be reported by AAM. In reference to *Mechanics* subscriptions, a suggestion was made to accept Credit Card charges only from outside US. S. Shrader, reporting for Secretary Mook, remarked that there are 616 paid members. Of these, 54 are Corresponding Members (outside the Americas), 4 are Student Members. New membership applications for 2001: 12 total – 9 Professional, 1 Student, and 2 Corresponding Members. New membership applications for 2002: 3 total – all professional. There are 117 Fellows, 12 of whom are not active paid members. A list of unpaid Fellow members was given to C. Bert. These Fellows will be notified of their delinquent dues payments and informed that their membership in AAM will be terminated, if these back dues are not paid in full.

11. **Editor's Report**. H. Espinosa reported on the financial status of AAM editorial operations (see attached). Discussion on how to make AAM more attractive through improvements in *Mechanics* and the web site– suggestion by Espinosa to have articles in either English or Spanish as acceptable languages. Discussion to add more information to web site – courses, idea exchanges, etc. Espinosa proposes to put Contents only on the web site in 2003. Haythornthwaite emphasized the need to continue *Mechanics* in hardcopy. The Editor's budget request (see attached) was $26,000/year, which includes part-time secretarial support, publications costs, and web update.

12. **Remarks on the new *Mechanics***. Thanks went to H. Espinosa for an outstanding job on development of the new *Mechanics* and AAM web site. The *Mechanics Contents* are now more useful than any previous time. M. Beatty described the convenience and utility of the various links to *Mechanics Contents* on the web site. There was some discussion about putting the *Contents* on the web site only instead of hardcopy publication. Espinosa suggested an electronic journal (within the current *Mechanics*) with very short innovative papers. Beatty stated that AAM's goal is not to compete with other journals. Espinosa suggested trying specialty articles that would go through a review process – these would replace the space vacated by removal of the *Contents*. The articles would be called *Mechanics Letters* and would be 2 pages submitted in pdf format. New Associate Editor appointments were discussed. Addition of Associate Editor with the web site as the principal role was discussed – Alberto Cuitino was appointed.

13. **Motion on the Budget**. Bert moved to approve Espinosa's budget – no quorum being present, the vote was postponed. Bert will seek email approval by the Board.

14. **Old Business**. Discussion on changing the term of President. The term of office of President Elect now runs parallel with President so it is not necessary to extend the President's term to 2 years. Bert is next President (2002-2003) and Wheeler the President Elect (2002-2003).

15. **New Business**. Discussion of June 2003 Calgary Conference – ad will be placed in *Mechanics* free. Heller brought up the policy of free ads. It was agreed that job announcement ads should be charged $200 effective September 1, 2002. Espinosa will collect the payments for job announcement ads and forward them to Heller. Call for papers, conference announcements, etc. will continue free of charge.

16. **Fellows Meeting**. Professor Bert acting as the current President-Elect (simultaneously Secretary to the Fellows) conducted the Fellows Meeting. Twelve Fellows were present. C. Bert reported that several nominations for Fellow have been received for consideration in the Fall election period 2002, and Fellows were encouraged to nominate outstanding colleagues. Membership requirements for Fellow nomination were discussed. It was moved and seconded that, effective in the 2002-2003 nomination and election period concluded in the Fall 2003, a nominee for Fellow must be a (Western Hemisphere, permanent resident) Member or Corresponding Member in good standing for a period of *at least five years* prior to nomination. The motion passed unanimously by the Fellows present.

17. **Members Meeting**. Dr. Ken Chong of NSF handed out a notice of an ASME web-cast. This will be put in *Mechanics* as a conference ad. Professor Jasiuk suggested interaction and joint participation with AAM and SES. Beatty suggested that he would like to see this joint participation and suggested they might get together with PACAM 2004. Interaction would provide good free advertisement for AAM – requested Jasiuk provide information for the next SES symposium. Jasiuk will go back to SES and subsequently report to AAM. Espinosa stated that the Board needs to be involved – get the Latin Americas involved in SES. Dr. Chong said he would be willing to help with research agendas associated with NSF.

18. **Announcement and Introduction**. Lewis Wheeler was announced as the new President Elect for 2002-2003.

19. **Closing Remarks**. Beatty extended thanks and appreciation to all Board Members and others for their support and assistance throughout the year. C. Bert was introduced as new President (2002-2003). Bert requested ideas for AAM Secretary, Secretary to the Fellow, and Regional Director Nominations. Bert thanked Beatty for a job well done.

20. **Meeting Adjourned** 3:30P EDT.

AAM Meeting in New Orleans

Wednesday, November 20, 2002

2:30 p.m. – Executive Committee
3:30 p.m. – Fellow Meeting
4:00 p.m. – General Membership

The AAM Meeting will take place during the *2002 ASME International Mechanical Engineering Congress* in New Orleans, Louisiana at the New Orleans Hilton/Ernest Morial Convention Center

ADVERTISEMENT POLICY

Upon the decision of the Board of Directors, an advertisement for a position opening is charged a flat rate of $200. Payment must be done only by check and sent to:

American Academy of Mechanics
Horacio D. Espinosa, Editor
Northwestern University
2145 Sheridan Road
Evanston, IL 60208
e-mail: mech1@clifton.mech.northwestern.edu

The FID number for AAM is 23-7045163. Make check payable to American Academy of Mechanics. Announcements for forthcoming events, conferences, and workshops are free of charge. Advertisements may be sent by FAX or e-mail (LaTex, MSWord, PDF or plain text). Logo of the institution may be included if the postscript (graphic file) is provided.

Mechanics is a bi-monthly magazine. To be considered for publication in forthcoming issues, an advertisement must be received one month in advance of the publication date. For example, an advertisement must be received before the end of November to appear in the January-February issue. Please note that the magazine is distributed at the beginning of the two-month period. The advertisement will continue to appear in future issues until the deadline of the position opening.

Visit the AAM website to read recent advertisements of position openings and past issues of Mechanics at http://www.AAMech.org.

MECHANICS On-line

To access *Mechanics* on-line, please visit

www.AAMech.org

Effective November 1, 2002, access to the on-line issues will be restricted to AAM members. A username and password will be required to access the on-line issues. This information will be sent by e-mail to all AAM members. If you do not receive the username and password information by e-mail, please contact the Editor's Assistant, Thomas Milic, at the following e-mail address: mech1@clifton.mech.northwestern.edu

American Academy of Mechanics

Founders Prize and Grant

Up to $10,000 For the Academic Year 2003-2004
(Deadline: July 1, 2003)

The American Academy of Mechanics is pleased to announce the availability of a Founder’s Prize and Grant to be awarded in September 2003 to a doctoral candidate in the field of Mechanics. Funding has been arranged by the Robert M. and Mary Haythornthwaite Foundation through the good offices of Professor Haythornthwaite, founder and first President of the Academy. The aware will be made on the recommendation of an AAM committee. The prize consists of a Certificate and $1,000 that will be presented at the annual meeting of the Academy, usually held in November. The Grant will be made to that same person in two installments, $6,000 in September 2003 and up to $3,000 in January 2004, the latter dependent on the size of the approved budget and receipt by the AAM committee of an acceptable progress report. In order to encourage contestants to think constructively about the impact of new and pending developments, they will be asked to compose an original essay of no more than a thousand words under the title “Progress through Mechanics”. The winning essay will be published in *mechanics*. The award is open to those who, as of July 1, 2003, are registered as graduate students at a degree granting institution within the Americas, have completed at least one year of full-time graduate study at that institution, have been assigned a thesis advisor at the institution and have had a doctoral thesis topic emphasizing mechanics approved by the institution following candidacy or equivalent procedures. There are no restrictions with regard to citizenship, residency, race, religion, or sex. Letters of support will be required of the thesis advisor and in addition one from either a Member or a Fellow of AAM. Contestants will be judged on the basis of the essay, plans, references and academic history. The intent of the Grant is to support the research of the student through an approved combination of equipment purchases, information access, travel, etc., but not routine living expenses or fees. Detailed rules for the competition will be issued soon: to receive them, express your interest to the committee by FAX to (215) 204-6936, or by writing to:

AAM Founders Prize and Grant Committee
c/o Civil and Environmental Engineering Department
Temple University (084-53)
Philadelphia, PA 19122

7th Meeting on Current Ideas in Mechanics and Related Fields
CIMRF – 2003

The 7th Meeting on Current Ideas in Mechanics and Related Fields (CIMRF – 2003) will take place at Portland State University in Portland, Oregon, August 18 – 21, 2003. Like previous CIMRF meetings, this symposium will be concerned with broadly understood applications of mathematics and mathematical techniques to mechanics. However, the leading theme of this conference will be the mathematical methods (geometric, group theoretical, variational, PDEs) in mechanics of materials with special emphasis on representation and understanding the role of inhomogeneities, phase transitions, their creation and evolution.

Plenary lectures will be given by Richard James (University of Minnesota), David Owen (Carnegie-Mellon), and Gareth Parry (University of Nottingham).

Call For Papers

These participants who would like to speak at the meeting are requested to send a one-page abstract (in TeX/LaTeX, both the source file and the dvi file) by e-mail to Serge Preston at serge@mth.pdx.edu , with a copy to Marek Elzanowski at marek@mth.pdx.edu , no later than **June 30, 2003**. Abstract macro will be available on the conference website at http://www.mth.pdx.edu/~marek/cimrf/2003/cimrf2003.html

Registration

Those interested in attending this meeting, are kindly requested to submit as soon as possible a *pre-registration form*, which can be found at http://www.mth.pdx.edu/~marek/cimrf/2003/cimrf2003.html

Conference Fees

The Conference fee for CIMRF – 2003 is $240.00, if paid by money order sent directly to the organizers, and $260.00, if paid by wire transfer. The conference fee includes the welcome reception planned for the evening of August 17th, coffee breaks, conference banquet on Wednesday, August 20th, and the book of abstracts.

Prospective participants are requested to send, preferably before **May 30, 2003**, an international money order, payable to CIMRF2003, to Marek Elzanowski, Department of Mathematics and Statistics, Portland State University, P.O.Box 751, Portland, Oregon 97207, U.S.A. The conference fee ($260.00) can also be paid directly to CIMRF2003 at US Bank, routing number: 123000220, account number: 153691205261.

Housing and Travel Information

Information about local hotels, travel directions, weather, local attractions etc., can be found on the conference website at http://www.mth.pdx.edu/~marek/cimrf/2003/cimrf2003.html

Marek Elzanowski (Portland, marek@mth.pdx.edu)
Marcelo Epstein (Calgary, epstein@enme.ucalgary.ca)
Serge Preston (Portland, serge@mth.pdx.edu)

PACAM VIII

Eighth Pan American Congress of Applied Mechanics

January 5-9, 2004

Havana, Cuba

http://www.pacam8.mcgill.ca/

The Eighth Pan American Congress of Applied Mechanics (PACAM VIII), jointly sponsored by the University of Havana, the Institute of Cybernetics, Mathematics, and Physics of Cuba, and the American Academy of Mechanics, will be held January 5-9, 2004 at the Convention Center, Havana, Cuba. The Honorary Chairman of the Organizing Committee is Prof. Alina Ruiz Jhones of the University of Havana. The Co-Chairmen are Prof. Martin Ostoja-Starzewski of McGill University and Prof. Reinaldo Rodríguez-Ramos of the University of Havana. The Chairman of the Editorial Committee is Prof. Julián Bravo-Castillero of the University of Havana, and the Chairman of the Local Arrangements Committee is Prof. Raúl Guinovart-Diaz of the University of Havana, Cuba.

The aim of sponsors is to promote progress in the broad field of mechanics by (1) exposing engineers and scientists, including graduate students, to new research findings, techniques, and problems, and (2) providing opportunities for personal interactions between mechanicians of North and South America, as well as other continents. It is the only conference sponsored by the American Academy of Mechanics (AAM).

The Pan American Congresses of Applied Mechanics are held every two years early in January, always in a Latin American venue, at a time when few other conferences are scheduled. The previous Congresses were held in Rio de Janeiro, Brazil in 1989; Valparaiso, Chile in 1991; São Paulo, Brazil in 1993; Buenos Aires, Argentina in 1995; San Juan, Puerto Rico in 1997, Rio de Janeiro, Brazil in 1999 and Temuco, Chile in 2002. Participants come from the Americas as well as Africa, Asia, Australia, and Europe.

Persons willing to organize special sessions in any area of mechanics are welcome to contact the organizers listed below. All the future announcements will be made at the website listed above, and through the AAM (http://www.AAMech.org/). Four-page papers for the conference proceedings will be due June 30, 2003, at either address:

Latin American Co-Chairman
Prof. Reinaldo Rodríguez-Ramos
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IUTAM Symposium On Integrated Modeling of Fully Coupled Fluid-Structure Interactions Using Analysis, Computations, and Experiments

1 June-6 June 2003
New Brunswick, New Jersey USA

http://cronos.rutgers.edu/~mechaero/iutam

Chairs:
Haym Benaroya and Timothy Wei, *Rutgers University*, New Jersey
benaroya@rci.rutgers.edu and twei@rci.rutgers.edu
Scientific Committee
Peter Bearman, *Imperial College of Science*, Technology and Medicine, UK
Earl Dowell, *Duke University*, North Carolina
Helmut Eckelmann, *Georg-August-Universität*, Germany
Peter Monkewitz, *IMHEF-EPFL*, Switzerland
Michael Païdoussis, *McGill University*, Canada
John Sheridan, *Monash University*, Australia
H.K. Moffatt, *Isaac Newton Institute for Mathematical Sciences*, UK

This Symposium will provide a forum for the latest thinking in analytical, computational and experimental modeling of structures interacting with fluid environments. The specific objective is to provide a structured format in which meaningful and lasting dialogues can be facilitated between leading researchers in the different component disciplines. It is intended that, through these dialogues, multidisciplinary linkages will be established leading to integrated approaches to modeling the complex, nonlinear interactions between fluids and structures. Examples of classes of interactions that may be addressed in this Symposium include ocean structures, fluid conveying structures, and aerospace structures. The energy transfer processes are inherently nonlinear in all aspects of the behavior. The important class of vortex-induced oscillations has regions of lock-in, where the structural natural frequencies rather than the fluid velocity govern the shedding, and there exists hysteretic behavior. The real fluid-structure system is one of complex exchanges of forces and energies, resulting in highly nonlinear behaviors. The ability to model, solve and test fully coupled fluid-structure systems portends a rich and profound understanding. In fact, recent research efforts have indeed started to focus on the development of fully coupled models. This Symposium is therefore a response to these new and exciting developments in the field. By bringing together a critical mass of key researchers in each discipline, and organizing the program to focus on multidisciplinary problem solving, this process of developing fully coupled fluid-structure interaction research programs can be reinforced and enhanced. We look forward to receiving abstracts for review, presentation, and eventual full publication, of topics that fall within the broad framework defined above.

DEADLINES

Submission of Abstracts: 1 February 2003
Notification of Acceptance: 15 March 2003
Hotel & Symposium Registration: 1 May 2003
Symposium: Sunday 1 June – Friday 6 June 2003
Final Manuscripts Due: Friday 13 June 2003 (FIRM)

FOURTH INTERNATIONAL SYMPOSIUM ON VIBRATIONS OF CONTINUOUS SYSTEMS

The Fourth International Symposium on Vibrations of Continuous Systems will take place in Keswick, England, July 7-11, 2003. The primary goal of this Symposium is to bring together outstanding experts in the field of vibrations of continuous systems from all over the world, to discuss technical topics in a very informal atmosphere. As before, participation will be by invitation only, and will be limited to maximum numbers of 50 participants and 40 presentations.

The Symposium is devoted to the vibrations of continuous systems (e.g. strings, rods, straight and curved beams, membranes, plates, shells, and three-dimensional bodies). Examples of topics to be considered include: free and forced vibration, linear and nonlinear vibration, undamped and damped vibration, fluid-structure interaction, and structural elements of composite material.

The Symposium location, Keswick, is in the heart of the Lake District of northwestern England, famous for its beautiful lakes and hills. Typical days at the Symposium will consist of morning hikes or bus excursions, presentation sessions in the afternoons, and social gathering times in the evenings. The outings and social gatherings have proved to be excellent ways of generating relaxed and informal technical discussions and friendships which have been of great value to ongoing research.

Individuals who are interested in taking part in this Symposium should write to:

Professor Arthur W. Leissa
General Chairman, ISVCS IV
Dept. of Mechanical Engineering
206 West 18th Ave.
Ohio State University
Columbus, Ohio 43210
USA

Letters should be accompanied by a one-page summary of the writer's research accomplishments (include a list of published books, papers, reports, etc.) in the theme of this Symposium.

SELECTIONS OF THE EDITOR

ON THE PATH OF PROGRESS IN THE THEORY OF ELASTIC STABILITY

Luis A. Godoy [1]

This is a summary of the topics covered in a 25-page paper published in Spanish in a previous issue of Mechanics (Volume 31, Number 3-4, March-April 2002). For detailed arguments, please refer to the original paper.

Several philosophers of science have studied the structure of scientific theories in order to explain the way in which theoretical changes occur in science. Among the most notable of such philosophers are Thomas S. Kuhn (1922-1996), who developed the new concept of scientific paradigm and considered the role of scientific revolutions; Imre Lakatos (1922-1974), who studied scientific progress in terms of programs of scientific research; and Larry Laudan, who emphasized traditions and utility in order to explain changes between theories. The center of this discussion is, to a great extent, about the rationality that drives scientists when they change from an old theory to a new one.

This paper addresses the question if such models of change of scientific theories are adequate for all fields of research and for all periods of history, and more specifically, if they are adequate for applied mechanics in the 20th century. According to Kuhn, there are universal patterns that explain a shift in paradigm in science. However, the examples considered by Kuhn were taken from Physics and Astronomy during the passage from the Middle Ages to the Renaissance. There has been some criticism to this universal approach, mainly from researchers in Biology. Mayr points out that philosophers of science pay too much attention to scientific discoveries and tend to neglect the importance of changes in scientific concepts.

The education of engineers during their doctoral studies is enriched in some cases by courses on epistemology; however, this subject is usually taught by philosophers of science in a traditional way, and it is expected that the doctoral student should find the relevance of the subject and transfer topics to his/her own discipline. Such a knowledge transfer process is often beyond the possibilities of most students.

This paper is motivated by a shortage of references on the philosophy of applied mechanics, which would help graduate students to learn about the construction of knowledge and the evolution of theories in their own field. Specifically, the theory of elastic stability is considered in order to understand the significance of changes that occurred mainly during the first part of the XX century. This is an interesting case, which illustrates the differences between searching for a "thing" (the buckling load) versus searching for a "process" (the passage from critical to post-critical equilibrium states).

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The paper reviews the classical theory of elastic stability using the books of S. Timoshenko (the two editions, 1936 and 1961) as representative of the state of the art. A crisis in the theory occurred due to the anomalous behavior of cylindrical shells under axial load, and this led to a lack of confidence in the accumulated theoretical knowledge, so that for some time engineers relied almost exclusively in experiments to evaluate buckling loads in many structural forms.

A transition period is identified between 1935 and 1960, in which several attempts were made to reconcile theory and experiments. But it was not until the work of W. T. Koiter became known and understood that a new paradigm was established in the sense of Kuhn. Many concepts that were already present in the classical theory were still present in Koiter's approach, and many elements that were developed during the transition period were incorporated; however, Koiter developed a new conceptual system and introduced new methodologies for the analysis. The new theory did not gain immediate acceptance and was severely questioned for a number of years. Anomalies were also found for which the theory did not have a complete solution; however, such anomalies did not undermine the new theoretical framework.

This paper argues that the theory of change due to Kuhn does not seem to reflect adequately the changes that occurred due to the passage from the classical theory of stability to the initial postcritical theory postulated by Koiter. There was never a complete abandonment of the classical theory due to a mass immigration to the new theory; an extinction of the old theory never occurred; and there was no need to translate the old terms into new ones, as Kuhn expects. It is concluded that the alternative approach by Lakatos, who emphasized more rational aspects of the conceptual change, may be more applicable to the field of applied mechanics.

Prof. Luis A. Godoy obtained his Ph. D. from University College London in 1979 for his work supervised by Prof. J. G. A. Croll. Since then he developed his career with positions of Professor at the National University of Cordoba in Argentina, Researcher of the Science Research Council of Argentina (CONICET), and Professor of the University of Puerto Rico at Mayaguez. Prof. Godoy has been an AAM member since 1984, and participated in the organization of two PACAM congresses as editor of the proceedings: in Buenos Aires (1995) and in San Juan (1997). He is the author of two books: "Thin-Walled Structures with Structural Imperfections" (Pergamon Press, 1996) and "Theory of Elastic Stability" (Taylor and Francis, 2000), and about 100 journal papers in applied mechanics and structural engineering.

XV

FLOW PHYSICS IN MICRODEVICES

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(Excerpted from Chapter 4 of *The Handbook of MEMS*, M. Gad-el-Hak, editor,
CRC Press, Boca Raton, Florida, 2002)

Abstract

Manufacturing processes that can create extremely small machines have been developed in recent years. Microelectromechanical systems (MEMS) refer to devices that have characteristic length of less than 1 mm but more than 1 micron, that combine electrical and mechanical components and that are fabricated using integrated circuit batch-processing techniques. Electrostatic, magnetic, pneumatic and thermal actuators, motors, valves, gears and tweezers of less than 100 µm size have been fabricated. These have been used as sensors for pressure, temperature, mass flow, velocity and sound, as actuators for linear and angular motions, and as simple components for complex systems such as micro-heat-engines and micro-heat-pumps. The technology is progressing at a rate that far exceeds that of our understanding of the unconventional physics involved in the operation as well as the manufacturing of those minute devices. The primary objective of this paper is to critically review the status of our understanding of fluid flow phenomena particular to microdevices. Continuum as well as molecular approaches to the problem will be surveyed.

1. Introduction

Tool making has always differentiated our species from all others on Earth. Aerodynamically correct wooden spears were carved by archaic Homo sapiens close to 400,000 years ago. Man builds things consistent with his size, typically in the range of two orders of magnitude larger or smaller than himself, as indicated in Figure 1. But humans have always striven to explore, build and control the extremes of length and time scales. In the voyages to Lilliput and Brobdingnag of Gulliver's Travels, Jonathan Swift speculated on the remarkable possibilities which diminution or magnification of physical dimensions provides. The Great Pyramid of Khufu was originally 147 m high when completed around 2600 B.C., while the Empire State Building constructed in 1931 is presently—after the addition of a television antenna mast in 1950—449 m high. At the other end of the spectrum of man-made artifacts, a dime is slightly less than 2 cm in diameter. Watchmakers have practiced the art of miniaturization since the thirteenth century. The invention of the microscope in the seventeenth century opened the way for direct observation of microbes and plant and animal cells. Smaller things were man-made in the latter half of this century. The transistor—invented in 1947—in today's integrated circuits has a size of 0.25 micron in production and approaches 50 nanometers in research laboratories. But what about the miniaturization of mechanical parts—machines—envisioned by Richard Feynman in a legendary lecture delivered in 1959?

Microelectromechanical systems refer to devices that have characteristic length of less than 1 mm but more than 1 micron, that combine electrical and mechanical components and that are fabricated using integrated circuit batch-processing technologies. Current manufacturing techniques for MEMS include surface silicon micromachining; bulk silicon micromachining; lithography, electrodeposition and plastic molding (or, in its original German, Lithographie Galvanoformung Abformung, LIGA); and electrodischarge machining (EDM).

MEMS are finding increased applications in a variety of industrial and medical fields, with a potential worldwide market in the billions of dollars. Accelerometers for automobile airbags, keyless entry systems, dense arrays of micromirrors for high-definition optical displays, scanning electron microscope tips to image single atoms, micro-heat-exchangers for cooling of electronic circuits, reactors for separating biological cells, blood analyzers and pressure sensors for catheter tips are but a few of current usage. Microducts are used in infrared detectors, diode lasers, miniature gas chromatographs and high-frequency fluidic control systems. Micropumps are used for ink jet printing, environmental testing and electronic cooling. Potential medical applications for small pumps include controlled delivery and monitoring of minute amount of medication, manufacturing of nanoliters of chemicals and development of artificial pancreas.

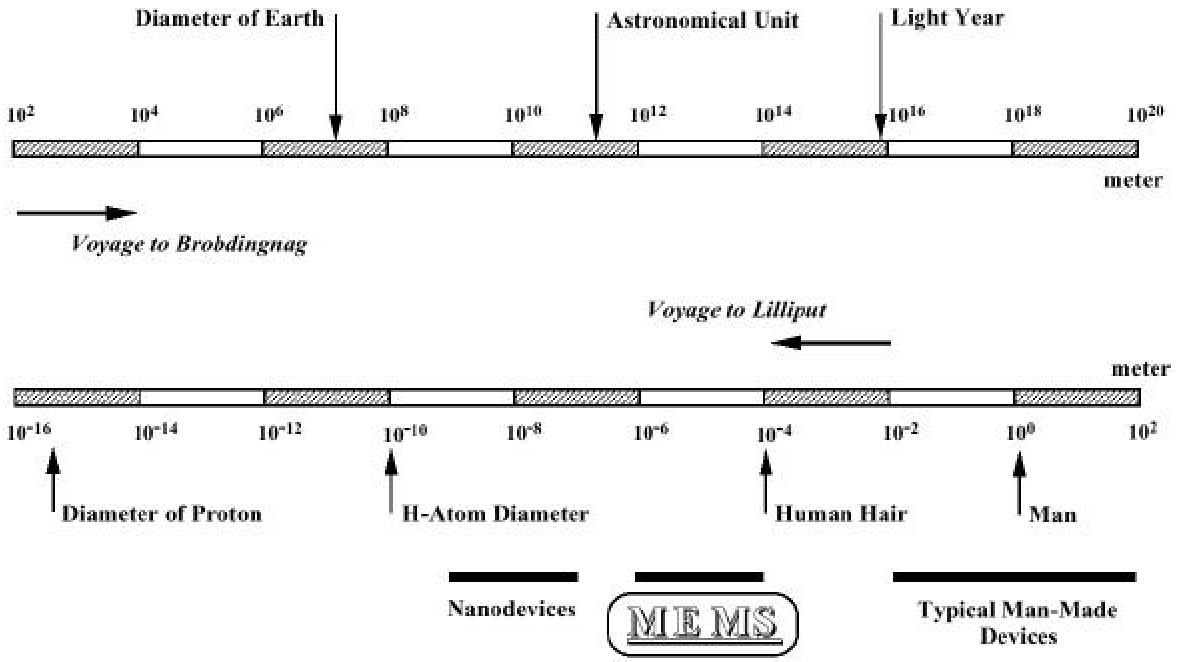

Figure 1: Scale of things, in meters. Lower scale continues in the upper bar from left to right. One meter is 10^6 microns, 10^9 nanometers, or 10^{10} Angstroms.

Not all MEMS devices involve fluid flows, but the present paper will focus on the ones that do. Microfluidics in this context refer to fluid flows in or around microdevices. Microducts, micropumps, microturbines and microvalves are examples of small devices involving the flow of liquids and gases. MEMS can also be related to fluid flows in an indirect way. The availability of inexpensive, batch-processing-produced microsensors and microactuators provides opportunities for targeting small-scale coherent structures in macroscopic turbulent shear flows. Flow control using MEMS promises a quantum leap in control system performance. Because of size limitation, the present paper only touches on its broad subject matter and the reader is referred to three other sources for further details (Gad-el-Hak, 1999; 2000; 2002). This paper is an abridged version of Chapter 4 of the handbook by Gad-el-Hak (2002). The book by Karniadakis and Beskok (2002) contains very useful information on the modeling of Microscale flows.

2. Fluid Mechanics Issues

The rapid progress in fabricating and utilizing microelectromechanical systems during the last decade has not been matched by corresponding advances in our understanding of the unconventional physics involved in the operation and manufacture of small devices. Providing such understanding is crucial to designing, optimizing, fabricating and operating improved MEMS devices.

Fluid flows in small devices differ from those in macroscopic machines. The operation of MEMS-based ducts, nozzles, valves, bearings, turbomachines, etc., cannot always be predicted from conventional flow models such as the Navier–Stokes equations with no-slip boundary condition at a fluid-solid interface, as routinely and successfully applied for larger flow devices. Many questions have been raised when the results of experiments with microdevices could not be explained via traditional flow modeling. The pressure gradient in a long microduct was observed to be non-constant and the measured flowrate was higher than that predicted from the conventional continuum flow model. Load capacities of microbearings were diminished and electric currents needed to move micromotors were extraordinarily high. The dynamic response of micromachined accelerometers operating at atmospheric conditions was observed to be over-damped.

In the early stages of development of this exciting new field, the objective was to build MEMS devices as productively as possible. Microsensors were reading something, but not many researchers seemed to know exactly what. Microactuators were moving, but conventional modeling could not precisely predict their motion. After a decade of unprecedented progress in MEMS technology, perhaps the time is now ripe to take stock, slow down a bit and answer the many questions that arose. The ultimate aim of this long-term exercise is to achieve rational-design capability for useful microdevices and to be able to characterize definitively and with as little empiricism as possible the operations of microsensors and microactuators.

In dealing with fluid flow through microdevices, one is faced with the question of which model to use, which boundary condition to apply and how to proceed to obtain solutions to the problem at hand. Obviously surface effects dominate in small devices. The surface-to-volume ratio for a machine with a characteristic length of 1 m is 1 m^{-1}, while that for a MEMS device having a size of 1 μm is 10^6 m^{-1}. The million-fold increase in surface area relative to the mass of the minute device substantially affects the transport of mass, momentum and energy through the surface. The small length-scale of microdevices may invalidate the continuum approximation altogether. Slip flow, thermal creep, rarefaction, viscous dissipation, compressibility, intermolecular forces and other unconventional effects may have to be taken into account, preferably using only first principles such as conservation of mass, Newton’s second law, conservation of energy, etc.

In this paper, I shall discuss continuum as well as molecular-based flow models, and the choices to be made. Computing typical Reynolds, Mach and Knudsen numbers for the flow through a particular device is a good start to characterize the flow. For gases, microfluid mechanics has been studied by incorporating slip boundary conditions, thermal creep, viscous dissipation as well as compressibility effects into the continuum equations of motion. Molecular-based models have also been attempted for certain ranges of the operating parameters. Use is made of the well-developed kinetic theory of gases, embodied in the Boltzmann equation, and direct simulation methods such as Monte Carlo. Microfluid mechanics of liquids is more complicated. The molecules are much more closely packed at normal pressures and temperatures, and the attractive or cohesive potential between the liquid molecules as well as between the liquid and solid ones plays a dominant role if the characteristic length of the flow is sufficiently small. In cases when the traditional continuum model fails to provide accurate predictions or postdictions, expensive molecular dynamics simulations seem to be the only first-principle approach available to rationally characterize liquid flows in microdevices. Such simulations are not yet feasible for realistic flow extent or number of molecules. As a consequence, the microfluid mechanics of liquids is much less developed than that for gases.

3. Fluid Modeling

There are basically two ways of modeling a flowfield. Either as the fluid really is—a collection of molecules—or as a continuum where the matter is assumed continuous and indefinitely divisible. The former modeling is subdivided into deterministic methods and probabilistic ones, while in the latter approach the velocity, density, pressure, etc., are defined at every point in space and time, and conservation of mass, energy and momentum lead to a set of nonlinear partial differential equations (Euler, Navier–Stokes, Burnett, etc.). Fluid modeling classification is depicted schematically in Figure 2.

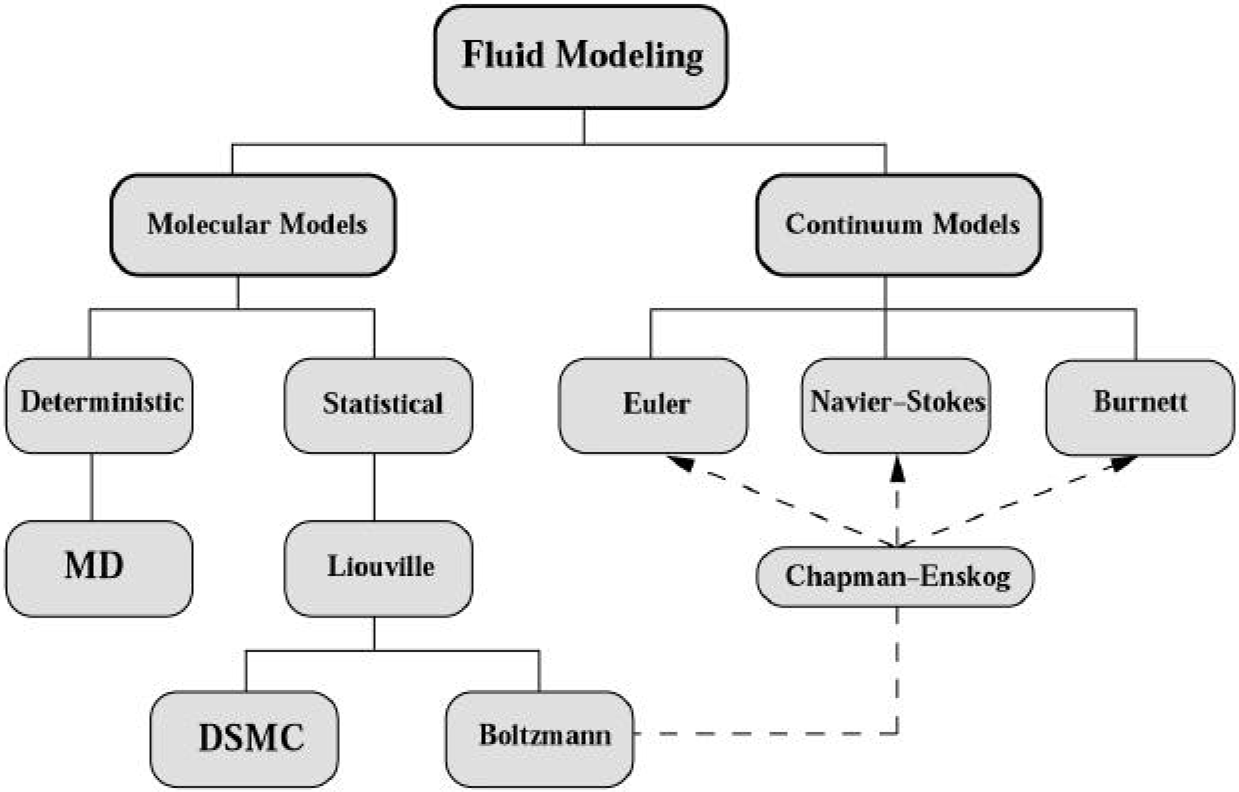

Figure 2: Molecular and continuum flow models.

The continuum model, embodied in the Navier–Stokes equations, is applicable to numerous flow situations. The model ignores the molecular nature of gases and liquids and regards the fluid as a continuous medium describable in terms of the spatial and temporal variations of density, velocity, pressure, temperature and other macroscopic flow quantities. For dilute gas flows near equilibrium, the Navier–Stokes equations are derivable from the molecularly-based Boltzmann equation, but can also be derived independently of that for both liquids and gases. In the case of direct derivation, some empiricism is necessary to close the resulting indeterminate set of equations. The continuum model is easier to handle mathematically (and is also more familiar to most fluid dynamicists) than the alternative molecular models. Continuum models should therefore be used as long as they are applicable. Thus, careful considerations of the validity of the Navier–Stokes equations and the like are in order.

Basically, the continuum model leads to fairly accurate predictions as long as local properties such as density and velocity can be defined as averages over elements large compared with the microscopic structure of the fluid but small enough in comparison with the scale of the macroscopic phenomena to permit the use of differential calculus to describe them. Additionally, the flow must not be too far from thermodynamic equilibrium. The former condition is almost always satisfied, but it is the latter which usually restricts the validity of the continuum equations. As will be seen in the following section, the continuum flow equations do not form a determinate set. The shear stress and heat flux must be expressed in terms of lower-order macroscopic quantities such as velocity and temperature, and the simplest (i.e. linear) relations are valid only when the flow is near thermodynamic equilibrium. Worse yet, the traditional no-slip boundary condition at a solid-fluid interface breaks down even before the linear stress–strain relation becomes invalid.

To be more specific, we temporarily restrict the discussion to gases where the concept of mean free path is well defined. Liquids are more problematic and we refer the reader to Gad-el-Hak (1999) for more details. For gases, the mean free path L is the average distance traveled by molecules between collisions. For an ideal gas modeled as rigid spheres, the mean free path is related to temperature T and pressure p as follows

$$L = \frac{1}{\sqrt{2}\, p\, n\, s^{2}} = \frac{k\, T}{\sqrt{2}\, p\, p\, s^{2}} \qquad (1)$$

where n is the number density (number of molecules per unit volume), s is the molecular diameter, and k is the Boltzmann constant (1.38×10^{-23} J/K.molecule).

The Navier–Stokes equations are valid when L is much smaller than a characteristic flow dimension L. As this condition is violated, the flow is no longer near equilibrium and the linear relation between stress and rate of strain and the no-slip velocity condition are no longer valid. Similarly, the linear relation between heat flux and temperature gradient and the no-jump temperature condition at a solid-fluid interface are no longer accurate when L is not much smaller than L.

The length-scale L can be some overall dimension of the flow, but a more precise choice is the scale of the gradient of a macroscopic quantity, as for example the density r,

$$L = \frac{r}{\left|\frac{\P r}{\P y}\right|} \qquad (2)$$

The ratio between the mean free path and the characteristic length is known as the Knudsen number

$$Kn = \frac{\mathrm{L}}{L} \qquad (3)$$

and generally the traditional continuum approach is valid, albeit with modified boundary conditions, as long as $Kn < 0.1$.

There are two more important dimensionless parameters in fluid mechanics, and the Knudsen number can be expressed in terms of those two. The Reynolds number is the ratio of inertial forces to viscous ones

$$Re = \frac{v_o L}{n} \tag{4}$$

where v_o is a characteristic velocity, and n is the kinematic viscosity of the fluid. The Mach number is the ratio of flow velocity to the speed of sound

$$Ma = \frac{v_o}{a_o} \tag{5}$$

The Mach number is a dynamic measure of fluid compressibility and may be considered as the ratio of inertial forces to elastic ones. From the kinetic theory of gases, the mean free path is related to the viscosity as follows

$$n = \frac{m}{r} = \frac{1}{2} L \bar{v}_m \tag{6}$$

where m is the dynamic viscosity, and $\bar{v}_m$ is the mean molecular speed which is somewhat higher than the sound speed a_o,

$$\bar{v}_m = \sqrt{\frac{8}{p g}} \, a_o \tag{7}$$

where g is the specific heat ratio (i.e. the isentropic exponent). Combining Equations (3)–(7), we reach the required relation

$$Kn = \sqrt{\frac{p g}{2}} \, \frac{Ma}{Re} \tag{8}$$

In boundary layers, the relevant length-scale is the shear-layer thickness d, and for laminar flows

$$\frac{d}{L} \sim \frac{1}{\sqrt{Re}} \tag{9}$$

$$Kn \sim \frac{Ma}{Re_d} \sim \frac{Ma}{\sqrt{Re}} \tag{10}$$

where Re_d is the Reynolds number based on the freestream velocity v_o and the boundary layer thickness d, and Re is based on v_o and the streamwise length-scale L.

Rarefied gas flows are in general encountered in flows in small geometries such as MEMS devices and in low-pressure applications such as high-altitude flying and high-vacuum gadgets. The local value of Knudsen number in a particular flow determines the degree of rarefaction and the degree of validity of the continuum model. The different Knudsen number regimes are determined empirically and are therefore only approximate for a particular flow geometry. The pioneering experiments in rarefied gas dynamics were conducted by Knudsen in 1909. In the limit of zero Knudsen number, the transport terms in the continuum momentum and energy equations are negligible and the Navier–Stokes equations then reduce to the inviscid Euler equations. Both heat conduction and viscous diffusion and dissipation are negligible, and the flow is then approximately isentropic (i.e. adiabatic and reversible) from the continuum viewpoint while the equivalent molecular viewpoint is that the velocity distribution function is everywhere of the local equilibrium or Maxwellian form. As Kn increases, rarefaction effects become more important, and eventually the continuum approach breaks down altogether. The different Knudsen number regimes are depicted in Figure 3.

