mechanics

Academia Americana de Mecánica • American Academy of Mechanics

Volume 32, Number 1-2 — January-February 2003

(references in the form "M28(3-4)" indicate the last time the Journal was cited in *mechanics:* v. **28**, n. 3-4, in this case.)

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.

mechanics (ISSN 0076-5783) **POSTMASTER:** Send address changes to *mechanics*, Subscription and Membership, ESM, MC 0219, Virginia Tech, Blacksburg, VA 24061 (Tel. 540-231-6871: Fax 540-231-2290). Editorial and Advertising: Horacio D. Espinosa, Northwestern University, 2145 Sheridan Rd., Evanston, IL 60208-3111 (Tel. 847-467-5989, Fax 847-491-3915). Membership in the American Academy of Mechanics includes the subscription to *mechanics*.

American Academy of Mechanics
Academia Americana de Mecánica

MESSAGE FROM THE PRESIDENT

Dear Members of the American Academy of Mechanics,

First, I want to congratulate Professor Horacio Espinosa of Northwestern University for receiving the Academy's Junior Award. His research activities as well as editorship of *MECHANICS* are outstanding.

Secondly, I want to congratulate our four newest Fellows of the Academy: Robert Brodkey of Ohio State, Ken Chong of the National Science Foundation, Giulio Maier of Milan Polytechnic, and Robert McMeeking of the University of California, Santa Barbara.

Third, I want to extend my best wishes to Professor Subhendu Datta of the University of Colorado, Boulder, who has succeeded me as the Secretary to the Fellows.

Looking ahead, I want to mention these upcoming meetings involving the Academy:

- AAM spring meeting in Scottsdale, AZ, in connection with the ASME Mechanics and Materials Conference, June 17-20, 2003
- AAM fall meeting in Washington, DC, in connection with the ASME International Mechanical Engineering Congress and Exhibition, November 16-21, 2003
- The 8th Pan American Congress of Applied Mechanics (PACAM VIII)) in Havana, Cuba, January 5-9, 2004

Sincerely,

Charles W. Bert
President

VISIT the AAM Website

at http://www.AAMech.org

AWARDS

The 2002 American Academy of Mechanics Junior Award Recipient:

Horacio D. Espinosa, Associate Professor of Mechanical Engineering, Northwestern University, received the AAM Junior Award, November 20, 2002, during the Applied Mechanics Banquet at the ASME International Mechanical Engineering Congress and Exposition in New Orleans, Louisiana. The award is given to recognize excellence in research during the first decade of the professional career.

Professor Espinosa has made important contributions in the area of wave propagation plate impact soft-recovery experiments and numerical simulations of damage and failure of brittle materials and fiber composites. He has developed a novel microcracking multiple-plane model that he recently integrated to a granular model to simulate dynamic failure of multi-layered ceramics. This has always been a very difficult problem because it involves modeling the transition from intact to pulverized ceramics, large deformation rate dependent plasticity, mesh adaptivity, multi-body contact including frictional effects and thermo-mechanical coupling. Other contributions from Professor Espinosa are in the area of composite materials. He developed a three-dimensional anisotropic elasto-visco-plastic model together with cohesive laws to capture intersonic crack propagation in unidirectional fiber composites. Professor Espinosa has also developed a variety of experimental techniques. Among them can be mentioned: novel wave propagation soft-recovery experiments, as well as dynamic friction, high temperature and dynamic fracture experiments. Recently, he designed and implemented a novel test for mechanical testing of freestanding thin films and microelectromechanical system (MEMS). Using this technique, he identified strong plasticity size effects, *in the absence of strain gradients*, in submicron gold, aluminum and copper films. These findings will have an important impact in the design of microelectronic and MEMS devices.

Two projects he is working on in emerging areas are: i) reliability of MEMS and NEMS-Radio Frequency switches for condition monitoring of airplane structures, and ii) design of a massively parallel multi-probe system for the fabrication of genomic chips. The MEMS/NEMS effort is an activity of the Center for Quality Engineering and Failure Prevention directed by Jan Achenbach. The genome chip project is an activity within the NSF-Nanoscience and Engineering Center at Northwestern University directed by Chad Mirkin.

Professor Espinosa received his degree in Civil Engineering from Universidad Nacional del Nordeste, Argentina, in 1981, his M.Sc. in Structural Engineering from Politecnico di Milano, Italy, in 1987, and his M.Sc. in Applied Mathematics and Ph.D. in Applied Mechanics from Brown University, in 1991 and 1992, respectively. Professor Espinosa was the recipient of two young investigator awards, NSF-Career and ONR-YIP, and co-PI of a multi-disciplinary research award (MURI) on Lightweight Armor Materials from ARO. He is also an Associate Editor of *Experimental Mechanics*, Guest Editor of three special journal volumes in Micro and Nanomechanics, Editor of *Mechanics*, and a Fellow of the American Academy of Mechanics.

BIOGRAPHICAL SKETCHES OF THE AMERICAN ACADEMY OF MECHANICS FELLOWS ELECTED IN NOVEMBER 2002

Professor Robert S. Brodkey is a Professor Emeritus in the Department of Chemical Engineering at The Ohio State University, where he has been on the faculty since 1957. Previously, he spent five years with Standard Oil of New Jersey at their Esso Research and Engineering facility.

He received his B.S. degree in chemistry and M.S. degree in chemical engineering from the University of California, Berkeley, and his Ph.D. degree in chemical engineering from the University of Wisconsin.

His research has been in the field of fluid mechanics with specialization in the areas of fundamental turbulent fluid flow, mixing, rheology, two-phase flow, and imaging for flow measurements. He is well known for his graduate and undergraduate texts, The Phenomena of Fluid Motions, and Transport Phenomena: A Unified Approach (with H.C. Hershey), respectively. Professor Brodkey has received awards in the U.S., Canada, Germany, and Japan. He is a fellow of AAAS, AIChE, American Institute of Chemists, and American Physical Society. The citation for his American Academy of Mechanics Fellow Award is "for pioneering research on the existence of coherent structures in turbulence using imaginative visualization techniques".

Professor Ken P. Chong is the Director of Mechanics and Materials at the National Science Foundation, a position he has held since 1999. For the ten preceding years he was Director of Structural Systems at NSF. Prior to joining NSF, he was a Professor and chairman of the Structures / Solid Mechanics Group at the University of Wyoming, and Sr. Project Engineer of R&D at National Steel Corp.

He received his BS degree from National Cheng Kung University in Taiwan, an MS degree in structures from University of Massachusetts, and MSE and PhD degrees in Engineering Mechanics from Princeton University.

Dr. Chong's research includes pioneering analysis and development of sandwich panels with cold-formed steel facings and foam cores. He has also developed new semi-circular fracture specimens for core-based brittle materials and conducted research on hybrid girders. Dr.Chong has been active in numerous technical society committees, such as chairing the ASCE Stability Committee and serving as Associate Editor of the ASCE Journal of Engineering Mechanics. Since 1987, he has edited the Journal of Thin-Walled Structures. He has edited or authored ten monographs, including the widely used elasticity text co-authored with Professor Art Boresi, Elasticity in Engineering Mechanics, which is now in its second edition. He has received numerous awards for his teaching such as the Dow and Halliburton awards and for his research leadership such as the Friedman Professional Recognition Award and the NSF Special Achievement Award. The citation for his American Academy of Mechanics Fellow Award is "for contributions to brittle fracture mechanics, tennis-racket sweet spots, composite panels, and leadership in supporting mechanics research".

Professor Giulio Maier is a Professor of Structural Engineering at the Technical University (Politecnico) of Milan, Italy, where he has been on the faculty since 1965. Prior to then, he was on the faculty at the University of Trieste, Italy.

He received his “Laurea” (M.S.) degree in mechanical engineering from the University of Trieste and his “Specializzazione” (Ph.D.) degree in aeronautical engineering from the University of Rome.

His research has been very broad, including solid mechanics aspects of both mechanical as well as structural engineering. For example, in the 1960s, he was the first to analyze structural instabilities and path bifurcations due to softening damage or nonassociated plastic flow, and at the same time, he was well known for his pioneering research in tension structures. He has been one of the most influential academics in Europe. He was the co-founder of the European Journal of Mechanics: Solids. He has served as consultant to industry for such major projects as the tension structure of the Genoa Sports Palace, the Transmediterranean Pipeline, the Messina Straits Submarine Tunnel, simulations of explosions, ductile fracture, and soil-structure interactions. He has received many awards from Belgium, China, Hungary, Italy, Poland, Russia, South Africa, and the U.S.

It should be noted that although Professor Maier does not reside in the Americas, has spent considerable time in the U.S. collaborating with U.S. researchers, attending conferences, and giving lectures. He has been a Corresponding Member of the American Academy of Mechanics and thus eligible for nomination and election to Fellow. The citation for his AAM Fellow Award is “for contributions to plastic shakedown, softening damage, fracture, structural optimization and identification, and boundary elements”.

Professor Robert M. McMeeking is Professor, Department of Mechanical and Environmental Engineering and Department of Materials at the University of California, Santa Barbara, where he has been on the faculty since 1985. Previously he was on the faculty in the Department of Theoretical and Applied Mechanics of the University of Illinois at Urbana-Champaign. He received his B.Sc. degree (with 1st class Honors) in mechanical engineering from the University of Glasgow, Scotland. His M.S. and Ph.D. degrees, both in Solid Mechanics, are from Brown University.

Professor McMeeking’s research has been very wide reaching, including plasticity, fracture mechanics, computational mechanics, glaciology, tough ceramics, composite materials, powder consolidation and sintering, ferroelectrics, structural evolution, and nanotribology.

Professor McMeeking has been honored as a visiting scholar at Cambridge University twice. He has been a lecturer in both the Midwest Mechanics Series and the Southwest Mechanics Series. He is a Fellow of the American Society of Mechanical Engineers. He serves on the editorial boards of several journals in the fields of solid mechanics and materials, and is the incoming Technical Editor to lead the ASME Journal of Applied Mechanics. He was recently recognized by the Institute for Scientific Information as a Highly Cited Researcher in the fields of Materials Science and Engineering. The citation for his American Academy of Mechanics Fellow Award is “for mechanics contributions to elastic-plastic fracture, tough ceramics, powder consolidation, composites, and ferroelectrics”.

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

SELECTIONS OF THE EDITOR

EDUCATION FOR THE PROFESSION FORMERLY KNOWN AS ENGINEERING

Reprinted with permission from MIT Press

By Rosalind Williams

Rosalind Williams is director of the Massachusetts Institute of Technology's program in science, technology, and society. This article is adapted from RETOOLING: A HISTORIAN CONFRONTS TECHNOLOGICAL CHANGE (MIT Press, 2002, http://mitpress.mit.edu/0262232235) and originally appeared in The Chronicle Review, Volume 49, Issue 20, Page B12.

Engineering is undergoing an identity crisis. The mission of engineering changes when its dominant problems no longer involve the conquest of nature but the creation and management of a self-made habitat. To adapt to this new habitat, engineers have to retool, starting with their understanding of engineering education. Today, technological change is something that happens to engineers as much as to anyone else.

For most of the 20th century, engineering faculty members assumed that industrial practice depended on students' understanding of science's "fundamentals": the laws of motion, the conservation of energy, the atomic structure of matter, electromagnetics, the rules of chemical action, fluid dynamics, and the like.

In the 1950s, for example, the department of aeronautics and astronautics at the Massachusetts Institute of Technology portrayed its curriculum as a tree with the basic sciences (math, physics, chemistry) as the deep roots, the applied sciences (fluid mechanics, thermodynamics) as the shallow root system, the engineering sciences (vehicle dynamics, flight control) as branches, and vehicle system engineering at the top.

Today that model is rapidly being displaced by the much more complex interactions of "technoscience" -- a constant process of interaction in interdisciplinary projects where the projects, not the disciplines, define the terms of engagement. In part that is because the science that is now most dynamic -- biology -- does not rest on first principles in the way that physics and chemistry do. More generally, the relationship between science and engineering is no longer summarized in a set of reliable equations; it now includes all the complexities of evolving life forms.

Participants in technoscience enter what the historian of science Peter L. Galison has called a "trading zone, an intermediate domain where procedures could be coordinated locally even where broader meanings clashed." In science, the fundamental unit of accomplishment remains the discovery; in engineering, the fundamental unit of accomplishment is problem solving. Yet in the trading zone of technoscience, engineers and scientists invent ways of communicating through instruments, habits, and words to coordinate a project even though they come from different professional cultures. The vitality of trading zones, technoscientific or otherwise, lies in breaking down boundaries, keeping things mixed up, developing a lot of interfaces, going with the flow.