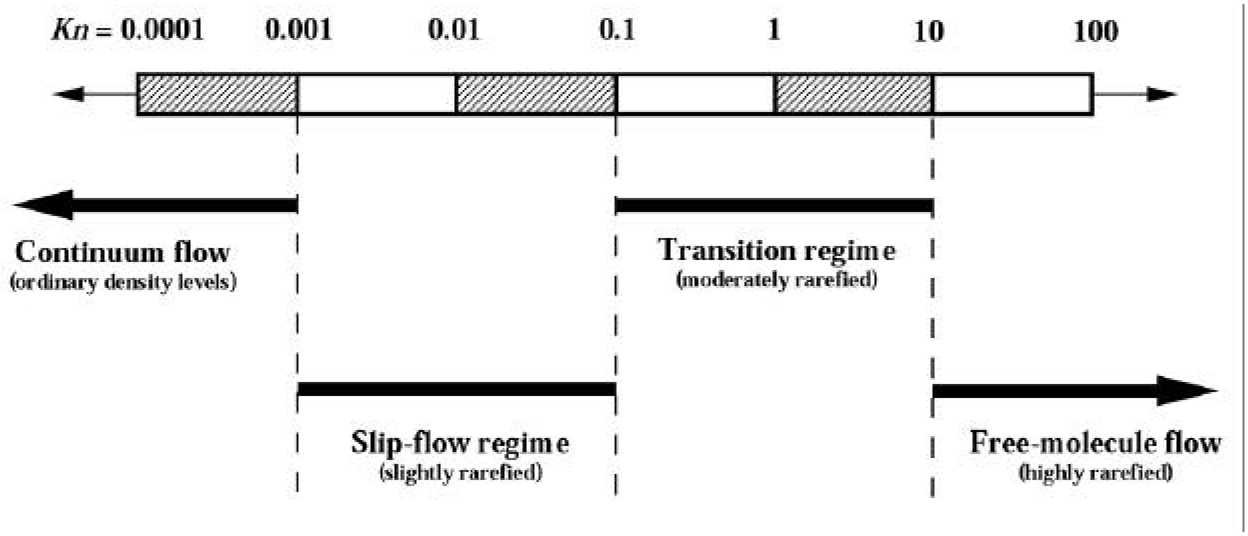

Figure 3: Knudsen number regimes.

As an example, consider air at standard temperature (*T*=288 K) and pressure ($p = 1.01 \times 10^5$ N/m^2). A cube one micron on a side contains 2.54×10^7 molecules separated by an average distance of 0.0034 micron. The gas is considered dilute if the ratio of this distance to the molecular diameter exceeds 7, and in the present example this ratio is 9, barely satisfying the dilute gas assumption. The mean free path computed from Equation (1) is L =0.065 µm. A microdevice with characteristic length of 1 µm would have *Kn*=0.065, which is in the slip-flow regime. At lower pressures, the Knudsen number increases. For example, if the pressure is 0.1 atm and the temperature remains the same, *Kn*=0.65 for the same 1 µm device, and the flow is then in the transition regime. There would still be over 2 million molecules in the same one-micron cube, and the average distance between them would be 0.0074 µm. The same device at 100 km altitude would have $Kn = 3 \times 10^4$, well into the free-molecule flow regime. Knudsen number for the flow of a light gas like helium is about 3 times larger than that for air flow at otherwise the same conditions.

Consider a long microchannel where the entrance pressure is atmospheric and the exit conditions are near vacuum. As air goes down the duct, the pressure and density decrease while the velocity, Mach number and Knudsen number increase. The pressure drops to overcome viscous forces in the channel. If isothermal conditions prevail, density also drops and conservation of mass requires the flow to accelerate down the constant-area tube. The fluid acceleration in turn affects the pressure gradient, resulting in a nonlinear pressure drop along the channel. The Mach number increases down the tube, limited only by choked-flow condition *Ma*=1. Additionally, the normal component of velocity is no longer zero. With lower density, the mean free path increases and *Kn* correspondingly increases. All flow regimes depicted in Figure 3 may occur in the same tube: continuum with no-slip boundary conditions, slip-flow regime, transition regime and free-molecule flow. The air flow may also change from incompressible to compressible as it moves down the microduct. A similar scenario may take place if the entrance pressure is, say, 5 atm, while the exit is atmospheric. This deceivingly simple duct flow may in fact manifest every single complexity discussed in this section. In the following four sections, we discuss in turn the

Navier–Stokes equations, compressibility effects, boundary conditions, and molecular-based models.

4. Continuum Model

We recall in this section the traditional conservation relations in fluid mechanics. A concise derivation of these equations can be found in Gad-el-Hak (2000). In here, we re-emphasize the precise assumptions needed to obtain a particular form of the equations. A continuum fluid implies that the derivatives of all the dependent variables exist in some reasonable sense. In other words, local properties such as density and velocity are defined as averages over elements large compared with the microscopic structure of the fluid but small enough in comparison with the scale of the macroscopic phenomena to permit the use of differential calculus to describe them. As mentioned earlier, such conditions are almost always met. For such fluids, and assuming the laws of non-relativistic mechanics hold, the conservation of mass, momentum and energy can be expressed at every point in space and time as a set of 5 partial differential equations as for 17 unknowns. Obviously, the continuum flow equations do not form a determinate set. To close the conservation equations, relation between the stress tensor and deformation rate, relation between the heat flux vector and the temperature field and appropriate equations of state relating the different thermodynamic properties are needed.

The stress–rate of strain relation and the heat flux–temperature gradient relation are approximately linear if the flow is not too far from thermodynamic equilibrium. This is a phenomenological result but can be rigorously derived from the Boltzmann equation for a dilute gas assuming the flow is near equilibrium. The resulting 6 equations in 6 unknown together with sufficient number of initial and boundary conditions constitute a well-posed, albeit formidable, problem. The system of equations is an excellent model for the laminar or turbulent flow of most fluids such as air and water under many circumstances, including high-speed gas flows for which the shock waves are thick relative to the mean free path of the molecules.

Considerable simplification is achieved if the flow is assumed incompressible, usually a reasonable assumption provided that the characteristic flow speed is less than 0.3 of the speed of sound. The incompressibility assumption is readily satisfied for almost all liquid flows and many gas flows. In such cases, the density is assumed either a constant or a given function of temperature (or species concentration).

5. Compressibility

The issue of whether to consider the continuum flow compressible or incompressible seems to be rather straightforward, but is in fact full of potential pitfalls. If the local Mach number is less than 0.3, then the flow of a compressible fluid like air can—according to the conventional wisdom—be treated as incompressible. But the well-known $Ma < 0.3$ criterion is only a necessary not a sufficient one to allow a treatment of the flow as approximately incompressible. In other words, there are situations where the Mach number can be exceedingly small while the flow is compressible. As is well documented in heat transfer textbooks, strong wall heating or cooling may cause the density to change sufficiently and the incompressible approximation to break down, even at low speeds. Less known is the situation encountered in some microdevices where the pressure may strongly change due to viscous effects even though the speeds may not be high enough for the Mach number to go above the traditional threshold of 0.3. Corresponding to the pressure changes would be strong density changes that must be taken into account when writing the continuum equations of motion.

Experiments in gaseous microducts confirm the above arguments. For both low- and high-Mach-number flows, pressure gradients in long microchannels are non-constant, consistent with the compressible flow equations.

There are three additional scenarios in which significant pressure and density changes may take place without inertial, viscous or thermal effects. First is the case of quasi-static compression/expansion of a gas in, for example, a piston-cylinder arrangement. The resulting compressibility effects are, however, compressibility of the fluid and not of the flow. Two other situations where compressibility effects must also be considered are problems with length-scales comparable to the scale height of the atmosphere and rapidly varying flows as in sound propagation.

6. Boundary Conditions

The continuum equations of motion described earlier require a certain number of initial and boundary conditions for proper mathematical formulation of flow problems. In this section, we describe the boundary conditions at a fluid-solid interface. Boundary conditions in the inviscid flow theory pertain only to the velocity component normal to a solid surface. The highest spatial derivative of velocity in the inviscid equations of motion is first-order, and only one velocity boundary condition at the surface is admissible. The normal velocity component at a fluid-solid interface is specified, and no statement can be made regarding the tangential velocity component. The normal-velocity condition simply states that a fluid-particle path cannot go through an impermeable wall. Real fluids are of course viscous and the corresponding momentum equation has second-order derivatives of velocity, thus requiring an additional boundary condition on the velocity component tangential to a solid surface.

Traditionally, the no-slip condition at a fluid-solid interface is enforced in the momentum equation and an analogous no-temperature-jump condition is applied in the energy equation. The notion underlying the no-slip/no-jump condition is that within the fluid there cannot be any finite discontinuities of velocity/temperature. Those would involve infinite velocity/temperature gradients and so produce infinite viscous stress/heat flux that would destroy the discontinuity in infinitesimal time. The interaction between a fluid particle and a wall is similar to that between neighboring fluid particles, and therefore no discontinuities are allowed at the fluid-solid interface either. In other words, the fluid velocity must be zero relative to the surface and the fluid temperature must equal to that of the surface. But strictly speaking those two boundary conditions are valid only if the fluid flow adjacent to the surface is in thermodynamic equilibrium. This requires an infinitely high frequency of collisions between the fluid and the solid surface. In practice, the no-slip/no-jump condition leads to fairly accurate predictions as long as $Kn < 0.001$ (for gases). Beyond that, the collision frequency is simply not high enough to ensure equilibrium and a certain degree of tangential-velocity slip and temperature jump must be allowed. This is a case frequently encountered in MEMS flows, and we develop the appropriate relations in this section.

Assuming isothermal conditions prevail, the above slip relation has been rigorously derived by Maxwell (1879) from considerations of the kinetic theory of dilute, monatomic gases. Gas molecules, modeled as rigid spheres, continuously strike and reflect from a solid surface, just as they continuously collide with each other. For an idealized perfectly smooth wall (at the molecular scale), the incident angle exactly equals the reflected angle and the molecules conserve their tangential momentum and thus exert no shear on the wall. This is termed specular reflection and results in perfect slip at the wall. For an extremely rough wall, on the other hand, the molecules reflect at some random angle uncorrelated with their entry angle. This perfectly diffuse reflection results in zero tangential-momentum for the reflected fluid molecules to be balanced by a finite slip velocity in order to account for the shear stress transmitted to the wall. A force balance near the wall leads to the following expression for the slip velocity

$$u_{gas} - u_{wall} = L \left.\frac{\partial u}{\partial y}\right|_w \qquad (11)$$

where L is the mean free path. The right-hand side can be considered as the first term in an infinite Taylor series, sufficient if the mean free path is relatively small enough. The equation above states that significant slip occurs only if the mean velocity of the molecules varies appreciably over a distance of one mean free path. This is the case, for example, in vacuum applications and/or flow in microdevices. The number of collisions between the fluid molecules and the solid in those cases is not large enough for even an approximate flow equilibrium to be established. Furthermore, additional (nonlinear) terms in the Taylor series would be needed as L increases and the flow is further removed from the equilibrium state.

For real walls some molecules reflect diffusively and some reflect specularly. In other words, a portion of the momentum of the incident molecules is lost to the wall and a (typically smaller) portion is retained by the reflected molecules. The tangential-momentum-accommodation coefficient σ_v is defined as the fraction of molecules reflected diffusively. This coefficient depends on the fluid, the solid and the surface finish, and has been determined experimentally to be between 0.2–0.8, the lower limit being for exceptionally smooth surfaces while the upper limit is typical of most practical surfaces. The final expression derived by Maxwell for an isothermal wall reads

$$u_{gas} - u_{wall} = \frac{2-\sigma_v}{\sigma_v} L \left.\frac{\partial u}{\partial y}\right|_w \qquad (12)$$

For $\sigma_v = 0$, the slip velocity is unbounded, while for $\sigma_v = 1$, Equation (12) reverts to (11). Similar arguments were made for the temperature-jump boundary condition by von Smoluchowski (1898).

7. Molecular-Based Models

In the continuum models discussed thus far, the macroscopic fluid properties are the dependent variables while the independent variables are the three spatial coordinates and time. The molecular models recognize the fluid as a myriad of discrete particles: molecules, atoms, ions and electrons. The goal here is to determine the position, velocity and state of all particles at all times. The molecular approach is either deterministic or probabilistic (refer to Figure 2). Provided that there is a sufficient number of microscopic particles within the smallest significant volume of a flow, the macroscopic properties at any location in the flow can then be computed from the discrete-particle information by a suitable averaging or weighted averaging process. The present section discusses molecular-based models and their relation to the continuum models previously considered.

The most fundamental of the molecular models is a deterministic one. The motion of the molecules are governed by the laws of classical mechanics, although, at the expense of greatly complicating the problem, the laws of quantum mechanics can also be considered in special circumstances. The modern molecular dynamics computer simulations (MD) have been pioneered by Alder and Wainwright (1957; 1958; 1970) and reviewed by Ciccotti and Hoover (1986), Allen and Tildesley (1987), Haile (1993) and Koplik and Banavar (1995). The simulation begins with a set of N molecules in a region of space, each assigned a random velocity corresponding to a Boltzmann distribution at the temperature of interest. The interaction between the particles is prescribed typically in the form of a two-body potential energy and the time evolution of the molecular positions is determined by integrating Newton's equations of motion. Because MD is based on the most basic set of equations, it is valid in principle for any flow extent and any range of parameters. The method is straightforward in principle but there are two hurdles: choosing a proper and convenient potential for particular fluid and solid combinations, and the colossal computer resources required to simulate a reasonable flowfield extent.

For purists, the former difficulty is a sticky one. There is no totally rational methodology by which a convenient potential can be chosen. Part of the art of MD is to pick an appropriate potential and validate the simulation results with experiments or other analytical/computational results. A commonly used potential between two molecules is the generalized Lennard-Jones 6–12 potential.

The second difficulty, and by far the most serious limitation of molecular dynamics simulations, is the number of molecules N that can realistically be modeled on a digital computer. Since the computation of an element of trajectory for any particular molecule requires consideration of *all* other molecules as potential collision partners, the amount of computation required by the MD method is proportional to N^2. Some saving in computer time can be achieved by cutting off the weak tail of the potential at, say, $r_c = 2.5s$, and shifting the potential by a linear term in r so that the force goes smoothly to zero at the cutoff. As a result, only nearby molecules are treated as potential collision partners, and the computation time for N molecules no longer scales with N^2.

The state of the art of molecular dynamics simulations in the early 2000s is such that with a few hours of CPU time, general purpose supercomputers can handle around 100,000 molecules. At enormous expense, the fastest parallel machine available can simulate around 10 million particles. Because of the extreme diminution of molecular scales, the above translates into regions of liquid flow of about 0.02 μm (200 Angstroms) in linear size, over time intervals of around 0.001 μs, enough for continuum behavior to set in for simple molecules. To simulate 1 s of real time for complex molecular interactions, e.g. including vibration modes, reorientation of polymer molecules, collision of colloidal particles, etc., requires unrealistic CPU time measured in hundreds of years.

MD simulations are highly inefficient for dilute gases where the molecular interactions are infrequent. The simulations are more suited for dense gases and liquids. Clearly, molecular dynamics simulations are reserved for situations where the continuum approach or the statistical methods are inadequate to compute from first principles important flow quantities. Slip boundary conditions for liquid flows in extremely small devices is such a case and is discussed in Gad-el-Hak (1999).

An alternative to the deterministic molecular dynamics is the statistical approach where the goal is to compute the probability of finding a molecule at a particular position and state. If the appropriate conservation equation can be solved for the probability distribution, important statistical properties such as the mean number, momentum or energy of the molecules within an element of volume can be computed from a simple weighted averaging. In a practical problem, it is such average quantities that concern us rather than the detail for every single molecule. Clearly, however, the accuracy of computing average quantities, via the statistical approach, improves as the number of molecules in the sampled volume increases. The kinetic theory of dilute gases is well advanced, but that for dense gases and liquids is much less so due to the extreme complexity of having to include multiple collisions and intermolecular forces in the theoretical formulation.

In the statistical approach, the fraction of molecules in a given location and state is the sole dependent variable. The independent variables for monatomic molecules are time, the three spatial coordinates and the three components of molecular velocity. Those describe a 6-dimensional phase space. For diatomic or polyatomic molecules, the dimension of phase space is increased by the number of internal degrees of freedom. Orientation adds an extra dimension for molecules which are not spherically symmetric. Finally, for mixtures of gases, separate probability distribution functions are required for each species. Clearly, the complexity of the approach increases dramatically as the dimension of phase space increases. The simplest problems are, for example, those for steady, one-dimensional flow of a simple monatomic gas.

To simplify the problem we restrict the discussion here to monatomic gases having no internal degrees of freedom. Furthermore, the fluid is restricted to dilute gases and molecular chaos is assumed. The former restriction requires the average distance between molecules d to be an order of magnitude larger than their diameter s. That will almost guarantee that all collisions between molecules are binary collisions, avoiding the complexity of modeling multiple encounters. The molecular chaos restriction improves the accuracy of computing the macroscopic quantities from the microscopic information. In essence, the volume over which averages are computed has to have sufficient number of molecules to reduce statistical errors. It can be shown that computing macroscopic flow properties by averaging over a number of molecules will result in statistical fluctuations with a standard deviation of approximately 0.1% if one million molecules are used and around 3% if one thousand molecules are used. The molecular chaos limit requires the length-scale L for the averaging process to be at least 100 times the average distance between molecules (i.e. typical averaging over at least one million molecules).

Figure 4, adapted from Bird (1994), shows the limits of validity of the dilute gas approximation ($d/s > 7$), the continuum approach ($Kn < 0.1$, as discussed previously), and the neglect of statistical fluctuations ($L/d > 100$). Using a molecular diameter of $s = 4 \times 10^{-10}$ m as an example, the three limits are conveniently expressed as functions of the normalized gas density r/r_o or number density n/n_o, where the reference densities r_o and n_o are computed at standard conditions. All three limits are straight lines in the log-log plot of L versus r/r_o, as depicted in Figure 4. Note the shaded triangular wedge inside which both the Boltzmann and Navier–Stokes equations are valid. Additionally, the lines describing the three limits very nearly intersect at a single point. As a consequence, the continuum breakdown limit always lies between the dilute gas limit and the limit for molecular chaos. As density or characteristic dimension is reduced in a dilute gas, the Navier–Stokes model breaks down before the level of statistical fluctuations becomes significant. In a dense gas, on the other hand, significant fluctuations may be present even when the Navier–Stokes model is still valid.

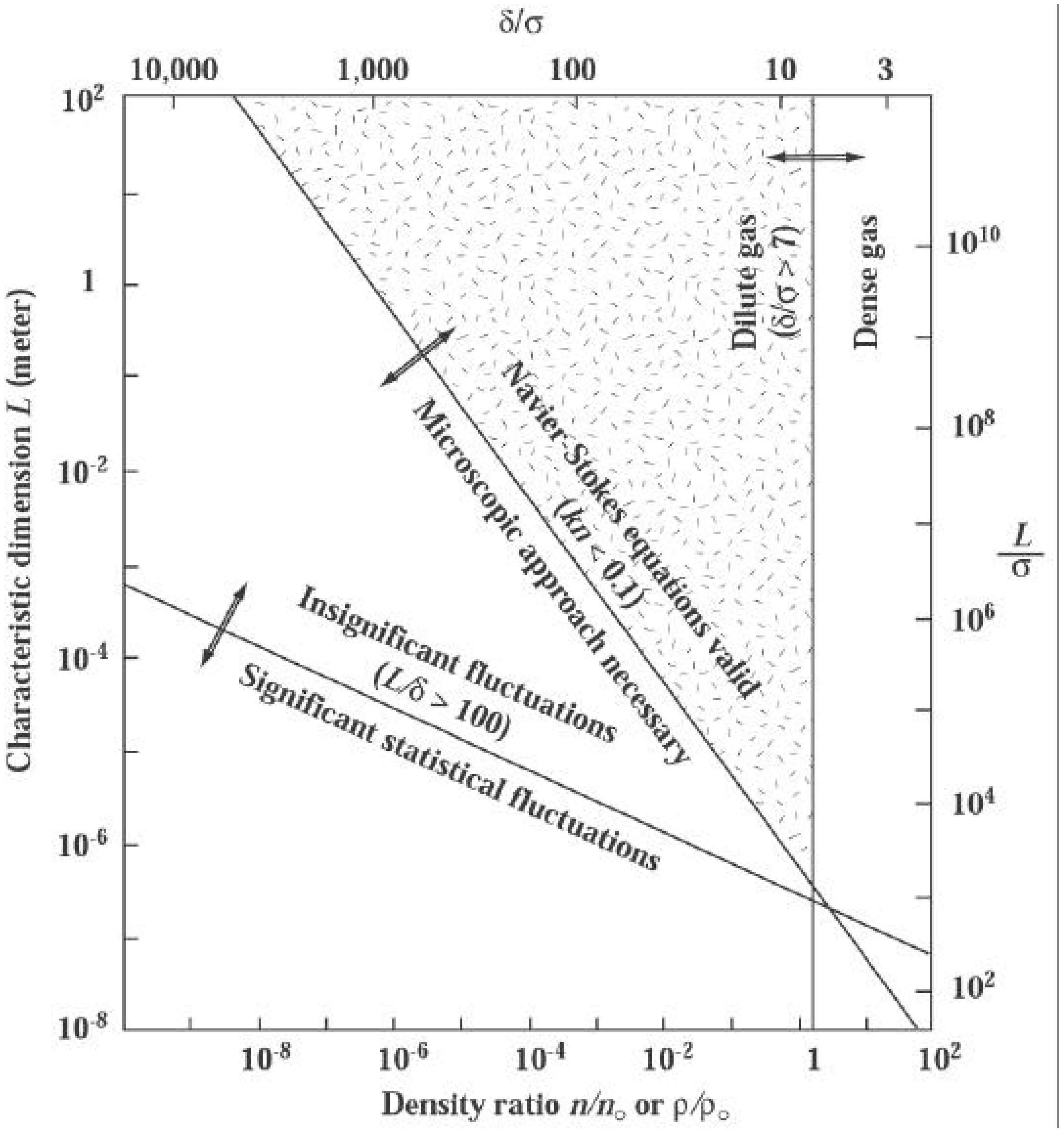

Figure 4: Effective limits of different flow models. From Bird (1994).

8. Summary

The traditional Navier–Stokes model of fluid flows with no-slip boundary conditions works only for a certain range of the governing parameters. This model basically demands two conditions. (1) The fluid is a continuum, which is almost always satisfied as there are usually more than one million molecules in the smallest volume in which appreciable macroscopic changes take place. This is the molecular chaos restriction. (2) The flow is not too far from thermodynamic equilibrium, which is satisfied if there is sufficient number of molecular encounters during a time period small compared to the smallest time-scale for flow changes. During this time period the average molecule would have moved a distance small compared to the smallest flow length-scale.

For gases, the Knudsen number determines the degree of rarefaction and the applicability of traditional flow models. As *Kn* tends to zero, the time- and length-scales of molecular encounters are vanishingly small compared to those for the flow, and the velocity distribution of each element of the fluid instantaneously adjusts to the equilibrium thermodynamic state appropriate to the local macroscopic properties as this molecule moves through the flow field. From the continuum viewpoint, the flow is isentropic and heat conduction and viscous diffusion and dissipation vanish from the continuum conservation relations, leading to the Euler equations of motion. At small but finite *Kn*, the Navier–Stokes equations describe near-equilibrium, continuum flows.

Gaseous flows are often compressible in microdevices even at low Mach numbers. Viscous effects can cause sufficient pressure drop and density changes for the flow to be treated as compressible. In a long, constant-area microduct, all Knudsen number regimes may be encountered and the degree of rarefaction increases along the tube. The pressure drop is nonlinear and the Mach number increases downstream, limited only by choked-flow condition.

Similar deviation and breakdown of the traditional Navier–Stokes equations occur for liquids as well, but there the situation is more murky. Existing experiments are contradictory. There is no kinetic theory of liquids, and first-principles prediction methods are scarce. Molecular dynamics simulations can be used, but they are limited to extremely small flow extents.

The material presented herein is but a very brief summary of a very broad area of research. Several phenomena particularly important in microdevices have not even been discussed, for example surface tension and electroosmotic effects. The reader is referred to the books by Gad-el-Hak (2002) and Karniadakis and Beskok (2002) to fill much of the missing details.

References

Alder, B.J., and Wainwright, T.E. (1957) "Studies in Molecular Dynamics," *J. Chemical Phys.* **27**, pp. 1208–1209.

Alder, B.J., and Wainwright, T.E. (1958) "Molecular Dynamics by Electronic Computers," in *Transport Processes in Statistical Mechanics*, ed. I. Prigogine, pp. 97–131, Interscience, New York.

Alder, B.J., and Wainwright, T.E. (1970) "Decay of the Velocity Auto-Correlation Function," *Phy. Rev. A* **1**, pp. 18–21.

Allen, M.P., and Tildesley, D.J. (1987) *Computer Simulation of Liquids*, Clarendon Press, Oxford, Great Britain.

Bird, G.A. (1994) *Molecular Gas Dynamics and the Direct Simulation of Gas Flows*, Clarendon Press, Oxford, Great Britain.

Ciccotti, G., and Hoover, W.G., editors (1986) *Molecular Dynamics Simulation of Statistical Mechanics Systems*, North Holland, Amsterdam, the Netherlands.

Gad-el-Hak, M. (1999) "The Fluid Mechanics of Microdevices—The Freeman Scholar Lecture," *J. Fluids Eng.* **121**, pp. 5–33.

Gad-el-Hak, M. (2000) *Flow Control: Passive, Active, and Reactive Flow Management*, Cambridge University Press, London, Great Britain.

Gad-el-Hak, M. (2002) *The MEMS Handbook*, CRC Press, Boca Raton, Florida.

Haile, J.M. (1993) *Molecular Dynamics Simulation: Elementary Methods*, Wiley, New York.

Karniadakis, G.Em, and Beskok, A. (2002) *Microflows: Fundamentals and Simulation*, Springer-Verlag, New York

Knudsen, M. (1909) “Die Gesetze der Molekularströmung und der inneren Reibungsströmung der Gase durch Röhren,” *Annalen der Physik* **28**, pp. 75–130.

Koplik, J., and Banavar, J.R . (1995) “Continuum Deductions from Molecular Hydroynamics,” *Annu. Rev. Fluid Mech.* **27**, pp. 257–292.

Maxwell, J.C. (1879) “On Stresses in Rarefied Gases Arising from Inequalities of Temperature,” *Phil. Trans. R. Soc. Part 1* **170**, pp. 231–256.

Von Smoluchowski, M. (1898) “Ueber Wärmeleitung in verdünnten Gasen,” *Annalen der Physik und Chemie* **64**, pp. 101–130.

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Carbon Nanotubes – the Route Toward Applications

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By Ray Baughman, Anvar Zakhidov, and Walt Heer

Many potential applications have been proposed for carbon nanotubes, including conductive and high-strength composites; energy storage and energy conversion devices; sensors; field emission displays and radiation sources; hydrogen storage media; and nanometer-sized semiconductor devices, probes, and interconnects. Some of these applications are now realized in products. Others are demonstrated in early to advanced devices, and one, hydrogen storage, is clouded by controversy. Nanotube cost, polydispersity in nanotube type, and limitations in processing and assembly methods are important barriers for some applications of single-walled nanotubes.

There are two main types of carbon nanotubes that can have high structural perfection. Single-walled nanotubes (SWNTs) consist of a single graphite sheet seamlessly wrapped into a cylindrical tube (Fig. 1, A to D). Multiwalled nanotubes (MWNTs) comprise an array of such nano-tubes that are concentrically nested like rings of a tree trunk (Fig. 1E).

Despite structural similarity to a single sheet of graphite, which is a semiconductor with zero band gap, SWNTs may be either metallic or semiconducting, depending on the sheet direction about which the graphite sheet is rolled to form a nanotube cylinder. This direction in the graphite sheet plane and the nanotube diameter are obtainable from a pair of integers (n, m) that denote the nanotube type (1). Depending on the appearance of a belt of carbon bonds around the nanotube diameter, the nanotube is either of the arm-chair ($n = m$), zigzag ($n = 0$ or $m = 0$), or chiral (any other n and m) variety. All arm-chair SWNTs are metals; those with $n – m = 3k$, where k is a nonzero integer, are semi-conductors with a tiny band gap; and all others are semiconductors with a band gap that inversely depends on the nanotube diameter (1).

The electronic properties of perfect MWNTs are rather similar to those of perfect SWNTs, because the coupling between the cylinders is weak in MWNTs. Because of the nearly one-dimensional electronic structure, electronic transport in metallic SWNTs and MWNTs occurs ballistically (i.e., without scattering) over long nanotube lengths, enabling them to carry high currents with essentially no heating (*2, 3*). Phonons also propagate easily along the nanotube: The measured room temperature thermal conductivity for an individual MWNT (>3000 W/m·K) is greater than that of natural diamond and the basal plane of graphite (both 2000 W/m·K) (4). Superconductivity has also been observed, but only at low temperatures, with transition temperatures of ~0.55 K for 1.4-nm-diameter SWNTs (5) and ~5 K for 0.5-nm-diameter SWNTs grown in zeolites (6).

Small-diameter SWNTs are quite stiff and exceptionally strong, meaning that they have a high Young's modulus and high tensile strength. Literature reports of these mechanical parameters can be confusing, because some authors use the total occupied cross-sectional area and others use the much smaller van der Waals area for defining Young's modulus and tensile strength. With the total area per nanotube in a nanotube bundle for normalizing the applied force to obtain the applied stress, the calculated Young's modulus for an individual (10, 10) nanotube is ~0.64 TPa (*7*), which is consistent with measurements (*8*). Because small-diameter nanotube ropes have been extended elastically by ~5.8% before breaking, the SWNT strength calculated from the product of this strain and modulus is ~37 GPa (*8, 9*), which is close to the maximum strength of silicon carbide nanorods (~53 GPa) (*10*). This modulus of ~0.64 TPa is about the same as that of silicon carbide nanofibers (~0.66 TPa) but lower than that of highly oriented pyrolytic graphite (~1.06 TPa) (10). More impressive and important for applications needing light structural materials, the density-normalized modulus and strength of this typical SWNT are, respectively, ~19 and ~56 times that of steel wire and, respectively, ~2.4 and ~1.7 times that of silicon carbide nanorods (*10*). The challenge is to achieve these properties of individual SWNTs in nanotube assemblies found in sheets and continuous fibers.

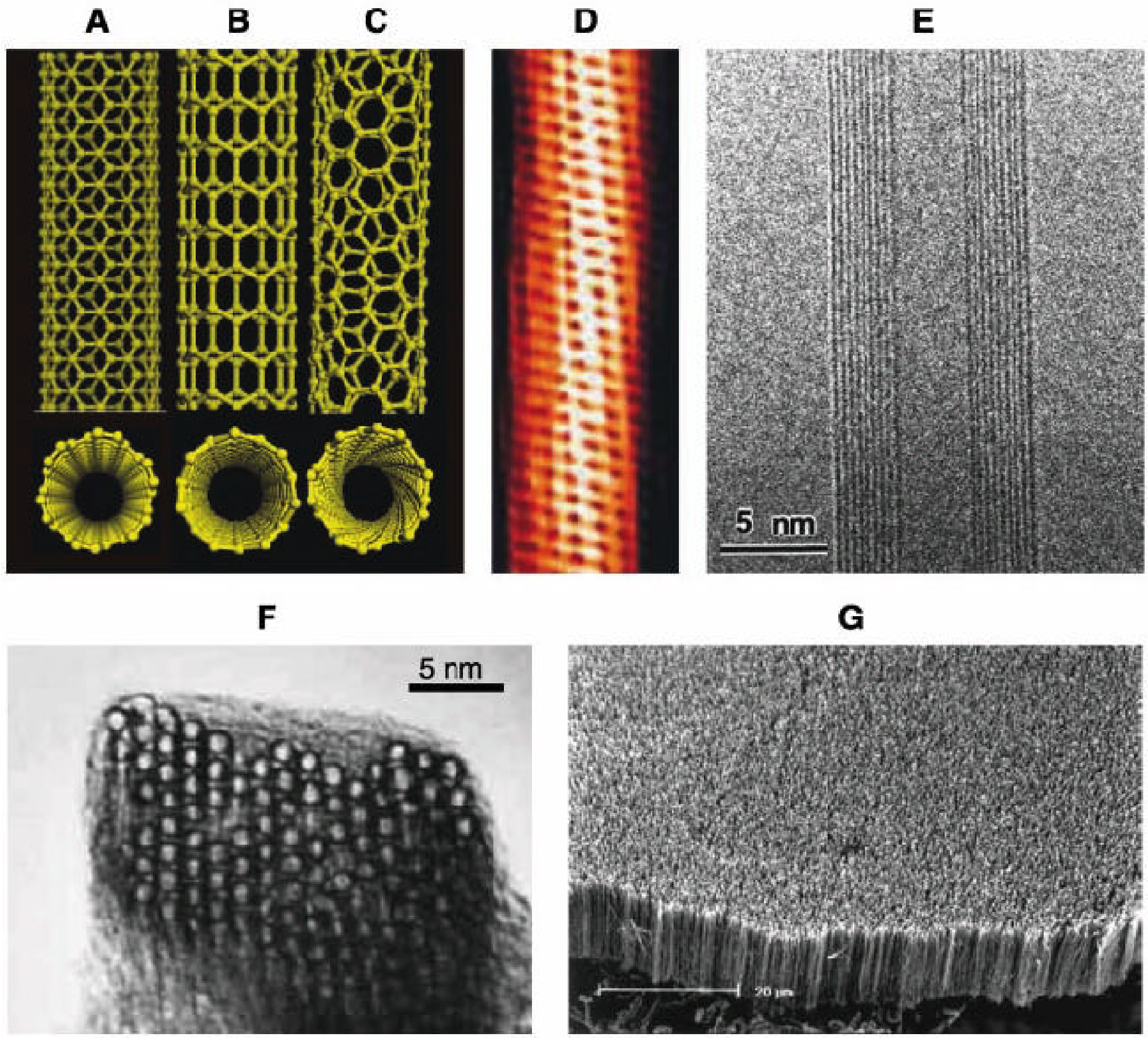

Fig.1.Schematic illustrations of the structures of **(A)** armchair**, (B)** zigzag, and **(C)** chiral SWNTs. Projections normal to the tube axis and perspective views along the tube axis are on the top and bottom, respectively. **(D)** Tunneling electron microscope image (*72*) showing the helical structure of a 1.3-nm-diameter chiral SWNT. **(E)** Transmission electron microscope (TEM) image of a MWNT containing a concentrically nested array of nine SWNTs. **(F)** TEM micrograph (18) showing the lateral packing of 1.4-nm-diameter SWNTs in a bundle. **(G)** Scanning electron microscope (SEM) image of an array of MWNTs grown as a nanotube forest (micrograph courtesy of L.Dai).

Nanotube Synthesis and Processing

SWNTs and MWNTs are usually made by carbon-arc discharge, laser ablation of carbon, or chemical vapor deposition (typically on catalytic particles) (*11*). Nanotube diameters range from ~0.4 to >3 nm for SWNTs and from ~1.4 to at least 100 nm for MWNTs (*6, 11*). Nanotube properties can thus be tuned by changing the diameter. Unfortunately, SWNTs are presently produced only on a small scale and are extremely expensive: High-purity samples cost about \$750/g, and samples containing substantial amounts of impurities cost about \$60/g (*12*). Many researchers have depended on production facilities started by Rick Smalley of Rice University for purified SWNTs, on laser ablation– produced nanotubes, and now on the high-pressure carbon monoxide (HiPco) nanotubes of Carbon Nanotechnology, Inc. (CNI). CNI "hopes to make around 9 kilograms a day by 2002, and could be turning out thousands of kilograms per week by 2004" (*13*, p. 144); it is hoped that this will bring the price down.

All currently known synthesis methods for SWNTs result in major concentrations of impurities. Carbon-coated metal catalyst contaminates the nanotubes of the HiPco route, and both carbon-coated metal catalyst and, typically, ~60% forms of carbon other than nanotubes are formed in the carbon-arc route (*11*). These impurities are typically removed by acid treatment, which introduces other impurities, can degrade nanotube length and perfection, and adds to nanotube cost. Another problem, especially for electronic devices, is that the usual synthetic routes result in mixtures of various semiconducting and metallic nanotubes. Metallic SWNTs can be selectively destroyed by electrical heating, so that only the semiconducting nanotubes needed for nanotube field-effect transistors (NT-FETs) survive (*14*). However, no route to substantial quantities of SWNTs of one type is yet known.

Commercial access to MWNTs is less problematic. Hyperion Catalysis International, Inc., pioneered the production of MWNTs in multiton quantities in the early 1990s. However, these nanotubes have not been widely available to and used by researchers, because Hyperion has generally sold nanotubes compounded as a minority component in plastics and has traditionally required purchaser agreements that restrict the independent pursuit of patents by customers. Furthermore, MWNTs produced catalytically by gas-phase pyrolysis, like the Hyperion nanotubes, have high defect densities compared to those produced by the more expensive carbon- arc process (*11*). However, the catalytically produced tubes are adequate for many applications, especially because they can be directly synthesized without major contamination by carbonaceous impurities.

When Hyperion's extremely strong composition- of-matter patent coverage on MWNTs (*15*) expires (in 2004 in the United States), other large-scale producers of MWNTs are likely to emerge. Mitsui recently announced plans to build a \$15.2 million production facility in Japan that will be capable of producing 120 ton/year (*16*). The company plans to market 20-nm-diameter MWNTs at about \$75/kg.

Nanotube sheets, fibers, and composites should retain the properties of the individual nanotubes as far as possible. A generic problem is that impurities readily coat the surface of nanotubes (as do gases such as oxygen) (*17*). Even nanometer-thick coatings can affect nanotube dispersibility, binding in composites, and the electronic and mechanical properties of junctions between nanotubes. Also, SWNTs normally form bundles of parallel tubes (Fig. 1F) (*18*), such that the full surface area of the individual nanotubes is not usually available for stress transfer with the matrix. Nanotube sheets (called "nanotube paper" or "bucky paper") are conventionally obtained by filtering SWNTs dispersed in a liquid, peeling the resulting sheet from the filter after washing and drying, and annealing the sheet at high temperatures to remove impurities (*19*). If SWNTs were not so expensive and if there were a commercial need, one could make nanotube sheets with similar methods (and at a similar scale) to those used to make ordinary paper. However, the maximum Young's modulus of sheets made by the filtration process does not substantially exceed that of sheets of ordinary organic polymers (typically ~1 to 4 GPa), and it increases from

~0.3 to ~6 GPa as increasing care is taken in removing secondary impurities (“bucky goo”) introduced during purification (*20*).

Advances have been made in producing polymer-containing SWNTs by melt spinning and in aligning the nanotubes by drawing. However, the melt viscosity becomes too high for conventional melt spinning when the nanotube content is much more than 10%, and demonstrated increases in strength and modulus are much smaller than those predicted from the rule of mixtures (*21*). Vigolo and others have developed a coagulation-based process that enables them to spin continuous fibers containing mostly SWNTs (*22, 23*). Currently, however, the draw rate from the coagulation bath is slow, the nanotube loading in the spinning solution is low (~0.4 weight %), and the nanotubes are not well aligned. The highest modulus obtained for fibers spun by a modification of Vigolo and others’ coagulation-based process is ~50 GPa (*20, 22*), more than an order of magnitude lower than the intrinsic modulus of individual SWNTs. Trace poly (vinyl alcohol) from the coagulation solution binds the nanotubes together in air more effectively than do van der Waals interactions, and it causes fiber swelling and corresponding degradation of mechanical properties in aqueous electrolytes; its removal by pyrolysis decreases Young’s modulus to ~15 GPa. Creep is also a major problem for these spun fibers (*20*). A recently developed fiber-spinning method for SWNTs, which appears to involve a lyotropic liquid crystal phase, increases the nanotube concentration in the spinning solution by more than an order of magnitude and yields oriented nanotube fibers (*24*). An improvement in coupling between nanotubes appears necessary to optimize the Young’s modulus and tensile strength of these spun nanotube fibers, which are presently low.

Technologies for patterned deposition of nanotubes on the micro- to nanometer scale are important for electronic devices, displays, and nanoscale actuators. With selected area deposition of catalyst, nanotubes have been grown as forests of vertically aligned MWNTs (*25*) (Fig. 1G), nanoprobes (*26*), and structures for field emission displays (*27, 28*). By combining surface-patterning techniques with fluidic assembly methods, Huang and co-workers (*29*) have made networks of crossed nanowire arrays that are individually addressable at each junction.

Carbon Nanotube Composites

The first realized major commercial application of MWNTs is their use as electrically conducting components in polymer composites. Depending on the polymer matrix, conductivities of 0.01 to 0.1 S/cm can be obtained for 5% loading; much lower conductivity levels suffice for dissipating electrostatic charge (*30*). The low loading levels and the nanofiber morphology of the MWNTs allow electronic conductivity to be achieved while avoiding or minimizing degradation of other performance aspects, such as mechanical properties and the low melt flow viscosity needed for thin-wall molding applications. In commercial automotive gas lines and filters, the nanotube filler dissipates charge buildup that can lead to explosions and better maintains barrier properties against fuel diffusion than do plastics filled with carbon black. Plastic semiconductor chip carriers and reading heads made from nanotube composites avoid contamination associated with carbon black sloughing. Similar materials are also used for conductive plastic automotive parts, such as mirror housings that are electrostatically painted on the assembly line, thereby avoiding separate painting and associated color mismatch. The smoothness of the surface finish provides an advantage over other conductive fillers.

Hyperion worked with major plastic producers, plastic compounders, and automotive manufacturers to develop these applications, which presently consume substantial tonnage of nanotubes. Cost dictates the use of MWNTs rather than SWNTs, but unbundled SWNTs should enable lower percolation levels, reducing the required loading levels further. A percolation threshold of 0.1 to 0.2% has been reported for SWNTs in epoxy, one-tenth that of commercially available 200-nm-diameter vapor- grown carbon fibers (*31*). The shielding of electromagnetic radiation from cell phones and computers by using molded SWNT and MWNT composites is also a potentially lucrative application, for which Eikos, Inc., has important patent coverage (*32*).

Incorporation of nanotubes into plastics can potentially provide structural materials with dramatically increased modulus and strength. The critical challenges lie in uniformly dispersing the nanotubes, achieving nanotube-matrix adhesion that provides effective stress transfer, and avoiding intratube sliding between concentric tubes within MWNTs and intrabundle sliding within SWNT ropes. Some promising results have been reported; for example, Biercuk and others (*31*) observed a monotonic increase of resistance to indentation (Vickers hardness) by up to 3.5 times on loading up to 2% SWNTs and a doubling of thermal conductivity with 1% SWNTs. Also, 1% MWNT loading in polystyrene increases the modulus and breaking stress by up to 42 and 25%, respectively (*33*).

Electrochemical Devices

Because of the high electrochemically accessible surface area of porous nanotube arrays, combined with their high electronic conductivity and useful mechanical properties, these materials are attractive as electrodes for de-vices that use electrochemical double-layer charge injection. Examples include “supercapacitors,” which have giant capacitances in comparison with those of ordinary dielectric-based capacitors, and electromechanical actuators that may eventually be used in robots. Like ordinary capacitors, carbon nanotube supercapacitors (*34–36*) and electromechanical actuators (*37*) typically comprise two electrodes separated by an electronically insulating material, which is ionically conducting in electrochemical devices. The capacitance for an ordinary planar sheet capacitor inversely depends on the interelectrode separation. In contrast, the capacitance for an electrochemical device depends on the separation between the charge on the electrode and the countercharge in the electrolyte. Because this separation is about a nanometer for nanotubes in electrodes, as compared with the micrometer or larger separations in ordinary dielectric capacitors, very large capacitances result from the high nanotube surface area accessible to the electrolyte. These capacitances (typically between ~15 and ~200 F/g, depending on the surface area of the nanotube array) result in large amounts of charge injection when only a few volts are applied (*34–37*). This charge injection is used for energy storage in nanotube supercapacitors and to provide electrode expansions and contractions that can do mechanical work in electromechanical actuators.

Supercapacitors with carbon nanotube electrodes can be used for applications that require much higher power capabilities than batteries and much higher storage capacities than ordinary capacitors, such as hybrid electric vehicles that can provide rapid acceleration and store braking energy electrically. The capacitances (180 and 102 F/g for SWNT and MWNT electrodes, respectively) and power densities (20 kW/kg at energy densities of ~7 W·hour/kg for SWNT electrodes) (*34*, *35*) are attractive, especially because performance can likely be improved by replacing SWNT bundles and MWNTs with unbundled SWNTs. An extraordinarily short discharge time of 7 ms was reported (*36*) for 10 MWNT capacitors connected in series, which operated at up to 10 V.

Nanotube electromechanical actuators function at a few volts, compared with the ~100 V used for piezoelectric stacks and the =1000 V used for electrostrictive actuators. Nanotube actuators have been operated at temperatures up to 350°C, and operation above 1000°C should be possible, on the basis of SWNT thermal stability and industrial carbon electrode electrochemical application above this temperature (*20*). From observed nanotube actuator strains that can exceed 1%, order-of-magnitude advantages over commercial actuators in work per cycle and stress generation capabilities are predicted if the mechanical properties of nanotube sheets can be increased to close to the inherent mechanical properties of the individual nanotubes (*20*). The maximum observed isometric actuator stress of SWNT actuators is presently 26 MPa (*20*). This is >10 times the stress initially reported for these actuators and ~100 times that of the stress generation capability of natural muscle, and it approaches the stress generation capability of high-modulus commercial ferroelectrics (~40 MPa). However, the ability to generate stress is still >100 times lower than that predicted for nanotube fibers with the modulus of the individual SWNTs.

The achievable actuator strain is largely independent of applied load, and hence the work during isobaric (constant load) contraction linearly increases with load until the material fails. The product of actuator strain and fracture stress for nanotube actuators, normalized to density, is already 50 times the corresponding gravimetric work achieved for commercial high-modulus ferroelectrics (*20*). However, creep prohibits the application of stresses approaching the fracture stress. The success of actuator technology based on carbon nanotubes will depend on improvements in the mechanical properties of nanotube sheets and fibers with a high surface area by increasing nanotube alignment and the binding between nanotubes. Because nanotube actuation depends on ion diffusion, ferroelectrics can be cycled much faster at maximum work per cycle than can large nanotube actuators, which eliminates some applications.

The use of nanotubes as electrodes in lithium batteries is a possibility because of the high reversible component of storage capacity at high discharge rates. The maximum reported reversible capacity is 1000 mA·hour/g for SWNTs that are mechanically milled in order to enable the filling of nanotube cores, as compared to 372 mA·hour/g for graphite (*38*) and 708 mA·hour/g for ball-milled graphite (*39*). However, the large irreversible component to capacity (coexisting with the large reversible storage capacity), an absence of a voltage plateau during discharge, and the large hysteresis in voltage between charge and discharge (*38*) currently limit energy storage density and energy efficiency, as compared with those of other competing materials.

Hydrogen Storage

Nanotubes have been long heralded as potentially useful for hydrogen storage (for example, for fuel cells that power electric vehicles or laptop computers). However, experimental reports of high storage capacities are so controversial that it is impossible to assess the applications potential (*40–44*). Numerous claims of high hydrogen storage levels have been shown to be incorrect; other reports (*45, 46*) of room temperature capacities above 6.5 weight % (a U.S. Department of Energy benchmark) await confirmation. Given the high research activity in this area, it is hoped that this controversy will soon be resolved.

Field Emission Devices

Industrial and academic research activity on electronic devices has focused principally on using SWNTs and MWNTs as field emission electron sources (*47, 48*) for flat panel displays (*49*), lamps (*50*), gas discharge tubes providing surge protection (*51*), and x-ray (*52*) and microwave generators (*53*). A potential applied between a carbon nanotube–coated surface and an anode produces high local fields, as a result of the small radius of the nanofiber tip and the length of the nanofiber. These local fields cause electrons to tunnel from the nanotube tip into the vacuum.

Electric fields direct the field-emitted electrons toward the anode, where a phosphor produces light for the flat panel display application (Fig. 2). However, the complete picture is not nearly so simple. Unlike for ordinary bulk metals, nanotube tip electron emission arises from discrete energy states, rather than continuous electronic bands (*54*). Also, the emission behavior depends critically on the nanotube tip structure: Enhanced emission results from opening SWNT (*48*) or MWNT (*50*) tips.

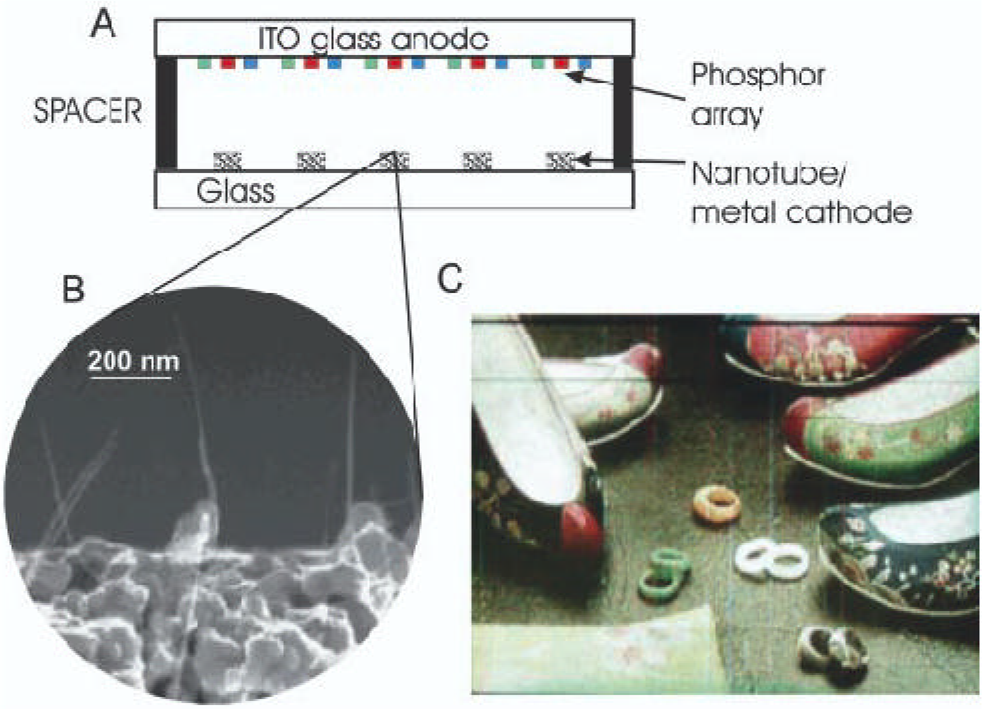

Fig.2. **(A)** Schematic illustration of a flat panel display based on carbon nanotubes. ITO, indium tin oxide. **(B)** SEM image (*49*) of an electron emitter for a display, showing well-separated SWNT bundles protruding from the supporting metal base. **(C)** Photograph of a 5-inch (13-cm) nanotube field emission display made by Samsung.

Nanotube field-emitting surfaces are relatively easy to manufacture by screen-printing nanotube pastes and do not deteriorate in moderate vacuum (10^{-8} torr). These are advantages over tungsten and molybdenum tip arrays, which require a vacuum of 10^{-10} torr and are more difficult to fabricate (*55*). Nanotubes provide stable emission, long lifetimes, and low emission threshold potentials (*47, 50*). Current densities as high as 4 A/cm^2 have been obtained, compared with the 10 mA/cm^2 needed for flat panel field emission displays and the >0.5 A/cm^2 required for microwave power amplifier tubes (*56*).

Flat panel displays are one of the more lucrative nanotube applications being developed by industry. However, they are also technically the most complex, requiring concurrent advances in electronic addressing circuitry, the development of low-voltage phosphors, methods for maintaining the required vacuum, spacers withstanding the high electric fields, and the elimination of faulty pixels. The advantages of nanotubes over liquid crystal displays are a low power consumption, high brightness, a wide viewing angle, a fast response rate, and a wide operating temperature range. Samsung has produced several generations of prototypes (Fig. 2), including a 9-inch (23-cm) red-blue-green color display that can reproduce moving images (*49*). Despite this impressive development, it is not certain when or whether the flat panel nanotube displays will be commercially available, considering concurrent improvements in relatively low-cost flat panel liquid crystal displays and the emerging organic and polymeric light-emitting diode displays.

Nanotube-based lamps are similar to displays in comprising a nanotube-coated surface opposing a phosphor-coated substrate, but they are less technically challenging and require much less investment. High-performance prototypes seem suitable for early commercialization, having a lifetime of >8000 hours, the high efficiency (for green phosphors) of environmentally problematic mercury-based fluorescent lamps, and the luminance required for large stadium-style displays (*50*). Nanotube-based gas discharge tubes may also soon find commercial use for protecting telecommunications networks against power surges. Devices comprising nanotube-containing cathodes separated from an anode by a millimeter-wide argon-filled gap provided a 4- to 20-fold improvement in breakdown reliability and an ~30% decrease in breakdown voltage, as compared to commercial devices (*51*).

If a metal target replaces the phosphorescent screen at the anode in a field emission device and the accelerating voltage is increased, x-rays are emitted instead of light. The resulting x-ray source has provided improved quality images of biological samples, probably because the energy range of the impacting electrons is narrower than that for thermionic electron sources (*52*). The compact geometry of nanotube-based x-ray tubes suggests their possible use in x-ray source arrays for medical imaging, possibly even for x-ray endoscopes for medical exploration. Another application requiring intense electron beams is for microwave generation. Here, improving the lifetime of the nanotube emitter under very high current (~500 mA/cm^2) operating conditions is a key technical challenge (*53*).

Nanometer-Sized Electronic Devices

Electronic circuits cannot continue to shrink by orders of magnitude and provide corresponding increases in computational power, unless radically different device materials, architectures, and assembly processes are developed. Dramatic recent advances have fueled speculation that nanotubes will be useful for downsizing circuit dimensions. For example, current-induced electromigration causes conventional metal wire interconnects to fail when the wire diameter becomes too small. The covalently bonded structure of carbon nanotubes militates against similar breakdown of nanotube wires, and because of ballistic transport, the intrinsic resistance of the nanotube should essentially vanish. Experimental results show that metallic SWNTs can carry up to 10^9 A/cm^2, whereas the maximum current densities for normal metals are ~10^5 A/cm^2 (*2, 57*). Unfortunately, the ballistic current carrying capability is less useful for presently envisioned applications because of necessarily large contact resistances. An electronic circuit involving electrical leads to and from a SWNT will have a resistance of at least $h/4e^2$ or 6.5 kilohms, where h is Planck’s constant and e is the charge of an electron (*58*). Contacting all layers in a MWNT could reduce this contact resistance, but it cannot be totally eliminated.

In nanotube field effect transistors (NT-FETs), gating has been achieved by applying a voltage to a submerged gate beneath a SWNT (Fig. 3, A and B), which was contacted at opposite nanotube ends by metal source and drain leads (*59*). The transistors were fabricated by lithographically applying electrodes to nanotubes that were either randomly distributed on a silicon substrate or positioned on the substrate with an atomic force microscope (*60, 61*).

A transistor assembled in this way may or may not work, depending on whether the chosen nanotube is semiconducting or metallic, over which the operator generally has no control. It is possible to selectively peel outer layers from a MWNT (Fig. 3C) until a nanotube cylinder with the desired electronic properties is obtained (*14*), but this process is not yet very reliable and is probably unsuitable for mass production. Overall device sizes for current NT-FETs, including contacts, are several hundred nanometers, not radically smaller than silicon-based field-effect transistors. A further reduction in size will require, among others, advances in microlithography.

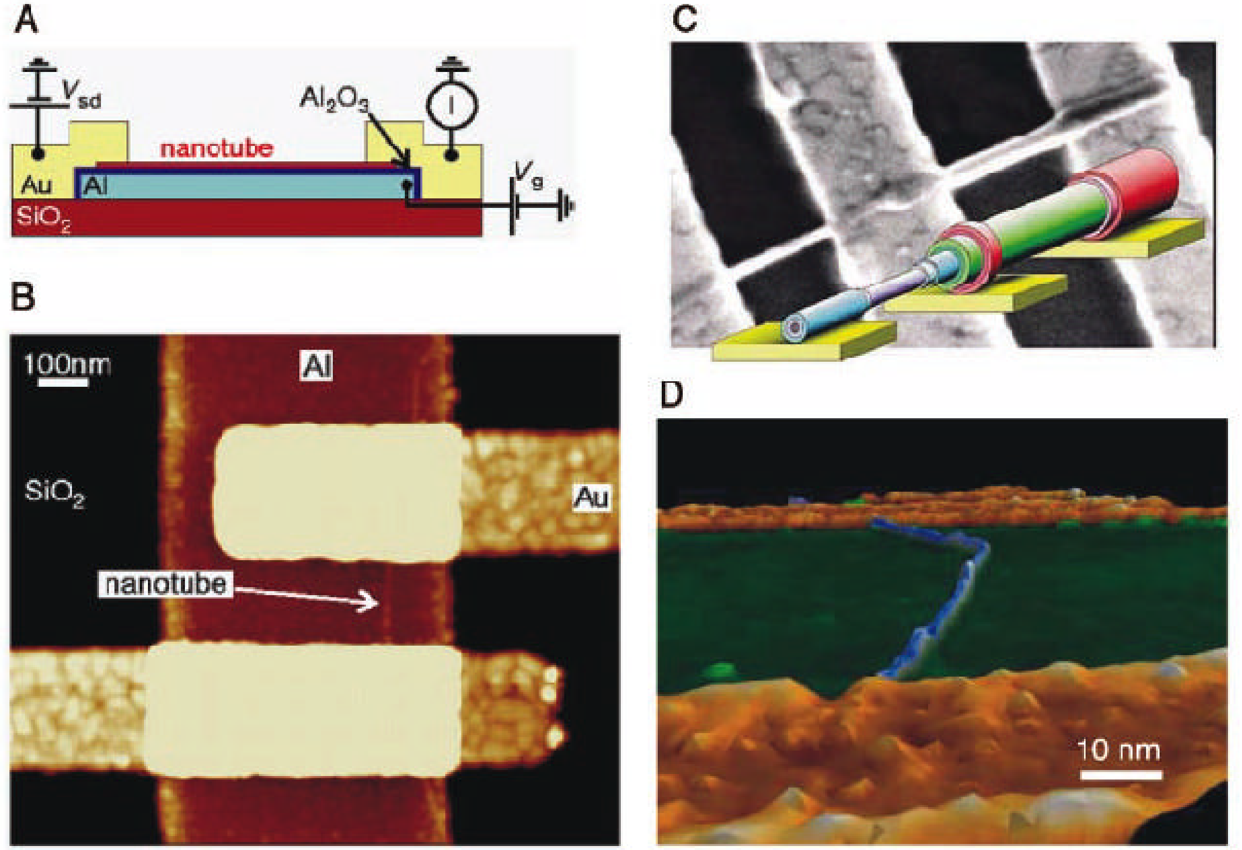

Fig.3.Nanoelectronic devices. **(A)** Schematic diagram (*61*) for a carbon NT-FET. The semiconducting nanotube, which is on top of an insulating aluminum oxide layer, is connected at both ends to gold electrodes.The nanotube is switched by applying a potential to the aluminum gate under the nanotube andaluminum oxide. V_{sd}, source-drain voltage; V_g, gate voltage. **(B)** Scanning tunneling microscope (STM) picture of a SWNT field-effect transistor (*61*) made using the design of (A). The aluminum strip is overcoated with aluminum oxide. **(C)** Image and overlaying schematic representation (*14*) for the effect of electrical pulses in removing successive layers of a MWNT, so that layers having desired transport properties for devices can be revealed. **(D)** STM image (*62*) of a nanotube having regions of different helicity on opposite sides of a kink, which functions as a diode; one side of the kink is metallic, and the opposite side is semiconducting. The indicated scale bar is approximate.

Research toward nanoscopic NT-FETs aims to replace the source-drain channel structure with a nanotube. A more radical approach is to construct entire electronic circuits from interconnected nanotubes. Because the electronic properties depend on helicity, it should be possible to produce a diode, for example, by grafting a metallic nanotube to a semiconducting nanotube. Such a device has been demonstrated. The bihelical nanotube was not, however, rationally produced; rather, it was fortuitously recognized in a normal nanotube sample by its kinked structure (Fig. 3D), which was caused by the helicity change (*62*). The development of rational synthesis routes to multiply branched and interconnected low-defect nanotubes with targeted helicity would be a revolutionary advance for nanoelectronics.

Recent developments have focused considerable media attention on nanotube nanoelectronic applications. With crossed SWNTs, three- and four-terminal electronic devices have been made (*63*), as well as a nonvolatile memory that functions like an electromechanical relay (*64*). Integrated nanotube devices involving two nanotube transistors have been reported (*61*, *64*), providing visions of large-scale integration. Patterned growth of SWNTs on a 4-inch (10-cm) silicon wafer (*65*) may prove an important step toward integrated nanotube electronics. IBM expects that nanotube electronics will be realized in about a decade (*66*). In reaching that goal, formidable technical hurdles must be overcome. Silicon technology is so entrenched that it will take an overwhelmingly compelling new technology to replace it. Nanotubes do not yet qualify, but the potential payoff is so great that this exciting research is amply justified from even a commercial viewpoint.

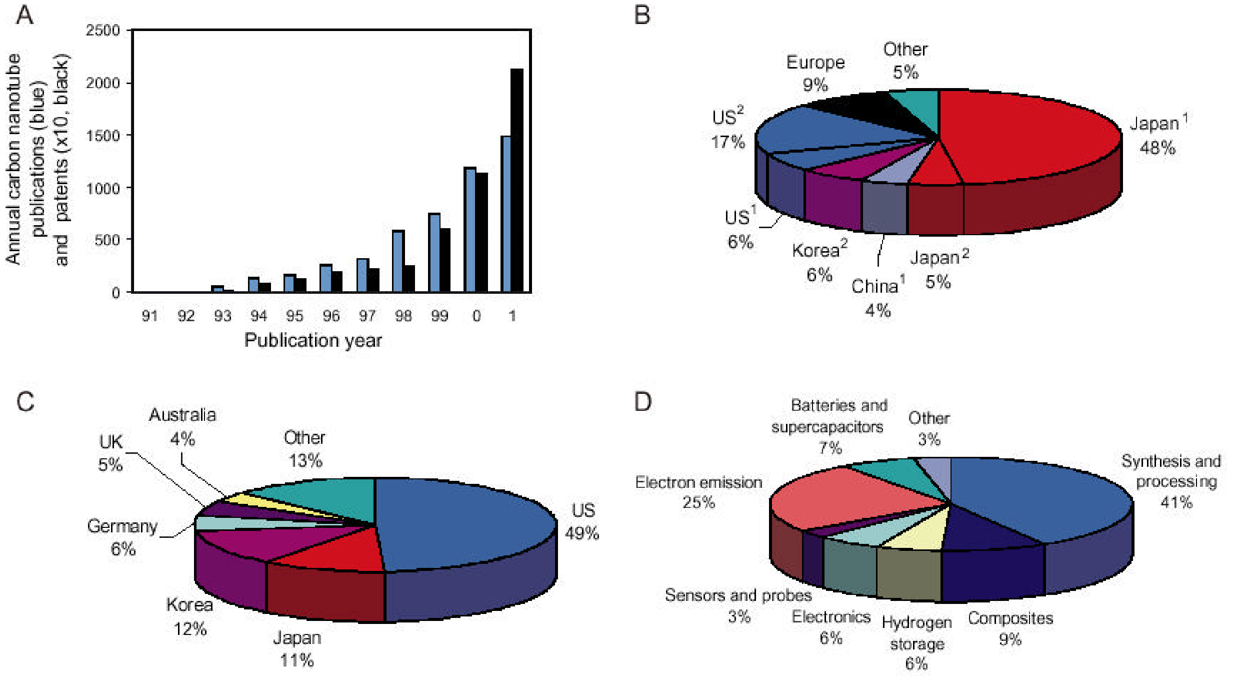

Fig.4. **(A)** Comparison of the annual number of scientific publications with the number of patent filings and issuances for the carbon nanotube area (*71*). **(B)** Percentages of total patent filings and issuances made by individuals in a country or region and filed either in the same location (superscript 1) or in a different location (superscript 2). **(C)** Percentages of multicountry (world or European) patent filings and issuances that originate from different countries. **(D)** Patent filings and issuances divided according to the main area of the invention. Although the database for these figures is dependent on the search method and involves judgments in assignments, the information shown here is thought to be reliable.

Sensors and Probes

Possible chemical sensor applications of non-metallic nanotubes are interesting, because nanotube electronic transport and thermopower (voltages between junctions caused by interjunction temperature differences) are very sensitive to substances that affect the amount of injected charge (*17*, *67*). The main advantages are the minute size of the nanotube sensing element and the correspondingly small amount of material required for a response. Major challenges remain, however, in making devices that differentiate between absorbed species in complex mixtures and provide rapid forward and reverse responses.

Carbon nanotube scanning probe tips for atomic probe microscopes are now sold by Seiko Instruments and manufactured by Daiken Chemical Company, Ltd. The mechanical robustness of the nanotubes and the low buckling force dramatically increase probe life and minimize sample damage during repeated hard crashes into substrates. The cylindrical shape and small tube diameter enable imaging in narrow, deep crevices and improve resolution in comparison to conventional nanoprobes, especially for high sample feature heights (*26*, *68*). Covalently modifying the nanotube tips, such as by adding biologically responsive ligands, enables the mapping of chemical and biological functions (*69*). Nanoscopic tweezers have been made that are driven by the electrostatic interaction between two nanotubes on a probe tip (*70*). They may be used as nanoprobes for assembly. These uses may not have the business impact of other applications, but they in-crease the value of measurement systems for characterization and manipulation on the nanometer scale.

The Past as Harbinger of the Future

The exponential increase in patent filings and publications on carbon nanotubes indicates growing industrial interest that parallels academic interest (Fig. 4A) (*71*). By percentage of total patent filings (53%), inventors in Japan have led the way (Fig. 4B), but 90% of these patent filings have not yet appeared as filings in other countries. If multicountry foreign filings (world and European patents) are used to gauge the perceived importance of inventions (Fig. 4C), Japan and Korea run a close race, and the United States has a four-fold advantage over each of them.

Consistent with the demonstrated commercial importance of nanotubes in composites, most of the patent filings (50%) are for nanotube synthesis, processing, and composites (Fig. 4D). Reflecting the advanced state of carbon nanotube displays and the attractiveness of related applications, electron emission devices command 25% of the patent filings. Nanotube electronic devices, which might have the most potential for changing the field, provided only 6% of the total patent filings. Impressive advances have been made in demonstrating nanotube electronic device concepts, but a decade or more of additional progress is likely required to reliably assess if and when these breakthroughs will reach commercial application.

Independent of the outcome of the ongoing races to exploit nanotubes in applications, carbon nanotubes have provided possibilities in nanotechnology that were not conceived in the past. Nanotechnologies of the future in many areas will build on the advances that have been made for carbon nanotubes.

References and Notes

1. S. G. Louie, *Top. Appl. Phys.* **80**, 113 (2001).
2. W. Liang *et al.*, *Nature* **411**, 665 (2001).
3. S. P. Frank, P. Poncharal, Z. L. Wang, W. A. de Heer, *Science* **280**, 1744 (1998).
4. P. Kim, L. Shi, A. Majumdar, P. L. McEuen, *Phys. Rev. Lett.* **87**, 215502 (2001).
5. M. Kociak *et al.*, *Phys. Rev. Lett.* **86**, 2416 (2001).
6. Z. K. Tang *et al.*, *Science* **292**, 2462 (2001).
7. G. Gao, T. Cagin, W. A. Goddard, *Nanotechnology* **9**, 184 (1998).
8. M.-F. Yu, B. S. Files, S. Arepalli, R. S. Ruoff, *Phys. Rev. Lett.* **84**, 5552 (2000).
9. D. A. Walters *et al.*, *Appl. Phys. Lett.* **74**, 3803 (1999).
10. E. W. Wong, P. E. Sheehan, C. M. Lieber, *Science* **277**, 1971 (1997).
11. R. G. Ding, G. Q. Lu, Z. F. Yan, M. A. Wilson, *J. Nanosci. Nanotechnol.* **1**, 7 (2001).
12. A listing of commercial suppliers of carbon nanotubes and related materials is available at www.rdg.ac.uk/~scsharip/tubes.htm.
13. P. Ball, *Nature* **414**, 142 (2001).
14. P. G. Collins, M. S. Arnold, Ph. Avouris, *Science* **292**, 706 (2001).
15. H. G. Tennent, U. S. Patent 4,663,230 (5 May 1987).

16. “Mitsui to begin construction of high-volume production plant for carbon nanotubes,” www.mitsui.co.jp/ tkabz/english/index.html (26 December 2001).
17. P. G. Collins, K. Bradley, M. Ishigami, A. Zettl, *Science* **287**, 1801 (2000).
18. A. Thess *et al*., *Science* **273**, 483 (1996).
19. A. G. Rinzler *et al*., *Appl. Phys*. **67**, 29 (1998).
20. R. H. Baughman *et al*., unpublished data.
21. R. Haggenmueller, H. H. Gommans, A. G. Rinzler, J. E. Fischer, K. I. Winey, *Chem. Phys. Lett*. **330**, 219 (2000).
22. B. Vigolo *et al*., *Science* **290**, 1331 (2000).
23. R. H. Baughman, *Science* **290**, 1310 (2000).
24. V. A. Davis *et al*., in preparation.
25. Z. F. Ren *et al*., *Science* **282**, 1105 (1998).
26. J. H. Hafner, C. L. Cheung, C. M. Leiber, *Nature* **398**, 761 (1999).
27. S. Fan *et al*., *Science* **283**, 512 (1999).
28. J. I. Sohn, S. Lee, H. Kim, *Appl. Phys. Lett*. **78**, 901 (2001).
29. Y. Huang, X. Duan, Q. Wei, C. M. Lieber, *Science* **291**, 630 (2001).
30. The Web site of Hyperion Catalysis International, Inc., is available at www.fibrils.com.
31. M. J. Biercuk *et al*., *Appl. Phys. Lett*. **80**, 2767 (2002).
32. P. Glatkowski *et al*., U. S. Patent 6,265,466 (24 July 2001).
33. D. Qian, E. C. Dickey, R. Andrews, T. Rantell, *Appl. Phys. Lett*. **76**, 2868 (2000).
34. K. H. An *et al*., *Adv. Funct. Mater*. **11**, 387 (2001).
35. C. Niu, E. K. Sickel, R. Hoch, D. Moy, H. Tennent, *Appl. Phys. Lett*. **70**, 1480 (1997).
36. C. Niu, J. Kupperschmidt, R. Hock, in *Proceedings of the 39th Power Sources Conference* (Maple Hill, NJ, 2000), pp.314-317.
37. R. H. Baughman *et al*., *Science* **284**, 1340 (1999).
38. B. Gao *et al*., *Chem. Phys. Lett*. **307**, 153 (1999).
39. F. Disma, C. Lenain, B. Beaudoin, L. Aymard, J.-M. Tarascon, *Solid State Ionics* **98**,145 (1997).
40. M. S. Dresselhaus, K. A. Williams, P. C. Eklund, *Mater. Res. Soc. Bull*. **24**, 45 (2000).
41. G. G. Tibbetts, G. P. Meisner, C. H. Olk, *Carbon* **39**, 2291 (2001).
42. M. Hirscher *et al*., *J. Alloys Compounds* **330-332**, 654 (2002).
43. C. Zandonella, *Nature* **410**, 734 (2001).
44. Y. Ye *et al*., *Appl. Phys. Lett*. **74**, 2307 (1999).
45. Y. Chen *et al*., *Appl. Phys. Lett*. **78**, 2128 (2001).
46. A. C. Dillon, M. J. Heben, *Appl. Phys*. **72**, 133 (2001).
47. W. A. de Heer, A. Chatelain, D. Ugarte, *Science* **270**, 1179 (1995).
48. A. G. Rinzler *et al*., *Science* **269**, 1550 (1995).
49. N. S. Lee *et al*., *Diamond Relat. Materials* **10**, 265 (2001).
50. Y. Saito, S. Uemura, *Carbon* **38** ,169 (2000).
51. R. Rosen *et al*., *Appl. Phys. Lett*. **76**, 1668 (2000).
52. H. Sugie *et al*., *Appl. Phys. Lett*.**78**, 2578 (2001).
53. O. Zhou, personal communication.
54. J.-M. Bonard *et al*., *Phys. Rev. Lett*. **81**, 1441 (1998).
55. J.-L. Kwo *et al*., *J. Vac. Sci. Technol.* B **19**, 23 (2001).
56. W. Zhu, C. Bower, O. Zhou, G. Kochanski, S. Jin, *Appl. Phys. Lett*. **75**, 873 (1999).
57. Z. Yao, C. L. Kane, C. Dekker, *Phys. Rev. Lett*. **84**, 2941 (2000).
58. Z. Yao, C. Dekker, Ph. Avouris, *Top. Appl. Phys*. **80**, 147 (2001).
59. S. Tans *et al*., *Nature* **393**, 49 (1998).
60. R. Martel, T. Schmidt, H. R. Shea, T. Hertel, Ph. Avouris, *Appl. Phys. Lett*. **73**, 2447 (1998).

61. A. Bachtold, P. Hadley, T. Nakanishi, C. Dekker, *Science* **294**, 1317 (2001); published online 4 October 2001 (10.1126/science.1065824).
62. Z. Yao, H. Ch. Postma, L. Balents, C. Dekker, *Nature* **402**, 273 (1999).
63. M. S. Fuhrer *et al.*, *Science* **288**, 494 (2000).
64. T. Rueckes *et al.*, *Science* **289**, 94 (2000).
65. N. R. Franklin, Y. Li, R. J. Chen, A. Javey, H. Dai, *Appl. Phys. Lett*. **79**, 4571 (2001).
66. "At IBM, a tinier transistor outperforms its silicon cousins," *New York Times*, 20 May 2002, p. C4.
67. J. Kong *et al.*, *Science* **287**, 622 (2000).
68. H. Dai, J .H. Hafner, A. G. Rinzler, D. T. Colbert, R. E. Smalley, *Nature* **384**, 147 (1996).
69. S. S. Wong, E. Joselevich, A. T. Woolley, C. L. Cheung, C. M. Lieber, *Nature* **394**, 52 (1998).
70. P. Kim, C. M. Lieber, *Science* **286**, 2148 (1999).
71. The analysis of patents and publications used the SciFinder Scholar search system (www.cas.org/SCIFINDER/SCHOL- AR/) for the term "carbon nanotube."
72. J. W. G. Wildoer, L. C. Venema, A. G. Rinzler, R. E. Smalley, C. Dekker, *Nature* **391**, 59 (1998).
73. We thank many researchers in the nanotube area for their insights, especially J. E. Fischer, S. Roth, R. Hoch, L. Crosthwait, and J. Robertson. We also thank S. Collins, J. S. Lamba, and S. Lee for their contributions to the figures and the analysis using the SciFinder search system. Supported by Defense Advanced Research Projects Agency contracts N00173-99-2000 and MDA972-02-C- 0005.

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Acta Materialia 50(11) 2002

2761	Coincidence structures of interfacial steps and secondary misfit dislocations in the habit plane between widmanstatten cementite and austenite	Ye F. Zhang WZ.
2779	Effect of native al2o3 on the elastic response of nanoscale al films	Saif MTA. Zhang S. Haque A. Hsia KJ.
2787	Experimental verification of the theoretical prediction of the phase structure of a ni-al-ti-cr-cu alloy	Wilson A. Bozzolo G. Noebe RD. Howe JM.
2801	Effects of dynamic grain boundary migration during the hot compression of high stacking fault energy metals	Gourdet S. Montheillet F.
2813	The hidden order behind jerky flow	Bharathi MS. Lebyodkin M. Ananthakrishna G. Fressengeas C. Kubin LP.
2825	An analysis of strengthening mechanisms in a mechanically alloyed, oxide dispersion strengthened iron aluminide intermetallic	Munoz-Morris MA. Oca CG. Morris DG.
2837	Halo formation in directional solidification	Nave MD. Dahle AK. StJohn DH.
2851	Effect of an electric field on the plastic deformation kinetics of electrodeposited cu at low and intermediate temperatures	Conrad H. Yang D.
2867	Behavior of a random hollow sphere metal foam	Lim TJ. Smith B. McDowell DL.
2881	Moderation of the recrystallization texture by nucleation at copper-type shear bands in al-1mg	Duckham A. Engler O. Knutsen RD.
2895	Residual stress effects on the compressive strength of unidirectional fibre composites	Jensen HM.
2905	Oxygen-molybdenum interaction with dislocations in nb-mo single crystals at elevated temperatures	Miura E. Yoshimi K. Hanada S.
2917	Physically-based model for creep in nickel-base superalloy c263 both above and below the gamma solvus	Manonukul A. Dunne FPE. Knowles D.
2933	Relaxation of compressed elastic islands on a viscous layer	Liang J. Huang R. Yin H. Sturm JC. Hobart KD. Suo Z.
2945	Linear bubble model of abnormal grain growth	Mullins WW. Vinals J.
2955	Grain boundary electronic structure related to the hightemperature creep resistance in polycrystalline al2o3	Yoshida H. Ikuhara Y. Sakuma T.
2967	A direct method for the crystallography of martensitic transformation and its application to tini and aucd	Jin YMM. Weng GJ.
2989	Polarization switching in pbtio3: an ab initio finite element simulation	Tadmor EB. Waghmare UV. Smith GS. Kaxiras E.
3003	Undercooling-dependent solidification behavior of levitated nd14fe79b7 alloy droplets	Gao J. Volkmann T. Herlach DM.
3013	Modeling of grain growth in two dimensions	Pande CS. Rajagopal AK.
3023	Influence of martensite stabilization on the low-temperature non-linear anelasticity in cu-zn-al shape memory alloys	Kustov S. Golyandin S. Sapozhnikov K. Cesari E. Van Humbeeck J. De Batist R.
3045	Dislocation emission at junctions between sigma=3 grain boundaries in gold thin films	Lucadamo G. Medlin DL.

Acta Materialia 50(12) 2002

3057	Computer simulation of 3-d grain growth using a phase-field model	Krill CE. Chen LQ.
3075	Modeling recrystallization of microalloyed austenite: effect of coupling recovery, precipitation and recrystallization	Zurob HS. Hutchinson CR. Brechet Y. Purdy G.
3093	The production of aln-rich matrix composites by the reactive infiltration of al alloys in nitrogen	Swaminathan S. Rao BS. Jayaram V.
3105	Formation of perovskite type phases during the high temperature oxidation of stainless steels coated with reactive element oxides	Chevalier S. Larpin JP.
3115	Effect of microstructure on dry sliding wear behaviour in cuznal shape memory alloys	Pena J. Gil FJ. Guilemany JM.
3125	Macroscopic crystal rotation patterns in rolled aluminium single crystals	Wert JA.
3141	Microstructure and properties of ti3alc2 prepared by the solid-liquid reaction synthesis and simultaneous in-situ hot pressing process	Wang XH. Zhou YC.
3151	Atomic structural environment of y in the residual glass phase of silicon nitride and alpha-sialon	Wang CM. Mitomo M.
3159	Microstucture evolution and interfacial properties in the fepb system	Monchoux JP. Rabkin E.
3175	Sic single fibre full-fragmentation during straining in a ti-6al-4v matrix studied by synchrotron x-rays	Preuss M. Withers PJ. Maire E. Buffiere JY.
3191	Deformation induced phase rearrangement in near eutectic tin-lead alloy	Abell KCR. Shen YL.
3203	Magnetism-induced solid solution effects in intermetallic ni60al40	Liu CT. Fu CL. Pike LM. Easton DS.
3211	Effect of alloying elements on the gamma to alpha transformation in steel. i	Odqvist J. Hillert M. Agren J.
3227	Percolation effects during interdiffusion in the cu-nial system	Rabkin E. Semenov VN. Winkler A.
3239	Reexamination of the solidification behavior of undercooled ni-sn eutectic melts	Li M. Nagashio K. Kuribayashi K.

3251	Damage sensitivity in a commercial al alloy processed by equal channel angular extrusion	Dupuy L. Blandin JJ.
3265	On the generation of thixotropic structures during melting of mg-al-zn alloy	Czerwinski F.
3283	Trapping of vacancies by rapid solidification	Hillert M. Schwind M. Selleby M.