The flow goes both ways. In the trading zone of biology and engineering, for example, biological research generates a constant stream of projects that engage engineers, especially mechanical and chemical engineers. At the same time, biologists think more and more like engineers as they probe systems and mechanisms, worry about quality control, and construct large technical systems. The best of them often bring specialized technical knowledge to their biological research.

A major factor in the success of this trading zone -- and more generally a major factor in the rise of technoscientific mixes -- is the role of information technology in providing a common, readily transferable language. Most engineering departments are becoming, to a greater or lesser extent, departments of applied-information technology. In the form of a common digital language, technology dissolves the familiar boundaries of engineering. It also lifts engineering, once the most down-to-earth of professions, from its familiar ground of materiality, endowing it with a ghostly lightness of being.

Fewer faculty members in engineering actually make things or build things; more work with symbols and models. In a sense they are still working with machines, of course, but the meanings of both engineering and machinery are redefined when the machines process information rather than matter. To see the evidence one need only survey the internal redefinitions of MIT's engineering departments. Today many members of the civil engineering faculty design not structures but software systems to manage construction. Similarly, in mechanical engineering, many faculty members are using electronics and computers to assume functions previously performed by conventional mechanical systems.

One side of engineering diffuses into the microscopic world of biology, another into the ethereal realm of cyberspace. Engineers always thought of themselves as doers; now some are logicians, sitting in an office all day, writing. Engineering is no longer necessarily applied science. It has developed its own theoretical wing, with practitioners who never actually build things and whose research takes them well beyond the range of common-sense experience.

An equally strong and apparently contradictory trend in engineering is to move engineering education, and to some extent engineering research, back toward the realities of industrial practice. In mature areas of engineering, there is little fundamental science of interest left to explore. In civil engineering, materials like concrete and steel are still essential for construction, but they offer dwindling interest for research.

In this situation, academically based engineers have two choices. Either they can migrate toward areas where the science is more exciting, or they can put new emphasis on non-science-based facets of engineering: how things are designed, how they are manufactured, how organizations work, how innovation is brought to market -- all of which are often lumped together under the label "practice."

The back-to-practice movement could also be called a back-to-the-market movement, in the sense of renewed and direct attention to profitability. In the postwar period, governmental policies shielded huge sectors of engineering practice -- defense contracting, highway construction, communications -- from direct market pressures. Government patronage made academics less tightly linked to industrial concerns and perspectives. Beginning around 1990, government support for research in science and engineering, both in corporations and in universities, began to level off in most areas (biology being the big exception). Since then, university-based engineers have sought to revitalize their links with industry as sources of research support and as employers of their graduates.

Industrial support for engineering research has been strongly market oriented. As government support has flattened, industry has begun to take a more "value-received perspective" in regard to research investments: They have to be justified in terms of the bottom line, and the short-term bottom line at that. Some corporate labs have become mission oriented; some have disappeared. As investment in research has diminished or scattered, consulting has become less important as a bridge between universities and industries. Instead, businesses have found that they can get the benefit of good research ideas by investing in and eventually buying up small companies, which pay more attention to marketability, timeliness, and productivity than university labs. Universities with strong engineering departments, like MIT, have found themselves competing not only with other higher-education institutions but also with start-up companies -- a fair number of which are connected with universities through their founders.

There are two major ways that engineers define getting back to practice. One group of engineers looks to a renewed emphasis on design; the other group advocates a new emphasis on large technological systems. The interesting psychological and sociological differences between these two groups could be summarized as follows: The design advocates identify with entrepreneurs, the systems advocates with managers. Many design advocates, whatever their age, have a sort of Young Turk quality. They challenge what they see as the engineering-science establishment, asserting that they do real engineering by designing and building useful things that actually work. In contrast, advocates of the technological-systems approach tend to be experienced individuals accustomed to working outside their departments or even outside their school. (At MIT, they often collaborate with the Sloan School of Management.)

Both the design movement and the systems engineering movement seek to reclaim a distinctive identity for engineering: to proclaim that here is something engineers do that scientists and businessmen do not do. In the end, however, the reclamation efforts only underscore engineering's loss of identity. In both design and systems work, many people other than engineers are in on the act. In design today, engineering, programming, science, language, and art converge. In dealing with technological systems, it is even more obvious that engineers have to collaborate with political scientists, economists, lawyers, and managers, just for starters. In fact, the constant dilemma for engineers at MIT and other universities is whether to hire these collaborators as faculty members or to try to get other departments and schools to hire them.

The good news is that engineering education is becoming more and more socialized. The bad news is that this is happening almost entirely under the aegis of business. Whatever the official curricular requirements, many engineering students regard economics or management as a de facto requirement. Students are looking for an education that is socially aware in a very pragmatic sense. They are increasingly aware that they need to know how society works, which is not necessarily the same thing as an education that highlights social responsibilities.

As a result, engineering education today is, as we say in the humanities, contested terrain -- a site where different strategic goals collide. Most students want a socially aware (in the practical sense) and technically oriented education. Design advocates and systems advocates want to reorient engineering education away from engineering science, but no one wants to give up the strengths of an engineering-science education. Yet the boundaries between engineering and science keep getting fuzzier as the biological sciences challenge the whole idea of "fundamentals."

The result is a curricular logjam. Everyone concerned with engineering education yearns for dynamite, if only they could agree on where to set the charge. From the faculty's point of view, designing an engineering curriculum is one of the most difficult design problems in engineering today. One faculty member joked that he truly wondered if degree requirements at MIT were a computable function.

Faculty members may laugh, but it is the student who has to cope with the multiplicity of uncoordinated demands.

What engineers are being asked to learn keeps expanding along with the scope and complexity of the hybrid world. Engineering has evolved into an open-ended Profession of Everything in a world where technology shades into science, art, and management, with no strong institutions to define an overarching mission. All the forces that pull engineering in different directions -- toward science, toward the market, toward design, toward systems, toward socialization -- add logs to the curricular jam.

Inevitably the profession formerly known as engineering will multiply into a much wider variety of grades, types, and levels because engagement with technology has far outgrown any one occupation. The future of engineering lies in accepting rather than resisting this multiplicity.

In terms of education, that means that the trend toward cramming more and more into the engineering curriculum runs in exactly the wrong direction. Few students will want to commit themselves to an educational track that is nearly all-consuming. What we now call engineering education should be lowering the threshold for entry, mixing itself with the larger world rather than trying to keep expanding its own world. Students are trying to do this mixing on their own, but in too many cases they are trying to pour new educational wine into old institutional containers.

The most obsolete institutional container is that of the "engineering school." Its raison d'être is to educate students for engineering, defined as a distinctive profession with its own well-defined identity. As this professional identity dissipates in a process of expansive disintegration, engineering schools will have to evolve or else find another mission. The segregation of engineering education served its purpose in the 19th century, by allowing an alternative form of education to develop. Now this segregation defeats the purposes both of engineering education and of higher education, at once marginalizing engineering and depriving the rest of higher education of its benefits. MIT still takes pride in not being Harvard -- but students at the two institutions today are virtually indistinguishable in aptitudes (including verbal and math SAT scores), social background, interests, and ambitions. Harvard, along with a host of other colleges and universities, is vigorously building up its technically oriented education, for which there is huge student demand.

The convergence of technological and liberal-arts education is a deep, long-term, and irreversible trend. Students need to be prepared for life in a world where technological, scientific, humanistic, and social issues are all mixed together. Such mixing will not take place if students have to decide from the outset that they are attending an "engineering school" as opposed to a "nonengineering school." No matter how excellent the engineering school, and no matter how racially and ethnically diverse, if it attracts mainly faculty members and students who gravitate toward the technical problem-solving approach, then those students have an education that does not prepare them well for life experience. Students need to be educated in an environment where they get used to justifying and explaining their approach to solving problems and also to dealing with people who have other ways of defining and solving problems. Only a hybrid educational environment will prepare engineering students for handling technoscientific life in a hybrid world.

MONITORING THE STRUCTURAL CONDITION OF CABLES: EXPERIMENTAL METHODS

by Patricio A. Laura

ABSTRACT

Cables and ropes are among the earliest structural elements used by man in the history of technology. They play a fundamental role in many life-sustaining situations: suspended and cable-stayed bridges, salvage operations, mining engineering, aerial transways, elevators, etc. Other important applications are: towing, remote control, and for the supply of communication or other service links between two vehicles. This paper surveys the techniques which attempt to provide detailed knowledge of the alterations of the structural health of the cable which may be produced by breakage of individual wires, fatigue and/or corrosion.

KEY WORDS. Cables, ropes, bridges, salvage operations, mining engineering, aerial transways, elevators, remote control, towing, wires.

INTRODUCTION

It has become of deep interest for civil engineers to perform non-destructive detection on possible damage in large-scale structures such as cable-suspended and cable stayed bridges, taut leg mooring systems, etc. [1-2].

Obviously, this is due to the fact that visual inspection is practically out of the question on one hand and on the other is not sufficiently reliable and accurate.

Significant effort is placed nowadays on system identification techniques and, certainly, the inherent structural dynamic properties are very important parameters to be used for monitoring structural alterations.

In the case of suspended and cable-stayed bridges one must distinguish between "global" structural properties and "localized" alterations. The breakage of individual wires in a cable will change the dynamic characteristics of the cable itself from a microdynamics viewpoint, but only the failure of a strand or strands will produce considerable changes in the static and dynamic response of the cable and of the global behavior of the bridge.

Certainly one possible way of detection of wire failure is by means of rather sophisticated technologies such as the electromagnetic (EM) method, acoustic emission, and fiber optics. But this is the case, in general, under controlled conditions.

When dealing with ocean engineering applications (towing operations, off - shore platforms, etc.) where mechanical cables are of fundamental importance, the previous considerations possess similar weight. In the case of a towed sonar the mechanical - electrical requirements are coupled during the towing operation.

P. A. A. Laura is Research Scientist and Professor Emeritus of Engineering, Universidad Nacional del Sur, Bahía Blanca, 8000, Argentina. He is also a Fellow of AAM.

An idea of the universality of cables is given by the fact that they are used in the Hidro-Cushion Camel developed at Treasure Island Naval Station in San Francisco, California in 1967. The Hidro-Cushion Camel consists of eight four, three foot water filled cells, grouped into four clusters, sandwiched between two timber rubbing faces and held in place by cables [3]. The water filled cylinders maintain constant pressure during compression upon impacting forces by forcing water out through small orifices in the tops of the cylinders. High energy absorption results from the compression of the cylinders and the resulting fluid dynamics action, bending of the timber faces, and crushing of the timber elements. Synthetic (e.g. kevlar) cables may be used to advantage.

As pointed out by Costello [4] "... a list of the uses of wire rope is almost endless... possible use of wire strands as braces for teeth... wire rope is also being considered in super conductivity applications, etc.".

ABOUT ROPES AND CABLES

Rope, probably made of plaited thongs, is already represented in use in Elam (southwest Asia) in the 4^{th} millenium B.C. Probably more modern is rope made of back fiber used in southeast Asia. On the other hand, cord has probably been used in the Upper Paleolithic period to attach tools to handles conforming knives, axes, etc. Late in the 2^{nd} millennium B.C., cables of considerable diameter are reproduced in bronze as handles of vessels in China [5]. For example, a cable made of copper wires was found in the ruins of Ninive, near Babylon, which was probably manufactured about 700 BC [4].

The first wire rope, made of steel, was fabricated by tying together single strands of straight wire, then grouping and tying several of these units together to form a rope. The performance of this structural element was unsatisfactory [6]. A more successful approach was developed by A. Albert in 1834 and the rope was utilized in a German mine. R. S. Newall obtained a patent in England in 1840 for the first wire-ropemaking machine [6].

However suitable, steel produced in long lengths and with uniform mechanical and chemical properties required for rope wire was possible about 1880 due to the invention of the Bessemer and Siemens-Martin processes for steel-making. It may be useful to recall at this point that a wire rope possesses, in general, three components:

a) wires that form the strand
b) a core and
c) multiwire strands that are helically wrapped around the core.