Acta Materialia 50(13) 2002

3293	On the growth of grains	Feppon JM. Hutchinson WB.
3301	Effect of chromium addition on the ordering behaviour of ni-mo alloy: experimental results vs. electronic structure calculations	Arya A. Dey GK. Vasudevan VK. Banerjee S.
3317	A general approach to grain growth driven by energy density differences	Deus AM. Fortes MA. Ferreira PJ. Sande JBV.
3331	A kinetic model for the field-activated synthesis of mosi2/sic composites: simulation of sps conditions	Heian EM. Feng A. Munir ZA.
3347	Microstructural evolution during directional annealing	Badmos AY. Frost HJ. Baker I.
3361	Effects of donor concentration and oxygen partial pressure on interface morphology and grain growth behavior in srtio3	Chung SY. Yoon DY. Kang SJL.
3373	Thermodynamic modeling of the fe-mo-zr system	Zinkevich M. Mattern N.
3385	Surface evolution in two-component system	Klinger L.
3397	Role of grain rotation during grain growth in a columnar microstructure by mesoscale simulation	Moldovan D. Wolf D. Phillpot SR. Haslam AJ.
3415	Compressive shear faults in ice: plastic vs. coulombic faults	Schulson EM.
3425	Microstrain effect on thermal properties of nanocrystalline cu	Qian LH. Wang SC. Zhao YH. Lu K.
3435	Microstructural evolution in passivated al films on si substrates during thermal cycling	Legros M. Hemker KJ. Gouldstone A. Suresh S. Keller-Flaig RM. Arzt E.
3453	The effect of yttrium on densification and grain growth in alpha-alumina	Voytovych R. MacLaren I. Gulgun MA. Cannon RM. Ruhle M.
3465	Creep deformation behavior of spherical al2o3 particle-reinforced al-mg matrix composites at high temperatures	Kawabata K. Sato E. Kuribayashi K.
3475	Influence of internal stresses in superplastic joining of zirconia toughened alumina	Gutierrez-Mora F. Goretta KC. Majumdar S. Routbort JL. Grimdisch M. Dominguez-Rodriguez A.
3487	Modeling vapor pressure effects on void rupture and crack growth resistance	Guo TF. Cheng L.
3501	A new glass-forming ability criterion for bulk metallic glasses	Lu ZP. Liu CT.
3513	Atomic-scale ab-initio study of the zr-h system: i. bulk properties	Domain C. Besson R. Legris A.
3527	Mechanical properties of cyromilled nanocrystalline zn studied by the miniaturized disk bend test	Zhang X. Wang H. Scattergood RO. Narayan J. Koch CC.

Acta Materialia 50(14) 2002

3535	Transformational behaviour of constrained shape memory alloys	Tsoi KA. Stalmans R. Schrooten J.
3545	The kinetics of the austenite-ferrite phase transformation of fe-mn: differential thermal analysis during cooling	Kempen ATW. Sommer F. Mittemeijer EJ.
3557	Interface mobility in m49.8ti42.2hf8 shape memory alloy	Dalle F. Perrin E. Vermaut P. Masse M. Portier R.
3567	Glass-forming ability and thermal stability of nd70-xfe20al10yx alloys	Qiu KQ. Zhang HF. Wang AM. Ding BZ. Hu ZQ.
3579	A reaction-layer mechanism for the delayed failure of micron-scale polycrystalline silicon structural films subjected to high-cycle fatigue loading	Muhlstein CL. Stach EA. Ritchie RO.
3597	Enhanced creep performance in an al-cu-mg-ag alloy through underageing	Lumley RN. Morton AJ. Polmear IJ.
3609	Thermodynamic and kinetic aspects of interfacial decohesion	Mishin Y. Sofronis P. Bassani JL.
3623	Tensile response of an fe-40ai-0.7c-0.5b alloy	Pang L. Han SM. Kumar KS.
3641	Indentation size effect in polycrystalline fcc metals	Elmustafa AA. Stone DS.
3651	Modeling of non-linear phenomena during deformation of interparticle necks by diffusion-controlled creep	Maximenko A. Roebben G. Van Der Biest O.
3661	Invariant distributions and stationary correlation functions of simulated grain growth processes	Nordbakke MW. Ryum N. Hunderi O.
3671	Deuterium driven phase transitions in the ti3al intermetallic	Xiao H. Robertson IM. Birnbaum HK.
3683	A local equilibrium model for internal oxidation	Li YL. Morral JE.
3693	Strain ageing in gamma(tial)-based titanium aluminides due to antisite atoms	Frobel U. Appel F.
3709	Ga-rich precipitates in fe ion implanted gaas	Sun K.
3717	Measurement and analysis of yield locus and work hardening characteristics of steel sheets wtih different r-values	Kuwabara T. Van Bael A. Iizuka E.
3731	Tensile deformation and fracture behaviour in nbsi2 and mosi2 single crystals	Nakano T. Azuma M. Umakoshi Y.
3743	Mechanical deformation of dendrites by fluid flow during the solidification of undercooled melts	Dragnevski K. Mullis AM. Walker DJ. Cochrane RF.

Acta Mechanica 156(3-4) 2002

131	The stability of the narrow-gap taylor-couette system with an axial flow	Chang MH. Chen CK.
145	Green's function approach to unsteady thermal stresses in an infinite hollow cylinder of functionally graded material	Kim KS. Noda N.
163	On modeling of extension and flexure response of electroelastic shells under biasing fields	Hu YT. Yang JS. Jiang Q.
179	Stability of dynamically propagating cracks in brittle materials	Uenishi K. Rossmanith HP.
193	On spatial and material settings of hyperelastodynamics	Steinmann P.
219	On complex-variable formulation for finite plane elastostatics of harmonic materials	Ru CQ.
235	Expansion fan in forced and passively moving frames	Wu ZN.
249	Nonstationary stokes friction relations: many-sphere hydrodynamic interactions	Pienkowska IT.

Acta Mechanica 157(1-4) 2002

1	Concerning the influence of wave breaking on monin-obukhov similarity theory	D'Alessio SJD.
15	Steady planar and non-swirling axisymmetric flows: flow classification and its use in numerical calculations of a quasi-newtonian fluid	Brunn PO. Ryssel E.
27	On efficient use of simulated annealing in complex structural optimization problems	Hasancebi O. Erbatur F.
51	Hencky's elasticity model and linear stress-strain relations in isotropic finite hyperelasticity	Xiao H. Chen LS.
61	A further exploration of the interaction direct derivative (idd) estimate for the effective properties of multiphase composites taking into account inclusion distribution	Du DX. Zheng QS.
81	Elastic constants and their admissible values for incompressible and slightly compressible anisotropic materials	Itskov M. Aksel N.
97	Asymptotically approximate model equations for nonlinear dispersive waves in incompressible elastic rods	Dai HH. Huo Y.
113	Size effects in the particle-reinforced metal-matrix composites	Chen SH. Wang TC.
129	The nonlinear effect of lattice mismatch parameter on morphological and compositional instabilities of epitaxial layers	Wu CH.
147	Application of the decomposition method to thermal stresses in isotropic circular fmis with temperature-dependent thermal conductivity	Chiu CH. Chen CK.
159	Transient thermal-mechanical response of glass-fiber reinforced plastics at low temperatures	Shindo Y. Narita F.
175	A macroscopic model of the diffusion and heat transfer processes in a periodically micro-stratified solid layer	Wozniak M. Wierzbicki E. Wozniak C.
187	Steady nonsimilar axisymmetric water boundary layers with variable viscosity and prandtl number	Saikrishnan P. Roy S.
201	Upper and lower bounds of the solution for an elliptic plate problem using a genetic algorithm	Lee ZY. Chen CK. Hung CI.
213	Stokes flow through a channel obstructed by horizontal cylinders	Wang CY.
223	Inversion of loading time history using displacement response of composite laminates: three-dimensional cases	Liu GR. Ma WB. Han X.
235	A brief note from the editor on the "second-order fluid"	Aksel N.

AIAA Journal 40(8) 2002

1481	Matchsticks, scramjets, and black holes: numerical simulation faces reality	Oran ES.
1495	Open-loop hover testing of a smart rotor model	Koratkar NA. Chopra I.
1503	Jet-cavity interaction tones	Raman G. Envia E. Bencic TJ.
1512	Deforming mesh for computational aeroelasticity using a nonlinear elastic boundary element method	Gao XW. Chen PC. Tang L.
1518	Novel approach for reducing rotor tip-clearance-induced noise in turbofan engines	Khorrami MR. Li F. Choudhari M.
1529	Modulation of near-wall turbulence structure with wall blowing and suction	Chung YM. Sung HJ. Krogstad PA.
1536	Transition prediction for three-dimensional boundary layers in computational fluid dynamics applications	Crouch JD. Crouch IWM. Ng LL.
1542	Boundary-layer transition measurements in hypervelocity flows in a shock tunnel	Mee DJ.
1549	Airfoil-boundary layer subjected to a two-dimensional asymmetrical turbulent wake	Kornilov VI. Pailhas G. Aupoix B.
1559	Numerical investigation of the turbulent mixing performance of a cantilevered ramp injector	Parent B. Sislian JP. Schumacher J.
1567	Effect of surface roughness on unseparated shock-wave turbulent boundary-layer interactions	Babinsky H. Inger GR.

1574	Application of large-eddy simulation to supersonic compression ramps	Rizzetta DP. Visbal MR.
1582	Microfabricated shear-stress sensors, part 3: reducing calibration uncertainty	Patel MP. Reshotko E. Hyman D.
1589	Flight test, modal analysis, and model refinement of the mir space station	Kim HM. Kaouk M.
1596	Closed-loop neurocontroller tests on piezoactuated smart rotor blades in hover	Spencer MG. Sanner RM. Chopra I.
1603	Simultaneous modeling of mechanical and electrical response of smart composite structures	Thornburgh RP. Chattopadhyay A.
1611	Static shape control of composite plates using. a slope-displacement-based algorithm	Chee CYK. Tong LY. Steven GP.
1619	Viscoelastic analysis of multiphase composites using the generalized method of cells	Orozco CE. Pindera MJ.
1627	Finite element formulation for thick sandwich plates on an elastic foundation	Perel VY. Palazotto AN.
1638	Analytical evaluation of damping in composite and sandwich structures	Birman V. Byrd LW.
1644	Prediction of residual strength and curvilinear crack growth in aircraft fuselages	Chen CS. Wawrzynek PA. Ingraffea AR.
1653	Stochastic reduced basis methods	Nair PB. Keane AJ.
1665	Collapse of rectangular aluminum plates with axial cracks	Corona E. Waters WA. Starnes JH.
1673	Motion of variable geometry truss for momentum management in spacecraft	Hanahara K. Tada Y.
1676	Modal actuator/sensor by modulating thickness of piezoelectric layers for smart plates	Sun DC. Tong LY. Wang DJ.
1679	Prediction and design of metal plate vibration behavior with bonded composite sheets	Sasajima M. Kakudate T. Narita Y.
1682	Experimental nonlinear response of tapered ceramic matrix composite plates to base excitation	Spottswood SM. Mignolet MP.
1687	Stability of spring-hinged cantilever column under combined concentrated and distributed loads	Rao GV. Raju KK.
1689	Vortical substructures in the shear layers forming leading-edge vortices	Mitchell AM. Molton P.

AIAA Journal 40(9) 2002

1697	Nonlinear aeroelasticity and unsteady aerodynamics	Dowell EH. Tang D.
1708	Direct numerical simulation of turbulent trailing-edge flow with base flow control	Yao YF. Sandham ND.
1717	Forward flight stability characteristics for composite hingeless rotors with transverse shear deformation	Jung SN. Kim KN. Kim SJ.
1726	Numerical simulation of sonic boom focusing	Auger T. Coulouvrat F.
1735	Analysis of the two similarity components of turbulent mixing noise	Viswanathan K.
1745	Time-accurate inlet and outlet conditions for unsteady transonic channel flow	Ballmann J. Britten G. Sofronov I.
1755	Local time-stepping algorithm for solving probability density function turbulence model equations	Muradoglu M. Pope SB.
1764	Probabilistic approach to free-form airfoil shape optimization under uncertainty	Huyse L. Padula SL. Lewis RM. Li W.
1773	Flow control with electrohydrodynamic actuators	Artana G. D'Adamo J. Leger L. Moreau E. Touchard G.
1780	Higher mean-flow approximation for solid rocket motors with radially regressing walls	Majdalani J. Vyas AB. Flandro GA.
1789	Spectrally resolved measurement of flame radiation to determine soot temperature and concentration	Snelling DR. Thomson KA. Smallwood GJ. Gulder OL. Weckman EJ. Fraser RA.
1796	Numerical study of blast-wave propagation in a double-bent duct	Liang SM. Weng KC. Takayama K.
1803	Vibrational excitation, thermal nonuniformities, and unsteady effects on supersonic blunt bodies	Candler GV. Kelley JD. Macheret SO. Shneider N. Adamovich IV.
1811	Detachment of the dynamic-stall vortex above a moving surface	Obabko AV. Cassel KW.
1823	Numerical prediction of fluid-resonant oscillation at low mach number	Inagaki M. Murata O. Kondoh T. Abe K.
1830	Effects of pressure-sensitive paint on experimentally measured wing forces and pressures	Schairer ET. Mehta RD. Olsen ME.
1839	Efficient aerodynamic design method using a tightly coupled algorithm	Sung CH. Kwon JH.
1846	Finite element modeling of thermopiezomagnetic smart structures	Sunar M. Al-Garni AZ. Ali MH. Kahraman R.
1852	Control stability analysis of smart beams with debonded piezoelectric actuator layer	Sun DC. Tong LY.
1860	Damage detection for composite plates using lamb waves and projection genetic algorithm	Xu YG. Liu GR. Wu ZP.
1867	Modeling of tapered sandwich panels using a high-order sandwich theory formulation	Thomsen OT. Vinson JR.
1876	Midfrequency vibrations of a complex structure: experiments and comparison with numerical simulations	Savin E.
1885	Temperature profile influence on layered plates response considering classical and advanced theories	Carrera E.
1897	Pressure gradients in the regenerator and overall pulse-tube refrigerator performance	Mayzus P. Fang L. Deng X. Fauvel OR. Bauwens L.
1907	Method for determination of viscoelastic parameters using the principle of correspondence	Sullivan RW. Johnson DP.
1909	Curvature corrections for algebraic reynolds stress modeling: a discussion	Hellsten A.

1912	Large-amplitude vibrations of spring-hinged beams	Rao GV. Raju KK.
1914	Material property identification of composite plates using neural network and evolution algorithm	Sung BJ. Park JW. Kim YH.
1916	Linear instability of laterally strained constant pressure boundary-layer flows (vol 39, pg 526, 2001)	Tyagi PK. Dey J.

Applied Mathematical Modelling 26(8) 2002

785	Variance reduction for monte carlo simulation of stochastic environmental models	Schoenmakers JGM. Heemink AW. Ponnambalam K. Kloeden PE.
797	Study on the modeling of timed-token protocol	Lu ZY. Wang LH. Yao DY.
807	Numerical problems associated with coupling hydrodynamic models in shelf edge regions: the surge event of february 1994	Davies AM. Hall P.
833	A derivation and solution of dynamic equilibrium equations of shear undeformable composite anisotropic beams using the dqem	Chen CN.

Applied Mathematics & Mechanics 23(5) 2002

493	Second order approximation solution of nonlinear large deflection problems of yongjiang railway bridge in ningbo	Chien WZ.
507	Dynamic response of plates due to moving vehicles using finite strip method	Cheng YS. Cheung YK. Au FTK.
514	The three-dimensional fundamental solution to stokes flow in the oblate spheroidal coordinates with applications to multiples spheroid problems	Zhuang H. Yan ZY. Wu WY.
535	Classification of bifurcations for nonlinear dynamical problems with constraints	Wu ZQ. Chen YS.
542	Research on the effect of cylinder particles on the turbulent properties in particulate flows	Lin JZ. Lin J. Shi X.
549	Localized coherent structures of the (2+1)-dimensional higher order broer-kaup equations	Zhang JF. Liu YL.
557	The concave or convex peaked and smooth soliton solutions of camassa-holm equation	Tian LX. Xu G. Liu ZR.
568	Set-valued extension of operators via steiner selections (i) - theoretical results	Teran P. Lopez-Diaz M.
580	Set-valued extension of operators via steiner selections (ii) - applications to approximation	Teran P. Lopez-Diaz M.
590	The properties of a kind of random symplectic matrices	Yan QY.
597	Buckling analysis of woven fabric under uniaxial tension in arbitrary direction	Zhang YT. Xu JF.
606	Proper application of a kind of matrix construction method in physical parameter identification of dynamic model	Li S. Zhang F. Wang B. Zhang XG.
614	On the isometric isomorphism of probabilistic metric spaces	Liu MX.
618	Remarks on the paper "the extinction behavior of the solutions for a class of reaction-diffusion equations"	Chen SL.

Applied Mathematics & Mechanics 23(6) 2002

619	Element functions of discrete operator difference method	Tian ZX. Tang LM. Liu ZX.
627	Dynamic production prediction and parameter identification for gas well with vertical fracture	Guo DL. Liu CQ. Zhao JZ.
634	A note on delta-perturbation expansion method	He JH.
639	Solution of the rayleigh problem for a powerlaw non-newtonian conducting fluid via group method	Abd-el-Malek MB. Badran NA. Hassan HS.
647	Mathematical modeling of near-wall flows of two-phase mixture with evaporating droplets	Wang BY. Osiptov AN.
655	Research of regularity of throwing movement for solid particle on the shaker's screen	Yao HS. Du J. Zhang MH.
660	Nonlinear evolution analysis of t-s disturbance wave at finite amplitude in nonparallel boundary layers	Tang DB. Xia H.
670	Third-order nonlinear singularly perturbed boundary value problem	Wang GC. Jin L.
678	Oscillatory properties of the solutions of nonlinear delay hyperbolic differential equations of neutral type	Liu AP. He MX.
686	Ishikawa iterative process for constructing solutions of m-accretive operator equations	Zeng LC.
694	Theoretical analysis of using airflow to purge residual water in an inclined pipe	Shen F. Yan ZY. Zhao YH. Horii K.
703	Double method of characteristics to analyze hydraulic-thermal transients of pipeline flow	Deng SS. Zhou ML. Pu JN.

712	Sensitivity coefficients of single-phase flow in low-permeability heterogeneous reservoirs	Cheng SQ. Zhang SZ. Huang YZ. Zhu WY.
721	Nonlinear analysis of a cracked rotor with whirling	Li XF. Xu PY. Shi TL. Yang SZ.
732	A posteriori error estimate of the dsd method for first-order hyperbolic equations	Kang T. Yu DH.

Archive for Rational Mechanics & Analysis 163(3) 2002

171	Interface evolution in three dimensions with curvature-dependent energy and surface diffusion: interface-controlled evolution, phase transitions, epitaxial growth of elastic films	Gurtin ME. Jabbour ME.
209	Invariant manifolds and the long-time asymptotics of the navier-stokes and vorticity equations on r-2	Gallay T. Wayne CE.

Archive for Rational Mechanics & Analysis 163(4) 2002

259	A sobolev-hardy inequality with applications to a nonlinear elliptic equation arising in astrophysics	Badiale M. Tarantello G.
295	Viscosity solutions of dynamic-programming equations for the optimal control of the two-dimensional navier-stokes equations	Gozzi F. Sritharan SS. Swiech A.
329	Homogeneous cooling states are not always good approximations to granular flows	Caglioti E. Villani C.

Archive for Rational Mechanics & Analysis 164(1) 2002

1	Energy scaling of compressed elastic films - three-dimensional elasticity and reduced theories	Ben Belgacem H. Conti S. DeSimone A. Muller S.
39	Concentration and lack of observability of waves in highly heterogeneous media	Castro C. Zuazua E.
73	Homogenization of non-uniformly bounded operators: critical barrier for nonlocal effects	Briane M.

Archive of Applied Mechanics 72(4-5) 2002

213	The contact problem of a rubber half-space dented by a rigid cone apex	Gao YC. Mai YW.
229	On consistent plate theories	Kienzler R.
248	Generalized variational principles for thermopiezoelectricity	He JH.
257	Analysis of 2d infinite anisotropic elastic strips and semi-strips	Hu YT. Chen CY.
266	A kinematic elastic nonshakedown theorem for implicit standard materials	Bodoville G.
279	On the application of the constant deflection-contour method in nonlinear vibrations of elastic plates	Banerjee MM. Rogerson GA.
293	An inelastic material model for filled polytetrafluorethylen	Kletschkowski T. Schomburg U. Bertram A.
300	Computational micro-to-macro transitions of discretized microstructures undergoing small strains	Miehe C. Koch A.
318	Impact response of an interface crack in a hybrid piezoelectric laminate	Kwon SM. Lee KY.
330	A new numerical procedure for free vibrations of pretwisted plates	Hu XX. Sakiyama T. Itakura K.
342	Driving forces and kinking of an oblique crack in bonded nonhomogeneous materials	Choi HJ.

Communications on Pure & Applied Mathematics 55(9) 2002

1089	A note on the abc conjecture	Hu PC. Yang CC.
1104	The vlasov-poisson-boltzmann system near maxwellians	Guo Y.
1136	The stability of localized solutions of landau-lifshitz equations	Gustafson S. Shatah J.
1160	Fredholm determinants, jimbo-miwa-ueno pi-functions, and representation theory	Borodin A. Deift P.

Communications on Pure & Applied Mathematics 55(10) 2002

1231	On the infinity-volume limit of the focusing cubic schrodinger equation	Rider BC.
1249	Hypersurfaces in minkowski space with vanishing mean curvature	Brendle S.
1280	The elliptic representation of the general painleve vi equation	Guzzetti D.

Composites - Part A: Applied Science & Manufacturing 33(7) 2002

913	Selection of composite materials and manufacturing routes for cost-effective performance	Bader MG.
935	Elevated temperature bending stress rupture behavior as4/apc-2 and comparison with as4/pps literature data	Mahieux CA. Scheurer C.
939	Analysis of the flax fibres tensile behaviour and analysis of the tensile stiffness increase	Baley C.
949	Diaphragm forming of continuous fibre reinforced thermoplastics: influence of temperature, pressure and forming velocity on the forming of upilex-r (r) diaphragms	Bersee HEN. Beukers A.
959	New set-up for measurement of permeability properties of fibrous reinforcements for rtm	Hoes K. Dinescu D. Sol H. Vanheule M. Parnas RS. Luo YW. Verpoest I.
971	Delamination detection in cfrp laminates with embedded small-diameter fiber bragg grating sensors	Takeda S. Okabe Y. Takeda N.
981	An approach to couple mold design and on-line control to manufacture complex composite parts by resin transfer molding	Lawrence JM. Hsiao KT. Don RC. Simacek P. Estrada G. Sozer EM. Stadtfeld HC. Advani SG.
991	Effect of thermal residual stress on the reflection spectrum from fiber bragg grating sensors embedded in cfrp laminates	Okabe Y. Yashiro S. Tsuji R. Mizutani T. Takeda N.
1001	Shape memory effect in the epoxy polymer-thermoexpanded graphite system	Beloshenko VA. Beygelzimer YE. Borzenko AP. Varyukhin VN.
1007	Governing equations for unsaturated flow through woven fiber mats. part 1. isothermal flows	Pillai KM.
1021	Flexural and interlaminar shear strength properties of carbon fibre/epoxy composites cured thermally and with microwave radiation	Nightingale C. Day RJ.

Computational Mechanics 28(6) 2002

435	Error estimates for isoparametric mixed finite element solution of 4th order elliptic problems with variable coefficients	Bhattacharyya PK. Nataraj N.
456	Iterative mesh partitioning optimization for parallel nonlinear dynamic finite element analysis with direct substructuring	Yang YS. Hsieh SH.
469	Comparison of three separated flow models	Zhang HQ. Yang WB. Chan CK. Lau KS.
479	An iterative boundary element algorithm for a singular cauchy problem in linear elasticity	Marin L. Elliott L. Ingham DB. Lesnic D.
489	A virtual work derivation of the scaled boundary finite-element method for elastostatics	Deeks AJ. Wolf JP.
505	On probabilistic viscous incompressible flow of some composite fluids	Kaminski MM.

Computational Mechanics 29(1) 2002

1	Numerical algorithm for triphasic model of charged and hydrated soft tissues	Hon YC. Lu MW. Xue WM. Zhou X.
16	Phase transitions in shape memory alloys with hyperbolic heat conduction and differential-algebraic models	Melnik RVN. Roberts AJ. Thomas KA.
27	A c-1-continuous formulation for 3d finite deformation frictional contact	Krstulovic-Opara L. Wriggers P. Korelc J.
43	Concrete at high temperature with application to tunnel fire	Schrefler BA. Brunello P. Gawin D. Majorana CE. Pesavento F.
52	On material forces and finite element discretizations	Mueller R. Maugin GA.
61	Modeling and simulation of progressive penetration of multilayered ballistic fabric shielding	Zohdi TI.
68	Wrinkling of nonlinear membranes	Schoop H. Taenzer L. Hornig J.
75	Parallel 3-d simulations for porous media models in soil mechanics	Wieners C. Ammann M. Diebels S. Ehlers W.

Computational Mechanics 29(2) 2002

89	Simultaneous optimal design of structural topology, actuator locations and control parameters for a plate structure	Zhu Y. Qiu J. Du H. Tani J.
98	Shape design sensitivity analysis and optimization of two-dimensional periodic thermal problems using bem	Lee DH. Kwak BM.
107	Comparisons of two meshfree local point interpolation methods for structural analyses	Liu GR. Gu YT.
122	Numerical solution of two-dimensional axisymmetric hyperbolic heat conduction	Shen W. Han S.
129	Configuration design sensitivity analysis and optimization of beam structures	Choi JH.

143	Oscillatory torsional flow of a viscoelastic solid	Phan-Thien N.
151	Modeling of 3d transversely piezoelectric and elastic bimaterials using the boundary element method	Liew KM. Liang J.
163	Geometric invariance	Bottasso CL. Borri M. Trainelli L.
170	Dynamic analysis of nonlinear membranes by the analog equation method: a boundary-only solution	Katsikadelis JT.
178	Near-wall function for turbulence closure models	Ng EYK. Tan HY. Lim HN. Choi D.

Computer Methods in Applied Mechanics & Engineering 191(34) 2002

3651	Advanced computer simulation of polycrystalline microstructure	Mahadevan S. Zhao YW.
3669	Continuous/discontinuous finite element approximations of fourth-order elliptic problems in structural and continuum mechanics with applications to thin beams and plates, and strain gradient elasticity [review]	Engel G. Garikipati K. Hughes TJR. Larson MG. Mazzei L. Taylor RL.
3751	Time-dependent behavior of composite beams with flexible connectors	Kwak HG. Seo YJ.

Computer Methods in Applied Mechanics & Engineering 191(35) 2002

3775	Element formulation and numerical techniques for stability problems in shells	Eriksson A. Pacoste C.
3811	Differential quadrature-layerwise modeling technique for three-dimensional analysis of cross-ply laminated plates of various edge-supports	Liew KM. Ng TY. Zhang JZ.
3833	Nonlinear diffusion and discrete maximum principle for stabilized galerkin approximations of the convection-diffusion-reaction equation	Burman E. Ern A.
3857	On the stability and convergence of fully discrete solutions in linear elastodynamics	Romero I.

Computer Methods in Applied Mechanics & Engineering 191(36) 2002

3885	Non-linear analysis of nearly saturated porous media: theoretical and numerical formulation	Larsson J. Larsson R.
3909	Adaptive multiresolution approach for solution of hyperbolic pdes	Alves MA. Cruz P. Mendes A. Magalhaes FD. Pinho FT. Oliveira PJ.
3929	Detection of flaws in composites from scattered elastic-wave field using an improved mu ga and a local optimizer	Xu YG. Liu GR.
3947	Wave propagation related to high-speed train - a scaled boundary fe-approach for unbounded domains	Ekevid T. Wiberg NE.
3965	Direct gear tooth contact analysis for hypoid bevel gears	Vogel O. Griewank A. Bar G.
3983	A discontinuous galerkin method for transient analysis of wave propagation in unbounded domains	Park SH. Tassoulas JL.

Computer Methods in Applied Mechanics & Engineering 191(37-38) 2002

4015	An integrated fe process model for precision analysis of thermo-mechanical behaviors of rolls and strip in hot strip rolling	Hwang SM. Sun CG. Ryoo SR. Kwak WJ.
4035	A three-node c-0 ans element for geometrically non-linear structural analysis	Kim JH. Kim YH.
4061	Analysis of wave propagation in saturated porous media. i. theoretical solution	Kim SH. Kim KJ. Blouin SE.
4075	Analysis of wave propagation in saturated porous media. ii. parametric studies	Kim SH. Kim KJ. Blouin SE.
4093	On solving elliptic stochastic partial differential equations	Babuska I. Chatzipantelidis P.
4123	Acoustic infinite elements for non-separable geometries	Shirron JJ. Dey S.
4141	Harmonic reproducing kernel particle method for free vibration analysis of rotating cylindrical shells	Liew KM. Ng TY. Zhao X. Reddy JN.
4159	Dynamic contact/impact problems, energy conservation, and planetary gear trains	Bajer A. Demkowicz L.
4193	Three dimensional finite element modeling of thermomechanical frictional contact between finite deformation bodies using r-minimum strategy	Xing HL. Makinouchi A.
4215	Reanalysis of linear and nonlinear structures using iterated shanks transformation	Hurtado JE.
4231	Model of fluid-structure interaction and its application to elastohydrodynamic lubrication	Hong YP. Chen DR. Kong XM. Wang JD.
4241	Energy conserving/decaying implicit time-stepping scheme for nonlinear dynamics of three-dimensional beams undergoing finite rotations	Ibrahimbegovic A. Mamouri S.
4259	A state space finite element for laminated composite plates	Sheng HY. Ye JQ.

Computers & Fluids 31(8) 2002

847	Analytical and numerical prediction of inviscid free surface flow in rotating channel	Pagalthivarthi KV. Ramanathan V.
867	Simulation of a viscous compressible flow past a circular cylinder with high-order discontinuous galerkin methods	Burbeau A. Sagaut P.
891	The flow induced in a three layer stratified fluid by a submerged sink or source with stagnation points on the free surfaces	Manik K. Wen X. Ingham DB.
911	Flow topology in a steady three-dimensional lid-driven cavity	Sheu TWH. Tsai SF.
935	On predicting abrupt contraction flows with differential and algebraic viscoelastic models	Mompean G.
957	Improving jet reactor configuration for production of carbon nanotubes	Povitsky A.
977	Application of triple-deck theory to the prediction of glaze ice roughness formation on an airfoil leading edge	Tsao JC. Rothmayer AP.
1015	One-shot airfoil optimisation without adjoint	Held C. Dervieux A.

Computers & Structures 80(12) 2002

1025	Progress in probabilistic mechanics and structural reliability	Frangopol DM.
1027	Microcracked bodies with random properties: a preliminary investigation on localization phenomena	Mariano PM. Gioffre M. Stazi FL. Augusti G.
1049	Simulation of second-order processes using karhunen-loeve expansion	Phoon KK. Huang SP. Quek ST.
1061	Simulation of non-gaussian wind pressures on a 3-d bluff body and estimation of design loads	Bartoli G. Borri C. Facchini L.
1071	Non-stationary flow forces for the numerical simulation of aeroelastic instability of bridge decks	Borri C. Costa C. Zahlten W.
1081	Vibration analysis of medical devices with a calibrated fea model	Wu JS. Zhang RRC. Radons S. Long XL. Stevens KK.
1087	Structural reliability analysis through fuzzy number approach, with application to stability	Savoia M.
1103	Efficient estimation of structural reliability for problems with uncertain intervals	Penmetsa RC. Grandhi RV.
1113	Reliability-based importance assessment of structural members with applications to complex structures	Gharaibeh ES. Frangopol DM. Onoufriou T.
1133	Reliability-based inspection optimization of complex structures: a brief retrospective	Onoufriou T. Frangopol DM.

Computers & Structures 80(13) 2002

1145	Advanced aerostatic stability analysis of cable-stayed bridges using finite-element method	Cheng J. Jiang JJ. Xiao RC. Xiang HF.
1159	On a general constitutive description for the inelastic and failure behavior of fibrous laminates - part i: lamina theory	Huang ZM.
1177	On a general constitutive description for the inelastic and failure behavior of fibrous laminates - part ii: laminate theory and applications	Huang ZM.
1201	The exact solution of coupled thermoelectroelastic behavior of piezoelectric laminates	Zhang C. Cheung YK. Di S. Zhang N.

Computers & Structures 80(14-15) 2002

1213	Solution strategies for fem analysis with nonlinear viscoelastic polymers	Beijer JGJ. Spoormaker JL.
1231	Eigenvalue branches and modes for flutter of cantilevered pipes conveying fluid	Ryu SU. Sugiyama Y. Ryu BJ.
1243	Effect of surface roughness on the static characteristics of rotor bearings with couple stress fluids	Naduvinamani NB. Hiremath PS. Gurubasavaraj G.
1255	Dynamic modeling of swept wing with ptfe method	Gasbarri P. Mannini A. Barboni R.
1267	A flow-condition-based interpolation finite element procedure for incompressible fluid flows	Bathe KJ. Zhang H.
1279	Consistent tangent stiffness for nonlocal damage models	Jirasek M. Patzak B.
1295	Computational approach to analysis and design of hydroforming process for an automobile lower arm	Kim J. Kang SJ. Kang BS.
1305	Optimization of steel structures using distributed simulated annealing algorithm on a cluster of personal computers	Park HS. Sung CW.
1317	The effect of aspect ratio on the elastoplastic response of stiffened plates loaded in uniaxial edge compression	Toulios M. Caridis PA.
1329	Buckling of sandwich beams with compliant interfaces	Volokh KY. Needleman A.

Computers & Structures 80(16-17) 2002

1337	A parallel procedure for nonlinear analysis of reinforced concrete three-dimensional frames	Romero ML. Miguel PF. Cano JJ.
1351	Bem for dynamic analysis using compact supported radial basis functions	Rashed YF.
1369	Semi-empirical equations for pipeline design by the finite element method	Famiyesin OOR. Oliver KD. Rodger AA.
1383	An optimization approach for indirect identification of cohesive crack properties	Que NS. Tin-Loi F.
1393	Vibration and damping analysis of composite plates using finite elements with layerwise in-plane displacements	Koo KN.
1399	Some algorithms to correct a geometry in order to create a finite element mesh	Ribo R. Bugeda G. Onate E.
1409	Vibration predictions and verifications of disk drive spindle system with ball bearings	Yang JP. Chen SX.
1419	The location of a concentrated mass on rectangular plates from measurements of natural vibrations	Ostachowicz W. Krawczuk M. Cartmell M.
1429	Identification of damage parameters for jointed rock	Xiang ZH. Swoboda G. Cen ZZ.
1441	On the structural behavior and the saint venant solution in the exact beam theory - application to laminated composite beams	El Fatmi R. Zenzri H.

Earthquake Engineering & Structural Dynamics 31(8) 2002

1481	Non-linear response analyses of rectangular rigid bodies subjected to horizontal and vertical ground motion	Taniguchi T.
1501	Prediction of the maximum credible ground motion in singapore due to a great sumatran subduction earthquake: the worst-case scenario	Megawati K. Pan TC.
1525	A recursive decomposition algorithm for network seismic reliability evaluation	Li J. He J.
1541	A response-based decoupling criterion for multiply-supported secondary systems	Chaudhuri SR. Gupta VK.
1563	Pseudodynamic tests on rubber base isolators with numerical substructuring of the superstructure and strain-rate effect compensation	Molina FJ. Verzeletti G. Magonette G. Buchet P. Renda V. Geradin A. Parducci A. Mezzi M. Pacchiarotti A. Federici L. Mascelloni S.
1583	Effect of boundary element details on the seismic deformation capacity of structural walls	Oh YH. Han SW. Lee LH.
1603	Mode-acceleration approach to seismic response of multiply-supported secondary systems	Rao VSC. Chaudhuri SR. Gupta VK.

Earthquake Engineering & Structural Dynamics 31(9) 2002

1623	Earthquake response of elastic sdf systems with non-linear fluid viscous dampers	Lin WH. Chopra AK.
1643	Plasticity-fibre model for steel triangular plate energy dissipating devices	Chou CC. Tsai KC.
1657	Damaging properties of ground motions and prediction of maximum response of structures based on momentary energy response	Hori N. Inoue N.
1681	Experimental investigation of the earthquake response of a model of a marble classical column	Mouzakis HP. Psycharis IN. Papastamatiou DY. Carydis PG. Papantonopoulos C. Zambas C.
1699	Numerical prediction of the earthquake response of classical columns using the distinct element method	Papantonopoulos C. Psycharis IN. Papastamatiou DY. Lemos JV. Mouzakis HP.
1719	Probabilistic analysis of peak response of mdof systems with uncertain psd function	Hong HP. Wang SS.
1735	Active viscous damping system with amplifying braces for control of mdof structures	Gluck J. Ribakov Y.
1753	Evaluation of combination rules for maximum response calculation in multicomponent seismic analysis by o. a. lopez, a. k. chopra and j. j. hernandez, earthquake engng struct. dyn. 2001; 30(9): 1379-1398	Anagnostopoulos SA.

Earthquake Engineering & Structural Dynamics 31(10) 2002

1757	Study of a semi-active stiffness damper under various earthquake inputs	Djajakesukma SL. Samali B. Nguyen H.
1777	Study on effects of damping in laminated rubber bearings on seismic responses for a 1/8 scale isolated test structure	Yoo B. Kim YH.
1793	Analysis and performance of a predictor-multicorrector time discontinuous galerkin method in non-linear elastodynamics	Bursi OS. Mancuso M.
1815	Characteristics of earthquake ground motions and the h/v of microtremors in the southwestern part of taiwan	Huang HC.

1831	Amplification of earthquake ground motion by steep topographic irregularities	Paolucci R.
1855	Market-based control of linear structural systems	Lynch JP. Law KH.
1879	Towards a direct collapse-load method of design for concrete frames subjected to severe ground motions	Griffith MC. Kawano A. Warner RF.

Engineering Fracture Mechanics 69(12) 2002

1289	Crack initiation at free edge of interface between thin films in advanced lsi	Kitamura T. Shibutani T. Ueno T.
1301	Domain-independent values of the j-integral for cracks in three-dimensional residual stress bearing bodies	Meith WA. Hill MR.
1315	Utilization of partial crack closure for fatigue crack growth modeling	Kujawski D.
1325	T-stress and its implications for crack growth	Tong J.
1339	Elastic t-stress for cracks in test specimens subjected to non-uniform stress distributions	Wang X.
1353	Influence of stress gradients on failure in contact strength tests with cylinder loading	Fett T. Munz D.
1363	Damage zone around crack tip and fracture toughness of rubber-modified epoxy resin under mixed-mode conditions	Lee DB. Ikeda T. Miyazaki N. Choi NS.
1377	Experimental approach to dimple fracture mechanisms under short pulse loading	Rizal S. Homma H. Nazer M. Kishida E.
1391	Determination of impact fracture toughness of polyethylene using arc-shaped specimens	Niglia J. Cisilino A. Seltzer R. Frontini P.

Engineering Fracture Mechanics 69(13) 2002

1403	Structural optimisation with fracture strength constraints	Jones R. Chaperon P. Heller M.
1425	On the application of the kitagawa-takahashi diagram to foreign-object damage and high-cycle fatigue	Peters JO. Boyce BL. Chen X. McNaney JM. Hutchinson JW. Ritchie RO.
1447	Approximate j estimates for tension-loaded plates with semi-elliptical surface cracks	Kim YJ. Shim DJ. Choi JB.
1465	Stress intensity factors for cracks in thin plates	Dirgantara T. Aliabadi MH.
1487	Verification of brittle fracture criteria for elements with v-shaped notches	Seweryn A. Lukaszewicz A.
1511	Fiducial marks as measures of thin film crack arrest toughness	Volinsky AA. Kottke ML. Moody NR. Gerberich WW.

Engineering Fracture Mechanics 69(14-16) 2002

1519	Fracture of functionally graded materials	Paulino GH.
1521	Statistical fracture modeling: crack path and fracture criteria with application to homogeneous and functionally graded materials	Becker TL. Cannon RM. Ritchie RO.
1557	Mixed-mode fracture of orthotropic functionally graded materials using finite elements and the modified crack closure method	Kim JH. Paulino GH.
1587	Analysis of spallation mechanism in thermal barrier coatings with graded bond coats using the higher-order theory for fgms	Pindera MJ. Aboudi J. Arnold SM.
1607	On the use of effective properties for the fracture analysis of microstructured materials	Dolbow JE. Nadeau JC.
1635	Theoretical investigation of the effect of plasticity on crack growth along a functionally graded region between dissimilar elastic-plastic solids	Tvergaard V.
1647	R-curve behavior in alumina-zirconia composites with repeating graded layers	Moon RJ. Hoffman M. Hilden J. Bowman KJ. Trumble KP. Rodel J.
1667	Effects of residual stress and geometry on crack kink angles in graded composites	Chapa-Cabrera J. Reimanis IE.
1679	Influence of elastic variations on crack initiation in functionally graded glass-filled epoxy	Rousseau CE. Tippur HV.
1695	Investigation of crack growth in functionally graded materials using digital image correlation	Abanto-Bueno J. Lambros J.
1713	Thermal fracture behavior of metal/ceramic functionally graded materials	Kawasaki A. Watanabe R.
1729	A surface crack in a graded medium loaded by a sliding rigid stamp	Dag S. Erdogan F.
1753	On the dynamic propagation of a finite crack in functionally graded materials	Meguid SA. Wang XD. Jiang LY.
1769	A viscoelastic functionally graded strip containing a crack subjected to in-plane loading	Jin ZH. Paulino GH.
1791	Transient thermoelastic responses of functionally graded materials containing collinear cracks	Noda N. Wang BL.