As stated by Costello [4]

> "... the core may be either wire rope, natural fibers or polypropylene and its main purpose consists of providing adequate support for the strands under normal bending and loading conditions... On the other hand, the strands have a center wire around which the individual metallic wires are wrapped helically. Modern methods require that the strands be permanently shaped into the helical configuration they will assume in the rope. The main property of ropes, yarns, cords, cables and strands is their capability of resist large axial loads as compared with bending or torsional influences".

It is generally agreed that nearly all operating structures require some type of monitoring of their integrity and health conditions to extend their life span or to prevent catastrophic failure. In the case where mechanical cables are used, e.g. suspended or stayed bridges, towing systems, etc., no globally ideal solutions for monitoring their structural condition have been found as of this date in view of the complexity of the dynamic environment and the tremendous length of cables employed. A similar situation takes place in off-shore structures, such as in mining operations.

In view of the fact that the weight of long wire rope catenarys becomes an excessive factor in the design and performance of the system, one modern and optimized solution is to use taut leg mooring systems employing polyester fiber ropes which possess nearly neutral buoyancy and are resistant to corrosion [2]. This solution has been successfully implemented by PETROBRAS, S.A. (Brazil). An important question about this solution is the long-term integrity of these synthetic fiber cables [7]. Consequently, a fundamental problem regarding these fiber ropes is to determine the ways in which they degrade under operating conditions. An outstanding overall research program is already in progress at the University of Reading, U.K. [2]

A short survey of the experimental techniques, which have been developed for non-destructive testing of cables and/or monitoring their condition, is presented in this paper.

EXPERIMENTAL TECHNIQUES FOR NONDESTRUCTIVE TESTING AND STRUCTURAL CONDITION MONITORING OF MECHANICAL CABLES.

The methodologies available are:

Visual Inspection and Measurement of the Cable Diameter

This approach provides a rough but important answer to the problem. Considerable experience is required. Surface flaws can be detected. The methodology must be used in combination with other test procedures, for instance, in connection with the X-rays inspection method.

X - rays

Once a damaged zone has been found, the X-rays approach will allow the determination of broken inner wires, degree of damage suffered by the core, etc.

Induced wave propagation

This technique has been developed by Kwun and Burkhardt [8]. The method uses the propagation properties of a wave induced by applying a transverse impulsive force to a rope. The technique can detect localized flaws and also determine the load magnitude acting in the rope.
The methodology allows for the inspection of a rope of several hundred feet in length, within several seconds and from a single location. It is applicable whether the rope material is metallic or non-metallic.

Magnestostrictive sensors

Kwun and Teller [9] have shown that fractured wires in a steel wire cable can be detected using magnetostrictively transmitted and detected mechanical waves without direct physical contact to the cable. The authors report good inspection depth (more than 15 mm), long inspection range (more than 100 m) and good detectability of small-size flaws (corresponding to approximately 2% of the total metallic cross-section of the cable). The sensors operated in a low 10 kHz frequency range.

Electromagnetic field (EM)

This technique is not applicable in the case of synthetic materials.

One must distinguish two basic modes of deterioration of wire rope: 1) loss of metallic cross-sectional area (LMA) produced by external and internal abrasion, and 2) corrosion and localized faults (LF), such as broken wires, kinks, etc. The first practical LF instruments used D.C magnetization of the rope. They measure the magnetic flux leakage surrounding the rope, and magnetically saturate a section of the steel rope in the longitudinal direction by strong permanent or electric magnets. In the case of broken wires or core, corrosion, or abrasion, the magnetic flux is distorted and leaks from the rope. The LMA AC instruments are based on AC magnetization of the rope which serves as a ferrous core of a transformer. A variation of the cross sectional area of the rope modifies the impedance area of the rope and, in turn, this change is a measure of the modification of the cross sectional area.

Some European and Canadian equipment presently used are of the LF type, while the operational systems developed in the USA can simultaneously detect broken wires and evaluate the loss of metallic cross sectional area (LMA) [10].

In the case of mooring ropes used in offshore applications, a waterproof sensor has been developed by Bavins [11].

Based on similar physical principles, the Magnetic Perturbation Cable System (MPC) of Nondestructive Evaluation (NDE) has been developed, and attempts to provide assessment of the structural integrity of the main structural cables of long-span suspension bridges. Barton et al. [10] describe the development of a magnetic perturbation NDE system for inspecting and monitoring wire ropes used in suspension bridges. The method has been applied with a certain degree of success to small diameter cables.

Acoustic emission method

If a crack propagates in a solid subjected to mechanical and/or thermal loading, the acoustic emission phenomenon takes place. A portion of the strain energy stored in the body is released and a compression wave propagates. In the case of a wire rope, the main sources of detectable acoustic emission include wire break, interwire fretting and corrosion. Emissions are also generated by the material used to terminate the rope in steel sockets. The displacements produced by the stress waves are detected by adequate instrumentation placed on the surface of the body under study and which convert mechanical into electrical signals. These signals are then amplified, conditioned, recorded, and located using difference in time of arrival techniques.

Apparently the first known study of acoustic emission phenomena in wire ropes was performed by Laura et al. [13] who used accelerometers clamped to 10 mm diameter rope to detect wire breaks at about 95% of the maximum load during rising load-tests to failure. The acoustic emission signals corresponding to wire breaks were 15 -20 dB above background noise.

Subsequent work was reported by Harris [14], Harris and Dunegan [15], Bamberger and Robert [16], Fritz [17], Matthews and Black [18], Matthews et al. [19], and Hanzawa et al. [20].
Extremely important research in the area was performed at University College, Cardiff by Casey and coworkers during the period 1980-1987. Based on the results obtained, elaborate instrumentation was developed by the research team to detect the failure of wires.
They reached to the following conclusions [21]:

I. The most realistic application of acoustic-emission technology to wire-rope applications is in the detection and location of wire breaks.
II. Successful detection and location of wire breaks is dependent upon rope construction, diameter, length and number of wire breaks.
III. The occurrence of large numbers of wire breaks works against the technique. Although such large numbers of wire breaks are only likely to be generated in the laboratory during the fatigue testing of rope specimens.
IV. Acoustic emission can be a useful laboratory tool, but application of the technique to ropes in service will probably be limited.
V. Future work needs to concentrate on the rope constructions which are most commonly used in industry, and on developing wire-break signatures that could be designed into future equipment. This can be achieved through narrow-band filters, matching the resonant frequency of the transducers to the main frequency components of a wire break and pattern-recognition software.

Possible applications of the acoustic emission method would be monitoring the section of rope at the fairlead pulley of a floating production platform and detecting wire breaks at the termination of bridge hanger cables where corrosion fatigue could take place.[21] In the case of a towing system, a very successful program was run by Matthews and Black [18]. Vanderveldt and Tran [21] were the first researchers to apply the acoustic emission technique to the study of synthetic rope failure. They have shown that the approach possesses a good potential. Later, Williams and Lee [23] found that acoustic emission is generated in a random fashion throughout the testing sample for up to 60% - 70 % of the ultimate load. After this load level a majority of the acoustic emission signals are generated in a more concentrated subdomain where the failure location may be probably located.

RECENTLY SUGGESTED TECHNIQUES

Fiber-Optics and Condition of Cables.

Ludden et al. [24] and Robertson and Ludden [25] tackled the problem of monitoring Kevlar Parafil fiber mooring ropes in service taking into account the following considerations [2]:

- monitoring yarn breakage by detection of acoustic emissions
- strain measurements along the rope length
- access limited to one end of the rope for interrogation purposes
- opto - electronics of relatively simple and robust nature
- rope temperature measurement and compensation in the range 0^0-50^0C
- strain: 0-2.5% range. As pointed out by Rebel et al. [2] this range is not adequate for polyester ropes
- total maximum operational length: 5 Km

An array of fiber Bragg grating pairs along the optical fiber was used to measure changes in reflection wavelength in order to determine strain and temperature. The principles of the monitoring system were shown to be effective by Robertson and Ludden [25]. Arrays of distributed fiber optic sensors have been used for monitoring the state of health of two Carbon Fiber Reinforced Polymer strands of a cable stayed bridge in Switzerland [26].

As reported by Rebel et al. [2], the European community is presently sponsoring Research and Development Projects on the subject matter (development of an optical scanning apparatus for ropes, OSCAR). Two projects have been finished already. It is estimated that the total installed cost of the OSCAR system will be much less than 10% of the cost of the mooring system. An attempt to detect the breakage of individual wires in a rope has also been proposed and successful tests have been run in air and in water [27, 28].

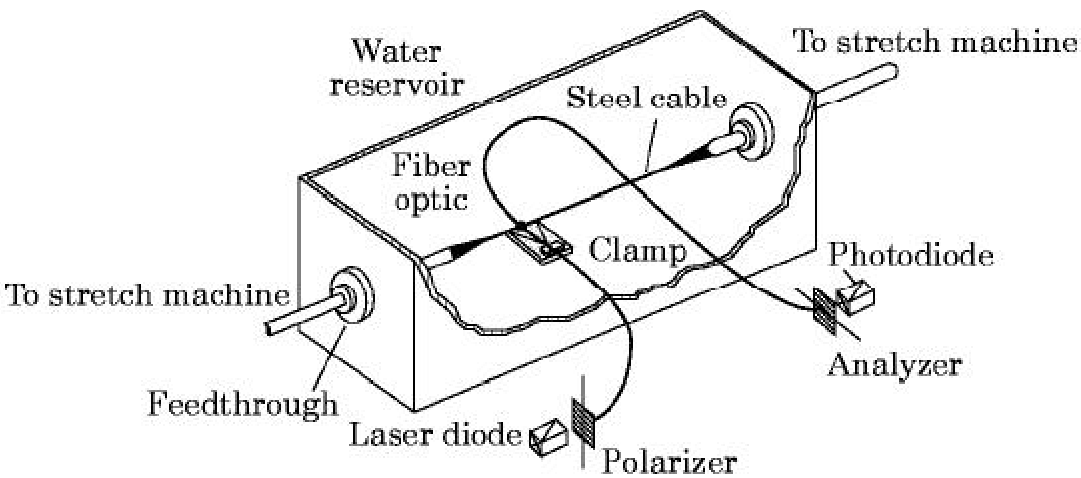

Figure 1. Experimental set-up developed for tests performed in water medium.[28]

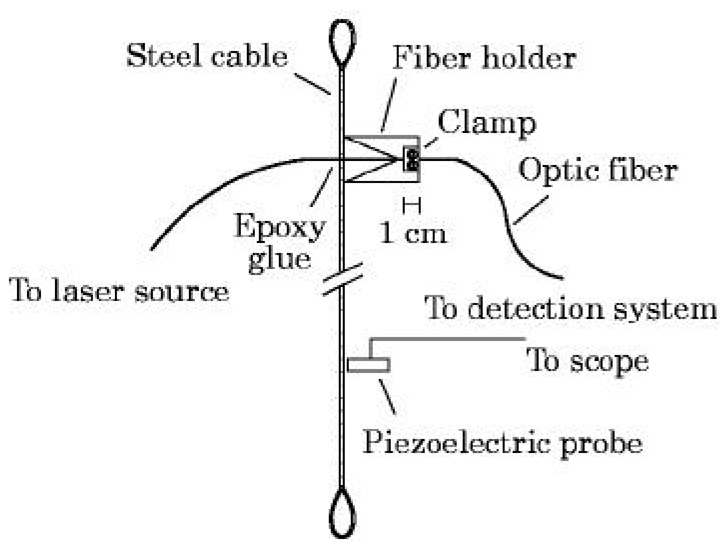

Figure 2. Details of the optic fiber-mechanical cable attachment.[28]

Experiments have also been performed in the case of kevlar cables [29]. The approach is based on the photoelastic property of the glass fiber. Figure 1 depicts the experimental arrangement used to obtain data about individual wires breaking on a cable submerged in water. A 40 cm long. 1.36 mm diameter steel cable composed of seven wires, 0.45 mm. diameter each, is stretched by means of a hydraulic system. An acrylic box with a couple of feedthroughs placed at opposite faces of a container was designed and built for keeping the cable and fiber sensor under water. The lightsource utilized in this test was a 5 m W GaAs diode laser and the photodetector at the end of the fiber consists of a photodiode: see Figure 2. A couple of polaroid sheets were used as polarizer and analyzer in order to detect variations of the light intensity due to the stress applied on the optic fiber as individual wires break. A monomode fiber 125 µm in diameter (jacket included) was attached to the steel multiwire cable using a holder designed to detect the transverse perturbation generated when individual wires break during the stretching procedure.

Typical results obtained are those shown in Figure 3, where successive breakage of four wires is observed. It is concluded that the methodology allows for the detection of breaking of wires with very clear signals, at least when performed under controlled laboratory conditions. Undoubtedly, serious practical difficulties must be overcome before the implementation in a real engineering system.

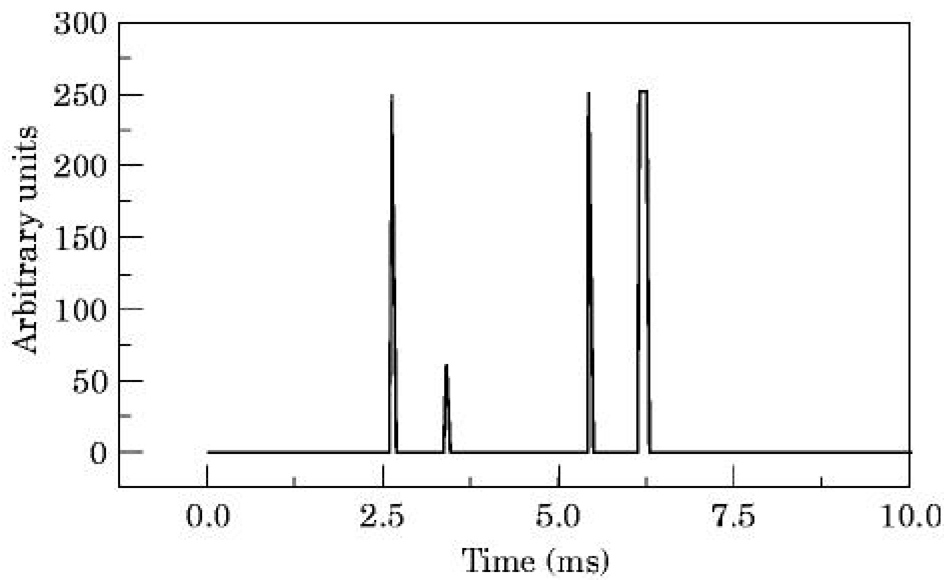

Figure 3. Signals corresponding to consecutive fracture of four wires (cable immersed in water).[28]

Optical fiber sensors for the distributed sensing of strain in cable systems have also been proposed by Uttamchandani et al. [30]. Fiber grating sensors have been used to detect the breakage of single wires in steel ropes [31]. Fiber optic Bragg gratings are also used in [32] to study the vibrational behavior of a cracked cantilever beam as the epoxy resin used to repair it is in the curing process. The authors indicate that the basic procedure may be of use in the case of a fractured healing bone.

Use of an Infrared Detector.

The basic system is made of:

- an infrared emitter diode
- a receiver diode.

The basic operation is the following: the infrared incident ray is reflected by the vibrating element according to its relative motion with respect to the transducer. The intensity of the reflected ray is modified as a function of the displacement of the vibrating object. This in turn allows for the determination of the frequency of the vibrating object from extremely low frequencies of excitation (approaching the static case) to any frequency value [33]. In the case of a mechanical cable the transducer senses the vibratory phenomenon generated by breakage of wires [34].

The thorough survey published by Rebel et al. [2] analyzes briefly other methodologies, which have also been proposed for the condition monitoring of cables:

Magnetic Resonance.

The study of damage in nylon ropes has been carried out by Bryden and Poehler [35-36]. They investigated the magnetic properties of unstressed and stressed nylon rope fibers and analyzed broken bonds in the polymer chain as the polymer is subjected to ultraviolet and X rays and mechanical fracture by different modes (stressing to failure, cutting and machining).

Conductive Internal Elements.

Javidinejad and Joshi [37] have investigated the insertion of conductive elements, e.g. copper wires or conductive thermoplastics, in a rope which fails when the individual strain limits are reached. Time domain reflectrometry methods, applied from both ends of the cable, may be utilized to determine the location of failure. References [38] and [39] considered the use of monitoring fatigue damage in carbon fibre composites by determining electrical resistance variations. Rebel et al. [2] discuss some of the problems which arise when the cable system operates in salt water.

CONCLUSION

The depth and thoroughness of Reference [2] makes it an extremely valuable contribution. Fiber optic strain sensors are discussed in detail as well as the problem of adequate strain ratio and monitoring fiber length. The authors discuss technological procedures for rope manufacturing in order to avoid damage to sensor arrays, the mechanical coupling between the monitoring system and the cable configuration, to fiber mooring ropes, as the title indicates. In view of the universality of the use of mechanical cables in a quasi-infinite number of applications, such as suspension and stayed-bridges, elevators, mine-hoists, aerial transways, ski chair lifts, and gondolas, as well as an almost endless list of ocean engineering applications (including the recovery of the H-bomb lost off Palomares, Spain), reliable monitoring systems are needed. Like many real life situations there is not a unique solution. Many of the existing proposed solutions will continue to possess validity depending upon the circumstances and researchers must be encouraged to improve them and to look for new ones which serve better to new, future requirements [40-41].

ACKNOWLEDGMENT

The preparation of this survey paper was sponsored by CONICET Research and Development Program by Secretaría General de Ciencia y Tecnología of Universidad Nacional del Sur and by

Fundación Rocca (TECHINT). The author is indebted to Mrs. M. Susana Grenada for her very valuable cooperation in the preparation of the present manuscript.

REFERENCES

1-Liu, Ch., Wang, T. L. and Quin, Q. (1999). Study on sensitivity of modal parameters for suspension bridges. Structural Eng. Mech., 8(5), 453 - 464.

2-Rebel, G., Chaplin, C. R., Groves-Kirby, C. and Ridge, I. M. L. (2000) Condition monitoring techniques for fibre mooring ropes. Insight 42, 384-390.

3-Derucher, K. N. and Heins, C. P. (1978). Bridge protective systems and devices. Editor: R. P. Mancill, Jr. U.S.C.G. contract CG-71955-A.

4-Costello, G. A. (1997). Theory of Wire Rope, New York: Springer.

5-Encyclopaedia Britannica. (1970). Vol. 19, 613-614.

6-Encyclopaedia Britannica. (1970). Vol. 23, 590-591.

7-Francois, M., Pereira, M. A. and Raposo, C. (1997). Classification of fibre rope moorings for floating production units. Offshore Engineering, Chapter 35, 155-165.

8-Kwun, H. and Bukhardt, G. L. (1992). Experimental investigation of dynamics of transverse-impulse wave propagation and dispersion in steel wire ropes. J. Acoust. Soc. Am. 92, 1973 - 1980.

9-Kwun, H. and Teller, C.M. (1993). Detection of fractured wires in steel cables using mechanical waves generated and detected with noncontact magnetostrictive sensors. Southwest Research Institute, San Antonio, Texas (unpublished report).

10-Weischedel, H. R. (1991). The inspection of mine hoist ropes. Wire Rope News and Sling Technology (June).

11-Bavins, T. G. (1998). NDT of semi-submersible production platform mooring. Proceedings of the Symposium on the Non - Destructive Testing of Wire Rope, British Institute for Non - Destructive Testing. London U.K.

12-Barton, J. R., Teller, C. M. and Suhler, S. A. (1989). Design, develop and fabricate a prototype nondestructive inspection and monitoring system for structural cables and strands of suspension bridges. Vol. I, Report FHWA-RD-89-158. Federal Highway Administration, McLean, Virginia (133 pp.).

13-Laura, P. A. A., Vanderveldt, H. and Gaffney, P. G. (1996). Acoustic detection of structural failure of mechanical cables. Journal of the Acoustical Society of America 45, 791-793.

14-Harris, D. O. (1972). Acoustic emission monitoring of life span cables on Dunbarton bridge, Report DC-72-TMll. Dunegan Division of Physical Acoustics Corp. San Juan Capistrano CA, 22 pp.

15-Harris, D. O. and Dunegan, R. L. (1974). Acoustic emission testing of wire rope. Materials Eval. 15, 1 - 6.

16-Bamberger, Y. and Robert, J. L. (1978). Acoustic testing of cables. Proceedings of the First European Conference on Non-Destructive Testing, Mainz, Germany, 2, 335-360.

17-Fritz, J. T. D. (1978). Experimental development of a wire rope monitoring device for laboratory fatigue testing.CSIR Control Report M 1593, Pretoria, South Africa.

18-Matthews, J. R. and Black, M. R. (1981). Acoustic emission signal of variable depth sonar tow cable. International Advances in Non-Destructive Testing 7, 181-214.

19-Matthews, J. R., Black, M. R. and Perkins, J. A. (1986). Cable integrity by acoustic emission. U.S. Patent Nº 4, 565, p. 964.

20-Hanezawa, M. (1982). Fatigue behavior of large diameter wire rope. Society of Petroleum Engineers Journal (June), 421-428.

21-Casey, N. F. and Laura, P. A. A. (1997). A review of the acoustic emission monitoring of wire rope. Ocean Engineering 24, 935-947.

22-Vanderveldt, H. H. and Tran, Q. (1971). Acoustic emission from synthetic rope. Naval Eng. J. 83, 65 - 68.

23-Williams, J. H. and Lee, S. S. (1982). Acoustic emissions - rupture load characteristics of double braided nylon rope. Marine Technology 19, 268-271.

24-Ludden, B. P., Carrol, J. E. and Burgoyne, C. J. (1995). Distributed optical fibre sensor for offshore applications. IEE Electronics Division Colloquium on Optical Techniques for Structural Monitoring, 8/1-8/5.

25-Robertson, P. A. and Ludden, B. P. (1997). A fiber optic distributed sensor system for conditionn monitoring of synthetic ropes. IEE Coloquium (Digest) 033, 12/1 - 12/6.

26-Brönnimann, R., Nellen, P. M. and Sennhauser, V. (1998). Application and reliability of a fibre optical surveillance system for a stay cable bridge. Smart Materials and Structures, 7, 229-236.

27-Cortázar, O. D., Larrondo, H. A., Laura, P. A. A. and Avalos, D. R. (1996). A low - cost fiber-optic system for monitoring the state of structural health of a mechanical cable. Ocean Engng. 23 (2), 193-199.

28-Cortázar, O. D., Larrondo, H. A., Avalos, D. R. and Laura, P. A. A. (1997). Fiber optic technology and structural condition monitoring of mechanical cables. Journal of Sound and Vibration 203, 536 - 541.

29-Cortázar, O. D., Tomasel, F. G. and Laura, P. A. A. (1998). Monitoring the structural health of kevlar cables by means of fiber-optic technology. Journal of Sound and Vibration 214, 576-579.

30-Uttamchandani, D., Culshaw, B., Overington, M. S., Parsey, M., Facchini, M. and Thevenaz, L. (1999). Distributed sensing of strain in synthetic fibre rope and cable constructions using optical fiber sensors. Presented at Photonics East'99, Boston, SPIE Proc. 3860.

31-Tomasel, F. G., Cortázar, O. D. and Laura, P. A.A. (2002). Health monitoring of steel cables by interrogation of optical fiber grating sensors. Journal of Sound and Vibration 252, 573-576.

32-Tomasel, F. G. and Laura, P. A. A. (2002). Assessing the healing of mechanical structures through changes in their vibrational characteristics detected by fiber optic Bragg gratings. Journal of Sound and Vibration 253, 523-527.

33-La Malfa, S. (1995). Infrared principles applied to the study of vibrations of mechanical systems. The Shock and Vibration Digest 27, 18-20.

34 –Laura, P. A. A., Ercoli, L. and La Malfa, S. (1995). Feasibility of detection of cable failure using infrared technology. Ocean Engineering, 22, 545 - 549.

35-Bryden, W. A. and Poehler, T. O. (1985). Non-destructive testing of nylon ropes using magnetic resonance techniques. Through the Eyes of an Eagle: 11th World Conference on Non-Destructive Testing, Columbus, Ohio. Vol. 3, 1746-1750.

36-Bryden, W. A. and Poehler, T.O. (1986). NDT of nylon ropes using magnetic resonance techniques. Review of Progress in Quantitative Non-Destructive Evaluation, 1393-1396.

37-Javidinejad, A. and Joshi, S. P. (1999). Design and structural testing of smart composite structures with embedded conductive thermo plastic film: Smart Materials 8, 585-590.

38-Wang, X. and Chung, D. D. L. (1997). Real-time monitoring of fatigue damage and dynamic strain in carbon fiber polymer matrix composite by electrical resistance measurement. Smart Materials 6, 504-508.

39-Irving, P. E. and Thiagarajan, C. (1998). Fatigue damage characterization in carbon fibre composite materials using an electrical potential technique. Smart Materials 7, 456-466.