Engineering Structures 24(8) 2002

1001	A comparative study on aseismic performances of base isolation systems for multi-span continuous bridge	Park KS. Jung HJ. Lee IW.
1015	Static, seismic and stability analyses of a prototype wind turbine steel tower	Bazeos N. Hatzigeorgiou GD. Hondros ID. Karamaneas H. Karabalis DL. Beskos DE.
1027	Buckling of a non-uniform, long cylindrical shell subjected to external hydrostatic pressure	Xue J. Fatt MSH.
1035	Evaluation of typhoon induced fatigue damage for tsing ma bridge	Li ZX. Chan THT. Ko JM.
1049	Performance and modelling of steel fibre reinforced piles under seismic loading	Buyle-Bodin F. Madhkhan M.
1057	Modelling of historical masonry structures: comparison of different approaches through a case study	Giordano A. Mele E. De Luca A.
1071	Bridge live load models from wim data	Miao TJ. Chan THT.
1085	Dynamic characteristics of cantilever grandstand roofs	Letchford CW. Denoon RO. Johnson G. Mallam A.
1091	Theory of principal components analysis and applications to multistory frame buildings responding to seismic excitation	Aschheim MA. Black EF. Cuesta I.
1105	A new design equation for predicting the joint shear strength of monotonically loaded exterior beam-column joints	Bakir PG. Boduroglu HM.

Engineering Structures 24(9) 2002

1119	A combined finite element based soil-structure interaction model for large-scale systems and applications on parallel platforms	Genes MC. Kocak S.
1133	A simplified crack model for weld fracture in steel moment connections	Righiniotis TD. Omer E. Elghazouli AY.
1141	Model of damage for rc elements subjected to biaxial bending	Marante ME. Florez-Lopez J.
1153	Stress-strain curve of laterally confined concrete	Chung HS. Yang KH. Lee YH. Eun HC.
1165	The displacement capacity of reinforced concrete coupled walls	Paulay T.
1177	A structural damage identification method for plate structures	Lee U. Shin J.
1189	Optimal design of steel frame using practical nonlinear inelastic analysis	Choi SH. Kim SE.
1203	Shake table testing of a base isolated model	Wu YM. Samali B.
1217	Efficient siesmic analysis of building structures with added viscoelastic dampers	Lee DG. Hong S. Kim J.
1229	Application of fuzzy sets for estimating service life of reinforced concrete structural members in corrosive environments	Anoop MB. Rao KB. Rao TVSRA.

Engineering Structures 24(10) 2002

1245	Effects of approaching flow on response characteristics of a cantilever bridge model in the wake of a hill	Roy UK. Kimura K. Selvam RP. Fujino Y.
1257	Optimum distribution of added viscoelastic dampers for mitigation of torsional responses of plan-wise asymmetric structures	Kim J. Bang S.
1271	Influence of stiffness degradation on strength demands of structures built on soft soil sites	Miranda E. Ruiz-Garcia J.
1283	Dynamic response of a curved bridge under moving truck load	Senthilvasan J. Thambiratnam DP. Brameld GH.
1295	Inelastic seismic response of code-designed reinforced concrete asymmetric buildings with strength degradation	Dutta SC. Das PK.
1315	Deck modeling for seismic analysis of skewed slab-girder bridges	Maleki S.
1327	Neural analysis of vibration problems of real flat buildings and data pre-processing	Kuzniar K. Waszczyszyn Z.
1337	Seismic assessment and design of r/c bridges with irregular congiguration, including ssi effects	Kappos AJ. Manolis GD. Moschonas IF.
1349	Improving the strength of fully composite steel-concrete-steel beam elements by increased surface roughness - an experimental study	Subedi NK. Coyle NR.
1357	Buckling of an internally hinged column with an elastic support	Wang CY.

European Journal of Mechanics B-Fluids 21(4) 2002

383	Buoyant flow in long vertical enclosures in the presence of a strong horizontal magnetic field. part 1. fully-established flow	Tagawa T. Authie G. Moreau R.
399	In-phase and out-of-phase break-up of two immersed liquid threads under influence of surface tension	Gunawan AY. Molenaar J. de Ven AAF.
413	Direct numerical simulation of the turbulent flow in a pipe with annular cross section	Quadrio M. Luchini P.

429	Active control of the turbulent flow over a swept fence	Huppertz A. Fernholz HH.
447	Unsteady heat transfer in impulsive falkner-skan flows: constant wall temperature case	Harris SD. Ingham DB. Pop I.
469	Kinetic model for the motion of compressible bubbles in a perfect fluid	Teshukov VM. Gavrilyuk SL.

Experiments in Fluids 33(1) 2002

5	Similarity of apparently random structures in the outer region of wall turbulence	Hommema SE. Adrian RJ.
13	Simultaneous velocity-surface heat transfer behavior of turbulent spots	Sabatino D. Smith CR.
22	Higher-order moments and spectra of velocity fluctuations in adverse-pressure-gradient turbulent boundary layer	Nagano Y. Houra T.
31	Reynolds stress anisotropy of turbulent rough wall layers	Smalley RJ. Leonardi S. Antonia RA. Djenidi L. Orlandi P.
38	The effects of wall roughness on the separated flow over a smoothly contoured ramp	Song S. Eaton JK.
47	A depth-of-field limited particle image velocimetry technique applied to oscillatory boundary layer flow over a porous bed	Lara JL. Cowen EA. Sou IM.
54	Control of vortex formation from a vertical cylinder in shallow water: effect of localized roughness elements	Kahraman A. Sahin B. Rockwell D.
66	Vortex shedding from tapered plates	Castro IP. Rogers P.
75	Extinction and relight in opposed flames	Korusoy E. Whitelaw JH.
90	Convective heat transfer in ribbed channels with a 180 degrees turn	Astarita T. Cardone G. Carlomagno GM.
101	Fully developed laminar flow of non-newtonian liquids through annuli: comparison of numerical calculations with experiments	Escudier MP. Oliveira PJ. Pinho FT. Smith S.
112	Time evolution of liquid drop impact onto solid, dry surfaces	Rioboo R. Marengo M. Tropea C.
125	Improvements of the interferometric technique for simultaneous measurement of droplet size and velocity vector field and its application to a transient spray	Maeda M. Akasaka Y. Kawaguchi T.
135	Laser doppler velocimetry measurement of turbulent bubbly channel flow	So S. Morikita H. Takagi S. Matsumoto Y.
143	Experimental studies on particle behaviour and turbulence modification in horizontal channel flow with different wall roughness	Kussin J. Sommerfeld M.
160	Speckle tomography of turbulent flows with density fluctuations	Fomin N. Lavinskaya E. Vitkin D.
170	Electro-osmosis-driven micro-channel flows: a comparative study of microscopic particle image velocimetry measurements and numerical simulations	Kim MJ. Beskok A. Kihm KD.
181	Computerized background-oriented schlieren	Meier GEA.
188	Development and application of streakline visualization in hypervelocity flows	Lemieux P. Hornung HG.
196	Coherent structures in plumes with and without off-source heating using wavelet analysis of flow imagery	Narasimha R. Saxena V. Kailas SV.
202	A novel method for instantaneous, quantitative measurement of molecular mixing in gaseous flows	Hu H. Koochesfahani MM.
210	Experimental investigation of near-wall effects on hot-wire measurements	Durst F. Zanoun ES.
219	Leonardo's vision of flow visualization	Gharib M. Kremers D. Koochesfahani MM. Kemp M.

Experiments in Fluids 33(2) 2002

225	Supersonic boundary-layer response to optically generated freestream disturbances	Schmisseur JD. Schneider SP. Collicott SH.
233	Turbulence-induced preferential concentration of solid particles in microgravity conditions	Fallon T. Rogers CB.
242	Drag reduction in polymer solutions based on splash visualization	Sabadini E. Alkschbirs MI.
249	Wall shear stress measurement in a turbulent pipe flow using ultrasound doppler velocimetry	Nowak M.
256	Influence of temperature transients and centrifugal force on fast-response pressure transducers	Denos R.
265	Quantitative three-dimensional imaging of soot volume fraction in turbulent non-premixed flames	Hult J. Omrane A. Nygren J. Kaminski CF. Axelsson B. Collin R. Bengtsson PE. Alden M.
270	Turbulence characteristics of the three-dimensional boundary layer on a rotating disk with jet impingement	Kang HS. Yoo JY.
281	A large stratified shear flow water channel facility	Bidokhti AA. Britter RE.
288	Take-off threshold velocity of saltating particles under heat radiation	Pajot F. el Moctar AO. Dupont P. Peerhossaini H.
296	Experimental analysis of turbulent flow structure in a fully developed rib-roughened rectangular channel with piv	Islam MS. Haga K. Kaminaga M. Hino R. Monde M.
307	Dynamic measurements in supercritical flow using instantaneous phase-shift interferometry	Astrakharchik-Farrimond E. Shekunov BY. York P. Sawyer NBE. Morgan SP. Somekh MG. See CW.

315	A micro-aerodynamic decelerator based on permeable surfaces of nanofiber mats	Zussman E. Yarin AL. Weihs D.
321	An economical droplet fog generator suitable for laser doppler anemometry and particle imaging velocity seeding	Jermy MC.
323	The effect of boundary conditions by the side of the nozzle of a low reynolds number jet	Romano GP.
334	Performance of a probe for measuring turbulent energy and temperature dissipation rates	Zhou T. Antonia RA. Chua LP.
346	Flow over convergent and divergent wall riblets	Koeltzsch K. Dinkelacker A. Grundmann R.
351	Scaling the inner region of turbulent plane wall jets	Tachie MF. Balachandar R. Bergstrom DJ.
355	Dual particle image velocimetry for transient flow field measurements	Guibert P. Lemoyne L.

Fatigue & Fracture of Engineering Materials & Structures 25(8-9) 2002

727	Near threshold fatigue crack growth versus long finite life	Paris PC. Tada H.
735	Mechanism of fatigue failure in ultralong life regime	Murakami Y. Yokoyama NN. Nagata J.
747	Specific features of high-cycle and ultra-high-cycle fatigue	Lukas P. Kunz L.
755	On 'multi-stage' fatigue life diagrams and the relevant life-controlling mechanisms in ultrahigh-cycle fatigue	Mughrabi H.
765	Characteristic s-n properties of high-carbon-chromium-bearing steel under axial loading in long-life fatigue	Sakai T. Sato Y. Oguma N.
775	Fatigue crack propagation behaviour derived from s-n data in very high cycle regime	Tanaka K. Akiniwa Y.
785	Some effects of martensitic transformation on fatigue resistance	Hornbogen E.
791	Secondary elastic crack tip stresses which may influence very slow fatigue crack growth	Paris PC.
795	Influence of atmospheric moisture on slow fatigue crack growth at ultrasonic frequency in aluminium and magnesium alloys	Papakyriacou M. Mayer H. Fuchs U. Stanzl-Tschegg SE. Wei RP.
805	Non-propagation conditions for fatigue cracks and fatigue in the very high-cycle regime	Pippan R. Tabernig B. Gach E. Riemelmoser F.
813	Very high-cycle fatigue behaviour of shot-peened high-carbon-chromium bearing steel	Shiozawa K. Lu L.
823	High-cycle rotating bending fatigue property in very long-life regime of high-strength steels	Ochi Y. Matsumura T. Masaki K. Yoshida S.
831	Evaluation of giga-cycle fatigue properties of some maraging steels by intermittent ultrasonic fatigue testing	Ishii H. Yagasaki T. Akagi H.
837	Very high cycle regime fatigue of thin walled tubes made from austenitic stainless steel	Carstensen JV. Mayer H. Brondsted P.
845	Environmental considerations for fatigue cracking	Wei RP.
855	Long-term corrosion fatigue behaviour of structural materials	Ebara R.
861	Step loading for very high cycle fatigue	Nicholas T.
871	Cumulative fatigue damage taking the threshold into account	Svensson T.
877	Parameter c lifetime calculation for the high cycle regime	Poting S. Zenner H.
887	Variable amplitude loading in the very high-cycle fatigue regime	Stanzl-Tschegg SE. Mayer H. Stich A.

Fatigue & Fracture of Engineering Materials & Structures 25(10) 2002

899	An engineering model for prediction of rolling contact fatigue of railway wheels	Ekberg A. Kabo E. Andersson H.
911	A mode ii weight function for subsurface cracks in a two-dimensional half-space	Mazzu A.
917	The equivalent strain energy density approach re-formulated and applied to sharp v-shaped notches under localized and generalized plasticity	Lazzarin P. Zambardi R.
929	Fracture assessment of a clad steel using various sintap defect assessment procedure levels	Motarjemi AK. Kocak M.
941	Fatigue of clamped connections with application to a stem-handlebar assembly for off-road bicycles	McKenna SP. Hill MR. Hull ML.
955	Fretting fatigue crack initiation mechanism in ti-6al-4v	Namjoshi SA. Mall S. Jain VK. Jin O.
965	Determination of weight functions for elastic t-stress from reference t-stress solutions	Wang X.
975	A low-cycle fatigue life prediction model of ultrafine-grained metals	Ding HZ. Mughrabi H. Hoppel HW.
985	Prediction of fatigue crack growth path in mechanical joints using a weight function approach	Heo SP. Yang WH.

Finite Elements in Analysis & Design 38(11) 2002

1015	A new method of structural modal reanalysis for topological modifications	Chen SH. Rong F.
1029	Use of finite element structural models in analyzing machine tool chatter	Baker JR. Rouch KE.

1047	Use of shallow class hierarchies to facilitate object-oriented nonlinear structural simulations	Balopoulos V. Abel JF.
1075	Automatic adaptive generation of a coupled finite element/element-free galerkin discretization	Karutz H. Chudoba R. Kratzig WB.

IMA Journal of Applied Mathematics 67(4) 2002

321	Asymptotic profiles and asymptotic distributions of energy in elastic waves scattering	Mabrouk M. Helali Z.
357	The riesz basis property of a timoshenko beam with boundary feedback and application	Xu GQ. Feng DX.
371	A priori estimates of the solution for the dirichlet problem	Villacampa Y. Balaguer A.
383	Short wave motion in a pre-stressed incompressible elastic plate	Kaplunov JD. Nolde EV. Rogerson GA.
401	On the duration of the total eclipse of a satellite of a body	Kostolansky E.
411	A partial differential equation which describes an interatomic surface	Site LD.

International Journal for Numerical & Analytical Methods in Geomechanics 26(9) 2002

845	Evolution of elastic properties in finite poroplasticity and finite element analysis	Bernaud D. Deude V. Dormieux L. Maghous S. Schmitt DP.
873	Characterization and reconstruction of a rock fracture surface by geostatistics	Marache A. Riss J. Gentier S. Chiles JP.
897	Mechanical behaviour of lixhe chalk partly saturated by oil and water: experiment and modelling	Collin F. Cui YJ. Schroeder C. Charlier R.

International Journal for Numerical & Analytical Methods in Geomechanics 26(10) 2002

925	Tensor visualizations in computational geomechanics	Jeremic B. Scheuermann G. Frey J. Yang ZH. Hamann B. Joy KI. Hagen H.
945	Modelling of anisotropic damage in brittle rocks under compression dominated stresses	Lu YF. Shao JF.
963	A generalized backward euler algorithm for the numerical integration of an isotropic hardening elastoplastic model for mechanical and chemical degradation of bonded geomaterials	Tamagnini C. Castellanza R. Nova R.
1005	Fuzzy parameters analysis of time-dependent fracture of concrete dam models	Barpi F. Valente S.

International Journal for Numerical & Analytical Methods in Geomechanics 26(11) 2002

1031	Semi-analytical elastostatic analysis of unbounded two-dimensional domains	Deeks AJ. Wolf JP.
1059	A unified approach to the implicit integration of standard, non-standard and viscous plasticity models	de Borst R. Heeres OM.
1071	A 2-d constitutive model for cyclic interface behaviour	Mortara G. Boulon M. Ghionna VN.
1097	Evaluation of a constitutive model for clays and sands: part i - sand behaviour	Pestana JM. Whittle AJ. Salvati LA.
1123	Evaluation of a constitutive model for clays and sands: part ii - clay behaviour	Pestana JM. Whittle AJ. Gens A.

International Journal for Numerical Methods in Engineering 54(11) 2002

1535	Numerical inclusion methods of solutions for variational inequalities	Ryoo CS. Agarwal RP.
1557	A new shear flexible cubic spline plate element for vibration analysis	Patel BP. Ganapathi M.
1579	Adaptive moving mesh methods for simulating one-dimensional groundwater problems with sharp moving fronts	Huang WZ. Zheng L. Zhan XY.
1605	Topology optimization of resonating structures using simp method	Tcherniak D.
1623	A point interpolation meshless method based on radial basis functions	Wang JG. Liu GR.
1649	A finite difference solution of non-linear systems of radiative-conductive heat transfer equations	Asllanaj F. Milandri A. Jeandel G. Roche JR.

International Journal for Numerical Methods in Engineering 54(12) 2002

1669	Analytical study and numerical experiments for degenerate scale problems in the boundary element method for two-dimensional elasticity	Chen JT. Kuo SR. Lin JH.
1683	An objective finite element approximation of the kinematics of geometrically exact rods and its use in the formulation of an energy-momentum conserving scheme in dynamics	Romero I. Armero F.
1717	Molecular dynamics and multiscale homogenization analysis of seepage/diffusion problem in bentonite clay	Ichikawa Y. Kawamura K. Fujii N. Nattavut T.
1751	A general and efficient formulation of fractures and boundary conditions in the finite element method	Juanes R. Samper J. Molinero J.
1775	Frame-indifferent beam finite elements based upon the geometrically exact beam theory	Betsch P. Steinmann P.

International Journal for Numerical Methods in Engineering 55(1) 2002

1	Higher-order boundary element methods for transient diffusion problems. part i: bounded flux formulation	Grigoriev MM. Dargush GF.
41	Higher-order boundary element methods for transient diffusion problems. part ii: singular flux formulation	Dargush GF. Grigoriev MM.
55	Genetic algorithm for discrete-sizing optimal design of trusses using the force method	Kaveh A. Kalatjari V.
73	Path-following analysis of thin-walled structures and comparison with asymptotic post-critical solutions	Garcea G. Trunfio GA. Casciaro R.
101	A monolithic smoothing-gap algorithm for contact-impact based on the signed distance function	Belytschko T. Daniel WJT. Ventura G.

International Journal for Numerical Methods in Engineering 55(2) 2002

127	An orthotropic damage model for masonry structures	Berto L. Saetta A. Scotta R. Vitaliani R.
159	An augmented spatial digital tree algorithm for contact detection in computational mechanics	Feng YT. Owen DRJ.
177	A feature-preserving volumetric technique to merge surface triangulations	Cebral JR. Camelli FE. Lohner R.
191	Classical and advanced multilayered plate elements based upon pvd and rmvt. part 1: derivation of finite element matrices [review]	Carrera E. Demasi L.
233	Accurate reanalysis of structures by a preconditioned conjugate gradient method	Kirsch U. Kocvara M. Zowe J.

International Journal for Numerical Methods in Engineering 55(3) 2002

253	Classical and advanced multilayered plate elements based upon pvd and rmvt. part 2: numerical implementations	Carrera E. Demasi L.
293	A new variable-order singular boundary element for two-dimensional stress analysis	Lim KM. Lee KH. Tay AAO. Zhou W.
317	Micromechanics of fibre glass composites at elevated temperatures	Tesar A. Sotakova D. Minar M.
339	Arbitrary order edge elements for electromagnetic scattering simulations using hybrid meshes and a pml	Ledger PD. Morgan K. Hassan O. Weatherill NP.
359	Meshless formulations for simply supported and clamped plate problems	Sladek J. Sladek V. Mang HA.

International Journal for Numerical Methods in Engineering 55(4) 2002

377	An efficient diagonal preconditioner for finite element solution of biot's consolidation equations	Phoon KK. Toh KC. Chan SH. Lee FH.
401	Relaxation iterative algorithms for solving cathodic protection systems with non-linear polarization curves	Sun W.
413	Linear and non-linear finite element error estimation based on assumed strain fields	Gabaldon F. Goicolea JM.
431	Material state remapping in computational solid mechanics	Rashid MM.
451	Mesh data structure selection for mesh generation and fea applications	Garimella RV.
479	Application of proper orthogonal decomposition to the discrete euler equations	Pettit CL. Beran PS.
499	Modelling of failure mode transition in ballistic penetration with a continuum model describing microcracking and flow of pulverized media (vol 54, pg 365, 2002)	Gailly BA. Espinosa HD.

International Journal for Numerical Methods in Fluids 39(9) 2002

763	Embedded turbulence model in numerical methods for hyperbolic conservation laws	Drikakis D.
783	The use of les subgrid-scale models for shock capturing	Adams NA.
799	Vles modelling of geophysical fluids with nonoscillatory forward-in-time schemes	Smolarkiewicz PK. Prusa JM.
821	A rationale for implicit turbulence modelling	Margolin LG. Rider WJ.
843	Large-scale organization of moist convection in idealized aquaplanet simulations	Grabowski WW.
855	Eddy resolving simulations of turbulent solar convection	Elliott JR. Smolarkiewicz PK.

International Journal for Numerical Methods in Fluids 39(10) 2002

865	A finite element method for the two-dimensional extended boussinesq equations	Walkley M. Berzins M.
887	Data assimilation of local model error forecasts in a deterministic model	Babovic TV. Fuhrman DR.
919	Large eddy simulation of free surface turbulent flow in partly vegetated open channels	Su XH. Li CW.
939	A finite volume approach for unsteady viscoelastic fluid flows	Al Moatassime H. Esselaoui D.
961	Age method simulations of a turbulent far-wake compared to spectral dns	Bisset DK.

International Journal for Numerical Methods in Fluids 39(11) 2002

979	Parallelization of a vorticity formulation for the analysis of incompressible viscous fluid flows	Brown MJ. Ingber MS.
1001	On the quadrilateral q(2)-p-1 element for the stokes problem	Boffi D. Gastaldi L.
1013	Towards entropy detection of anomalous mass and momentum exchange in incompressible fluid flow	Naterer GF. Rinn D.
1037	On streamline diffusion arising in galerkin fem with predictor/multi-corrector time integration	Eguchi Y.
1053	Exact solutions of the generalized navier-stokes equations for benchmarking	Bourchtein A.

International Journal for Numerical Methods in Fluids 39(12) 2002

1073	Some recent finite volume schemes to compute euler equations using real gas eos	Gallouet T. Herard JM. Seguin N.
1139	On the validity of the perturbation approach for the flow inside weakly modulated channels	Zhou H. Khayat RE. Martinuzzi RJ. Straatman AG.
1161	A novel finite point method for flow simulation	Cheng M. Liu GR.

International Journal of Damage Mechanics 11(3) 2002

205	Micromechanics of stiffness damage in ceramic-based fiber-reinforced composites	Araki S. Saito K.
223	Constitutive modeling of creep and damage behaviors of the non-mises type for a class of polycrystalline metals	Kawai M.
247	Experimental study of biaxial creep damage for type 304 stainless steel	Sakane M. Tokura H.
263	Interface debonding model and its application to the mixed mode interface fracture toughness	Omiya M. Kishimoto K.
287	Experimental characterization of matrix cracking behavior in thermally cycled cfrp laminates	Ogihara S. Kobayashi A. Ishiguro T. Otani N.

International Journal of Engineering Science 40(12) 2002

1285	Stability criterion and stationary states in a superconducting wire of limited length	Guemouri Y. Meuris C. El Khomssi M.
1297	On the mechanics of a growing tumor	Ambrosi D. Mollica F.
1317	Minimum principles for the bending problem of elastic plates with voids	Scarpetta E.
1329	Generalized thermo-viscoelastic plane waves with two relaxation times	Othman MIA. Ezzat MA. Zaki SA. El-Karamany AS.
1349	Evaluation of the three-dimensional elastic green's function in anisotropic cubic media	Lee VG.

1363	Total lagrangian perspectives on analytical sensitivities for flexible beams	Gosling PD. Liu L.
1381	Penetration of a rigid projectile into a multi-layered target: theory and numerical computations	Yossifon G. Yarin AL. Rubin MB.
1403	A variational principle for magnetohydrodynamics with high hartmann number flow	He JH.

International Journal of Engineering Science 40(13) 2002

1411	A time domain approach to sh waves on a piezoelectric layer	Romeo M.
1435	Local buckling of the elastic and viscoelastic coating around the penny-shaped interface crack	Rzayev OG. Akbarov SD.
1453	Extended sneddon and muki solutions for multilayered elastic materials	Ai ZY. Yue ZQ. Tham LG. Yang M.
1485	On the linear problem of swelling porous elastic soils with incompressible fluid	Quintanilla R.
1495	Separation characteristics of fluid flow inside two parallel plates with wavy surface	Mahmud S. Islam AKMS. Mamun MAH.
1511	Mhd flow over a moving plate in a rotating fluid with magnetic field, hall currents and free stream velocity	Takhar HS. Chamkha AJ. Nath G.
1529	Gravity flow of granular materials in contracting cylinders and tapered tubes	Spencer AJM. Bradley NJ.

International Journal of Fatigue 24(9) 2002

913	Evaluation of multiaxial fatigue criteria under irregular loading	Han C. Chen X. Kim KS.
923	Estimating the fatigue stress concentration factor of machined surfaces	Arola D. Williams CL.
931	Low-cycle fatigue behavior of haynes (r) hr-120 (r) alloy	He YH. Chen LJ. Liaw PK. McDaniels RL. Brooks CR. Seeley RR. Klarstrom DL.
943	Temperature dependence of fatigue-fracture-mode change in cu-sio2 alloy	Miura H. Sakai T. Kato M.
949	A literature survey on fatigue analysis approaches for rubber [review]	Mars WV. Fatemi A.
963	Experimental study and modelling of short fatigue crack growth in aluminium alloy al7010-t7451 under random loading	Wei LW. de los Rios ER. James MN.
977	Computer simulation of variable amplitude fatigue crack initiation behaviour using a new strain-based cumulative damage model	Lynn AK. DuQuesnay DL.
987	Strain-rate effects on low cycle fatigue mechanism of eutectic sn-pb solder	Kanchanomai C. Miyashita Y. Mutoh Y.
995	Fatigue damage mechanisms in advanced hybrid titanium composite laminates	Rhymer DW. Johnson WS.
1003	Ann back-propagation prediction model for fracture toughness in microalloy steel	Haque ME. Sudhakar KV.

International Journal of Fatigue 24(10) 2002

1013	A computational model for determination of service life of gears	Glodez S. Sraml M. Kramberger J.
1021	Laser shock processing and its effects on microstructure and properties of metal alloys: a review [review]	Montross CS. Wei T. Ye L. Clark G. Mai YW.
1037	Multidimensional force spectra of cnc machine tools and their applications, part one: force spectra	Wang YQ. Jia YZ. Shen GX.
1047	Mixed-mode, high-cycle fatigue-crack growth thresholds in ti-6al-4v: role of small cracks	Nalla RK. Campbell JP. Ritchie RO.
1063	A study on the crack initiation and growth from delta-ferrite/gamma phase interface under continuous fatigue and creep-fatigue conditions in type 304l stainless steels	Hong HU. Rho BS. Nam SW.
1071	Methodology for modelling the small crack fatigue behaviour of aluminium alloys	Bruzzi MS. McHugh PE.
1079	Numerical simulation of cyclic plasticity and damage of an aluminium metal matrix composite with particulate sic inclusions	Fleming WJ. Temis JM.
1089	Fatigue behaviour of fe-cr-si-b metallic glass wires	Verduzco JA. Hand RJ. Davies HA.
1095	Fatigue life predictions in polymer particle composites	Antunes FV. Ferreira JM. Costa JD. Capela C.

International Journal of Fracture 115(2) 2002

23	Derivative procedure for bem based-computation of change in natural frequency with crack size	Medhekar NV. Maiti SK.
29	Micromechanics of fracture in notched samples of heavily drawn steel	Toribio J. Ayaso J.
35	Antiplane permeable edge cracks in a piezoelectric strip of finite width	Li XF. Tang GJ.
101	Delamination buckling and propagation analysis of honeycomb panels using a cohesive element approach	Han TS. Ural A. Chen CS. Zehnder AT. Ingraffea AR. Billington SL.
125	Propagation of a penny-shaped hydraulic fracture parallel to the free-surface of an elastic half-space	Zhang X. Detournay E. Jeffrey R.

159	Damage evolution under severe plastic deformation	Lapovok R.
173	Examination of free-edge crack nucleation around an open hole in composite laminates	Yang B.
193	Dominance of asymptotic crack tip fields in elastic functionally graded materials	Anlas G. Lambros J. Santare MH.

International Journal of Fracture 115(3) 2002

43	Method for calculating the stress intensity factor for small-to-medium edge cracks	Kotousov A. Jones R.
49	Extraction of elastic moduli from granular compacts	Zohdi TI. Monteiro PJM. Lamour V.
55	An examination of scatter in small fatigue crack growth	Carlson RL.
205	Determination of the fracture toughness of a low alloy steel by the instrumented charpy impact test	Rossoll A. Berdin C. Prioul C.
227	A finite element modelling study of strain localization in the vicinity of near-surface cavities as a cause of subsurface fatigue crack initiation	Borbely A. Mughrabi H. Eisenmeier G. Hoppel HW.
233	Theoretical investigation of elastoplastic notch fields under triaxial stress constraint	Guo WL.
251	On crack arrest in ceramic/metal assemblies	Charles Y. Hild F.
273	An analysis of a fracture specimen for rough crack in shear	Young LJ.
287	An investigation of the effects of crack front curvature on the crack-tip opening displacement of a707 steel	Zhou J. Soboyejo WO.

International Journal of Fracture 115(4) 2002

63	Anomalies of flow in fracture networks under compression	Sahouryeh E. Andruszkiw M.
69	Kinked cracks and richard fracture criterion	Fett T. Munz D.
75	Tensile stresses in an inclusion ahead of the crack tip	Duan JY. Li ZH.
305	Analysis of damaged material containing periodically distributed elliptical microcracks by using the homogenization method based on the superposition method	Kato T. Nishioka T.
323	Dynamic crack-tip field for tensile cracks propagating in power-law hardening materials	Zhu XK. Hwang KC.
343	Effect of fracture path on the toughness of weld metal	Gubeljak N. Legat J. Kocak M.
361	Singularities near three-dimensional corners in composite laminates	Dimitrov A. Andra H. Schnack E.
377	Stress intensity factor analysis of elliptical corner cracks in mechanical joints by weight function method	Heo SP. Yang WH.

International Journal of Heat & Mass Transfer 45(20) 2002

4069	Local heat transfer measurements of plate finned-tube heat exchangers by infrared thermography	Ay HC. Jang JY. Yeh JN.
4079	Experimental assessment of the effects of body force, surface tension force, and inertia on flow boiling chf	Zhang H. Mudawar I. Hasan MM.
4097	Contact melting inside an elastic capsule	Wilchinsky AV. Fomin SA. Hashida T.
4107	Critical heat flux correlation for subcooled boiling flow in narrow channels	Kureta M. Akimoto H.
4117	Analytical investigations for heat conduction problems in anisotropic thin-layer media with embedded heat sources	Hsieh MH. Ma CC.
4133	Critical heat flux of natural circulation boiling in a vertical tube - effect of oscillation and circulation on chf	Monde M. Mitsutake Y.
4141	Fringe probing of an evaporating microdroplet on a hot surface	Jia WC. Qiu HH.
4151	Theoretical model for the thermal conductivity of a packed bed of solid spheroids in the presence of a static gas, with no adjustable parameters except at low pressure and temperature	Slavin AJ. Arcas V. Greenhalgh CA. Irvine ER. Marshall DB.
4163	Velocity effect on electronic-antifouling technology to mitigate mineral fouling in enhanced-tube heat exchanger	Lee SH. Cho YI.
4175	Theory of thermal resistance between solids with randomly sized and located contacts	Laraqi N. Bairi A.
4181	Experimental and numerical investigation of the steady periodic solid-liquid phase-change heat transfer	Casano G. Piva S.
4191	Heat transfer to a row of impinging jets in consideration of optimization	Brevet P. Dejeu C. Dorignac E. Jolly M. Vullierme JJ.
4201	Influence of the particle-turbulence modulation modelling in the simulation of a non-isothermal gas-solid flow	Boulet P. Moissette S.

4217	Laminar natural convection in differentially heated rectangular enclosures with vertical diffusive walls vaf costa	Costa VAF.
4227	Stability of natural convection between spherical shells: energy theory	Travnikov VV. Rath HJ. Egbers C.
4237	Thermodynamically consistent thermal energy equation for an adsorbent/fluid system	Mitrovic J.

International Journal of Heat & Mass Transfer 45(21) 2002

4241	Laminar mixed convection boundary layers induced by a linearly stretching permeable surface	Ali M. Al-Yousef F.
4251	Concentration fields in the solidification processing of metal matrix composites	Moussa B. Simpson JE. Garimella SV.
4267	Solution of an initial-boundary value problem for heat conduction in a parallelepiped by time partitioning	Yen DHY. Beck JV. McMasters RL. Amos DE.
4281	Radiation and mass transfer effects on flow of an incompressible viscous fluid past a moving vertical cylinder	Ganesan P. Loganathan P.
4289	Frost formation and frost crystal growth on a cold plate in atmospheric air flow	Cheng CH. Shiu CC.
4305	Non-darcy effects in buoyancy driven flows in an enclosure filled with vertically layered porous media	Merrikh AA. Mohamad AA.
4315	Effects of preheating and operation conditions on combustion in a porous medium	Huang Y. Chao CYH. Cheng P.
4325	Theoretical studies on transient pool boiling based on microlayer model	Zhao YH. Masuoka T. Tsuruta T.
4333	Temperature, velocity and mean turbulence structure in strongly heated internal gas flows - comparison of numerical predictions with data	Mikielewicz DP. Shehata AM. Jackson JD. McEligot DM.
4353	Numerical simulation for heat and fluid characteristics of square duct with discrete rib turbulators	Tatsumi K. Iwai H. Inaoka K.
4361	Thermal mixing in a water tank during heating process	Kang MG.
4367	A note on the modeling of local thermal non-equilibrium in a structured porous medium	Nield DA.
4369	On the ratio of heat to mass transfer coefficient for water evaporation and its impact upon drying modeling	Chen XD. Lin SXQ. Chen GH.
4373	Effect of turbulence on taylor dispersion for oscillatory flows	Ye XF. Zhang JW.

International Journal of Heat & Mass Transfer 45(22) 2002

4381	Heat and mass transfer bibliography - cis works	Martynenko OG.
4401	Experimental studies of combined heat transfer in turbulent mixed convection fluid flows in double-skin-facades	Zollner A. Winter ERF. Viskanta R.
4409	Pool boiling heat transfer in binary mixtures of ammonia/water	Inoue T. Monde M. Teruya Y.
4417	Effects of flow obstacles on the critical heat flux in a vertical tube cooled with upward flow of r-134a	Pioro IL. Groeneveld DC. Doerffer SS. Guo Y. Cheng SC. Vasic A.
4435	Comparison of chf measurements in horizontal and vertical tubes cooled with r-134a	Pioro IL. Groeneveld DC. Leung LKH. Doerffer SS. Cheng SC. Antoshko YV. Guo Y. Vasic A.
4451	Mixing and film cooling in supersonic duct flows	Schuchkin V. Osipov M. Shyy W. Thakur S.
4463	Experimental and theoretical study of orientation effects on flow boiling chf	Zhang H. Mudawar I. Hasan MM.
4479	An experimental investigation into the heat transfer on wing walls in a circulating fluidized bed boiler	Dutta A. Basu P.
4493	Numerical simulation of turbulent flow field and heat transfer in a two-dimensional channel with periodic slit ribs	Liou TM. Chen SH. Shih KC.
4507	Mass transfer by free and forced convection from single spherical liquid drops	Waheed MA. Henschke M. Pfennig A.
4515	Photoacoustic detection of drug diffusion into a membrane: theory and numerical analysis	Bodzenta J. Bukowski RJ. Christ A. Pogoda T.
4525	Convective heat transfer to temperature dependent property fluids in the entry region of corrugated tubes	Rainieri S. Pagliarini G.
4537	Feedback control of the instability of a fluid layer flowing down a vertical cylinder	You XY.

International Journal of Heat & Mass Transfer 45(23) 2002

4543	Role of length scales on microwave thawing dynamics in 2d cylinders	Basak T. Ayappa KG.
4561	Splashing of molten tin droplets on a rough steel surface	Shakeri S. Chandra S.
4577	Linear stability analysis of the solidification of a supercooled liquid in a half-space	Lambert RA. Rangel RH.
4589	An experimental and theoretical study of the effects of heat conduction through the support fiber on the evaporation of a droplet in a weakly convective flow	Yang JR. Wong SC.
4599	Boiling incipience in microchannels	Ghiaasiaan SM. Chedester RC.
4607	Dendritic constructal heat exchanger with small-scale crossflows and larger-scales counterflows	Bejan A.

4621	Combined thermocapillary and natural convection in rectangular containers with localized heating	Lee KJ. Kamotani Y. Yoda S.
4631	A study of the effect of ultrasonic vibrations on phase-change heat transfer	Oh YK. Park SH. Cho YI.
4643	An inverse problem in simultaneous estimating the biot numbers of heat and moisture transfer for a porous material	Huang CH. Yeh CY.
4655	Heat transfer characteristics of a two-phase closed thermosyphon to the fill charge ratio	Park YJ. Kang HK. Kim CJ.
4663	Simultaneous estimation of extinction coefficient distribution, scattering albedo and phase function of a two-dimensional medium	Ou NR. Wu CY.
4675	Thermodynamics bifurcations of boiling structure	Chai LH. Shoji M.
4683	Evaporative cooling of water in a natural draft cooling tower	Fisenko SP. Petruchik AI. Solodukhin AD.
4695	Solutocapillary convection in the float-zone process with a strong magnetic field	Walker JS. Dold P. Croll A. Volz MP. Szofran FR.
4703	Creeping flow of a polymeric liquid passing over a transverse slot with viscous dissipation	Wu GH. Lin YM.

International Journal of Impact Engineering 27(6) 2002

577	Perforation of high-strength double-ply fabric system by varying shaped projectiles	Lim CT. Tan VBC. Cheong CH.
593	Close-range blast loading of aluminium foam panels	Hanssen AG. Enstock L. Langseth M.
619	Deep penetration of a non-deformable projectile with different geometrical characteristics	Chen XW. Li QM.
639	Experimental investigation into the response of chopped-strand mat glassfibre laminates to blast loading	Franz T. Nurick GN. Perry MJ.
669	Axially pro-loaded steel tubes subjected to lateral impacts: an experimental study	Zeinoddini M. Parke GAR. Harding JE.

International Journal of Impact Engineering 27(7) 2002

691	Momentum exchange alteration in projectile/target impact	Cipparone G. Bourne B. Orphal D. Goldsmith W.
709	Dyna-modelling of the high-velocity impact problems with a split-element algorithm	Resnyansky AD.
729	Compressive response of circular cell polycarbonate honeycombs under inplane biaxial static and dynamic loading. part i: experiments	Chung J. Waas AM.
755	Numerical study of shear deformation in ti-6al-4v at medium and high strain rates, critical impact velocity in shear	Bonnet-Lebouvier AS. Klepaczko JR.
771	A three-dimensional abrasion algorithm for projectile mass loss during penetration	Beissel SR. Johnson GR.

International Journal of Impact Engineering 27(8) 2002

791	Reliability analysis of a buried concrete, target under missile impact	Choudhury MA. Siddiqui NA. Abbas H.
807	Behind-the-armor debris analysis	Yossifon G. Yarin AL.
837	Impact failure of beams using damage mechanics: part i - analytical model	Alves M. Jones N.
863	Impact failure of beams using damage mechanics: part ii - application	Alves M. Jones N.

International Journal of Impact Engineering 27(9) 2002

901	Implast symposia and large deformations - a perspective	Gupta NK.
919	An undex response validation methodology	O'Daniel JL. Krauthammer T. Koudela KL. Strait LH.
939	Dynamic tensile deformation and fracture of metal cylinders at high strain rates	Singh M. Suneja HR. Bola MS. Prakash S.
955	Impact behavior of shear-failure-type rc beams without shear rebar	Kishi N. Mikami H. Matsuoka KG. Ando T.
969	Prototype impact tests on ultimate impact resistance of pc rock-sheds	Kishi N. Konno H. Ikeda K. Matsuoka KG.