40-Laura, P. A. A. (1993). Nondestructive testing and structural condition monitoring of mechanical cables. Applied Mechanics Reviews 46, 133-138.

41-Laura. P. A. A. (1995). Evaluating the structural condition of synthetic and metallic cables. Ocean Engineering 22, 551-562.

POSITION OPENINGS

Faculty Position

The John and Bea Slattery Chair in Aerospace Engineering

Department of Aerospace Engineering
Texas A&M University

The Department of Aerospace Engineering at Texas A&M University invites nominations and applications for the John and Bea Slattery Chair in Aerospace Engineering.

To fill this prestigious position we are seeking candidates who have made outstanding contributions to one or more areas of research in aerospace engineering and have gained international recognition. We expect the selected candidate to actively participate in our undergraduate and graduate programs of education, conduct interdisciplinary and multi-disciplinary research within the Department, across the University and beyond, and provide academic leadership.

The Department of Aerospace Engineering has an undergraduate enrollment of over 500 and the current graduate enrollment exceeds 90. Affiliated with the department are the Aerospace Vehicle Systems Institute (AVSI) and the Commercial Space Center for Engineering (CSCE). The department is the leading participant in the newly established NASA URETI for Intelligent Bio-Nano Materials and Structures for Aerospace Vehicles. The research funding in aerospace engineering at Texas A&M University stands at more than $4 million in the year 2002. Please visit http://aeromaster.tamu.edu for further details on the department's activities.

Please send nominations or applications to:

Dr. Ramesh Talreja
Tenneco Professor and Head
Department of Aerospace Engineering
Texas A&M University
3141 TAMU
College Station, Texas 77843-3141
talreja@aero.tamu.edu

Texas A&M University is an equal opportunity employer

Faculty Position

Department of Aerospace Engineering

Texas A&M University

The Department of Aerospace Engineering at Texas A&M University invites applications for a faculty position in aerospace engineering. The appointment will be at a rank commensurate with the applicant's qualifications. An endowed position is also possible.

The position is related to activities within the scope of a newly established NASA URETI for Intelligent Bio-Nano Materials and Structures for Aerospace Vehicles. Particular areas of interest are nanomaterials, biomaterials, multifunctional material systems, active materials and smart structures, molecular simulation, multi-scale material modeling, and composites. The selected candidate will be expected to teach courses in one or more of the aerospace engineering disciplines such as mechanics and materials, and to conduct multidisciplinary research.

The Department has active research programs in solid mechanics and structures, aerodynamics and fluids, and dynamics and control, and is engaged in collaborative multidisciplinary research across campus and with other universities. Available within the Department and elsewhere on campus are research centers, laboratories and facilities such as Center for Mechanics of Composites, Center for Mechanics and Control, Materials Testing Laboratory, Intelligent Systems Laboratory, Polymer Technology Center, Center for Integrated Microchemical Systems, Laboratory for Molecular Simulations and Microscopy & Imaging Center.

Applicants should send a curriculum vita, a brief statement of their interests that includes their vision for research and teaching, and five references to

Dr. Ramesh Talreja
Tenneco Professor and Head
Department of Aerospace Engineering
Texas A&M University
3141 TAMU
College Station, Texas 77843-3141
talreja@aero.tamu.edu
http://aeromaster.tamu.edu

Texas A&M University is an equal opportunity employer

Stanford University

Department of Mechanical Engineering

Faculty Position

The Department of Mechanical Engineering at Stanford University invites applicants for a tenure-track faculty position at the junior level (Assistant or untenured Associate Professor) in the broadly defined area of mechanics. We are searching for an energetic and visionary individual in any area of mechanics, but we are especially interested in the following: multiscale modeling and simulation with application to materials, devices or biological systems; nano- and micro-scale mechanics; computational and solid mechanics.

Applicants must hold a doctorate in an appropriate field and must have demonstrated an ability to carry out outstanding research and have a strong record of, or promise for, exceptional teaching. Appointment will be at a rank commensurate with the applicant's experience.

Applicants should send a curriculum vita, a brief statement of their interests that includes their vision for their research area and teaching, copies of one or two publications, and complete contact information for at least five references, to the following address:

Professor Peter M. Pinsky
Department of Mechanical Engineering
275 Durand Building-496 Lomita Mall
Stanford University
Stanford, CA 94305-4040

Applications are requested by November 30, 2002, but will continue to be accepted until the position is filled. Stanford University is an equal opportunity employer and welcomes nominations of women and minority group members and applications from them.

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.

ANNOUNCMENTS

IU AM

International Congress of Theoretical and Applied Mechanics

August 15 - 21, 2004 ¨ Warsaw, Poland

President:	*Co-Chairman:*	*Co-Chairman:*	*Secretary-General:*
Witold Gutkowski	Michal Kleiber	Wlodzimierz Kurnik	Tomasz Kowalewski
PAN, Warszawa	*IPPT PAN, Warszawa*	*Politechnika Warszawska*	*IPPT PAN, Warszawa*

First Announcement and Call For Papers

http://ictam04.ippt.gov.pl

SCIENTIFIC PROGRAM

Congress participants are encouraged to submit a paper. Papers are sought for all topics corresponding to Pre-Nominated Session or Mini-Symposium subject matters. The paper must be in English and should present material that is novel and preferably unpublished at the time of the Congress. All papers presented at the Congress are by invitation based on the recommendation of the International Papers Committee. No author will be invited to present more than one paper. Prospective authors are asked to submit only one paper for consideration.

MINI-SYMPOSIA

Smart materials and structures ? Tissue, cellular and molecular biomechanics ? Mechanics of thin films and nanostructures ? Microfluidics ? Microgravity flow phenomena ? Atmosphere and ocean dynamics

Pre-Nominated Sessions:

IN FLUID MECHANICS

Biological fluid dynamics ? Boundary layers ? Combustion and flames ? Complex and smart fluids ? Compressible flow ? Computational fluid dynamics (jointly with IACM) ? Convective phenomena ? Drops and bubbles ? Environmental fluid mechanics ? Experimental methods in fluid mechanics ? Flow control ? Flow in porous media ? Flow instability and transition ? Flow in thin films ? Fluid mechanics of materials processing ? Granular flows ? Low-Reynolds-number flow ? Magnetohydrodynamics ? Multiphase flows ? Solidification and crystal growth ? Stirring and mixing ? Fluid mechanics of suspensions ? Topological fluid mechanics ? Turbulence ? Vortex dynamics ? Waves

IN SOLID MECHANICS

Computational solid mechanics (jointly with IACM) ? Contact and friction problems (jointly with IAVSD)? Control of multibody systems ? Control of structures ? Damage mechanics ? Dynamic plasticity of structures ? Elasticity ? Experimental methods in solid mechanics ? Fatigue ? Fracture and crack mechanics (jointly with ICF) ? Functionally graded materials ? Impact and wave propagation ? Material instabilities ? Mechanics of composites ? Mechanics of phase transformations (jointly with IACM) ? Mechanics of porous materials ? Multibody dynamics ? Plasticity and viscoplasticity ? Plates and shells (jointly with IACM) ? Rock mechanics and geomechanics ? Solid mechanics in manufacturing ? Stability of structures ? Stochastic micromechanics ? Structural optimization (jointly with ISSMO) ? Structural vibrations ? Viscoelasticity and creep

TOPICS INVOLVING BOTH FLUID MECHANICS AND SOLID MECHANICS

Acoustics ? Chaos in fluid and solid mechanics ? Continuum mechanics ? Fluid-structure interaction ? Mechanics of foams and cellular materials ? Multiscale phenomena in mechanics

Correspondence related to the Congress should be sent to:

Prof. Tomasz Kowalewski, ICTAM04 Secretary-General
Institute of Fundamental Technological Research
Swietokrzyska 21, 00-049 Warszawa, Poland
e-mail: ictam04@ippt.gov.pl

Nonlinear Dynamics, Chaos, Control and Their Applications to Engineering Sciences

Editors: José M. Balthazar, Paulo B. Gonçalves, Reyolando M. F. L. R. F. Brasil, Ibere L. Caldas, and Felipe B. Rizatto

- Vol. 3: New Trends in Dynamics and Control (ISBN: 85-900351-3-1), 15 Chapters, 204 pages, 2002
- Vol. 4: Recent Devopments in Nonlinear Dynamics (ISBN: 85- 900351-4-X), 11 Chapters, 401 pages, 2002
- Vol. 5: Chaos, Control and Time Series (ISBN: 85- 900351-5-3), 5 Chapters, 447 pages, 2002
- Vol. 6: Applications of Nonlinear Phenomena (ISBN: 85- 900351-6-6), 5 Chapters, 427 pages, 2002

These volumes contain the papers presented in the scientific event: I, II and III; Conference In Nonlinear Dynamics, Chaos, Control and Their Applications to Engineering Sciences held in Campos do Jordão, São Paulo, Brazil, July 31 - August 4, 2000 (ICONNE 2000).

Other volumes of the series are also available :

- Vol. 1: (ISBN: 85-900351-1-5), 3 Chapters, 377 pages. J M Balthazar, D T Mook, J M Rosário (Editors). *Copyright© 1997 Brazilian Society of Mechanical Sciences (ABCM), American Academy of Mechanics (AAM)*
- Vol. 2: Vibrations with Measurements and Control (ISBN: 85- 900351-2-3), 15 Chapter, 250 pages. J M Balthazar *Copyright©1999 Brazilian Society of Applied and Computational Mathematics (SBMAC), Brazilian Society of Mechanical Sciences (ABCM), Society for Industrial and Applied Mathematics(SIAJM)*

These volumes are also available in the Portuguese language:

- Applications on Dynamics and Control (ISBN: 85-85769-09-2), 501 pages, 16 Chapters, 2001. *Copyright© 2001 Brazilian Society of Applied and Computational Mathematics (SBMAC), Brazilian Society of Mechanical Sciences (ABCM).*
- Proceedings of The First Brazilian School on Dynamics and Control (ISBN: 85-85769-08-4), 233 pages, 2001. *Copyright© 2001 Brazilian Society of Applied and Computational Mathematics (SBMAC), Brazilian Society of Mechanical Sciences (ABCM).*
- Proceedings of The Second Brazilian School on Dynamics and Control (ISBN: 85-6883-05-0), CD-ROM, 2002. *Copyright© 2001 Brazilian Society of Applied and Computational Mathematics (SBMAC), Brazilian Society of Mechanical Sciences (ABCM).*

For further information, please contact:

Prof. Dr. J M Balthazar, *Editor-in-Chief*
State University of São Paulo at Rio Claro
São Paulo, PO Box 178, 13500-230 Rio Claro, SP, Brazil
E-mail: jmbaltha@rc.unesp.br

CALL FOR PROPOSALS TO HOST AN IUTAM SYMPOSIUM

or

INSTRUCTIONAL SUMMER SCHOOL IN 2006 OR 2007

The United States National Committee on Theoretical and Applied Mechanics (USNC/TAM) seeks proposals from U. S. authors and institutions to host IUTAM Symposia or Instructional Summer Schools in 2006 or 2007. Information for US proposers can be found on the USNC/TAM website at: http://www7.nationalacademies.org/usnctam. IUTAM provides a small amount of financial support for symposia and summer schools. US organizers are strongly encouraged to seek additional financial support from other sources. The primary use of financial support is to help with travel expenses for younger scientists and for scientists from developing countries.

IUTAM Symposia

The goal of an IUTAM Symposium is to assemble a group of active scientists, within a well-defined field, for the development of science in that field. Participation is by invitation only. In order to achieve effective communication within the group it should, typically, be limited to 60-80 scientists with expertise in the subject area of the symposium. Symposia typically consist of a few invited lectures, and a larger number of contributed papers, presented as lectures and/or posters, all pre-screened by the Symposium Scientific Committee.

IUTAM Instructional Summer Schools

The purpose of an IUTAM Instructional Summer School is to provide lectures by leading experts in a new or emerging field of science and engineering in order to foster developments in that field. Schools are typically 3–5 days in length and intended primarily for younger scientists and those with only limited knowledge in the specific field of the school. Participation of is by invitation only.

Proposal Submission

Proposals from the United States to host a symposium or summer school should be submitted on the appropriate two-page Proposal Submission Form available on the USNC/TAM website. The completed proposal should be sent electronically to the USNC/TAM Secretary (herak@virginia.edu) no later than January 15, 2004. Proposers may submit their proposals directly to IUTAM. However, experience has shown that proposals benefit from the feedback provided by USNC/TAM, and that the recommendation of USNC/TAM when the proposal is finally submitted to IUTAM carries considerable weight.

Final Approvals

Proposals will be assessed by the USNC/TAM and then forwarded to IUTAM where they are reviewed by IUTAM panels. The IUTAM General Assembly will vote on the panel recommendations in August 2004 at the International Congress on Theoretical and Applied Mechanics in Warsaw, Poland (http://ictam04.ippt.gov.pl/).

FIRST CALL FOR PAPERS:
2003 MECHANICS AND MATERIALS CONFERENCE

ww.eas.asu.edu/~cpd/conference.html

The **2003 Mechanics and Materials Conference**, also known as the Summer meeting of the Applied Mechanics and Materials Division of the ASME, will take place in Scottsdale, Arizona from June 17 to 20th, 2003. The venue is the renown Camelback Inn Resort. Abstracts are now being sought for the many sessions and special symposia being organized and covering most areas of mechanics and materials. The conference web site ww.eas.asu.edu/~cpd/conference.html provides all information currently available and will be periodically updated.

For additional information or questions, please send an email to: mechmat2003@asu.edu

Submission of abstracts should be accomplished before **February 15th** and preferably by uploading to the web site. Note that the abstracts of the papers to be presented at the conference will be collected in a book distributed to all attendees.

We look forward to seeing you in Scottsdale!

Profs. Dusan Krajcinovic and Marc Mignolet
Conference Co-Chairs

MINI-SYMPOSIUM: TRIBUTE TO KIRK C. VALANIS
Call for Abstracts

Sixteenth ASCE Engineering Mechanics Conference (EM2003)
University of Washington, Seattle, Washington, July 16-18, 2003

As a tribute to Dr. Kirk Valanis' visionary and lasting contributions in mechanics a Mini-Symposium comprising of three sessions will be held at the 16th ASCE Engineering Mechanics Conference. The Symposium will provide a forum for discussion of new as well as non-traditional developments in solid mechanics, specifically in the areas of fundamental constitutive theory, thermodynamics of materials and its applications to constitutive theory, plasticity theories - including finite stain theories - and plasticity models, internal variable theory, nano and micromechanics, material science and engineering.

The Mini-Symposium is organized by: Vassilis Panoskaltsis (Case Western Reserve University), Stein Sture (University of Colorado, Boulder), George Z. Voyiadjis (Louisiana State University), and Victor Kaliakin (University of Delaware)

One-page abstract submission deadline: **January 15, 2003**
Submit via e-mail to: Prof. V. Panoskaltsis (vpp@nestor.eciv.cwru.edu) or to Prof. S. Sture (sture@grieg.colorado.edu)

Paper submission deadline: **April 15, 2003**
Early registration (EM2003) deadline: **June 16, 2003**
EM2003 Conference: **July 16-18, 2003**

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
Professor Reinaldo Rodriguez-Ramos
Facultad de Matematica y Computacion
Universidad de la Habana
San Lazaro y L, Vedado, CP 10400
La Habana, Cuba
reinaldo@matcom.uh.cu
http://www.uh.cu

North American Co-Chairman
Professor Martin Ostoja-Starzewski
Department of Mechanical Engineering
McGill University
817 Sherbrooke Street West
Montreal, PQ, Canada H3A 2K6
martin.ostoja@mcgill.ca
http://www.mcgill.ca

Note on travel to Cuba from the United States-a link has been provided on the PACAM website that shows travel **is** possible to Cuba from the United States.

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.

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

Access to the on-line issues is restricted to AAM members. A username and password is required to access the on-line issues. This information was sent by e-mail to all AAM members. If you did 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

Acta Materialia 50(18) 2002

Acta Materialia 50(19) 2002

Acta Mechanica 158(3-4) 2002

AIAA Journal 40(11) 2002

Applied Mathematical Modelling 26(12) 2002

1113	Dynamic modelling of flexible robotic mechanisms and adaptive robust control of trajectory computer simulation - part i	Knani J.
1125	Thermoelasticity without energy dissipation of materials with microstructure	Quintanilla R.
1139	A sigma coordinate 3d kappa-epsilon model for turbulent free surface flow over a submerged structure	Li CW. Zhu B.
1151	Maximum entropy analysis to the n policy m/g/1 queueing system with a removable server	Wang KH. Chuang SL. Pearn WL.

Applied Mathematics & Mechanics 23(8) 2002

867	Restudy of theories for elastic solids with microstructure	Dai TM.
875	The transient elliptic flow of power-law fluid in fractal porous media	Song FQ. Liu CQ.
881	Cavitated bifurcation for incompressible hyperelastic material	Ren JS. Cheng CJ.
889	General solution of the overall bending of flexible circular ring shells with moderately slender ratio and applications to the bellows (i) - governing equation and general solution	Zhu WP. Huang Q.
898	General solution of the overall bending of flexible circular ring shells with moderately slender ratio and applications to the bellows (ii) - calculation for omega-shaped bellows	Zhu WP. Huang Q.
906	Numerical simulation of orientation distribution function of cylindrical particle suspensions	Lin JZ. Zhang LX.
913	Unilateral contact problems using quasi-active set strategy	Xuan ZC. Li XS.
922	On influence of kinematics to equivalent linear damping of helicopter blade hydraulic damper	Hu GC. Xiang JW. Zhang XG.
931	Numerical simulation of oil migration-accumulation of multilayer and its application	Yuan YR. Zhao WD. Cheng AJ. Wang WQ. Han YJ.
942	Some problems in the z-c-x space	Zhu CX.
948	Topology and vortex structures of a curving turbine cascade with tip clearance (i) - experimental model and topological flow patterns on both endwalls and blade surfaces	Yang QH. Huang HY. Han WJ.
958	Topology and vortex structures of a curving turbine cascade with tip clearance (ii) - topological flow pattern and vortex structure in the transverse section of a blade cascade	Yang QH. Huang HY. Han WJ.
963	Series perturbations approximate solutions to n-s equations and modification to asymptotic expansion matched method	Li DM. Zhang HP. Gao YX.
973	Chaos-regularization hybrid algorithm for nonlinear two-dimiensional inverse heat conduction problem	Wang DG. Liu YX. Li SJ.
981	Bifurcations of subharmonic solutions in periodic perturbation of a hyperbolic limit cycle	Han MA. Gu SS.
987	Perturbation theory for nonlinear klein-gordon equation	Liu TG. Yan JR.

Archive for Rational Mechanics & Analysis 164(4) 2002

287	Spectral stability of small shock waves	Freistuhler H. Szmolyan P.
311	Infinitely many syzygies	Montgomery R.
341	From molecular models to continuum mechanics	Blanc X. Le Bris C. Lions PL.

Archive of Applied Mechanics 72(6-7) 2002

363	Spectral structures and radiation patterns of scattering waves in a layered acoustic half-space	Touhei T.
379	Robust-controller design with hard constraint on the control signal - application for active vibration suppression of flexible structure	Forrai A. Hashimoto S. Funato H. Kamiyama K.
395	Imperfection sensitivity and stability of an elastic-plastic conical shell under axisymmetrical load	Zielnica J.
418	Analysis of various effects in dynamic cyclic fatigue damage	Dornowski W. Perzyna P.
439	Characterization of electroelastic beams under biasing fields with applications in buckling analysis	Hu YT. Yang JS. Jiang Q.
451	Continuum modelling and the internal instability of certain periodic structures	Wierzbicki E. Wozniak C.
458	On a moving griffith crack in anisotropic piezoelectric solids	Soh AK. Liu JX. Lee KL. Fang DN.
470	Wave propagation in transversely isotropic plates in generalized thermoelasticity	Verma KL. Hasebe N.

483	Static and dynamic analysis of a gradient-elastic bar in tension	Tsepoura KG. Papargyri-Beskou S. Polyzos D. Beskos DE.
498	A modular damage model for quasi-brittle solids - interaction between initial and induced anisotropy	Halm D. Dragon A. Charles Y.
511	Weak shock waves in constrained thermoelastic solids	Gultop T.
522	Buckling of an elastically restrained multi-step non-uniform beam with multiple cracks	Li QS.
536	Evolutionary random response problem of a coupled vehicle-bridge system	Li JQ. Leng XL. Fang T.

Communications on Pure & Applied Mathematics — 55(12) 2002

1507	Boundary concentration phenomena for a singularly perturbed elliptic problem	Malchiodi A. Montenegro M.
1569	The generation, propagation, and extinction of multiphases in the kdv zero-dispersion limit	Grava T. Tian FR.

Composites - Part A: Applied Science & Manufacturing — 33(9) 2002

1159	Interfacial bond strength and fracture energy at room and elevated temperature in titanium matrix composites (scs-6/timetal 834)	Zeng WD. Peters PWM. Tanaka Y.
1171	Carbon composites based on multiaxial multiply stitched preforms. part 1. geometry of the preform	Lomov SV. Belov EB. Bischoff T. Ghosh SB. Chi TT. Verpoest I.
1185	Engineering and characterisation of the interface in flax fibre/polypropylene composite materials. part ii. the effect of surface treatments on the interface	Zafeiropoulos NE. Baillie CA. Hodgkinson JM.
1191	Elastic behaviour of circular composite plates transversely loaded at the centre	Caprino G. Langella A. Lopresto V.
1199	Robotic tow placement for local reinforcement of glass mat thermoplastics (gmts)	Wakeman MD. Hagstrand PO. Bonjour F. Bourban PE. Manson JAE.
1209	Fracture behaviour of cross-ply nicalon/cas-ii glass-ceramic matrix composite laminate at room and elevated temperatures	Yasmin A. Bowen P.
1219	Electrical and impact properties of the hybrid knitted inlaid fabric reinforced polypropylene composites	Cheng KB. Lee KC. Ueng TH. Mou KJ.
1227	Characteristics of cf/pei tape winding process with on-line consolidation	Dai SC. Ye L.
1239	Synthesis of unsaturated polyesters for improved interfacial strength in carbon fibre composites	Gamstedt EK. Skrifvars M. Jacobsen TK. Pyrz R.
1253	Improving joints between composites and steel using perforations	Melograna JD. Grenestedt JL.
1263	Branch and bound search to optimize injection gate locations in liquid composite molding processes	Gokce A. Hsiao KT. Advani SG.

Computational Mechanics — 29(4-5) 2002

277	A general algorithm for the numerical evaluation of nearly singular boundary integrals of various orders for two- and three-dimensional elasticity	Ma H. Kamiya N.
289	Simulation of airbag inflation processes using a coupled fluid structure approach	Marklund PO. Nilsson L.
298	Time-dependent creep fracture using singular boundary elements	Providakis CP. Kourtakis SG.
307	Combined shape and sizing optimization of truss structures	Wang D. Zhang WH. Jiang JS.
313	An integral equation approach to the inclusion-crack interactions in three-dimensional infinite elastic domain	Dong CY. Cheung YK. Lo SH.
322	Swept and curved wings: a numerical approach based on generalized lifting-line theory	Devinant P. Gallois T.
332	A mixed least squares method for solving problems in linear elasticity: theoretical study	Tchonkova M. Sture S.
340	A rate-independent elastoplastic constitutive model for biological fiber-reinforced composites at finite strains: continuum basis, algorithmic formulation and finite element implementation	Gasser TC. Holzapfel GA.
361	A boundary element method for solving 3d static gradient elastic problems with surface energy	Tsepoura KG. Papargyri-Beskou S. Polyzos D.
382	A localized differential quadrature (ldq) method and its application to the 2d wave equation	Zong Z. Lam KY.
392	Boundary collocation method for acoustic eigenanalysis of three-dimensional cavities using radial basis function	Chen JT. Chang MH. Chen KH. Chen IL.
409	Crashworthiness design optimization using successive response surface approximations	Kurtaran H. Eskandarian A. Marzougui D. Bedewi NE.
422	The influence of inlet velocity profile on three-dimensional three-generation bifurcating flows	Zhang CH. Liu Y. So RMC. Phan-Thien N.
430	Stability analysis of an explicit finite element scheme for plane wave motions in elastic solids	Ling X. Cherukuri HP.