International Journal of Mechanical Sciences 44(6) 2002

1047	Experimental and mechanical model for predicting the behaviour of minor axis beam-to-column semi-rigid joints	de Lima LRO. de Andrade SAL. Vellasco PCGD. da Silva LS.
1067	Reinforced masonry walls under blast loading	Mayrhofer C.

1081	Modelling of the effectiveness of bicycle helmets under impact	Hui SK. Yu TX.
1101	On the quasi-static piercing of square metal tubes	Lu G. Wang X.
1117	Plastic mechanism analysis of circular tubes under pure bending	Elchalakani M. Zhao XL. Grzebieta RH.
1145	Modes of axial collapse of unconstrained capped frusta	Alghamdi AAA. Aljawi AAN. Abu-Mansour TMN.
1163	Optimal design of stepped circular plates with allowance for the effect of transverse shear deformation	Chung KC. Wang CM.
1179	Differential cubature method for analysis of shear deformable rectangular plates on pasternak foundations	Teo TM. Liew KM.
1195	Levy solutions for vibration of multi-span rectangular. plates	Xiang Y. Zhao YB. Wei GW.
1219	Plastic limit loads of defective pipes under combined internal pressure and axial tension	Heitzer A.
1225	Stability loss analyses of the elastic and viscoelastic composite rotating thick circular plate in the framework of the three-dimensional linearized theory of stability	Yahnioglu N. Akbarov SD.
1245	On the optimal die curvature in deep drawing processes	Dejmal I. Tirosh J. Shirizly A. Rubinsky L.

International Journal of Mechanical Sciences 44(7) 2002

1259	Frequency analysis of submerged cylindrical shells with the wave propagation approach	Zhang XM.
1275	Analysis of rectangular laminated composite plates via fsdt meshless method	Wang J. Liew KM. Tan MJ. Rajendran S.
1295	Densification behavior of aluminum alloy powder under cold compaction	Lee SC. Kim KT.
1309	Numerical simulation of fine-blanking process using a mixed finite element method	Chen ZH. Tang CY. Lee TC. Chan LC.
1335	Investigation of the influence of specimen geometry on quench behaviour of steels by x-ray determination of surface residual stresses	Gur CH.
1349	Fracture criteria identification using an inverse technique method and blanking experiment	Hambli R. Reszka M.
1363	Characteristic solutions for the statics of repetitive beam-like trusses	Karpov EG. Dorofeev DL. Stephen NG.
1381	An investigation of fracture criteria for predicting surface fracture in paste extrusion	Domanti ATJ. Horrobin DJ. Bridgwater J.
1411	Bursting failure prediction in tube hydroforming processes by using rigid-plastic fem combined with ductile fracture criterion	Lei LP. Kim J. Kang BS.
1429	Effects of solid distribution on the elastic buckling of honeycombs	Chuang CH. Huang JS.
1445	On the rotating elastic-plastic solid disks of variable thickness having concave profiles	Eraslan AN. Orcan Y.
1467	Analysis of hot limit strains of a superplastic 5083 aluminum alloy under biaxial tension	Chan KC. Chow KK.
1479	Vibration analysis of delaminated composite beams and plates using a higher-order finite element	Hu N. Fukunaga H. Kameyama M. Aramaki Y. Chang FK.
1505	Springback analysis of thin rectangular bars of non-linear work-hardening materials under torsional loading	Dwivedi JP. Shah SK. Upadhyay PC. Das Talukder NK.

International Journal of Non-Linear Mechanics 37(8) 2002

1261	Hysteresis in mechanical systems - modeling and dynamic response	Vestroni F. Noori M.
1263	Observations on cualni single crystals	Abdullah N. Kastner O. Muller I. Musolff A. Xu H. Zak G.
1275	Hysteresis in shape-memory alloys	Ortin J. Delaey L.
1283	On hysteresis in elasto-plasticity and in ferromagnetism	Visintin A.
1299	Models for one-variant shape memory materials based on dissipation functions	Bernardini D. Pence TJ.
1319	Inversion of ramberg-osgood equation and description of hysteresis loops	Mostaghel N. Byrd RA.
1337	Reliable solutions to the problem of periodic oscillations of an elastoplastic beam	Krejci P.
1351	Optimal control of dynamical systems with preisach hysteresis	Belbas SA. Mayergoyz ID.
1363	Modeling the dynamic behavior of shape memory alloys	Seelecke S.
1375	Optimization of hysteretic characteristics of damping devices based on pseudoelastic shape memory alloys	Masuda A. Noori M.
1387	Chaos in a shape memory two-bar truss	Savi MA. Pacheco PMCL. Braga AMB.
1397	Drifting response of hysteretic oscillators to stochastic excitation	Bouc R. Boussaa D.
1407	Random response of integrable duhem hysteretic systems under non-white excitation	Ni YQ. Ying ZG. Ko JM. Zhu WQ.
1421	Resonant and coupled response of hysteretic two-degree-of-freedom systems using harmonic balance method	Masiani R. Capecchi D. Vestroni F.
1435	Development of adaptive modeling techniques for non-linear hysteretic systems	Smyth AW. Masri SF. Kosmatopoulos EB. Chassiakos AG. Caughey TK.
1453	On the hysteresis of wire cables in stockbridge dampers	Sauter D. Hagedorn P.

International Journal of Plasticity 18(9) 2002

1133	A multiscale model of plasticity	Zbib HM. de la Rubia TD.
1165	The origins of heterogeneous deformation during primary hot working of ti-6al-4v	Bieler TR. Semiatin SL.
1191	Inelastic analysis of new thermal ratchetting due to a moving temperature front	Igari T. Kobayashi M. Yoshida F. Imatani S. Inoue T.
1219	On the predictive capabilities of anisotropic yield criteria for metals undergoing shearing deformations	Tugcu P. Wu PD. Neale KW.
1237	Numerical analysis and elastic-plastic deformation behavior of anisotropically damaged solids	Brunig M.

International Journal of Pressure Vessels & Piping 79(6) 2002

385	Evaluation of leak-before-break assessment methodology for pipes with a circumferential through-wall crack. part i: stress intensity factor and limit load solutions	Takahashi Y.
393	Evaluation of leak-before-break assessment methodology for pipes with a circumferential through-wall crack. part ii: j-integral estimation	Takahashi Y.
403	The coupled effects of thickness and delamination on cracking resistance of x70 pipeline steel	Guo W. Dong H. Lu M. Zhao X.
413	Diagnosis of cracking in the boiler shell seam welds at sizewell a power station	Exworthy LF. Little WJ. Flewitt PEJ.
427	Engineering c-integral estimates for generalised creep behaviour and finite element validation	Kim YJ. Kim JS. Huh NS.
445	Correlation of the microshear toughness and fracture toughness for pressure vessel steels and structural steels	Zhang XP. Dorn L. Shi YW.
451	Elastic-plastic j and cod estimates for axial through-wall cracked pipes	Kim YJ. Huh NS. Park YJ.

International Journal of Pressure Vessels & Piping 79(7) 2002

467	Effect of weld geometry and residual stresses on fatigue in butt-welded joints	Teng TL. Fung CP. Chang PH.
483	Probabilistic failure analysis of nuclear piping with empirical study of taiwan's bwr plants	You JS. Wu WF.
493	Mechanical and thermal stresses in a functionally graded hollow cylinder due to radially symmetric loads	Jabbari A. Sohrabpour S. Eslami MR.
499	Vibration of air-coupled transverse bulkheads of a submarine	Chang HT. Chen JH. Tseng JG.
507	Buckling of externally pressurised barrelled shells: a comparison of experiment and theory	Blachut J.
519	Three-dimensional analysis of a cross-ply cylindrical shell subjected to a localized circumferential shear force	Bhaskar K. Ganapathysaran N.
525	Evaluation of leak-before-break assessment methodology for pipes with a circumferential through-wall crack. part iii: estimation of crack opening area	Takahashi Y.

International Journal of Solids & Structures 39(16) 2002

4133	Ultrasonic waves in layered anisotropic media: characterization of multidirectional composites	Rokhlin SI. Wang L.
4151	On the spatial behavior in the theory of swelling porous elastic soils	Gales C.
4167	Enhancing flutter and buckling capacity of column by piezoelectric layers	Wang Q. Quek ST.
4181	Mixed variational formulations for continua with microstructure	Mosconi M.
4197	On foundations of the hardy cross method	Volokh KY.
4201	Magnetoelectric green's functions and their application to the inclusion and inhomogeneity problems	Li JY.
4215	Impact failure characteristics in sandwich structures part i: basic failure mode selection	Xu LR. Rosakis AJ.
4237	Impact failure characteristics in sandwich structures part ii: effects of impact speed and interfacial strength	Xu LR. Rosakis AJ.
4249	Analysis of the dynamic propagation of adiabatic shear bands	Bonnet-Lebouvier AS. Molinari A. Lipinski P.
4271	Postbuckling of laminated cylindrical shells with piezoelectric actuators under combined external pressure and heating	Shen HS.
4291	On static analysis of finite repetitive structures by discrete fourier transform	Karpov EG. Stephen NG. Dorofeev DL.
4311	Three-dimensional stress constraint in an elastic plate with a notch	Kotousov A. Wang CH.
4327	Electro-chemo-mechanical couplings in saturated porous media: elastic-plastic behaviour of heteroionic expansive clays	Gajo A. Loret B. Hueckel T.

Inverse Problems in Engineering 10(3) 2002

183	On point mass identification in rods and beams from minimal frequency measurements	Morassi A. Dilena M.
203	An inverse problem for the helmholtz equation involving two semi-infinite fluids	Chakrabarti A. Daripa P. Roy S.
215	The numerical solution of the three dimensional inverse obstacle scattering problem for point source generated wave fields	You YX. Miao GP.
235	Cauchy problems for laplace equation on compact sets	Titarenko VN. Yagola AG.
255	Linear robust control of identified state-space non-linear inverse compensated si engine	Petridis AP. Shenton AT.
271	Inverse convection-diffusion problem of estimating boundary velocity based on internal temperature measurements	Szczygiel I. Fic A.

Inverse Problems in Engineering 10(4) 2002

293	An iterative algorithm for the backward heat conduction problem based on variable relaxation factors	Jourhmane M. Mera NS.
309	On determination of the material constants of laminated cylindrical shells based on an inverse optimal approach	Han X. Xu D. Yap FF. Liu GR.
323	Application of inverse analysis to thermal contact resistance between very rough nonconforming surfaces	Ghojel J.
335	Boundary element regularisation methods for solving the cauchy problem in linear elasticity	Marin L. Elliott L. Ingham DB. Lesnic D.
359	Optimum robot design based on task specifications using evolutionary techniques and kinematic, dynamic, and structural constraints	Shiakolas PS. Koladiya D. Kebrle J.
377	Recovery of cracks from incomplete boundary data	Cimetiere A. Delvare F. Jaoua M. Kallel M. Pons F.

Journal of Applied Mechanics 69(5) 2002

570	A microstructurally based orthotropic hyperelastic constitutive law	Bischoff JE. Arruda EA. Grosh K.
580	A surface crack in a graded medium under general loading conditions	Dag S. Erdogan F.
589	Vibration and post-buckling of in-plane loaded rectangular plates using a multiterm galerkin's method	Ilanko S.
593	The isotropic ellipsoidal inclusion with a polynomial distribution of eigenstrain	Rahman M.
602	Scission and healing in a spinning elastomeric cylinder at elevated temperature	Wineman AS. Shaw JA.
610	Dynamic condensation and synthesis of unsymmetric structural systems	Rao GV.
617	Extracting physical parameters of mechanical models from identified state-space representations	De Angelis M. Lus H. Betti R. Longman RW.
626	Analysis of a three-dimensional crack terminating at an interface using a hypersingular integral equation method	Qin TY. Noda NA.
632	Plane thermal stress analysis of an orthotropic cylinder subjected to an arbitrary, transient, asymmetric temperature distribution	Yee YC. Moon TJ.
641	Constitutive model of a transversely isotropic bingham fluid	Robinson DN. Kim KJ. White JL.
649	The proportional-damping matrix of arbitrarily damped linear mechanical systems	Angeles J. Ostrovskaya S.
657	Elastic-plastic contact analysis of a sphere and a rigid flat	Kogut L. Etsion I.
663	Dynamic shear fracture at subsonic and transonic speeds in a compressible neohookean material under compressive prestress	Brock LM.
671	On an elastic circular inhomogeneity with imperfect interface in antiplane shear	Schiavone P.
675	Radiation loading of a cylindrical source in a fluid-filled cylindrical cavity embedded within a fluid-saturated poroelastic medium	Hasheminejad SM. Hosseini H.
684	Buckling of laminated composite rectangular plates under transient thermal loading	Shukla KK. Nath Y.
693	Crack-tip field of a supersonic bimaterial interface crack	Wu J.
696	Effective antiplane dynamic properties of fiber-reinforced composites	Wang XD. Gan S.
700	Elasticity solution for a laminated orthotropic cylindrical shell subjected to a localized longitudinal shear force	Bhaskar K. Ganapathysaran N.
703	Bubble shape in non-newtonian fluids	De Kee D. Fong CFCM. Yao J.
705	Dynamic stability of a rotor partially filled with a viscous liquid	Tao M. Zhang W.
708	Dynamic stability of a flexible spinning cylinder partially filled with liquid	Tao M. Zhang W.

711	Discussion: "on the relationship between the l-integral and the bueckner work-conjugate integral" (shi,j.p., liu,x.h., and li,j., 2000 asme j. appl. mech., 67, pp. 828-829)	Chen YZ. Lee KY.
712	Discussion: "a critical reexamination of classical metal plasticity" (wilson,c.d., 2002, asme j. appl. mech., 69, pp. 63-68)	Lissenden CJ.
713	On some issues in shakedown analysis (vol 68, pg 799, 2001)	Maier G.

Journal of Biomechanical Engineering 124(4) 2002

334	Mucosal folding in biologic vessels	Hrousis CA. Wiggs BJR. Drazen JM. Parks DM. Kamm RD.
342	Self-sealing, large bore arterial punctures: a counterintuitive new phenomenon	Roeder BA. Babbs CF. Schoenlein WE. Kokini K. Sadeghi F.
347	A new method for predicting the opening angle for soft tissues	Van Dyke TJ. Hoger A.
355	A three-dimensional finite element model for arterial clamping	Gasser TC. Schulze-Bauer CAJ. Holzapfel GA.
364	Influence of connection geometry and svc-ivc flow rate ratio on flow structures within the total cavopulmonary connection: a numerical study	Khunatorn Y. Mahalingam S. DeGroff CG. Shandas R.
378	Unsteady and three-dimensional simulation of blood flow in the human aortic arch	Shahcheraghi N. Dwyer HA. Cheer AY. Barakat AI. Rutaganira T.
388	A modified micropipette aspiration technique and its application to tether formation from human neutrophils	Shao JY. Xu JB.
397	A new in vitro model to evaluate differential responses of endothelial cells to simulated arterial shear stress waveforms	Blackman BR. Garcia-Cardena G. Gimbrone MA.
408	Assessment of mechanical properties of adherent living cells by bead micromanipulation: comparison of magnetic twisting cytometry vs optical tweezers	Laurent VM. Henon S. Planus E. Fodil R. Balland M. Isabey D. Gallet F.
422	Influence of the lateral ventricles and irregular skull base on brain kinematics due to sagittal plane head rotation	Ivarsson J. Viano DC. Lovsund P.
432	Origin of the biomechanical properties of wood related to the fine structure of the multi-layered cell wall	Yamamoto H. Kojima Y. Okuyama T. Abasolo WP. Gril J.
441	Competing effects of buckling and anchorage strength on optimal wheat stalk geometry	Farquhar T. Zhou J. Wood WH.
450	Mri gradient coil cylinder sound field simulation and measurement	Mechefske CK. Wu YH. Rutt BK.
456	Time-dependent circumferential deformation of cortical bone upon internal radial loading	Brown CU. Norman TL. Kish VL. Gruen TA. Blaha JD.
462	Predicting the failure response of cement-bone constructs using a non-linear fracture mechanics approach	Mann KA. Damron LA.
471	Multi-axial spine biomechanical testing system with speckle displacement instrumentation	Chung SM. Teoh SH. Tsai KT. Sin KK.

Journal of Biomechanics 35(8) 2002

1011	Understanding muscle coordination of the human leg with dynamical simulations	Zajac FE.
1019	Tensile properties of in vivo human tendinous tissue	Maganaris CN.
1029	In vivo motion of the rectus femoris muscle after tendon transfer surgery	Asakawa DS. Blemker SS. Gold GE. Delp SL.
1039	Mechanical considerations in the design of surgical reconstructive procedures	Friden J. Lieber RL.
1047	Kinematic simulation of fracture reduction and bone deformity correction under unilateral external fixation	Kim YH. Inoue N. Chao EYS.
1059	The importance of being light: aerodynamic forces and weight in ski jumping	Schmolzer B. Muller W.
1071	In vitro biomechanical analysis of glenoids before and after implantation of prosthetic components	Maurel N. Diop A. Grimberg J. Elise S.
1081	A one-dimensional model for the propagation of transient pressure waves through the lung	Grimal Q. Watzky A. Naili S.
1091	Combination of topological parameters and bone volume fraction better predicts the mechanical properties of trabecular bone	Pothuaud L. Van Rietbergen B. Mosekilde L. Beuf O. Levitz P. Benhamou CL. Majumdar S.
1101	A morphological model of vertebral trabecular bone	Kim HS. Al-Hassani STS.
1115	Numerical simulation of steady flow fields in a model of abdominal aorta with its peripheral branches	Lee D. Chen JY.
1123	Hierarchical genetic algorithm versus static optimization - investigation of elbow flexion and extension movements	Raikova RT. Aladjov HT.
1137	Predicting the kinetics of cell spreading	Frisch T. Thoumine O.
1143	Reconstruction of shoulder function using a reflected long head biceps: a moment arm study	Tang CY. Mak AFT. Hung LK. Wong HS. Pacaldo T.
1149	Measurements of wave speed and reflected waves in elastic tubes and bifurcations (vol 35, pg 775, 2002)	Khir AW. Parker KH.

Journal of Biomechanics 35(9) 2002

1155	Statistical methods in finite element analysis	Dar FH. Meakin JR. Aspden RM.
1163	A mechano-regulation model for tissue differentiation during fracture healing: analysis of gap size and loading	Lacroix D. Prendergast P.
1173	Fourier analysis of trunk displacements: a method to identify the lame limb in trotting horses	Audigie F. Pourcelot P. Degueurce C. Geiger D. Denoix JM.
1183	Passive force characteristics of an architecturally complex muscle	van Eijden TMGJ. Turkawsaki SJJ. van Ruijven LJ. Brugman P.
1191	How morphology predicts mechanical properties of trabecular structures depends on intra-specimen trabelcular thickness variations	van Lenthe GH. Huiskes R.
1199	Are mineralized tissues open crystal foams reinforced by crosslinked collagen? - some energy arguments	Hellmich C. Ulm FJ.
1213	Assessment of the aortic stress-strain relation in uniaxial tension	Sokolis DP. Boudoulas H. Karayannacos PE.
1225	The influence of out-of-plane geometry on pulsatile flow within a distal end-to-side anastomosis	Papaharilaou Y. Doorly DJ. Sherwin SJ.
1241	Reduced oxygen release from erythrocytes by the acceleration-induced flow shift, observed in an oxygen-permeable narrow tube	Tateishi N. Suzuki Y. Shirai M. Cicha I. Maeda N.
1253	Three-dimensional finite element modeling of skeletal muscle using a two-domain approach: linked fiber-matrix mesh model	Yucesoy CA. Koopman BHFJM. Huijing PA. Grootenboer HJ.
1263	The internal mechanics of the intervertebral disc under cyclic loading	Riches PE. Dhillon N. Lotz J. Woods AW. McNally DS.
1273	A rheological motor model for vertebrate skeletal muscle in due consideration of non-linearity	Tamura Y. Saito M.
1279	Evaluation of the global optimisation method within the upper limb kinematics analysis	Roux E. Bouilland S. Godillon-Maquinghen AP. Bouttens D.
1285	Osmotic loading to determine the intrinsic material properties of guinea pig knee cartilage	Flahiff CM. Narmoneva DA. Huebner JL. Kraus VB. Guilak F. Setton LA.
1291	Comment on normal hip joint contact pressure distribution in single-leg standing-effect of gender and an atomic parameters	Mann RW.

Journal of Composite Materials 36(15) 2002

1781	Modeling and characterization of fatigue strength of laminated composites with knitted fabric reinforcement	Huang ZM. Ramakrishna S. Thwe AA.
1803	The dynamic stress field in the matrix surrounding a spheroidal particle	Paskaramoorthy R. Kienhofer F. Meguid SA.
1825	Observations of fiber fracture and interfacial debonding phenomena using the fragmentation test in single fiber composites	Kim BW. Nairn JA.
1859	Effect of matrix cracks on damping in unidirectional and cross-ply ceramic matrix composites	Birman V. Byrd LW.
1879	Validation of the quadratic composite failure criteria with out-of-plane shear terms	Huybrechts S. Maji A. Lao J. Wegner P. Meink T.
1889	Laser ultrasonic array system for real-time cure monitoring of polymer-matrix composites	Fomitchov PA. Kim YK. Kromine AK. Krishnaswamy S.

Journal of Composite Materials 36(16) 2002

1905	On-line processing of unidirectional fiber composites using radiative heating: i. model	Chern BC. Moon TJ. Howell JR.
1935	On-line processing of unidirectional fiber composites using radiative heating: ii. radiative properties, experimental validation and process parameter selection	Chern BC. Moon TJ. Howell JR.
1967	Probability-based modelling of composites manufacturing and its application to optimal process design	Li H. Foschi R. Vaziri R. Fernlund G. Poursartip A.
1993	Influence of fixation structures on the in-plane permeability of unidirectional glass fiber tapes	Endruweit A. Ermanni P.
2011	Effect of injection rate and post-fill cure pressure on properties of resin transfer molded disks	Olivero KA. Barraza HJ. O'Rear EA. Altan MC.

Journal of Composite Materials 36(17) 2002

2031	Non-singular term effect for the inclined crack extension in anisotropic solids under uniaxial loading	Lim WK.
2045	Variable density composite systems constructed by metal particle modified prepregs	Gilbert EN. Hayes BS. Seferis JC.

2061	New experimental data for enthalpy of reaction and temperature- and degree-of-cure-dependent specific heat and thermal conductivity of the hercules 3501-6 epoxy system	Chern BC. Moon TJ. Howell JR. Tan WL.
2073	The effect of thermal cycling and isothermal exposure on the mechanical properties of sic particle reinforced al composites	Ahn JJ. Ochiai S.
2085	Transverse crack propagation in the specimen width direction of cfrp laminates under static tensile loadings	Yokozeki T. Aoki T.
2101	Effect of concrete based alkali solutions on short-term durability of e-glass/vinylester composites	Karbhari VM. Murphy K. Zhang S.

Journal of Composite Materials 36(18) 2002

2125	Response of cross-ply composite to off-axis loading	Tamuzs V. Andersons J. Sparnins E. Varna J.
2135	Static characterization of carbon-carbon brake disk	Yoo JS. Oh SH. Kim CG. Hong CS. Kim KS.
2153	Effect of interleaved non-woven carbon tissue on interlaminar fracture toughness of laminated composites: part i - mode ii	Lee SH. Noguchi H. Kim YB. Cheong SK.
2169	Effect of interleaved non-woven carbon tissue on interlaminar fracture toughness of laminated composites: part ii - mode i	Lee SH. Noguchi H. Kim YB. Cheong SK.
2183	Energy absorption behavior of double-chamfer triggered glass/epoxy circular tubes	Song HW. De XW. Zhao GF.
2199	Bearing behavior of joints in pultruded composites	Wang YJ.

Journal of Computational Physics 180(1) 2002

1	Numerical methods for multiple inviscid interfaces in creeping flows	Kropinski MCA.
25	A finite difference domain decomposition method using local corrections for the solution of poisson's equation	Balls GT. Colella P.
54	Computation of multiphase mixture flows with compressibility effects	Venkateswaran S. Lindau JW. Kunz RF. Merkle CL.
78	A continuation and bifurcation technique for navier-stokes flows	Sanchez J. Marques F. Lopez JM.
99	Creation of spatial charge separation in plasmas with rigorously charge-conserving local electromagnetic field solvers	Othmer C. Motschmann U. Glassmeier KH.
110	A note on the unified coordinate system for computing shock waves	Wu ZN.
120	Finite difference schemes for incompressible flow based on local pressure boundary conditions	Johnston H. Liu JG.
155	Using k-branch entropy solutions for multivalued geometric optics computations	Gosse L.
183	Analysis of an exact fractional step method	Chang W. Giraldo F. Perot B.
200	Direct numerical simulation of spatial transition to turbulence using fourth-order vertical velocity second-order vertical vorticity formulation	Bhaganagar K. Rempfer D. Lumley J.
229	Discrete singular convolution-finite subdomain method for the solution of incompressible viscous flows	Wan DC. Patnaik BSV. Wei GW.
256	Very large electronic structure calculations using an out-of-core filter-diagonalization method	Toledo S. Rabani E.
270	Nonreflecting boundary conditions for the time-dependent wave equation	Alpert B. Greengard L. Hagstrom T.
297	Maxwell's equations for structures with symmetries	Weiland T. Zagorodnov I.
313	Dna electrophoresis studied with the cage model	van Heukelum A. Barkema GT. Bisseling RH.
327	Stochastic modelling of 1-d shallow water flows over uncertain topography	Horritt MS.
339	A critical comparison of eulerian-grid-based vlasov solvers	Arber TD. Vann RGL.
358	Smoothed particle hydrodynamics using interparticle contact algorithms	Parshikov AN. Medin SA.
383	Energy conservation error in the material point method for solid mechanics	Bardenhagen SG.

Journal of Computational Physics 180(2) 2002

407	A particle-mesh method for the shallow water equations near geostrophic balance	Frank J. Reich S.
427	Modeling three-dimensional multiphase flow using a level contour reconstruction method for front tracking without connectivity	Shin S. Juric D.
471	Numerical simulation of dendritic solidification with convection: two-dimensional geometry	Al-Rawahi N. Tryggvason G.
497	Nonlinear landau damping in spherically symmetric vlasov poisson systems	Heerlein C. Zwicknagel G.
506	An implicit particle-in-cell method for granular materials	Cummins SJ. Brackbill JU.
549	On backtracking failure in newton-gmres methods with a demonstration for the navier-stokes equations	Tuminaro RS. Walker HF. Shadid JN.
559	A general-purpose finite-volume advection scheme for continuous and discontinuous fields on unstructured grids	Dendy ED. Padial-Collins NT. VanderHeyden WB.
584	Half-moment closure for radiative transfer equations	Dubroca B. Klar A.

597	Accurate omega-psi spectral solution of the singular driven cavity problem	Auteri F. Quartapelle L. Vigevano L.
616	A triangulated vortex method for the axisymmetric euler equations	Carley M.
642	A new version of the fast multipole method for screened coulomb interactions in three dimensions	Greengard LF. Huang JF.
659	Particle transport through scattering regions with clear layers and inclusions	Bal G.
686	A general deterministic treatment of derivatives in particle methods	Eldredge JD. Leonard A. Colonius T.
710	Unconditionally stable methods for hamilton-jacobi equations	Karlsen KH. Risebro NH.
736	Divergence- and curl-preserving prolongation and restriction formulas	Toth G. Roe PL.
751	3d analysis of crystal/melt interface shape and marangoni flow instability in solidifying liquid bridges	Lappa M. Savino R.

Journal of Computational Physics 181(1) 2002

1	Efficient evaluation of the matrix elements of the coulomb potential between plane waves and gaussians	Polasek M. Carsky P.
9	Stochastic projection method for fluid flow - ii. random process	Le Maitre OP. Reagan MT. Najm HN. Ghanem RG. Knio OM.
45	Modeling and computation of random thermal fluctuations and material defects in the ginzburg-landau model for superconductivity	Deang J. Du Q. Gunzburger MD.
68	Large eddy simulation of high-reynolds-number free and wall-bounded flows	Fureby C. Grinstein FF.
98	Outflow boundary conditions for the fourier transformed two-dimensional vlasov equation	Eliasson B.
126	Coupling of fast multipole method and microlocal discretization for the 3-d helmholtz equation	Darrigrand E.
155	On the use of higher-order finite-difference schemes on curvilinear and deforming meshes	Visbal MR. Gaitonde DV.
186	Nodal high-order methods on unstructured grids - i. time-domain solution of maxwell's equations	Hesthaven JS. Warburton T.
222	A coupled schrodinger drift-diffusion model for quantum semiconductor device simulations	Degond P. El Ayyadi A.
260	Direct simulation of the motion of neutrally buoyant circular cylinders in plane poiseuille flow	Pan TW. Glowinski R.
280	On accuracy of adaptive grid methods for captured shocks	Yamaleev NK. Carpenter MH.
317	Particle rezoning for multidimensional kinetic particle-in-cell simulations	Lapenta G.
338	A genuinely multidimensional high-resolution scheme for the elastic-plastic wave equation	Giese G. Fey M.
354	Artificial wind - a new framework to construct simple and efficient upwind shock-capturing schemes	Sokolov IV. Timofeev EV. Sakai J. Takayama K.
394	Vorticity-divergence semi-lagrangian shallow-water model of the sphere based on compact finite differences (vol 179, pg 180, 2002)	Tolstykh MA.

Journal of Engineering Mathematics 43(1) 2002

1	A perturbation-based numerical method for solving a three-dimensional axisymmetric indentation problem	Pavliotis GA. Holmes MH.
19	Satellite-to-satellite tracking and satellite gravity gradiometry (advanced techniques for high-resolution geopotential field determination)	Freeden W. Michel V. Nutz H.
57	Green functions for initial free-surface flows due to 3d impulsive bottom deflections	Miloh T. Tyvand PA. Zilman G.
75	On the numerical solution of the dirichlet initial boundary-value problem for the heat equation in the case of a torus	Chapko R.
89	Waves and singularities in nonlinear capillary free-surface flows	Tooley S. Vanden-Broeck JM.

Journal of Engineering Mechanics 128(8) 2002

807	Below macro: driving forces of micromechanics	Dormieux L. Ulm FJ.
808	Continuum micromechanics: survey	Zaoui A.
817	Upscaling heterogeneous media by asymptotic expansions	Auriault JL.
823	Mechanics of composite solids	Whitaker S.
829	Real porous media: local geometry and transports	Adler PM. Thovert JF. Bekri S. Yousefian F.
840	Extension of poroelastic analysis to double-porosity materials: new technique in microgeomechanics	Berryman JG.
848	Micromechanical approach to nonlinear poroelasticity: application to cracked rocks	Deude V. Dormieux L. Kondo D. Maghous S.
856	Micromechanics of unsaturated granular media	Chateau X. Moucheront P. Pitois O.

864	Micromechanical basis of concept of effective stress	Didwania AK.
869	Failure properties of fractured rock masses as anisotropic homogenized media	de Buhan P. Freard J. Garnier D. Maghous S.
876	Effect of inclusions on friction coefficient of highly filled composite materials	Lemarchand E. Ulm FJ. Dormieux L.
885	Homogenized behavior equations for porous bingham viscoplastic material	Perrin G.
889	Micromechanical analysis of anisotropic damage in brittle materials	Pensee V. Kondo D. Dormieux L.
898	Micromechanical model for ultrastructural stiffness of mineralized tissues	Hellmich C. Ulm FJ.

Journal of Engineering Mechanics 128(9) 2002

909	Stable boundary element method/finite element method procedure for dynamic fluid-structure interactions	Yu GY. Lie ST. Fan SC.
916	Vibration suppression with resettable device	Jabbari F. Bobrow JE.
925	Effect of nonlinear wave kinematics on dynamic response of spars	Anam I. Roesset JM.
935	Explicit pseudodynamic algorithm with unconditional stability	Chang SY.
948	Turbulence characteristics in gradual channel transition	Papanicolaou AN. Hilldale R.
961	Redundancy index of lifeline systems	Hoshiya M. Yamamoto K.
969	Simple nonlinear model for elastic response of cohesionless granular materials	Taciroglu E. Hjelmstad KD.
979	Mathematical model for design of mass dampers for wind excited structures	Mattei M. Ricciardelli F.
989	Moving loads identification through regularization	Zhu XQ. Law SS.
1001	Vibration of axially loaded rotating cross-ply laminated cylindrical shells via ritz method	Liew KM. Ng TY. Zhao X.
1008	Higher-order finite strip method for postbuckling analysis of imperfect composite plates	Zou GP. Qiao PZ.
1016	Dynamic response of plates on elastic foundation to moving loads	Huang MH. Thambiratnam DP.

Journal of Fluid Mechanics 461 2002

1	Whole-field velocity measurements around an axisymmetric body with a stratford-smith pressure recovery	Hammache M. Browand FK. Blackwelder RF.
25	Response of base suction and vortex shedding from rectangular prisms to transverse forcing	Mills R. Sheridan J. Hourigan K.
51	Pipe flow measurements over a wide range of reynolds numbers using liquid helium and various gases	Swanson CJ. Julian B. Ihas GG. Donnelly RJ.
61	On the streamwise evolution of turbulent boundary layers in arbitrary pressure gradients	Perry AE. Marusic I. Jones MB.
93	Swept-wing boundary-layer receptivity to surface non-uniformities	Gaponenko VR. Ivanov AV. Kachanov YS. Crouch JD.
127	Experiments on the motion of gas bubbles in turbulence generated by an active grid	Poorte REG. Biesheuvel A.
155	Scalar probability density function and fine structure in uniformly sheared turbulence	Ferchichi M. Tavoularis S.
183	Riemann wave description of erosional dam-break flows	Fraccarollo L. Capart H.
229	Nonlinear smoluchowski slip velocity and micro-vortex generation	Ben Y. Chang HC.
239	Upper bounds on general dissipation functionals in turbulent shear flows: revisiting the 'efficiency' functional	Kerswell RR.
277	Drag and lift forces on a bubble rising near a vertical wall in a viscous liquid	Takemura F. Takagi S. Magnaudet J. Matsumoto Y.
301	The effect of compressibility on the critical swirl of vortex flows in a pipe	Rusak Z. Lee JH.
321	Exact results with the j-integral applied to free-boundary flows	Ben Amar M. Rice JR.
343	Scattering of oblique waves in a two-layer fluid	Linton CM. Cadby JR.
365	Laminar flow past a sphere rotating in the streamwise direction	Kim D. Choi H.
387	Free-surface flows emerging from beneath a semi-infinite plate with constant vorticity	McCue SW. Forbes LK.
411	Direct numerical simulations of supercritical fluid mixing layers applied to heptane-nitrogen (vol 436, pg 1, 2001)	Miller RS. Harstad KG. Bellan J.

Journal of Fluid Mechanics 462 2002

1	A new boussinesq method for fully nonlinear waves from shallow to deep water	Madsen PA. Bingham HB. Liu H.
31	The structure of an unstable circular vortex in a background straining flow	Higgins K. Ooi A. Chong MS.
43	Influence of vortex-pairing location on the three-dimensional evolution of plane mixing layers	Estevadeordal J. Kleis SJ.
79	Airway closure: surface-tension-driven non-axisymmetric instabilities of liquid-lined elastic rings	Heil M. White JP.
111	The effect of viscous heating on the stability of taylor-couette flow	Al-Mubaiyedh UA. Sureshkumar R. Khomami B.

133	Experimental studies on the stability of newtonian taylor-couette flow in the presence of viscous heating	White JM. Muller SJ.
161	Double-diffusive finger convection: influence of concentration at fixed buoyancy ratio	Pringle SE. Glass RJ.
185	The influence of geometry on inviscid decay rates in haemodynamic flows	Blyth MG. Mestel AJ.
209	Anisotropic enhancement of turbulence in large-scale, low-intensity turbulent premixed propane-air flames	Furukawa J. Noguchi Y. Hirano T. Williams FA.
245	Area-volume properties of fluid interfaces in turbulence: scale-local self-similarity and cumulative scale dependence	Catrakis HJ. Aguirre RC. Ruiz-Plancarte J.
255	Noise-driven wave transitions on a vertically falling film	Chang HC. Demekhin EA. Saprikin SS.
285	Numerical investigation of the propagation of planar shock waves in saturated flexible porous materials: development of the computer code and comparison with experimental results	Levi-Hevroni D. Levy A. Ben-Dor G. Sorek S.
307	Life of a smooth liquid sheet	Clanet C. Villermaux E.
341	Life of a flapping liquid sheet	Villermaux E. Clanet C.
365	Magnetorotational instability of dissipative couette flow	Goodman J. Ji HT.
383	Instability and mode interactions in a differentially driven rotating cylinder	Lopez JM. Hart JE. Marques F. Kittelman S. Shen J.

Journal of Fluid Mechanics 463 2002

1	Nonlinear rheology of a dilute emulsion of surfactant-covered spherical drops in time-dependent flows	Vlahovska P. Blawzdziewicz J. Loewenberg M.
25	On sound generation by the interaction between turbulence and a cascade of airfoils with non-uniform mean flow	Evers I. Peake N.
53	The evolution of strained turbulent plane wakes	Rogers MM.
121	Analysis of the radar reflectivity of aircraft vortex wakes	Shariff K. Wray A.
163	On the stability of a falling liquid curtain	Schmid PJ. Henningson DS.
173	Once again on the supersonic flow separation near a corner	Korolev GL. Gajjar JSB. Ruban AI.
201	Suboptimal feedback control of turbulent flow over a backward-facing step	Kang SW. Choi H.
229	Linear three-dimensional instability of a magnetically driven rotating flow	Grants I. Gerbeth G.
241	Self-similar enstrophy divergence in a shell model of isotropic turbulence	Melander MV. Fabijonas BR.
259	Vortical flow. part 1. flow through a constant-diameter pipe	Mattner TW. Joubert PN. Chong MS.
293	Buoyancy-driven ventilation between two chambers	Lin YJP. Linden PF.
313	Investigation of a 'transonic resonance' with convergent-divergent nozzles	Zaman KBMQ. Dahl MD. Bencic TJ. Loh CY.
345	Analysis of singular inertial modes in a spherical shell: the slender toroidal shell model	Rieutord M. Valdettaro L. Georgeot B.
361	Hydromagnetic taylor-couette flow: numerical formulation and comparison with experiment	Willis AP. Barenghi CF.
377	Multiple-arrayed pressure measurement for investigation of the unsteady flow structure of a reattaching shear layer	Lee I. Sung HJ.
403	Possible alternative to r-lambda-scaling of small-scale turbulence statistics	Hill RJ.

Journal of Fluid Mechanics 464 2002

1	Direct numerical simulation of a transitional supercritical binary mixing layer: heptane and nitrogen	Okong'o NA. Bellan J.
35	Extension of second-order stokes theory to variable bathymetry	Belibassakis KA. Athanassoulis GA.
81	Turbulent convection driven by surface cooling in shallow water	Zikanov O. Slinn DN. Dhanak MR.
113	Plif flow visualization and measurements of the richtmyer-meshkov instability of an air/sf6 interface	Collins BD. Jacobs JW.
137	Bubble collapse near a solid boundary: a numerical study of the influence of viscosity	Popinet S. Zaleski S.
165	Emergence of intense jets and jupiter's great red spot as maximum-entropy structures	Bouchet F. Sommeria J.
209	Viscous flow between two moving parallel disks: exact solutions and stability analysis	Aristov SN. Gitman IM.
217	Solitary waves with recirculation zones in axisymmetric rotating flows	Derzho O. Grimshaw R.
251	Buoyant gravity currents along a sloping bottom in a rotating fluid	Lentz SJ. Helfrich KR.
279	Migration of an insulating particle under the action of uniform ambient electric and magnetic fields. part 1. general theory	Moffatt HK. Sellier A.
287	Experimental study of a vortex in a magnetic field	Sreenivasan B. Alboussiere T.
311	Flow transitions in three-dimensional double-diffusive fingering convection in a porous cavity	Sezai I.
345	Low-prandtl-number convection in a rotating cylindrical annulus	Plaut E. Busse FH.
365	Nonlinear sloshing in zero gravity	Billingham J.
393	The linear stability of flat stokes layers	Blennerhassett PJ. Bassom AP.