Computer Methods in Applied Mechanics & Engineering 191(45) 2002

Computer Methods in Applied Mechanics & Engineering 191(46) 2002

Computers & Fluids 32(2) 2003

Computers & Fluids 32(3) 2003

Computers & Structures 80(23) 2002

Computers & Structures 80(24) 2002

Computers & Structures 80(25) 2002

Computers & Structures 80(26) 2002

Engineering Fracture Mechanics 69(18) 2002

Engineering Fracture Mechanics 70(1) 2003

1	Mesh-free analysis of cracks in isotropic functionally graded materials	Rao BN. Rahman S.
29	Extended finite element method and fast marching method for three-dimensional fatigue crack propagation	Sukumar N. Chopp DL. Moran B.
49	Micro structure-based fatigue modeling of cast a356-t6 alloy	McDowell DL. Gall K. Horstemeyer MF. Fan J.
81	The efficiency of mechanical concrete comminution	Momber AW.
93	Fracture mechanics approach to facesheet delamination in honeycomb: measurement of energy release rate of the adhesive bond	Ural A. Zehnder AT. Ingraffea AR.
105	Dynamics of anisotropic composite cantilevers weakened by multiple transverse open cracks	Song O. Ha TW. Librescu L.
125	Fractal dimension - a measure of fracture roughness and toughness of concrete	Issa MA. Islam MS. Chudnovsky A.

Engineering Structures 25(1) 2003

1	A simple shear wall model taking into account stiffness degradation	Brun M. Reynouard JM. Jezequel L.
11	Earthquake response of tall reinforced concrete chimneys	Wilson JL.
25	Direct displacement-based design for building with passive energy dissipation systems	Lin YY. Tsai MH. Hwang JS. Chang KC.
39	Seismic effectiveness of tuned mass dampers for damage reduction of structures	Pinkaew T. Lukkunaprasit P. Chatupote P.
47	Response of drilled shafts with minor flaws to axial and lateral loads	O'Neill M. Tabsh SW. Sarhan H.
57	Damage identification in beam-type structures: frequency-based method vs mode-shape-based method	Kim JT. Ryu YS. Cho HM. Stubbs N.
69	Full-scale testing of space steel frame subjected to proportional loads	Kim SE. Kang KW. Lee DH.
81	3-d second-order plastic-hinge analysis accounting for local buckling	Kim SE. Lee J. Park JS.
91	An analytical model to evalulate the static soil pressure on a buried structure	Karinski YS. Dancygier AN. Leviathan I.
103	Performance of reinforced concrete buildings during the august 17, 1999 kocaeli, turkey earthquake, and seismic design and construction practise in turkey	Sezen H. Whittaker AS. Elwood KJ. Mosalam KM.
115	Pumice concrete for structural wall panels	Cavaleri L. Miraglia N. Papia M.

European Journal of Mechanics B-Fluids 21(5) 2002

495	Investigations of time-growing instabilities in laminar separation bubbles	Rist U. Maucher U.
511	The effect of viscosity, surface tension and non-linearity on richtmyer-meshkov instability	Carles P. Popinet S.
527	Vortex dynamics in a model left ventricle during filling	Baccani B. Domenichini F. Pedrizzetti G.
545	A note on bodewadt-hartmann layers	Davidson PA. Potherat A.
561	Focusing of edge waves above a sloping beach	Kurkin A. Pelinovsky E.
579	Poiseuille, thermal creep and couette flow: results based on the ces model of the linearized boltzmann equation	Siewert CE.
599	Study of a shock wave structure in gas mixtures on the basis of the boltzmann equation	Raines A.

Experimental Mechanics 42(3) 2002

232	A simple technique for determining yield strength of thin films	Gordon MH. Schmidt WF. Qiao Q. Huang B. Ang SS.
237	Optoelectronic strain measurement for flywheels	Emerson RP. Bakis CE.
247	On testing of charpy specimens using the one-point bend impact technique	Rittel D. Pineau A. Clisson J. Rota L.
253	The use of automated projection interferometry in monitoring aerofoil buckling	Featherston CA. Lester WD.
261	Experimental investigation of structural response to generalized ground shock excitations	Lu Y. Hao H. Ma GW.
272	Digital volume correlation including rotational degrees of freedom during minimization	Smith TS. Bay BK. Rashid MM.
279	Characterization of short duration stress pulses generated by impacting laminated carbon-fiber/epoxy composites with magnetic flyer plates	Bruck HA. Casem D. Williamson RL. Epstein JS.
288	Distributed strain sensing using frequency-modulated continuous-wave reflectometric optical technique	Seah LK. Won PC.
295	Computational method for the spsd of dynamic systems and its application	Zhao WL. Liu DG.
298	Determination of impact parameters by optical measurement of the impactor displacement	Degrieck J. Verleysen P.
303	Systematic errors in digital image correlation due to undermatched subset shape functions	Schreier HW. Sutton MA.

Experiments in Fluids 33(4) 2002

Fatigue & Fracture of Engineering Materials & Structures 25(11) 2002

Finite Elements in Analysis & Design 39(1) 2002

Finite Elements in Analysis & Design 39(2) 2002

IMA Journal of Applied Mathematics 67(5) 2002

International Journal for Numerical & Analytical Methods in Geomechanics 26(13) 2002

International Journal for Numerical & Analytical Methods in Geomechanics 26(14) 2002

International Journal for Numerical Methods in Engineering 55(11) 2002

International Journal for Numerical Methods in Engineering 55(12) 2002

International Journal for Numerical Methods in Fluids 40(8) 2002

International Journal of Damage Mechanics 11(4) 2002

International Journal of Engineering Science 40(18) 2002

International Journal of Engineering Science 40(19) 2002

International Journal of Fatigue 25(1) 2003

International Journal of Fracture 116(4) 2002

International Journal of Heat & Fluid Flow 23(6) 2002

International Journal of Heat & Mass Transfer 46(1) 2003

International Journal of Heat & Mass Transfer 46(2) 2003

International Journal of Impact Engineering 28(1) 2003

International Journal of Impact Engineering 28(2) 2003

International Journal of Mechanical Sciences 44(9) 2002

International Journal of Non-Linear Mechanics 38(3) 2003

International Journal of Non-Linear Mechanics 38(4) 2003

International Journal of Non-Linear Mechanics 38(5) 2003

International Journal of Plasticity 18(12) 2002

International Journal of Plasticity 19(1) 2003

International Journal of Solids & Structures 39(21-22) 2002

International Journal of Solids & Structures 39(23) 2002

Journal of Applied Mechanics 69(6) 2002

Journal of Composite Materials 36(21) 2002

Journal of Computational Physics 182(1) 2002

47	Algorithm refinement for stochastic partial differential equations. i. linear diffusion	Alexander FJ. Garcia AL. Tartakovsky DM.
67	Remeshed smoothed particle hydrodynamics for the simulation of viscous and heat conducting flows	Chaniotis AK. Poulikakos D. Koumoutsakos P.
91	Finesse: axisymmetric mhd equilibria with flow	Belien AJC. Botchev MA. Goedbloed JP. van der Holst B. Keppens R.
118	Implementation of the variational riemann problem solution for calculating propagation of sound waves in nonuniform flow fields	Men'shov I. Nakamura Y.
149	Adaptive solution of partial differential equations in multiwavelet bases	Alpert B. Beylkin G. Gines D. Vozovoi L.
191	A super-grid-scale model for simulating compressible flow on unbounded domains	Colonius T. Ran HY.
213	Unconditionally stable and robust adjacent-cell diffusive preconditioning of weighted-difference particle transport methods is impossible	Azmy YY.
234	A dynamic atomistic-continuum method for the simulation of crystalline materials	Weinan E. Huang ZY.
262	On the theory and computation of surface tension: the elimination of parasitic currents through energy conservation in the second-gradient method	Jamet D. Torres D. Brackbill JU.
277	Two-fluid marangoni-benard convection with a deformable interface	Tavener SJ. Cliffe KA.
301	Reconstruction of turbulent fluctuations using a hybrid rans/les approach	Labourasse E. Sagaut R.
337	A simple compact fourth-order poisson solver on polar geometry	Lai MC.
346	Conservative and orthogonal discretization for the lorentz force	Toth G.

Journal of Engineering Mathematics 44(2) 2002

107	Control over electric field in traveling wave applicators	Lurie KA. Yakovlev VV.
125	Semi-analytical solutions for continuous-flow microwave reactors	Lee MZC. Marchant TR.
147	A note on caustics and two-dimensional hot spots in microwave heating	Reimbert CG. Jorge MC. Minzoni AA. Vargas CA.
155	Microwave heating in multiphase systems: evaluation of series solutions	Ayappa KG. Sengupta T.
173	Microwave heating of laminate panels	Kriegsmann GA. Tilley BS.
199	Temperature modulations in a circuit model of microwave heating	Reimbert CG. Jorge MC. Minzoni AA. Vargas CA.

Journal of Engineering Mathematics 44(3) 2002

207	Flame quenching through endothermic reaction	Lazarovici A. Kalliadasis S. Merkin JH. Scott SK.
229	Analysis of radiative heat-loss effects in thermal explosion of a gas using the integral manifold method	Goldfarb I. Gol'dhstein V. Greenberg JB. Kuzmenko G.
245	Bifurcation of cavitation solutions for incompressible transversely isotropic hyperelastic materials	Ren JS. Cheng CJ.
259	Liquid impact, kinetic energy loss and compressibility: lagrangian, eulerian and acoustic viewpoints	Cooker MJ.
277	On diffusion theory in turbulence	Brouwers JJH.
297	Water-wave scattering by two symmetric circular-arc-shaped thin plates	Mandal BN. Gayen R.

Journal of Engineering Mechanics 128(11) 2002

1119	Nonlocal integral formulations of plasticity and damage: survey of progress [review]	Bazant ZP. Jirasek M.
1150	Bending stiffness of fiber-reinforced circular seismic isolators	Tsai HC. Kelly JM.
1158	Displacement accuracy of discontinuous deformation analysis method applied to sliding block	Doolin DM. Sitar N.
1169	Flow establishment in elastic pipes	Lam KWF. Leutheusser HJ.
1174	Collapse of composite rings due to delamination buckling under external pressure	Rasheed HA. Tassoulas JL.
1182	Influence of particle shape and surface friction variability on response of rod-shaped particulate media	O'Sullivan C. Bray JD. Riemer MF.
1193	Advances in modeling of aerodynamic forces on bridge decks	Chen XZ. Kareem A.
1206	Application of wigner-ville transform to evaluate tensile forces in seven-wire prestressing strands	Chen HL. Wissawapaisal K.
1215	Numerical simulation of viscoplastic and frictional heating during finite deformation of metal. part i: theory	Adam L. Ponthot JP.
1222	Numerical simulation of viscoplastic and frictional heating during finite deformation of metal. part i: applications	Adam L. Ponthot JP.
1233	Inelastic cyclic buckling of aluminum shear panels	Rai DC.

Journal of Fluid Mechanics 469 2002

Journal of Fluid Mechanics 470 2002

Journal of Fluids & Structures 16(7) 2002

957	Aeroacoustic response of diffusers and bends: comparison of experiments with quasi-steady incompressible flow models	Dequand S. Van Lier L. Hirschberg A. Huijnen J.
971	A simplified linearized model for the fluid-coupled vibrations of spent nuclear fuel racks	Moreira M. Antunes J.
989	Flow-induced vibration of free edges of thin films	Chang YB. Moretti PM.

Journal of Non-Newtonian Fluid Mechanics 107(1-3) 2002

1	Determination of discrete relaxation spectra using simulated annealing	Jensen EA.
13	Improvement in techniques for the determination of extensional rheological data from entrance flows: computational and experimental analysis	Zatloukal M. Vlcek J. Tzoganakis C. Saha P.
39	Mean field heat transfer scaling for non-newtonian stagnant lid convection	Reese CC. Solomatov VS.
51	Large amplitude oscillatory shear as a way to classify the complex fluids	Hyun K. Kim SH. Ahn KH. Lee SJ.
67	Numerical studies of fiber suspensions in an axisymmetric radial diverging flow: the effects of modeling and numerical assumptions	Chung DH. Kwon TH.
97	On the stability of thermally driven shear flow of an oldroyd-b fluid heated from below	Kaloni PN. Lou J.
111	Drop deformation for non-newtonian fluids in slow flows	Greco F.
133	Wall detachment and high rate surface defects during extrusion of clay	Kulikov OL. Hornung K.

Journal of Reinforced Plastics & Composites 21(16) 2002

1423	Analysis of thin-walled composite beams with arbitrary layup	Kollar LP. Pluzsik A.
1467	Bounds on transverse modulus of a multiphase composite	Sharma R. Ranjan A. Sharma A.
1477	Free vibration analysis of two layered cross-ply laminated beams using layer-wise trigonometric shear deformation theory	Shimpi RP. Ainapure AV.
1493	A study on biodegradable composite prepared from jute felt and polyesteramide (bak)	Dash BN. Sarkar M. Rana AK. Mishra M. Mohanty AK. Tripathy SS.
1505	Progressive failure analysis of laminated composite plates by finite element method	Pal P. Ray C.

Journal of Sound & Vibration 257(1) 2002

3	Dynamic analysis of an automatic washing machine with a hydraulic balancer	Bae S. Lee JM. Kang YJ. Kang JS. Yun JR.
19	Improvement of the semi-analytical method, for determining the geometrically non-linear response of thin straight structures: part ii - first and second non-linear mode shapes of fully clamped rectangular plates	El Kadiri A. Benamar R.
63	Plane wave solutions and modal analysis in higher order shear and normal deformable plate theories	Batra RC. Vidoli S. Vestroni F.
89	Strategy for finding a near-optimal measurement set for parameter estimation from modal response	Pothisiri T. Hjelmstad KD.
107	Dynamic response of a rotating flexible arm carrying a moving mass	Yau DTW. Fung EHK.
119	A new method for separating longitudinal waves in a large diameter hopkinson bar	Zhao PJ. Lok TS.
131	Prediction of non-cavitating underwater propeller noise	Seol H. Jung B. Suh JC. Lee S.
157	Control design of active vibration isolation using mu-synthesis	Bai MR. Liu W.
177	Effects of viscous friction and non-friction damping mechanisms in a reciprocating engine	Wang Y. Lim TC.
189	Wave propagation through cylinders and spheres as computed by ordinary exponentials	Ivansson S.
202	A modified mickens procedure for certain non-linear oscillators	Lim CW. Wu BS.

Journal of Sound & Vibration 257(2) 2002

207	A novel approach for the analysis of high-frequency vibrations	Wei GW. Zhao YB. Xiang Y.
247	Health-monitoring method for bridges under ordinary traffic loadings	Lee JW. Kim JD. Yun CB. Yi JH. Shim JM.
265	Vibration power transmission over a rectangular area of an infinite plate subject to uniform conphase velocity excitation	Dai J. Lai JCS.
283	Vibrational power transmission from a machine to its supporting cylindrical shell	Li WL. Daniels M. Zhou W.
301	Dynamic analysis of large-diameter sagged cables taking into account flexural rigidity	Ni YQ. Ko JM. Zheng G.
321	Is a simple support really that simple?	Aglietti GS. Cunningham PR.
337	Non-linear beam oscillations excited by lateral force at combination resonance	Avramov KV.

Journal of Sound & Vibration 257(3) 2002

Journal of Sound & Vibration 257(4) 2002

Journal of Sound & Vibration 257(5) 2002

Journal of Sound & Vibration 258(1) 2002

Journal of the Mechanics & Physics of Solids 50(12) 2002

Journal of Thermal Stresses 26(1) 2003

Journal of Vibration & Control 8(6) 2002

Journal of Vibration & Control 8(7) 2002

Journal of Vibration & Control 8(8) 2002

JSME International Journal Series C- Mechanical Systems Machine Elements & Manufacturing 45(3) 2002

794	Evaluation of bending strength of carburized gears based on inferential identification of principal surface layer defects	Masuyama T. Inoue K. Yamanaka M. Kitamura K. Saito T.
802	Analysis of bubbly lubrication in journal bearings	Choi S. Kim KW.
809	Subdivision surface approximation of data points and polygon models	Takeuchi S. Suzuki H. Kanai T. Kimura F.
815	Product development methodology for machine tools - (usability analysis of man-machine interface)	Shinno H. Hashizume H. Yoshioka H. Itoh K.
821	Wear reduction effects of ca sulfonate on coated tools in hobbing	Matsuoka H. Ono H. Tsuda Y.

Meccanica 37(6) 2002

491	An increasing number of moments in relativistic extended thermodynamics	Pennisi S.
503	Bounds on the elastic moduli of completely random two-dimensional polycrystals	Chinh PD.
515	Strong ellipticity of transversely isotropic elasticity tensors	Padovani C.
527	Limit analysis of structures with stochastic strengths by a static approach	Caddemi S. Ricciardi G. Sacca C.
545	Isoenergetic families of planar orbits generated by homogeneous potentials	Borghero F. Bozis G.
555	Effect of lateral linear stiffness on nonlinear characteristics of hunting motion of a railway wheelset	Yabuno H. Okamoto T. Aoshima N.
569	Nonlinear oscillations and stability of parametrically excited cylindrical shells	Goncalves PB. Del Prado ZJGN.
599	Buoyancy convection in low prandtl number liquids with large temperature variation	Saravanan S. Kandaswamy P.

Mechanics of Materials 34(11) 2002

685	Variational formulation of fluid infiltrated porous material in thermal and mechanical equilibrium	Lopatnikov SL. Cheng AHD.
705	Fracture mechanisms in particle composites: statistical aspects in lattice type analysis	van Mier JGM. van Vliet MRA. Wang TK.
725	Micromechanics applied to the thermal shock behavior of refractory ceramics	Schmitt N. Burr A. Berthaud Y. Poirier J.
749	A novel technique for characterizing elastic properties of thin biological membrane	Ju BF. Liu KK. Ling SF. Ng WH.

Mechanics of Materials 34(12) 2002

755	Threshold strength predictions for laminar ceramics with cracks that grow straight	Hbaieb K. McMeeking RM.
773	A generalization of gittus' viscoplastic "mechanical equation of state" to multiaxial stress states	Jarvstrat N.
779	A method to extract the mechanical properties of particles in collision based on a new elasto-plastic normal force-displacement model	Zhang XA. Vu-Quoc L.
795	Endochronic viscoplastic material models for filled ptfe	Kletschkowski T. Schomburg U. Bertram A.
809	Uniaxial and non-proportionally multiaxial ratcheting of u71mn rail steel: experiments and simulations	Kang GZ. Gao Q.

Mechanics Research Communications 29(5) 2002

283	Chaotic behaviors of a bilinear hysteretic oscillator	Li HG. Zhang JW. Wen BC.
291	From global dynamical models to the henon-heiles potential	Caranicolas ND.
299	Bifurcation of nonlinear internal resonant normal modes of a class of multi-degree-of-freedom systems	Li XY. Chen YS. Wu ZQ. Chen FQ.
307	A contribution to the stability of nonholonomic systems	Zhu HP. Yu AB.
315	On the critical damping in multi-degree-of-freedom systems	Bulatovic RM.
321	On the motion of thin plates and shells subject to stokes damping	Beatty MF.
327	Effects of sh waves in a functionally graded plate	Han X. Liu GR.
339	Von mises yield criterion and nonlinearly hardening variable thickness rotating annular disks with rigid inclusion	Eraslan AN.
351	An improved id fiber dry spinning mass transfer model	Chandler KW. Peddieson J. Idem SA. Rochelle SG.
359	Nonlinear dynamic responses of twin-tube hydraulic shock absorber	Liu YQ. Zhang JW.
367	Cross-section deformation of tubular composite shafts subjected to static loading conditions	Gubran HBH. Gupta K.
375	Study of the swelling behavior of a compacted soil using flexible odometer	Windal T. Shahrour I.
383	An elastoplastic model for unsaturated rocks and concrete	Bourgeois F. Shao JF. Ozanam O.
391	A critical review of some damage models with unilateral effect [review]	Cormery F. Welemane H.
397	Near-tip out of plane displacement fields for dynamic crack propagation in functionally graded materials	Parameswaran V. Shukla A.

407	Closed-form solution for a mode-iii interfacial edge crack between two bonded dissimilar elastic strips	Wu XF. Dzenis YA.
413	Multi-cracks problem for piezoelectric materials strip subjected to dynamic loading	Huang HM. Shi HJ. Yin Y.
425	A moving piezoelectric screw dislocation	Wang X. Zhong Z.
431	Existence of shear bands in hyperelastic solids	Gultop T.
437	The comparison of two approaches to numerical modelling of gas-particles turbulent flow and heat transfer in a pipe	Bourloutski ES. Bubenchikov AM. Starchenko AV.

Medical Engineering & Physics 24(9) 2002

565	Mathematical modelling for the new millenium: medicine by numbers [review]	Smye SW. Clayton RH.
575	Modelling of flow and wall behaviour in a mildly stenosed tube	Lee KW. Xu XY.
587	Dynamic model of the role of platelets in the blood coagulation system	Xu CQ. Zeng YJ. Gregersen H.
595	An advanced computer-aided geometric modeling and fabrication method for human middle ear	Sun QL. Chang KH. Dormer KJ. Dyer RK. Gan RZ.
607	Does low output laser stimulation enhance the healing of crural ulceration? some critical remarks	Franek A. Krol P. Kucharzewski M.
617	Morphological study of the proximal femur: a new method of geometrical assessment using 3-dimensional reverse engineering	Mahaisavariya B. Sitthiseripratip K. Tongdee T. Bohez ELJ. Vander Sloten J. Oris P.
623	The sensitivity of posturographic parameters to acquisition settings	Schmid M. Conforto S. Camomilla V. Cappozzo A. D'Alessio T.
633	Precision test apparatus for evaluating the heating pattern of radiofrequency ablation devices	Chang I. Beard B.

Proceedings of the Royal Society of London Series A-Mathematical Physical & Engineering Sciences 458(2027) 2002

2561	Stability of frictional heating in plane couette flow at fixed power input	Subrahmaniam N. Johns LE. Narayanan R.
2571	Generalized markowitz mean-variance principles for multi-period portfolio-selection problems	Draviam T. Chellathurai T.
2609	Asymptotic expansions of lattice green's functions	Martinsson PG. Rodin GJ.
2623	Elastic deformation in a crystal plate where lattice-parameter mismatch is present between adjacent growth sectors. ii - measurement of lattice tilts by synchrotron x-ray reticulography	Arridge RGC. Lang AR. Makepeace APW.
2645	Stability analyses of long liquid bridges in the presence of gravity and flow	Atreya S. Steen PH.
2671	Self-adjoint time operator is the rule for discrete semi-bounded hamiltonians	Galapon EA.
2691	Isospectral vibrating beams	Gladwell GML.
2705	Lyapunov exponents for two nonlinear systems driven by real noises	Liu XB. Liew KM.
2721	On the use of interpolative quadratures for hypersingular integrals in fracture mechanics	Korsunsky AM.
2735	Supercritical regimes of liquid-metal fluid motions in electromagnetic fields: wall-bounded flows	Chen ZM. Price WG.
2759	A proof of the gamma test	Evans D. Jones AJ.
2801	Delayed-feedback control of chaotic roll motion of a flooded ship in waves	Mitsubori K. Aihara KU.
2815	Parametrically driven surface waves in surfactant-covered liquids	Kumar S. Matar OK.
2829	A short proof for bargmann-type inequalities	Schmidt KM.

Quarterly of Applied Mathematics 60(4) 2002

601	An analytical study of the kelvin-helmholtz instabilities of compressible, magnetized tangential velocity discontinuities with generalized polytrope laws	Brown KG. Choudhury SR.
631	Proper orthogonal decomposition for flow calculations and optimal control in a horizontal cvd reactor	Ly HV. Tran HT.
657	The initial-value problem for the kelvin-helmholtz instabilities of high-velocity magnetized shear layers with generalized polytrope laws	Brown KG. Choudhury SR.
675	Singular solutions to a nonlinear elliptic boundary value problem originating from corrosion modeling	Bryan K. Vogelius M.
695	The riemann problem for an elastic string with a linear hooke's law	Hanche-Olsen H. Holden H. Risebro NH.
707	Composition systems	Geman S. Potter DF. Chi ZY.
737	Model-based tracking of moving objects in cluttered environments	Gidas B. Gomes FC. Robertson C.
773	Asymptotic behavior of subsonic entropy solutions of the isentropic euler-poisson equations	Li HL. Markowich P. Mei M.

Rheologica Acta 41(6) 2002

SIAM Journal on Applied Mathematics 63(1) 2002

Structural & Multidisciplinary Optimization 24(4) 2002

Studies in Applied Mathematics 109(4) 2002

Thin-Walled Structures 40(12) 2002

Wave Motion 36(4) 2002

Wave Motion 37(1) 2003

Zeitschrift fur Angewandte Mathematik und Mechanik 82(11-12) 2002