Journal of Fluid Mechanics 465 2002

1	Dynamo mechanism in a rotating spherical shell: competition between magnetic field and convection vortices	Ishihara N. Kida S.
33	Modulated rotating waves in an enclosed swirling flow	Blackburn HM. Lopez JM.
59	The transition from steady to weakly turbulent flow in a close-packed ordered array of spheres	Hill RJ. Koch DL.
99	Navier-stokes solutions of unsteady separation induced by a vortex	Obabko AV. Cassel KW.
131	On the scattering of baroclinic rossby waves by a ridge in a continuously stratified ocean	Owen GW. Abrahams ID. Willmott AJ. Hughes CW.
157	Linear processes in stably and unstably stratified rotating turbulence	Hanazaki H.
191	Predictability of quasi-geostrophic turbulence	Merryfield WJ. Holloway G.
213	Oscillatory forcing of flow through porous media. part 1. steady flow	Graham DR. Higdon JJL.
237	Oscillatory forcing of flow through porous media. part 2. unsteady flow	Graham DR. Higdon JJL.
261	Granular shear flows at the elastic limit	Campbell CS.
293	Recirculation within a fluid sphere at moderate reynolds numbers	Barry DA. Parlange JY.
301	A quasi-steady approach to the instability of time-dependent flows in pipes	Ghidaoui MS. Kolyshkin AA.
331	Vorticity transport in a corner formed by a solid wall and a free surface	Grega LM. Hsu TY. Wei T.
353	Interaction of a vortex ring with a piston vortex	Allen JJ. Auvity B.
379	Self-organization mechanisms for the formation of nearshore crescentic and transverse sand bars	Caballeria M. Coco G. Falques A. Huntley DA.

Journal of Fluids & Structures 16(3) 2002

271	Active wing flutter suppression using a trailing edge flap	Borglund D. Kuttenkeuler J.
295	Vortex breakdown from a pitching delta wing incident upon a plate: flow structure as the origin of buffet loading	Ozgoren M. Sahin B. Rockwell D.
317	The structure of turbulent shear flow around a two-dimensional porous fence having a bottom gap	Kim HB. Lee SJ.
331	Temporal stability of flow through viscoelastic tubes	Hamadiche M. Gad-el-Hak M.
361	Acoustic resonance in the inlet scroll of a turbo-compressor	Ziada S. Oengoren A. Vogel A.
375	Dynamic simulation of marine risers moving relative to each other due to vortex and wake effects	Sagatun SI. Herfjord K. Holmas T.
391	Nonlinear inertial loading. part i: accelerations in steep 2-d water waves	Swan C. Bashir T. Gudmestad OT.
417	Self-induced sloshing caused by an upward round jet impinging on the free surface	Madarame H. Okamoto K. Iida M.

Journal of Fluids & Structures 16(4) 2002

435	Numerical simulation of flow induced by a cylinder orbiting in a large vessel	Teschauer I. Schafer M. Kempf A.
453	Oblique vortex shedding behind tapered cylinders	Valles B. Andersson HI. Jenssen CB.
465	Application of a modified k-epsilon model to the prediction of aerodynamic characteristics of rectangular cross-section cylinders	Shimada K. Ishihara T.
487	Numerical research on the coherent structures in a mixing layer with cross-shear	Lin JZ. Yu ZS. Shao XM.
497	Development of a three-dimensional viscous aeroelastic solver for nonlinear panel flutter	Gordnier RE. Visbal MR.
529	An experimental study of paper flutter	Watanabe Y. Suzuki S. Sugihara M. Sueoka Y.
543	A theoretical study of paper flutter	Watanabe Y. Isogai K. Suzuki S. Sugihara M.
561	Hydroelastic vibration of a circular container bottom plate using the galerkin method	Cheung YK. Zhou D.

Journal of Fluids Engineering 124(3) 2002

565	Liquid film atomization on wall edges - separation criterion and droplets formation model	Maroteaux F. Llory D. Le Coz JF. Habchi C.
576	Numerical simulation of droplet flows and evaluation of interfacial area	Watanabe T. Ebihara K.
584	Finite element simulations of free surface flows with surface tension in complex geometries	Wang G.
595	Does the minimum fluidization exist?	Delebarre A.
601	A cavitation erosion model for ductile materials	Berchiche N. Franc JP. Michel JM.
607	High reynolds number, unsteady, multiphase cfd modeling of cavitating flows	Lindau JW. Kunz RF. Boger DA. Stinebring DR. Gibeling HJ.
617	Mathematical basis and validation of the full cavitation model	Singhal AK. Athavale MM. Li HY. Jiang Y.
625	Continuous wavelet transforms of instantaneous wall pressure in slug and churn upward gas-liquid flow	McClusky HL. Holloway MV. Beasley DE. Ochterbeck JM.

634	Film thickness and wave velocity measurements in a vertical duct	Kumar R. Gottmann M. Sridhar KR.
643	Multi-parameter sensing with a thermal silicon flow sensor	van Putten MJAM. Kleijn CR. van den Akker HEA.
650	A universal, nonintrusive method for correcting the reading of a flow meter in pipe flow disturbed by installation effects	Wildemann C. Merzkirch W. Gersten K.
657	Truncation error analysis in turbulent boundary layers	Di Mascio A. Paciorri R. Favini B.
664	The effects of surface roughness on the mean velocity profile in a turbulent boundary layer	Bergstrom DJ. Kotey NA. Tachie MF.
671	Analysis and experiments on three-dimensional, irregular surface roughness	van Rij JA. Belnap BJ. Ligrani PM.
678	Inception of turbulence in the stokes boundary layer over a transpiring wall	Majdalani J. Barron J. Van Moorhem WK.
685	Accurate evaluation of the loss coefficient and the entrance length of the inlet region of a channel	Sadri RM. Floryan JM.
694	Spreading of nonuniform jets in wind	Bhattacharyya S. Smith FT.
700	Numerical simulation of viscoplastic fluid flows through an axisymmetric contraction	Jay P. Magnin A. Piau JM.
706	Analysis of impinging and countercurrent stagnating flows by reynolds stress model	Im YH. Huh KY. Kim KY.
719	Effect of radial clearance on the flow between corotating disks in fixed cylindrical enclosures	Al-Shannag M. Herrero J. Humphrey JAC. Giralt F.
728	A comparison of second-moment closure models in the prediction of vortex shedding from a square cylinder near a wall	Straatman AG. Martinuzzi RJ.
737	A study of vortex shedding in a staggered tube array for steady and pulsating cross-flow	Konstantinidis E. Balabani S. Yianneskis M.
747	Development of swirling flow in a rod bundle subchannel	McClusky HL. Holloway MV. Beasley DE. Conner ME.
756	The application of advance methods in analyzing the performance of the air curtain in a refrigerated display case	Navaz HK. Faramarzi R. Gharib M. Dabiri D. Modarress D.
765	A method for pressure calculation in ball valves containing bubbles	Campagne CV. Nicodemus R. de Bruin GJ. Lohse D.
772	Predicting globe control valve performance - part 1: cfd modeling	Davis JA. Stewart M.
778	Predicting globe control valve performance - part ii: experimental verification	Davis JA. Stewart M.
784	The effect of the operating point on the pressure fluctuations at the blade passage frequency in the volute of a centrifugal pump	Parrondo-Gayo JL. Gonzalez-Perez J. Fernandez-Francos J.
791	Piv measurements in the impeller and the vaneless diffuser of a radial flow pump in design and off-design operating conditions	Wuibaut G. Bois G. Dupont P. Caignaert G. Stanislas M.
798	Cfd calculation of a mixed flow pump characteristic from shutoff to maximum flow	Muggli FA. Holbein P. Dupont P.
803	Application of fractional calculus to fluid mechanics	Kulish VV. Lage JL.
806	Constant pressure laminar, transitional and turbulent flows - an approximate unified treatment	Dey J.
809	Discussion: "comprehensive approach to verification and validation of cfd simulations - part 1: methodology and procedures" (stern, f., wilson, r. v.., coleman, h. w.., and paterson, e. g.., 2001, asme j. fluids eng., 123, pp. 793-802)	Oberkampf WL.
810	Closure to "discussion of 'comprehensive approach to verification and validation of cfd simulations - part 1: methodology and procedures' " (2002, asme j. fluids eng., 124, p. 809)	Stern F. Wilson R.

Journal of Intelligent Material Systems & Structures 12(10) 2001

665	The army research office's adaptive structures research program	Anderson GL.
671	Vibration suppression of structures using passive shape memory alloy energy dissipation devices	Salichs J. Hou Z. Noori M.
681	A system identification technique using pseudo-wavelets	Hou ZK. Hera A.
689	Linear location of acoustic emission sources with a single channel distributed sensor	Sundaresan MJ. Schulz MJ. Ghoshal A.
701	Research on f-scan acoustic imaging of composite materials	Chen YF. Luo W. Fu DY. Shi K.
709	Electro-mechanical impedance method for crack detection in thin plates	Zagrai AN. Giurgiutiu V.

Journal of Intelligent Material Systems & Structures 12(11) 2001

721	Modeling and numerical simulation on thermomechanical behavior of sma plates with two-way shape memory effect	Takagi T. Luo Y. Suzuki S. Matsumoto M. Tani J.
729	Energy dissipation analysis of piezoceramic semi-active vibration control	Corr LR. Clark WW.
737	Piezoelectric hydraulic pump system dynamic model	Oates WS. Lynch CS.
745	A plate electrostrictive finite element - part i: modeling and variational formulations	Pablo F. Osmont D. Ohayon R.

761	Finite element modeling of shape memory alloy composite actuators: theory and experiment	Ghomshei MM. Khajepour A. Tabandeh N. Behdinan K.
775	Simultaneous active damping and health monitoring of aircraft panels	Inman DJ. Ahmadian M. Claus RO.
785	Modal sensor for axial propagating waves in an infinite in-vacuo pipe	Variyart W. Brennan MJ.

Journal of Intelligent Material Systems & Structures 12(12) 2001

795	Active structural acoustic control of a launch vehicle fairing using monolithic piezoceramic actuators	Lane SA. Griffin S. Leo D.
807	Overview of modern lithography techniques and a mems-based approach to high throughput rate electron beam lithography	Chase JG. Smith BW.
819	Finite element modeling and active control of an inflated torus using piezoelectric devices	Lewis JA. Inman DJ.
835	A systematic method for the design of piezostack actuator integrated robots for high-speed and precision operation	Rastegar JS. Yuan LF.
847	Effective electroelastic properties of a piezocomposite with viscoelastic and dielectric relaxing matrix	Jiang B. Batra RC.
867	Actuator power reduction using l-c oscillator circuits	Sirohi J. Chopra I.

Journal of Microelectromechanical Systems 11(4) 2002

285	Direct silicon-silicon bonding by electromagnetic induction heating	Thompson K. Gianchandani YB. Booske J. Cooper RF.
293	Electroless nickel films: properties and fabricated cavity structure	Yi SH. von Preissig FJ. Kim ES.
302	Electrostatic actuation of microscale liquid-metal droplets	Latorre L. Kim J. Lee J. de Guzman PP. Lee HJ. Nouet P. Kim CJ.
309	A new in situ residual stress measurement method for a mems thin fixed-fixed beam structure	Chen S. Baughn TV. Yao ZJ. Goldsmith CL.
317	Silicon nitride cantilevers with oxidation-sharpened silicon tips for atomic force microscopy	Grow RJ. Minne SC. Manalis SR. Quate CF.
322	Ir uncooled bolometers based on amorphous gexsi1-xoy on silicon micromachined structures	Iborra E. Clement M. Herrero LV. Sangrador J.
330	Single mask, large force, and large displacement electrostatic linear inchworm motors	Yeh R. Hollar S. Pister KSJ.
337	Wireless micromachined ceramic pressure sensor for high-temperature applications	Fonseca MA. English JM. von Arx M. Allen MG.
344	Feasibility test of an electromagnetically driven valve actuator for glaucoma treatment	Bae B. Kim N. Kee H. Kim SH. Lee Y. Lee S. Park K.
355	Integration of two degree-of-freedom magnetostrictive actuation and piezoresistive detection: application to a two-dimensional optical scanner	Bourouina T. Lebrasseur E. Reyne G. Debray A. Fujita H. Ludwig A. Quandt E. Muro H. Oki T. Asaoka A.
362	A new fem approach for field and torque simulation of electrostatic microactuators	Delfino F. Rossi M.
372	Deformation and structural stability of layered plate microstructures subjected to thermal loading	Dunn ML. Zhang YH. Bright VM.
385	Guidelines for etching silicon mems structures using fluorine high-density plasmas at cryogenic temperatures	de Boer MJ. Gardeniers JGE. Jansen HV. Smulders E. Gilde MJ. Roelofs G. Sasserath JN. Elwenspoek M.

Journal of Non-Newtonian Fluid Mechanics 104(2-3) 2002

87	Viscoelastic mobility problem of a system of particles	Yu ZS. Phan-Thien N. Fan YR. Tanner RI.
125	Numerical prediction of extensional flows in contraction geometries: hybrid finite volume/element method	Aboubacar M. Matallah H. Tamaddon-Jahromi HR. Webster MF.
165	Squeeze flow of concentrated long fibre suspensions: experiments and model	Servais C. Luciani A. Manson JAE.
185	Easier flow of viscoplastic materials with ultrasonic longitudinal wall motion	Piau JM. Piau M.

Journal of Non-Newtonian Fluid Mechanics 105(1) 2002

1	Viscoplastic flow around a cylinder kept between parallel plates	Zisis T. Mitsoulis E.
21	Novel shear modulus equations for concentrated emulsions of two immiscible elastic liquids with interfacial tension	Pal R.
35	Viscoelastic flows studied by smoothed particle dynamics	Ellero M. Kroger M. Hess S.
53	Surfactant spreading on a thin weakly viscoelastic film	Zhang YL. Matar OK. Craster RV.

Journal of Non-Newtonian Fluid Mechanics 105(2-3) 2002

79	A methodology for the derivation of non-darcian models for the flow of generalized newtonian fluids in porous media	Tsakiroglou CD.
111	Dynamics of linear, entangled polymeric liquids in shear flows	Neergaard J. Schieber JD.
131	Viscoelastic mobility problem using a boundary element method	Phan-Thien N. Fan XJ.
153	Determination of the molecular weight distribution of entangled linear polymers from linear viscoelasticity data	Van Ruymbeke E. Keunings R. Bailly C.
177	A note on transient stress calculation via numerical simulations	Cristini V. Macosko CW. Jansseune T.
189	Viscoplastic boundary layer (vol 102, pg 193, 2002)	Piau JM.

Journal of Non-Newtonian Fluid Mechanics 106(1) 2002

1	Dynamics of worm-like micelles: the cox-merz rule	Manero O. Bautista F. Soltero JFA. Puig JE.
17	Similarity solutions for jet breakup in a giesekus fluid with inertia	Renardy M. Losh D.
29	Drop formation dynamics of constant low-viscosity, elastic fluids	Cooper-White JJ. Fagan JE. Tirtaatmadja V. Lester DR. Boger DV.

Journal of Reinforced Plastics & Composites 21(8) 2002

681	Fracture behaviour of frp composite laminates with two interacting embedded delaminations at the interface	Chakraborty D. Pradhan B.
699	Welding of plastics - introduction into heating by radiation	Bonten C. Tuchert C.
711	Effect of prepreg geometry on the prepreg and plain weave composite properties	Mariatti M. Nasir M. Ismail H.
723	Significance of processing parameters on the warpage of rotationally molded parts	Liu SJ. Chen CF.
735	An elasto-plastic stress analysis in a polymer matrix composite beam of arbitrary orientation subjected to transverse linearly distributed load	Esendemir U.
749	The influence of cooling rate on the fracture properties of a thermoplastic-based fibre-metal laminate	Guillen JF. Cantwell WJ.

Journal of Reinforced Plastics & Composites 21(9) 2002

775	A review of refined shear deformation theories of isotropic and anisotropic laminated plates [review]	Ghugal YM. Shimpi RP.
815	A model for fracture probability as a function of stress and strain	Andreassen E.
847	Reprocessing effects on the properties of a hybrid nylon 6,6-composite reinforced with short glass and carbon fibers	Licea-Claverie A. Valdez JO. Garcia-Hernandez E. Zizumbo A. Alvarez-Castillo A. Castano VM.
857	Compressive strength of epoxy with bimodal filling of flyash	Kulkarni SM. Kishore.

Journal of Reinforced Plastics & Composites 21(10) 2002

869	Delaminated woven fabric composite plates under transverse quasi-static loading: experimental studies	Naik NK. Reddy KS.
879	An experimental method to continuously measure permeability of fiber preforms as a function of fiber volume fraction	Stadtfeld HC. Erninger M. Bickerton S. Advani SG.
901	On the effect of e-glass fiber on the cure behavior of vinylester composites	Karbhari VM. Lee R.
919	A study of flexural behavior of reinforced concrete beam strengthened with carbon fiber-reinforced plastic (cfrp)	Ng SC. Lee S.
939	Residual stresses in stainless steel fiber-reinforced aluminium matrix composite plates with central square hole	Akbulut H. Senel M.

Journal of Reinforced Plastics & Composites 21(11) 2002

963	Mode-ii fracture at the interface between a base and a repair graphite/epoxy laminates	Jarrah MA. Tahat MSM. Hoa SV.
983	Hygrothermal effects on rt-cured glass-epoxy composites in immersion environments. part a: moisture absorption characteristics	Srihari S. Revathi A. Rao RMVGK.

993	Hygrothermal effects on rt-cured glass-epoxy composites in immersion environments. part b: degradation studies	Srihari S. Revathi A. Rao RMVGK.
1003	An attempt at predicting failure in a random glass/epoxy composite laminate	Okoli OI. Abdul-Latif A.
1013	The use of phosphogypsum as a filler for thermoplastics, part i: the use of phosphogypsum as a filler for polyolefine compositions	Kowalska E. Wielgosz Z.
1027	Parametric characterization of the thin-wall injection molding of thermoplastic composites	Liu SJ. Hsu CH. Chang CY.
1043	The use of phosphogypsum as a filler for thermoplastics, part ii: phosphogypsum as a filler for polyamide 6 and for pvc	Kowalska E. Kawinska B.

Journal of Reinforced Plastics & Composites 21(12) 2002

1055	Simultaneous simulation of solid conveying, melting and melt flow between parallel plates: an approximation to the flow in a screw extruder	Chiew LM. Gupta M.
1079	Processing of polypropylene foams in melt compounding based rotational foam molding	Pop-Iliev R. Park CB.
1101	Laser transmission welding of semi-crystalline thermoplastics - part i: optical characterization of nylon based plastics	Kagan VA. Bray RG. Kuhn WP.
1123	Modeling the tensile behavior of milano rib knit fabric composites	Huang ZM. Ramakrishna S. Leong KH.

Journal of Reinforced Plastics & Composites 21(13) 2002

1149	An analytical method for thermoelastic analysis of 3d orthogonal interlock woven composites	Naik NK. Sridevi E.
1193	Thermal property measurements during curing of thermoset resins using steady periodic conditions	Garnier B. Sommier A.
1205	An elastic-plastic stress analysis of simply supported thermoplastic composite beams under a transverse uniformly distributed load	Sayman O. Kucuk M. Esendemir U. Ondurucu A.
1221	Friction and wear performance evaluation of carbon fibre reinforced ptfe composite	Bijwe J. Neje S. Indumathi J. Fahim M.

Journal of Sound & Vibration 253(5) 2002

941	A wave model for a pneumatic tyre belt	Pinnington RJ. Briscoe AR.
961	Radial force transmission to the hub from an unloaded stationary tyre	Pinnington RJ.
985	Resonances of a non-linear s.d.o.f. system with two time-delays in linear feedback control	Ji JC. Leung AYT.
1001	Analysis of a piezoelectric multimorph in extensional and flexural motions	Ha SK. Kim YH.
1015	Higher vibration modes in railway tracks at their cut-off frequencies	Pfaffinger MR. Dual J.
1039	An inverse eigenvalue formulation for optimizing the dynamic behaviour of pin-jointed structures	Dioudi MS. Bahai H. Esat II.
1051	Dynamic stiffness method for circular stochastic timoshenko beams: response variability and reliability analyses	Gupta S. Manohar CS.
1087	Vibration signal analysis and feature extraction based on reassigned wavelet scalogram	Peng Z. Chu F. He Y.
1101	Multiple damage location with flexibility curvature and relative frequency change for beam structures	Lu Q. Ren G. Zhao Y.
1115	A study of various barriers in enclosed sound field by using the computer program-sofis	Xiangyang Z. Kean C. Jincai S.
1125	Stability of a short uniform cantilever column subjected to an intermediate follower force	Nair RG. Rao GV. Singh G.
1131	A curved box beam element considering shear lag effect and its static and dynamic applications	Wu YP. Lai YM. Zhu YL. Pan WD.
1140	Reply to "comments on 'vibration analysis of thin cylindrical shells using wave propagation approach"'	Zhang XM.

Journal of Sound & Vibration 254(1) 2002

1	Lining-deformation-induced modal coupling as squeal generator in a distributed parameter disc brake model	Flint J. Hulten J.
23	Optimization of anisotropic sandwich beams for higher sound transmission loss	Thamburaj P. Sun JQ.
37	Random response of preisach hysteretic systems	Ying ZG. Zhu WQ. Ni YQ. Ko JM.
51	Local-mode resonance and its structural effects under horizontal ground shock excitations	Lu Y. Hao H. Ma G. Zhou Y.

69	The forced vibration and boundary control of pretwisted timoshenko beams with general time dependent elastic boundary conditions	Lin SM. Lee SY.
91	Stochastic averaging of duhem hysteretic systems	Ying ZG. Zhu WQ. Ni YQ. Ko JM.
105	Time-frequency analysis of a suspension bridge based on gps	Xu L. Guo JJ. Jiang JJ.
117	Feedforward adaptive control of flexural vibration in a beam using wave amplitudes	Halkyard CR. Mace BR.
143	Reliability analysis of suspension bridges against flutter	Pourzeynali S. Datta TK.
163	Global chaos control of non-autonomous systems	Hsiao YC. Tung PC.
175	Fundamental frequency of transverse vibration of a circular plate of rectangular orthotropy with a secant support	Laura PAA. Gutierrez RH. Rossi RE.
179	A parametric study on vibrating clamped elliptical plates with variable thickness	Bayer I. Guven U. Altay G.
189	Control volume and system formulations for translating media and stationary media with moving boundaries	Zhu WD.

Journal of Sound & Vibration 254(2) 2002

203	Micro-sensing characteristics and modal voltages of linear/non-linear toroidal shells	Tzou HS. Wang DW.
219	An inverse aeroacoustic problem on rotor wake/stator interaction	Luo J. Li XD.
231	Solution of coupled acoustic problems: a partially opened cavity coupled with a membrane and a semi-infinite exterior field	Kim YH. Kim SM.
245	Stochastic averaging of strongly non-linear oscillators under bounded noise excitation	Huang ZL. Zhu WQ. Ni YQ. Ko JM.
269	The energy mobility	Orefice G. Cacciolati C. Guyader JL.
297	The unbalanced magnetic pull and its effects on vibration in a three-phase generator with eccentric rotor	Guo D. Chu F. Chen D.
313	New non-linear modelling for vibration analysis of a straight pipe conveying fluid	Lee SI. Chung J.
327	Identification of multiple faults in rotor systems	Bachschmid N. Pennacchi P. Vania A.
367	Vibration analysis of a damped arch using an iterative laminate model	Kovacs B.
379	An analytical approach to determining the dynamic characteristics of a cylindrical shell with closing cracks	Roytman A. Titova O.
387	A note on the non-linear phenomena accompanying propagation of high-frequency sound waves in ducts	Denisov KP. Khitrik VL.
393	On the design of bars and beams for desired mode shapes	Lai E. Ananthasuresh GK.
407	Beck's column as the ugly duckling	Sugiyama Y. Ryu SU. Langthjem MA.

Journal of Sound & Vibration 254(3) 2002

411	Effect of elastic foundation on asymmetric vibration of polar orthotropic linearly tapered circular plates	Gupta US. Ansari AH.
427	Coupled axial-lateral-torsional dynamics of a rotor-bearing system geared by spur bevel gears	Li M. Hu HY. Jiang PL. Yu L.
447	Prediction of dynamic characteristics using updated finite element models	Modak SV. Kundra TK. Nakra BC.
469	Study on the radiation acoustic field of rectangular radiators in flexural vibration	Shuyu L.
481	Vibration of twisted and curved cylindrical panels with variable thickness	Sakiyama T. Hu XX. Matsuda H. Morita C.
503	Modelling of vibrating systems using time-domain finite element method	Suk J. Kim Y.
523	Response of a plate to diffuse acoustic field using statistical energy analysis	Renji K. Nair PS. Narayanan S.
541	The dynamic stiffness matrix method in forced vibration analysis of multiple-cracked beam	Khiem NT. Lien TV.
557	Effect of grazing-bias flow interaction on acoustic impedance of perforated plates	Sun X. Jing X. Zhang H. Shi Y.
575	Approximating the hysteretic damping matrix by a viscous matrix for modelling in the time domain	Henwood DJ.
595	The reverberation time of tall spaces	Coley DA.
599	Computing the lowest eigenvalue with rayleigh quotient iteration	Rajendran S.
613	Transverse vibrations of circular solid and annular plates of generalized anisotropy	Bambill DV. Laura PAA. Rossit CA.

Journal of Sound & Vibration 254(4) 2002

621	A concentrated mass on the spinning unconstrained beam subjected to a thrust	Yoon SJ. Kim JH.
635	A fast time-domain integration method for computing non-stationary response histories of linear oscillators with discrete-time random forcing	Dunne JF.
677	Non-linear free vibration analysis of a string under bending moment effects using the perturbation method	Khadem SE. Rezaee M.
693	Dynamic buckling of a cylindrical shell with variable thickness subject to a time-dependent external pressure varying as a power function of time	Aksogan O. Sofiyev AH.

703	Free transverse vibrations of an elastically connected complex beam-string system	Oniszczuk Z.
717	Dynamic modelling and vibration analysis of a flexible cable-stayed beam structure	Fung RF. Lu LY. Huang SC.
727	On group velocity of elastic waves, in an anisotropic plate	Chen Y. Guo L.
733	Low-oscillation complex wavelets	Addison PS. Watson JN. Feng T.
763	Time integration of non-linear dynamic equations by means of a direct variational method	Rosales MB. Filipich CP.
777	Vibrational modes of trumpet bells	Moore TR. Kaplon JD. McDowall GD. Martin KA.
787	A new method for in-plane vibration analysis of circular rings with widely distributed deviation	Yoon YJ. Lee JM. Yoo SW. Choi HG.
801	Transverse vibrations of a circular annular plate with a free inner edge and a secant support	Rossi RE.
805	On the orthogonal wavelet transform for model reduction/synthesis of structures	Al-Aghbari M. Scarpa F. Staszewski WJ.
818	Energy expressions for rotating tapered timoshenko beams	Banerjee JR. Sobey AJ.

Journal of Sound & Vibration 254(5) 2002

823	A novel technique for inverse identification of distributed stiffness factor in structures	Liu GR. Chen SC.
837	Analysis of disc brake noise using a two-degree-of-freedom model	Shin K. Brennan MJ. Oh JE. Harris CJ.
849	Axisymmetric vibrations of concentric dissimilar orthotropic composite annular plates	Greenberg JB. Stavsky Y.
867	Non-linear generalization of principal component analysis: from a global to a local approach	Kerschen G. Golinval JC.
877	Robust vibration control of a beam using the h-infinity-based controller with model error compensator	Wang DA. Huang YM.
897	The dynamics of a vibromachine with parametric excitation	Belovodsky VN. Tsyfansky SL. Beresnevich VI.
911	Vibrations of non-uniform continuous beams under moving loads	Dugush YA. Eisenberger M.
927	Interaction between a liquid layer and vibrating plates: application to the displacement of liquid droplets	Scortesse J. Manceau JF. Bastien F.
939	Natural frequencies and mode shapes of a free-free beam with large end masses	Kirk CL. Wiedemann SM.
951	Free vibration of a partially liquid-filled and submerged, horizontal cylindrical shell	Ergin A. Temarel P.
967	Identification of speed-dependent bearing parameters	Tiwari R. Lees AW. Friswell MI.
987	Modes of contact and uniqueness of solutions for systems with friction-affected sliders	Klepp HJ.
997	Mass and stiffness fixed points of vibrational discrete systems	Abu-Hilal M.
1005	Calculation of the jump frequencies in the response of s.d.o.f. non-linear systems	Malatkar P. Nayfeh AH.
1012	Comparison of different modelling techniques to simulate the vibration of a cracked rotor	Keiner H. Gadala MS.

Journal of Sound & Vibration 255(1) 2002

1	A semi-analytical approach to the non-linear dynamic response problem of beams at large vibration amplitudes, part ii: multimode approach to the steady state forced periodic response	Azrar L. Benamar R. White RG.
43	Non-linear dynamic analysis of the two-dimensional simplified model of an elastic cable	Zhao YY. Wang LH. Chen DL. Jiang LZ.
61	Active control of pressure fluctuations due to flow over helmholtz resonators	Kook H. Mongeau L. Franchek MA.
77	Feedforward algorithms with simplified plant model for active noise control	Pawelczyk M.
97	The role and experimental determination of equivalent mass in complex sea models	Gelat P. Lalor N.
111	Application of modified vlasov model to free vibration analysis of beams resting on elastic foundations	Ayvaz Y. Ozgan K.
129	High-wavenumber acoustic radiation from a thin-walled axisymmetric cylinder	Keith GM. Peake N.
147	High-wavenumber acoustic radiation from a thin-walled scarfed cylinder	Keith GM. Peake N.
161	Non-linear vibrations of shell-type structures: a review with bibliography [review]	Moussaoui F. Benamar R.
185	Comparison of fourier sine and cosine series expansions for beams with arbitrary boundary conditions	Li WL.
195	Transverse vibrations of isotropic, thin circular plates with a rectangularly orthotropic circular core	Gutierrez RH. Laura PAA. Rossi RE.
199	Comments on "a novel approach to determine the frequency equations of combined dynamical systems"	Gurgoze M.
201	Comments on "a novel approach to determine the frequency equations of combined dynamical systems" author's reply	Cha PD.

Journal of Sound & Vibration 255(2) 2002

203	Dsc analysis of rectangular plates with non-uniform boundary conditions	Zhao YB. Wei GW.
229	A simple model to estimate the impact force induced by piston slap	Cho SH. Ahn ST. Kim YH.
243	Instability of vibration of a moving-train-and-rail coupling system	Zheng DY. Fan SC.
261	Parametric study for an efficient meshless method in vibration analysis	Wang YH. Li WD. Tham LG. Lee PKK. Yue ZQ.
281	Structure-borne noise and vibration of concrete box structure and rail viaduct	Ngai KW. Ng CF.
299	The exact solutions for the natural frequencies and mode shapes of non-uniform beams with multiple spring-mass systems	Chen DW. Wu JS.
323	Discrete huygens' modelling approach to wave propagations in a homogeneous elastic field	Kagawa Y. Fujitani T. Fujita Y. Chai L. Wakatsuki N. Tsuchiya T.
337	Tracking control of the flexible slider-crank mechanism system under impact	Fung RF. Sun JH. Wu JW.
357	On the free vibration of stiffened shallow shells	Nayak AN. Bandyopadhyay JN.
383	Design sensitivity analysis and optimization of an engine mount system using an frf-based substructuring method	Lee DH. Hwang WS. Kim CM.
399	On the extension of the integro-modal approach	Anyunzoghe E. Cheng L.
407	Proportionally damped systems subjected to damping modifications by several viscous dampers	Gurgoze M.
413	Dynamic equilibrium equations of non-prismatic beams defined on an arbitrarily selected co-ordinate system (vol 230, pg 241, 2000)	Chen CN.
415	Some remarks on the numerical time intergration of non-linear dynamical systems (vol 252, pg 935, 2002)	Bornemann PB. Galvanetto U. Crisfield MA.

Journal of Sound & Vibration 255(3) 2002

417	The influence of control system design on the performance of vibratory gyroscopes	Loveday PW. Rogers CA.
433	A geometrically non-linear model of rotating shafts with internal resonance and self-excited vibration	Luczko J.
457	H-adaptive refinement strategy for acoustic problems with a set of natural frequencies	Fuenmayor FJ. Denia FD. Albelda J. Giner E.
481	A method of identifying interface characteristic for machine tools design	Lin Y. Chen W.
489	On the frequency response function of a damped cantilever simply supported in-span and carrying a tip mass	Gurgoze M. Erol H.
501	Affective evaluations of and reactions to exterior and interior vehicle auditory quality	Vastfjall D. Gulbol MA. Kleiner M. Garling T.
519	Diffraction studies of some conventional and novel microphone baffles	Swenson GW.
531	Investigation of automotive creep groan noise with a distributed-source excitation technique	Bettella M. Harrison MF. Sharp RS.
549	In-service identification of non-linear damping from measured random vibration	Iourtchenko DV. Dimentberg MF.
555	Physical and numerical modelling of the dynamic behavior of a fly line	Gatti-Bono C. Perkins NC.
579	Vibration characteristics and transient response of shear-deformable functionally graded plates in thermal environments	Yang J. Shen HS.
603	Discussion on "nature of stationarity of the rayleigh quotient at the natural modes in the rayleigh-ritz method"	Ilanko S.
608	Reply to: discussion on "nature of stationarity of the rayleigh quotient at the natural modes in the rayleigh-ritz method"	Bhat RB.
610	An analytical solution of fluid-structure coupling oscillation in one-dimensional ideal condition under small disturbance	Huang D. Guo W. Li X.

Journal of Sound & Vibration 255(4) 2002

615	Interaction of a spherical shock wave and a submerged fluid-filled circular cylindrical shell	Iakovlev S.
635	Parametric stabilization of a gyroscopic system	McDonald RJ. Namachchivaya NS.
663	On the relation between complex modes and wave propagation phenomena	Ahmida KM. Arruda JRF.
685	Active-passive piezoelectric absorbers for systems under multiple non-stationary harmonic excitations	Morgan RA. Wang KW.
701	Dynamic characteristics of stepped cantilever beams connected with a rigid body	Kwon HD. Park YP.
719	Chaos and chaos synchronization of a symmemic gyro with linear-plus-cubic damping	Chen HK.
741	On the normal forms of certain parametrically excited systems	Zhang WY. Huseyin K. Ye M.
763	Damping optimization by integrating enhanced active constrained layer and active-passive hybrid constrained layer treatments	Liu Y. Wang KW.

777	Influence of some thin shell theories on the evaluation of the noise level in stiffened cylinders	Ruotolo R.
789	Analysis of non-linear oscillators having non-polynomial elastic terms	Mickens RE.
793	Free vibration of continuous slab-beam skewed bridges	Maleki S.

Journal of Sound & Vibration 255(5) 2002

805	On proper orthogonal co-ordinates as indicators of modal activity	Feeny BF.
819	Statistical properties of random sparse arrays	Kook H. Davies P. Bolton JS.
849	Finite element and boundary element modelling for the acoustic wave transmission in mean flow medium	Tsuji T. Tsuchiya T. Kagawa Y.
867	Dynamic dem model of multi-spans rotor system	Yan M. Zhang K. Chen Y.
883	Existence of natural frequencies of systems with artificial restraints and their convergence in asymptotic modelling	Ilanko S.
899	Optimization of simplified models meshed with finite triangular plate elements	Michot S. Piranda J. Trivaudey F.
915	Identification of crack location in vibrating beams from changes in node positions	Dilena M. Morassi A.
931	The effects of large vibration amplitudes on the mode shapes and natural frequencies of thin elastic shells. part ii: a new approach for free transverse constrained vibration of cylindrical shells	Moussaoui F. Benamar R. White RG.
965	Vibration analysis of twisted cantilevered conical composite shells	Lee JJ. Yeom CH. Lee I.
983	Transverse vibrations of a thin, elastic circular plate with mixed boundary conditions	Rossi RE. Laura PAA.
987	Alternative solution to ”the finite residual motion of a damped four-degree-of-freedom vibrating system”	Gurgoze M.
989	Dqem vibration analyses of non-prismatic shear deformable beams resting on elastic foundations	Chen CN.

Journal of Sound & Vibration 256(1) 2002

1	Disturbance due to mechanical sources in micropolar elastic medium with voids	Kumar R. Choudhary S.
17	Fundamental frequency of cracked beams in bending vibrations: an analytical approach	Fernandez-Saez J. Navarro C.
33	Flexural intensity measurement on finite plates using modal spectrum ideal filtering	Nejade A. Singh R.
65	Dynamics and distributed control of conical shells laminated with full and diagonal actuators	Tzou HS. Wang DW. Chai WK.
81	Dynamic behaviour of a cracked soldered joint	Dineva P. Gross D. Rangelov T.
103	Free vibrations of multilayepled plates based on a mixed variational approach in conjunction with global piecewise-smooth functions	Messina A.
131	Line force receptance of an elastic cylindrical shell with heavy exterior fluid loading	Skelton EA.
155	An estimator-based sliding-mode control for maneuvering a flexible spacecraft	Sung YG.
173	Surface wave propagation in a micropolar thermoelastic medium without energy dissipation	Kumar R. Deswal S.
179	Experiments with tuned absorber - impact damper combination	Semercigil SE. Collette F. Huynh D.
189	Evolutionary random responses of linear random structures	Fang T. Leng XL. Sun MN. Li JQ.

Journal of Strain Analysis for Engineering Design 37(5) 2002

375	Analysis of the buckling of long cylindrical shells embedded in an elastic medium using the energy method	Fok SL.
385	A two-term stress function approach to evaluate stress distributions in bonded joints of different geometries	Lazzarin P. Quaresimin M. Ferro P.
399	Shakedown analysis for complex loading using superposition	Muscat M. Hamilton R. Boyle JT.
413	Postbuckling of axially loaded shear-deformable laminated cylindrical panels	Shen HS.
427	A consideration of x-ray circumferential residual stress measurement on cylindrical component surfaces	Oguri T. Murata K. Uegami K. Sato Y.
437	On the analysis of singular stress fields part 1: finite element formulation and application to notches	Tur M. Fuenmayor J. Mugadu A. Hills DA.
445	Force field superposition analysis of three-dimensional stress concentrations	Fenner RT.
459	On the continuum properties of repetitive beam-like pin-jointed structures	Stephen NG. Zhang Y.

Journal of the Mechanics & Physics of Solids 50(9) 2002

1789	A computational model for the indentation and phase transformation of a martensitic thin film	Belik P. Luskin M.
1817	A continuum description of the energetics and evolution of stepped surfaces in strained nanostructures	Shenoy VB. Freund LB.
1843	Prediction and observation of crack tip microstructure in shape memory cualni single crystals	Vasko GM. Leo PH. Shield TW.
1869	Plane strain dynamics of elastic solids with intrinsic boundary elasticity, with application to surface wave propagation	Ogden RW. Steigmann DJ.
1897	The free energy of mixing for n-variant martensitic phase transformations using quasi-convex analysis	Govindjee S. Mielke A. Hall GJ.
1923	On the functional form of non-local elasticity kernels	Picu RC.
1941	An atomistic-based finite deformation membrane for single layer crystalline films	Arroyo M. Belytschko T.
1979	Modeling the evolution of crystallographic dislocation density in crystal plasticity	Arsenlis A. Parks DM.
2011	A theory of network alteration for the mullins effect	Marckmann G. Verron E. Gornet L. Chagnon G. Charrier P. Fort P.

Journal of the Mechanics & Physics of Solids 50(10) 2002

2029	On oblique contact of creeping solids	Larsson J. Storakers B.
2057	A phase field model for failure in interconnect lines due to coupled diffusion mechanisms	Bhate DN. Bower AF. Kumar A.
2085	A coupled atomistic/continuum model of defects in solids	Shilkrot LE. Curtin WA. Miller RE.
2107	A numerical approximation to the elastic properties of sphere-reinforced composites	Segurado J. Llorca J.
2123	Homogenization of inelastic solid materials at finite strains based on incremental minimization principles. application to the texture analysis of polycrystals	Miehe C. Schotte J. Lambrecht M.
2169	Dislocation core spreading at interfaces between metal films and amorphous substrates	Gao HJ. Zhang L. Baker SP.
2203	Micromechanical approach to the behavior of poroelastic materials	Dormieux L. Molinari A. Kondo D.
2233	Application of a partially relaxed shape memory free energy function to estimate the phase diagram and predict global microstructure evolution (vol 50, pg 501, 2002)	Hall GJ. Govindjee S.
2235	An elementary molecular-statistical basis for the mooney and rivlin-saunders theories of rubber elasticity (vol 50, pg 571, 2002)	Fried E.

Journal of Thermal Stresses 25(8) 2002

705	Sensitivity analysis in thermo-elastic-plastic problems	Kubicki K. Sluzalec A.
719	Thermoelastic wave and front propagation	Berezovski A. Maugin GA.
745	Thermoelastic buckling of plates with imperfections based on a higher order displacement field	Mossavarali A. Eslami MR.
773	A theoretical investigation of pure metal solidification on a deformable mold in the absence of interfacial coupling	Yigit F. Hector LG. Richmond O.

Journal of Thermal Stresses 25(9) 2002

813	Topology of the four-mode strain energy of thermally buckling plates	Lee J.
859	Magnetothermoelasticity with thermal relaxation in a conducting medium with variable electrical and thermal conductivity	Ezzat MA. El-Karamany AS.
877	Thermoelastic interactions without energy dissipation in an unbounded medium with a spherical cavity due to a thermal shock at the boundary	Mukhopadhyay S.
889	Thermal stresses in joined semi-infinite solids	Yu JH. Kuang ZB. Gu MY.

Journal of Vibration & Control 8(4) 2002

425	Passive control of the vibration and sound radiation from submerged shells	Oh J. Ruzzene M. Baz A.
451	On the stability of a tuned vibration absorber for time varying multiple frequencies	Olgac N. Huang C.
467	Vibrostability of the milling process described by the time-variable parameter model	Marchelek K. Pajor M. Powalka B.

481	Method of reducing the number of dof in the machine tool-cutting process system from the point of view of vibrostability analysis	Pajor M. Marchelek K. Powalka B.
493	Determination of the global sensitivity of the vibrostability limit for improving machine tools dynamics	Marchelek K. Powalka B.
503	Integral equation approach for beams with multi-patch piezo sensors and actuators	Sloss JM. Bruch JC. Sadek IS. Adali S.
527	Vibration control of a suspension system via a magnetorheological fluid damper	Lai CY. Liao WH.

Journal of Vibration & Control 8(5) 2002

553	Structured model reference adaptive control for a wing section with structural nonlinearity	Ko J. Strganac TW. Junkins JL. Akella MR. Kurdila AJ.
575	Control of structural vibrations by confinement in the presence of parameter uncertainties and disturbances	Choura S. Yigit AS.
595	Double panel partition (avnc) by means of optimized piezoceramic structural boundary control	Jemai B. Ichchou MN. Jezequel L.
619	Optimal performance of the tlcd in structural pitching vibration control	Xue SD. Ko JM. Xu YL.
643	Obstruction identification in a compliant tube with application to airway passages	Al-Jumaily AM. Du Y.
659	Discrete speed controller design of a marine diesel engine including sampling effects due to fuel injection	Mosleh M. Al-Ali A.
673	Modelling of a beam with a breathing edge crack and some observations for crack detection	Nandi A. Neogy S.

JSME International Journal Series A- Solid Mechanics & Material Engineering 45(3) 2002

331	Elasto-plastic damage analysis of functionally graded materials subjected to thermal shock and thermal cycle	Lee JM. Toi Y.
339	Dynamic response of poroelastic moderately thick shells of revolution saturated in viscous fluid	Takezono S. Tao K. Gonda T.
348	Wave propagation in transversely isotropic fluid-saturated poroelastic media	Liu Y. Liu K. Tanimura S.
356	Micromechanical analysis of crack closure mechanism for intelligent material containing tini fibers - (2nd report, numerical calculation of stress intensity factor in the process of shape memory shrinkage of tini fibers)	Araki S. Ono H. Saito K.
363	Stress singularity analysis of axisymmetric piezoelectric bonded structure	Li YL. Sato Y. Watanabe K.
371	The surface crack problem for a layered elastic medium with a functionally graded nonhomogeneous interface	Ueda S. Mukai T.
379	Study on kinking fracture from interfacial cracks and the separated j integrals	Nishioka T. Yao JL. Nozaki T. Syano S. Fujimoto T.
388	Estimation of dynamic stress intensity for one-point bend specimen by inverse analysis	Gunawan FE. Homma H. Shah QH. Mihradi S.
395	Component separation method of the dynamic j integral for evaluating mixed-mode stress intensity factors in dynamic interfacial fracture mechanics problems	Nishioka T. Hu QH. Fujimoto T.
407	3d elasto-plastic stress analysis by the method of arbitrary lines	Kaminishi K. Ando R.
413	A numerical study of dynamic buckling of thin-walled hollow square columns subjected to axial impact	Gotoh M. Sawairi Y. Yamashita M.
420	A new method using energy release elements to estimate the bonding strength	Hatsuda T. Minamitani R.
428	Dynamic creep behaviors of si-ti-c-o ceramic fiber bonded body under bend loading at elevated temperature	Hatanaka K. Sen Z. Kajii S. Ishikawa T.
437	Mathematical model of load pass and prediction of fatigue life on bolt threads with reduced lead	Asayama Y.
448	Real-time measurement of nanometer displacement distribution by integrated phase-shifting method	Fujigaki M. Morimoto Y. Yabe M.

JSME International Journal Series C- Mechanical Systems Machine Elements & Manufacturing 45(2) 2002

393	Statistical seismic response analysis of piping system with a teflon friction support	Hanawa Y. Shimizu N.
402	Vibration suppression design of adaptive truss structures by simulated annealing	Kunimoto N. Ikeda M.
409	Modeling, control and experiment of a feedback active noise control system for free sound fields	Adachi S. Sano H.
417	General collocation method for three dimensional acoustic analysis of a simple expansion chamber	Jeong WB. Ahn SJ. Kim BJ. Hwang SM. Yoo WS.
426	Nonlinear analysis of friction induced vibrations of a two-degree-of-freedom model for disc brake squeal noise	Shin K. Oh JE. Brennan MJ.

433	A step-by-step integration scheme utilizing the cardinal b-splines	Inoue T. Sueoka A.
442	Nonlinear vibration control by semi-active piezo-actuator damping	Wang D. Guo ZY. Hagiwara I.
449	Neuro-fuzzy control for pneumatic servo system	Shibata S. Jindai M. Yamamoto T. Shimizu A.
456	Robust position and attitude control of an active vibration isolation system	Miura T. Ikeda M. Yasuda M.
462	Variable structure controller design for output tracking of a class of discrete-time nonlinear systems	Liao TL. Chien TI.
470	The neural-fuzzy thermal error compensation controller on cnc machining center	Tseng PC. Chen SL.
479	Sensor fusion and bang-bang control with nonholonomic constraints	Lyon D.
487	Optimal motion cueing algorithm using the human body model	Han MC. Lee HS. Lee S. Lee MH.
492	Dynamic analysis of the x-shaped groove aerostatic bearings with disk-spring compensator	Chen MF. Lin YT.
502	A piezoelectric micropump using resonance drive with high power density	Park JH. Yokota S. Yoshida K.
510	Investigation of the impedance characteristic of human arm for development of robots to cooperate with humans	Rahman MM. Ikeura R. Mizutani K.
519	Optimum tolerances synthesis for globoidal cam mechanisms	Cheng HY.
527	Study on process planning system for holonic manufacturing - (selection of machining sequences and sequences of machining equipment)	Rais S. Sugimura N. Kokubun A.
534	Detecting shape of weld defect image on x-ray film by image processing applied genetic algorithm	Aoki K. Suga Y.
543	Development of concave conical gear used for marine transmissions - (2nd report, principal normal radii of concave conical gear and design of a pair of gears)	Komatsubara H. Mitome K. Ohmachi T.
551	Decentralized job shop scheduling by recursive propagation method	Hino R. Moriwaki T.
558	Influences of newly formed woven bone on tissue stresses in rat caudal vertebrae subjected to mechanical loading - (a study based on morphological measurement using a micro-ct and computational stress analysis)	Kurata K. Higaki H. Miura H. Mawatari T. Murakami T. Iwamoto Y.
567	Extended assemblability evaluation method (aem) - (extended quantitative assembly producibility evaluation for assembled parts and products)	Ohashi T. Iwata M. Arimoto S. Miyakawa S.
575	Collaborative design supporting system for manufacturing systems	Nakano M. Sato S. Arai E.
581	Shape imperfection in cylindrical cups formed by processes of deep- and stretch-drawing with ironing	Satoh J. Gotoh M. Maeda Y.
593	Development of micro ultrasonic abrasive machining system - (1st report, studies in micro ultrasonic abrasive machining)	Kuriyagawa T. Shirosawa T. Saitoh O. Syoji K.
601	D-stability analysis for a class of uncertain discrete systems with multiple time delays	Chen CF. Pan ST. Hsieh JG.
606	Wiener-hammerstein model identification-recursive algorithms	Emara-Shabaik HE. Ahmed MS. Al-Ajmi KH.
614	Analysis and synthesis of general-type goldberg five-revolute mechanism	Lee CC.
628	Normal meshes for multiresolution analysis of irregular meshes with boundaries	Lee KY. Kang SC. Kim TW.
637	Dual mode transmission designs for motorcycles	Sheu KB. Yan HS.
647	Analysis of spherical form errors to coordinate measuring machine data	Chen MC.

Mathematics & Mechanics of Solids 7(3) 2002

217	The convexity properties of a class of constitutive models for biological soft issues	Wilber JP. Walton JR.
237	Incorporation of microfield distortion into rapid effective property design	Zohdi TI.
255	From saturated elasticity to finite evolution, plasticity and growth	Epstein M.
285	On the thermodynamic stability of elastic heat-conducting solids subject to a deformation-temperature constraint	Dunwoody J. Ogden RW.
307	Pulling apart a press-fitted joint	Kinkaid NM. O'Reilly OM.

Meccanica 36(6) 2001

605	Tribology and its many facets: from macroscopic to microscopic and nano-scale phenomena	Czichos H.
617	Surface roughness and contact: an apology	Greenwood JA. Wu JJ.
631	Microstructural changes in surface layers of metal during running-in friction processes	Garbar I.
641	Prediction of friction and wear of sliding contacts, based on generalizational theory of thermal dynamics and modelling of friction and wear of tribosystems	Khovansky VN. Chichinadze AV.
651	Erosion of ductile and brittle materials (development of a fem-based model and its assessment against theoretical models and experimental data)	Aquaro D. Fontani E.
663	The tribological effect of mechanically produced micro-dents by a micro diamond pyramid on medium carbon steel surfaces in rolling-sliding contact	Nakatsuji T. Mori A.
675	An attempt to evaluate cohesion in wc/co/cr coatings by controlled scratching	Hawthorne HM. Xie Y.
683	Wear mechanisms of electrical steel sheets, hard metal and high speed steel pins coated with tialn and ticn	Bressan J. Hesse R. Silva EM.
691	A model of contact forces in pneumatic motor vanes	Bertetto AM. Mazza L. Pastorelli S. Raparelli T.

701	Experimental study of the influence of changes in load direction on the performance of a crown bearing	Costa L. Fillon M. Miranda AS. Claro JCP.
709	Pressure distribution in a curvilinear thrust bearing with one porous wall lubricated by a bingham fluid	Walicki E. Walicka A. Makhaniok A.
717	The effect of bubbly oil on the thd lubrication of tilting-pad journal bearings subjected to rotating unbalance load	El-Butch AMA.
731	Rotordynamic coefficients for labyrinth gas seals: single control volume model	Malvano R. Vatta F. Vigliani A.
745	Study of conic permanent magnet bearings	Bassani R. Ciulli E. Di Puccio F. Musolino A.

Meccanica 37(1-2) 2002

3	Stochastic analysis of self-induced vibrations	Rudinger F. Krenk S.
15	Stochastic response of offshore structures via statistical cubicization	Floris C. Pulega R.
33	Energy based stochastic estimation of nonlinear oscillators with parametric random excitation	Roberts JB. Vasta M.
51	A galerkin approach for power spectrum determination of nonlinear oscillators	Spanos PD. Di Paola M. Failla G.
67	Dynamic analysis of prestressed cables with uncertain pretension	Sofi A. Borino G. Muscolino G.
85	Rigorous stochastic averaging at a center with additive noise	Namachchivaya NS. Sowers RB.
115	Numerical analysis of structural systems subjected to non-gaussian random fields	Gioffre M. Gusella V.
129	Bounded control of random vibration: hybrid solution to hjb equations	Dimentberg M. Iourtchenko D. Bratus' A.
143	A new twist of the method of successive approximations to yield closed-form solutions for inhomogeneous vibrating beams by integral method	Elishakoff I. Baruch M. Becquet R.
167	Dynamic response of non-linear systems to random trains of non-overlapping pulses	Iwankiewicz R.
179	Static and dynamic analysis of non-linear uncertain structures	Impollonia N. Muscolino G.
193	Integral representations of increments of stochastic processes	Lutes LD.
207	Time delay induced effects on control of non-linear systems under random excitation	Bilello C. Di Paola M. Pirrotta A.

Meccanica 37(3) 2002

221	A new model for the dynamics of dispersions in a batch reactor: numerical approach	Mancini A. Rosso F.
239	Dynamics of multi-body rotors: numerical and experimental fem analysis of the scientific earth experiment galileo galilei ground	Brusa E. Zolfini G.
255	Singularity curves of a parallel pointing system	Gregorio RD. Sinatra R.
269	An exact solution of torsion problem for an incomplete torus with application to helical springs	Kobelev V.
283	Unsteady viscous flows about bodies: vorticity release and forces	Graziani G. Bassanini P.
305	Bifurcations in the oscillatory flow over a wavy wall	Scandura P. Vittori G. Blondeaux P.

Mechanics of Materials 34(6) 2002

313	Damage growth and permeability change in triaxial compression tests of inada granite	Oda M. Takemura T. Aoki T.
333	Dynamic mechanical behavior of steam-treated wood	Karenlampi PP. Tynjala P. Strom P.
349	Measuring intrinsic elastic modulus of pb/sn solder alloys	Basaran C. Jiang JB.
363	Modeling the anisotropy and creep in orthotropic aluminum-silicon carbide composite rotating disc	Singh SB. Ray S.

Mechanics of Materials 34(7) 2002

373	Mechanical properties of microcrystalline cellulose - part i. experimental results	Abdel-Hadi AI. Zhupanska OI. Cristescu ND.
391	Mechanical properties of microcrystalline cellulose - part ii. constitutive model	Zhupanska OI. Abdel-Hadi AI. Cristescu ND.
401	Influence of microstructure on scattering of plane elastic waves by a distribution of partially debonded elliptical inclusions	Sato H. Shindo Y.
411	Mechanisms of toughening and strengthening in ceramic-based nanocomposites	Awaji H. Choi SM. Yagi E.
423	Elastic-plastic deformation of a rotating solid disk of exponentially varying thickness	Eraslan AN. Orcan Y.
433	Dynamic fiber debonding and frictional push-out in model composite systems: numerical simulations	Bi X. Li Z. Geubelle PH. Lambros J.

Mechanics of Structures & Machines 30(3) 2002

279	A differential geometric method for kinematic analysis of two- and three-degree-of-freedom rigid body motions	Bandyopadhyay S. Ghosal A. Ravani B.
309	Partial-interaction analysis of composite beam/column members	Wu YF. Oehlers DJ. Griffith MC.
333	Time-dependent response of an interface crack between dissimilar viscoelastic media	Chang RC.
353	Numerical probabilistic analysis of structural/acoustic systems	Allen MJ. Vlahopoulos N.
381	Random vibration of coulomb oscillators subjected to support motion with a non-gaussian moment closure method	Fatica G. Floris C.
411	Symbolic methods for systems of implicit ordinary differential equations (vol 30, pg 103, 2002)	Schlacher K. Kugi A.

Mechanics Research Communications 29(1) 2002

3	The impulsive motion of flat plate in a generalized second grade fluid	Tan WC. Xu MY.
11	Plasticity field adjacent to faces of asperities on a rotating roll after initial indentation into a half-space	Shi JY. McElwain DLS. Domanti SA.
17	Multi-objective discrete optimization of laminated structures	Spallino R. Rizzo S.
27	Micro-mechanical approximation to the stress field around an inclined fiber of frcc	Hu XD. Day R. Dux P.
35	On a method of comparison for plate elements in finite element engineering software programs	Bezine G.
45	Non-linear global elastic behaviour of a periodically jointed material	Maghous S. de Buhan P. Dormieux L.
53	Piezoelectricity with polarization gradient: homogenization	Telega JJ. Bytner S.
61	A fundamental solutions for transversely isotropic, piezoelectric solids under electrically irrotational approximation	Daros CH.

Mechanics Research Communications 29(4) 2002

197	A minimal model for studying properties of the mode-coupling type instability in friction induced oscillations	Norbert HA. Fischer M. Ralph AB. Gaul L.
207	Dynamic behavior of two collinear anti-plane shear cracks in a functionally graded layer bonded to dissimilar half planes	Ma L. Wu LZ. Guo LC.
217	A moving mode-iii crack in functionally graded piezoelectric material: permeable problem	Jin B. Zhong Z.
225	Dynamic stress intensity factors around two rectangular cracks in an infinite elastic plate under impact load	Itou S.
235	Mean stress in a granular medium in dynamics	Fortin J. Millet O. de Saxce G.
241	A simple anisotropic clay plasticity model	Dafafias YF. Manzari MT. Akaishi M.
247	The influence of pre-loading and thermal recovery on the viscoelastic response of filled elastomers	Drozdov AD. Dorfmann A.
257	Direct calculation of agma geometry factor j by making use of polynomial equations	Arikan MAS.
269	Elastic-plastic stresses in linearly hardening rotating solid disks of variable thickness	Orcan Y. Eraslan AN.

Medical Engineering & Physics 24(6) 2002

375	The science behind mobility devices for individuals with multiple sclerosis [review]	Fay BT. Boninger ML.
385	Application of simulated annealing for estimating baeps in endocochlear pathologies	Nait-Ali A. Siarry P.
393	Numerical investigation of the haemodynamics at a patched arterial bypass anastomosis	Cole JS. Watterson JK. O'Reilly MJG.
403	Comparison of performance of spherical and realistic head models in dipole localization from noisy eeg	Vanrumste B. Van Hoey G. Van de Walle R. D'Have MRP. Lemahieu IA. Boon PAJM.
419	A computer system for acoustic analysis of pathological voices and laryngeal diseases screening	Hadjitodorov S. Mitev P.
431	Arthroscopic assessment of human cartilage stiffness of the femoral condyles and the patella with a new tactile sensor	Uchio Y. Ochi M. Adachi N. Kawasaki K. Iwasa J.
437	Handling missing marker coordinates in 3d analysis	Desjardins P. Plamondon A. Nadeau S. Delisle A.
441	Evaluation of wheelchair sling seat and sling back crashworthiness	Ha D. Bertocci G. Karg P. Deemer E.

Nonlinear Dynamics 29(1-4) 2002

3	A predictor-corrector approach for the numerical solution of fractional differential equations	Diethelm K. Ford NJ. Freed AD.
23	Markovian diffusive representation of nonrational distributed random processes and application to turbulence simulation over structures	Mouyon P. Imbert N. Montseny G.
37	Finite element formulation of viscoelastic constitutive equations using fractional time derivatives	Schmidt A. Gaul L.
57	Variable order and distributed order fractional operators	Lorenzo CF. Hartley TT.
99	Fractional calculus via functional calculus: theory and applications	Kempfle S. Schafer I. Beyer H.
129	Time fractional diffusion: a discrete random walk approach	Gorenflo R. Mainardi F. Moretti D. Paradisi P.
145	Solution for a fractional diffusion-wave equation defined in a bounded domain	Agrawal OP.
157	The fractional fourier transform and harmonic oscillation	Kutay MA. Ozaktas HM.
173	Fractional discrete-time signal processing: scale conversion and linear prediction	Ortigueira MD. Matos CJC. Piedade MS.
191	Analytical stability bound for a class of delayed fractional-order dynamic systems	Chen YQ. Moore KL.
201	Dynamics and control of initialized fractional-order systems	Hartley TT. Lorenzo CF.
235	Describing function analysis of systems with impacts and backlash	Barbosa RS. Machado JAT.
251	A suggestion of fractional-order controller for flexible spacecraft attitude control	Manabe S.
269	Using fractional order adjustment rules and fractional order reference models in model-reference adaptive control	Vinagre BM. Petras I. Podlubny I. Chen YQ.
281	Analogue realizations of fractional-order controllers	Podlubny I. Petras I. Vinagre BM. O'Leary P. Dorcak L.
297	Fractional motion control: application to an xy cutting table	Orsoni B. Melchior P. Oustaloup A. Badie T. Robin G.
315	Chaotic phenomena and fractional-order dynamics in the trajectory control of redundant manipulators	Duarte FBM. Machado JAT.
343	Fractional differentiation in passive vibration control	Moreau X. Ramus-Serment C. Oustaloup A.
363	Crone control: principles and extension to time-variant plants with asymptotically constant coefficients	Sabatier J. Oustaloup A. Iturricha AG. Lanusse P.

Probabilistic Engineering Mechanics 17(3) 2002

219	Estimation of input parameters in complex simulation using a gaussian process metamodel	Park JS. Jeon J.
227	Reliability analysis of a mechanical contact between deformable solids	Moro T. El Hami A. El Moudni A.
233	Analysis of structures subjected to random wind loading by simulation in the frequency domain	Ambrosini RD. Riera JD. Danesi RF.
241	Predicting response spectra for earthquake signals generated as filtered noise	Kjell G.
253	Non-gaussian simulation using hermite polynomial expansion: convergences and algorithms	Puig B. Poiron F. Soize C.
265	Spectral density estimation of stochastic vector processes	Yuen KV. Katafygiotis LS. Beck JL.
273	The truncated hausdorff moment problem solved by using kernel density functions	Athanassoulis GA. Gavriliadis PN.
293	Implementation of karhunen-loeve expansion for simulation using a wavelet-galerkin scheme	Phoon KK. Huang SP. Quek ST.
305	Reliability analysis of chloride penetration in saturated concrete	Kong JS. Ababneh AN. Frangopol DM. Xi YP.

Proceedings of the Royal Society of London Series A-Mathematical Physical & Engineering Sciences 458(2024) 2002

1783	Discotic liquid crystals as quasi-one-dimensional electrical conductors	Chandrasekhar S. Balagurusamy VSK.
1795	Structure and stability of weak-heat-release detonations for finite mach numbers	Short M. Blythe PA.
1809	The maxwell-vlasov system for an exact field on a curved space-time	Noutchegueme N. Njabo SBT.
1825	Eulair: a novel finite-element-based cartesian grid euler flow solver that does not require cut-cell geometric information at solid boundaries	Venkatasubban CS.
1845	Null-space construction using cofactors from a screw-algebra context	Dai JS. Jones JR.
1867	Mixing in the stokes flow in a cylindrical container	Malyuga VS. Meleshko VV. Speetjens MFM. Clercx HJH. van Heijst GJF.
1887	Elastic waves and homogenization in oblique periodic structures	Zalipaev VV. Movchan AB. Poulton CG. McPhedran RC.
1913	Lamb wave propagation in inhomogeneous elastic waveguides	Pagneux V. Maurel A.
1931	On green's function for a three-dimensional exponentially graded elastic solid	Martin PA. Richardson JD. Gray LJ. Berger JR.
1949	Curve squeal of train wheels: unstable modes and limit cycles	Heckl MA.
1967	Discrete fourier transforms and their application to stress-strain problems in composite mechanics: a convergence study	Brown CM. Dreyer W. Muller WH.

1989	Stability chart for the delayed mathieu equation	Insperger T. Stepan G.
1999	Shock-induced brittle failure of boron carbide	Bourne NK.
2007	A slender-body theory in oseen flow	Chadwick E.
2017	Isotropic probabilistic models for directions, planes and referential systems	Xu PL.

Proceedings of the Royal Society of London Series A-Mathematical Physical & Engineering Sciences 458(2025) 2002

2039	Time-dependent geometrical changes in a ceramic ink droplet	Tay BY. Edirisinghe MJ.
2053	Sea waves and mass transport on a sloping beach	Blondeaux P. Brocchini M. Vittori G.
2083	Object conjugate reconstruction (ocr): a step forward in holographic metrology	Barnhart DH. Halliwell NA. Coupland JM.
2099	Equivalence between the fundamental equations of elasticity and conductivity in a magnetic field	Skal AS.
2119	The suppression of an exothermic branched-chain flame through endothermic reaction and radical scavenging	Gray BF. Kalliadasis S. Lazarovici A. Macaskill C. Merkin JH. Scott SK.
2139	Some general periodic solutions for optical cascading	Porubov AV. Parker DF.
2153	Thermodynamically consistent modelling of abrasive granular materials. i - non-equilibrium theory	Kirchner NP.
2177	Long-wave forcing by the breaking of random gravity waves on a beach	Baldock TE. Huntley DA.
2203	The stability of limit-cycle oscillations in a nonlinear aeroelastic system	Trickey ST. Virgin LN. Dowell EH.
2227	Quasi-static studies of the deformation and failure of pbx 9501	Rae PJ. Palmer SJP. Goldrein HT. Field JE. Lewis AL.
2243	Shear-band development in polycrystalline metal with strength-differential effect and plastic volume expansion	Kuroda M. Kuwabara T.
2261	Liesegang pattern development in carbonating traditional lime mortars	Rodriguez-Navarro C. Cazalla O. Elert K. Sebastian E.
2275	From circle packing to covering on a sphere with antipodal constraints	Fowler PW. Tarnai T. Gaspar Z.
2289	The chronology of funafuti atoll: revisiting an old friend	Ohde S. Greaves M. Masuzawa T. Buckley HA. Van Woesik R. Wilson PA. Pirazzoli PA. Elderfield H.

Quarterly Journal of Mechanics & Applied Mathematics 55(Part 3) 2002

327	Stability of rotating liquid films	Gomes DA.
345	Long-wave vibrations of a nearly incompressible isotropic plate with fixed faces	Kaplunov JD. Nolde EV.
357	On the critical solutions in coating and rimming flow on a uniformly rotating horizontal cylinder	Wilson SK. Hunt R. Duffy BR.
385	A slender rivulet of a power-law fluid driven by either gravity or a constant shear stress at the free surface	Wilson SK. Duffy BR. Hunt R.
409	Asymptotic and numerical solutions for a hammocking model	O'Brien SBG. Casey V.
421	Radiation conditions for rough surfaces in linear elasticity	Charalambopoulos A. Gintides D. Kiriaki K.
443	Convective plume paths from a line source	Rees DAS. Storesletten L.
457	The fundamental differential form and boundary-value problems	Fokas AS. Zyskin M.
481	On the existence of embedded surface waves along arrays of parallel plates	Evans DV. Porter R.

Quarterly of Applied Mathematics 60(3) 2002

401	Existence of weak solutions to the elastic string equations in three dimensions	Reiff AM.
425	Sufficient condition for the existence of solutions of a free boundary problem	Hayouni M. Novruzi A.
437	Shock reflection for the damped p-system	Hsiao L. Li HL.
461	Viscosity solutions for dynamic problems with slip-rate dependent friction	Ionescu IR.
477	Global attractivity in an rbc survival model of wazewska and lasota	Li JW. Cheng SS.
485	A modified ginzburg-landau model for josephson junctions in a ring	Hill E. Rubinstein J. Sternberg P.
505	Qualitative analysis on a chemotactic diffusion model for two species competing for a limited resource	Wang XF. Wu YP.
533	Large-time stability of travelling waves for a class of fully nonlinear parabolic equations	Camilli F. Molinari M.
547	L-2-regularity theory of linear strongly elliptic dirichlet systems of order 2m with minimal regularity in the coefficients	Ebenfeld S.
577	Subsonic lamb waves in anisotropic plates	Kuznetsov SV.
589	Accurate calculation of prolate spheroidal radial functions of the first kind and their first derivatives	Van Buren AL. Boisvert JE.

Rheologica Acta 41(5) 2002

383	Rheology of poly(methyl methacrylate-co-styrene) particles suspended in water: effects of electrostatic surface layer	Horigome M. Yada M. Watanabe H.
394	Dynamic melt flow of nanocomposites based on poly-epsilon-caprolactam	Utracki LA. Lyngaae-Jorgensen J.
408	Effect of polymer bridging on rheological properties of dispersions of charged silica particles in the presence of low-molecular-weight physically adsorbed poly(ethylene oxide)	Zaman AA. Delorme N.
418	Bidisperse polymeric mixtures for independent control of viscosity and elasticity	Velankar S. Moldenaers P.
427	Nonlinear convective stability problems of viscoelastic fluids in finite domains	Park HM. Ryu DH.
441	Rheology of milled black cumin (nigella sativa l.)	Abu-Jdayil B.
448	Development of a double-beam rheo-optical analyzer for full tensor measurement of optical anisotropy in complex fluid flow	Takahashi T. Shirakashi M. Miyamoto K. Fuller GG.
456	An innovative extensional viscometer for low-viscosity and low-elasticity liquids	Agarwal S. Gupta KK.
461	Bounds for interpolating complex effective moduli of viscoelastic materials from measured data	Eyre DJ. Milton GW. Lakes RS.
471	Harmonic analysis in rheological property measurement	Karis TE. Seymour CM. Kono RN. Jhon MS.
475	An in situ rheological and sans investigation of the crosslinking reaction of polyisoprene and dicumyl peroxide	Botti A. Pyckhout-Hintzen W. Richter D. Straube E.

SIAM Journal on Applied Mathematics 62(6) 2002

1837	Hidden invariances in problems of two-dimensional and three-dimensional wall jets for newtonian and non-newtonian fluids	Krechetnikov R. Lipatov I.
1856	Wkb method with repeated roots and its application to the buckling analysis of an everted cylindrical tube	Fu YB. Pour MS.
1872	Exponential asymptotics and capillary waves	Chapman SJ. Vanden-Broeck JM.
1899	Models for solidification and splashing in laser percussion drilling	Smith WR.
1924	The dynamics of multispike solutions to the one-dimensional gierer-meinhardt model	Iron D. Ward MJ.
1952	Asymptotic solutions of a phase-field model or alloy solidification	Clemons CB. Hariharan SI. Young GW.
1980	Occupancy numbers in testing random number generators	Figotin A. Gordon A. Molchanov S. Quinn J. Stavrakas N.
2012	Theoretically exact filtered backprojection-type inversion algorithm for spiral ct	Katsevich A.
2027	Saint-venant's principle for antiplane shear deformations of linear piezoelectric materials	Borrelli A. Horgan CO. Patria MC.
2045	The thickness of a marangoni-driven thin liquid film emerging from a meniscus	Munch A.
2064	Can mixing materials make electromagnetic signals travel faster?	Solna K. Milton GW.
2092	Frechet derivatives for some bilinear inverse problems	Dierkes T. Dorn O. Natterer F. Palamodov V. Sielschott H.
2114	On the existence of two-dimensional, localized, rotating, self-similar vortical structures	Rossi LF. Graham-Eagle J.
2129	Boundary-integral calculations of two-dimensional electromagnetic scattering in infinite photonic crystal slabs: channel defects and resonances	Haider MA. Shipman SP. Venakides S.
2149	Parameter identification for semiconductor diodes by lbic imaging	Fang WF. Ito K. Redfern DA.
2175	Combustion fronts in porous media	Da Mota J. Dantas W. Marchesin D.

Structural & Multidisciplinary Optimization 23(5) 2002

331	Wolfram stadler 4.7.1937 20.10.2001 - obituary	Rozvany GIN.
336	Simultaneous topology optimization of structure and supports	Buhl T.
347	Multi-fidelity design of stiffened composite panel with a crack	Vitali R. Haftka RT. Sankar BV.
357	Multiobjective robust design using physical programming	Messac A. Ismail-Yahaya A.
372	Topology design based on transferred and potential transferred forces	Harasaki H. Arora JS.
382	Structural optimization of forest machines with hybridized nonsmooth and global methods	Auvinen P. Makela MM. Makinen J.
390	Use of structural dynamic and fatigue sensitivity derivatives in an automotive design optimization	Zeiler TA.
398	On nonunique solutions in topology optimization	Kutylowski R.
404	Optimum load and resistance factor design of steel space frames using genetic algorithm (vol 21, pg 292, 2001)	Hayalioglu MS.

Structural & Multidisciplinary Optimization 23(6) 2002

405	Stochastic optimization of acoustic response - a numerical and experimental comparison	Tinnsten M. Carlsson P. Jonsson M.
412	Development of visual design steering as an aid in large-scale multidisciplinary design optimization. part i: method development	Winer EH. Bloebaum CL.
425	Development of visual design steering as an aid in large-scale multidisciplinary design optimization. part ii: method validation	Winer EH. Bloebaum CL.
436	Multicriterion optimization of composite laminates for maximum failure margins with an interactive descent algorithm	Kere P. Koski J.
448	Optimized structural sandwich panels with minimum delamination hazards	Hohe J. Becker W.
460	Decision criteria in dual response	Ross DL. Osborne DM. George JH.
467	Truss topology optimization by a modified genetic algorithm	Kawamura H. Ohmori H. Kito N.

Structural & Multidisciplinary Optimization 24(1) 2002

1	Hierarchical optimization of material and structure	Rodrigues H. Guedes JM. Bendsoe MP.
11	Optimization of nuclear fuel reloading by the homogenization method	Allaire G. Castro C.
23	A sensitivity analysis method for linear and nonlinear transient heat conduction with precise time integration	Gu YX. Chen BS. Zhang HW. Grandhi R.
38	Robust airfoil optimization to achieve drag reduction over a range of mach numbers	Li W. Huyse L. Padula S.
51	Efficient optimization of a noise transfer function by modification of a shell structure geometry - part i: theory	Marburg S.
60	Efficient optimization of a noise transfer function by modification of a shell structure geometry - part ii: application to a vehicle dashboard	Marburg S. Hardtke HJ.
72	An optimization technique for the solution of the signorini problem using the boundary element method	Leontiev A. Huacasi W. Herskovits J.
78	Developing genetic programming techniques for the design of compliant mechanisms	Parsons R. Canfield SL.

Studies in Applied Mathematics 109(1) 2002

1	High-order interaction of solitary waves on shallow water	Marchant TR.
19	Singularly perturbed vector and scalar nonlinear schrodinger equations with persistent homoclinic orbits	Li YG.
39	Isothermic surfaces generated via backlund and moutard transformations: boomeron and zoomeron connections	Degasperis A. Rogers C. Schief WK.

Studies in Applied Mathematics 109(2) 2002

67	Envelope solitary waves and periodic waves in the ab equations	Tan BK. Boyd JP.
89	Reciprocal figures, graphical statics, and inversive geometry of the schwarzian bkp hierarchy	Konopelchenko BG. Schief WK.
125	Low mach number limit of viscous polytropic flows: formal asymptotics in the periodic case	Bresch D. Desjardins B. Grenier E. Lin CK.

Theoretical & Applied Fracture Mechanics 38(1) 2002

1	A field model interpretation of crack initiation and growth behavior in ferroelectric ceramics: change of poling direction and boundary condition	Sih GC.
15	Damage analysis of tetragonal perovskite structure ceramics implicated by asymptotic field solutions and boundary conditions	Sih GC. Song ZF.
37	Strain energy density prediction of fatigue crack growth from hole of aging aircraft structures	Zuo JZ. Kermanidis AT. Pantelakis SG.
53	Influence of surface effects on fatigue of microcracks nucleation	Sauzay M. Gilormini P.
63	Damage model of elastic rubber particulate composites	Garishin OC. Moshev VV.
71	Surface protection for aa8090 aluminum alloy by diffusion bonding	Wu YW. Lo YL.
81	Modeling of voids/cracks and their interactions	Yang CH. Soh AK.
103	Buckling and cracking characteristics of two-layered plate in tension	Guz AN. Dyshel MS.

Thin-Walled Structures 40(7-8) 2002

555	Plates and shells: mechanics and applications	Zingoni A.
557	Vibration of cross-ply laminated composite plates subjected to initial in-plane stresses	Matsunaga H.
573	Free vibrations of simply-supported piezoelectric adaptive plates: an exact sandwich formulation	Benjeddou A. Deu JF. Letombe S.
595	Contact based delamination and fracture analysis of composites	Mohammadi S. Forouzan-sepehr S. Asadollahi A.
611	Green's functions for the bending of thin plates under various boundary conditions and applications: a review	Hasebe N. Wang X.
625	A new stiffened plate element for the analysis of arbitrary plates	Barik M. Mukhopadhyay M.
641	Recent advances in local-global fe analysis of shells of revolution	Gould PL. Hara T.
651	Large-scale cooling towers as part of an efficient and cleaner energy generating technology	Harte R. Kratzig WB.
665	Dynamics of axisymmetric hyperbolic shell structures	Nasir AM. Thambiratnam DP. Butler D. Austin P.
691	Parametric stress distribution in shell-of-revolution sludge digesters of parabolic ogival form	Zingoni A.
703	Numerical analysis for environmental effects in circular tanks	Melerski ES.

Thin-Walled Structures 40(9) 2002

729	Future directions and challenges in shell stability analysis [review]	Arbocz J. Starnes JH.
755	First-order generalised beam theory for arbitrary orthotropic materials	Silvestre N. Camotim D.
791	Second-order generalised beam theory for arbitrary orthotropic materials	Silvestre N. Camotim D.

Thin-Walled Structures 40(10) 2002

815	Plastic mechanism analysis of concrete-filled double-skin (shs inner and shs outer) stub columns	Zhao XL. Han BK. Grzebieta RH.
835	The effects of patch loads on thin-walled steel silos	Gillie M. Rotter JM.
853	Buckling behavior of cold-formed zed-purlins partially restrained by steel sheeting	Ye ZM. Kettle RJ. Li LY. Schafer BW.
865	Shell element of relative degree of freedom and its application on buckling analysis of thin-walled structures	Li JZ. Hung KC. Cen ZZ.
877	Discontinuity effects at cone-cone axisymmetric shell junctions	Zingoni A.
893	Stability of circular cylindrical steel shells under combined loading	Winterstetter TA. Schmidt H.

Wave Motion 36(3) 2002

203	On alfven waves convected by a radial flow in a non-uniform magnetic field	Campos LMBC. Gil PJS.
221	A two-dimensional, depth-integrated model for internal wave propagation over variable bathymetry	Lynett PJ. Liu PLF.
241	Semi-stability of embedded solitons in the general fifth-order kdv equation	Tan Y. Yang JK. Pelinovsky DE.
257	Some properties of surface acoustic waves in anisotropic-coated solids, studied by the impedance method	Shuvalov AL. Every AG.
275	Waves in approximately constrained materials and applications to fiber-reinforced composites	Bortoloni L. Pastrone F.
287	Long wave asymptotic integration of the governing equations for a pre-stressed incompressible elastic layer with fixed faces	Nolde EV. Rogerson GA.
305	On the theory of plane inhomogeneous waves in anisotropic elastic media (vol 34, pg 401, 2001)	Shuvalov AL.

Zeitschrift fur Angewandte Mathematik und Mechanik 82(8) 2002

507	Creep analysis of thin-walled structures	Altenbach H.
535	The derivative with respect to a tensor: some theoretical aspects and applications	Itskov M.
545	On the effects of spinline cooling and surface tension in fiber spinning	Hagen T.
559	Convergent iterative schemes for a non-isentropic hydrodynamic model for semiconductors	Amster P. Pinnau R.
567	Nonlinear instability of cylindrical interface with mass and heat transfer in magnetic fluids	Lee DS.

Zeitschrift fur Angewandte Mathematik und Physik 53(4) 2002

539	Parametric dependence of phase boundary solution to model kinetic equations	Kazmierczak B. Piechor K.
569	Laminar assisting mixed convection heat transfer from a vertical isothermal cylinder to water with variable physical properties	Pantokratoras A.
584	The analogue of the eshelby tensor for a piezoelectric spheroidal inclusion in the hexagonal electroelastic medium	Kuhn R. Michelitsch T. Levin VM. Vakulenko AA.
603	A consistent model for adhesion: the case of the rod	Naili S. Yasmineh S.
621	Integral solutions of boundary value problems with non-standard boundary conditions in a theory of bending of elastic plates	Schiavone P. Ru CQ.
634	Ansatz solutions to the cauchy initial value problem of the nonlinear particle transport theory	Boffi VC. Dukek G. Nonnenmacher TF.
650	Threshold results for semilinear parabolic equations	Wang MX. Gu YG.
661	Stationary solution of the navier-stokes equations in a 2d bounded domain for incompressible flow with discontinuous density	Santos MM.
676	Differential equations, hysteresis, and time delay	Kopfova J. Kopf T.
692	Landesman-lazer conditions for sturm-liouville bvps with generalized fucik types of resonant points of asymptotically positively homogeneous equations	Dong YJ.
704	Boundedness of the temperature for the general fremond model for shape memory alloys	Stefanelli U.