SEM Experimentally Speaking...
http://sem.org
Volume 4 | Issue 4
December | 2013

MESSAGE FROM THE PRESIDENT

Emmanuel Gdoutos, SEM President, 2013-2014

IN THIS Issue

Society for Experimental Mechanics, Inc.
7 School Street • Bethel, CT 06801 USA
http://sem.org • 203.790.6373
director@sem1.com

NURTURING TODAY'S EXPERIMENTALIST

I am recollecting the time in the late sixties when, as a student of Civil Engineering of the National Technical University of Athens, I joined the Laboratory of Applied Mechanics under the directorship of the late Professor P.S. Theocaris and explored the wonders of experimental mechanics. I had already taken a course in experimental mechanics, in which we conducted tension, three-point bending, creep/relaxation, fatigue, and hardness tests. We measured displacements with strain gages, and Huggenberger extensometers having a system of levers with a magnification factor of 1200. On the research level, the methods of photoelasticity, photoelastic coatings, geometrical moiré, interferometry, and holography were in full swing in our laboratory. The optical method of caustics for the experimental determination of stress intensity factors in crack problems was under development at the time. We used this method for many crack and singularity problems. In my first project in photoelasticity, I used the shear difference method for the separation of principal stresses: Imagine starting from one boundary of the body to reach the other boundary, and find the boundary conditions not satisfied: All your hard work in vain. To determine the sum of the principal stresses we used the numerical method of relaxation and solved a system of linear equations, tremendously tedious when the system was greater than four by four, the electrical and membrane analog methods, among others. And, we combined the sum with the difference of the principal stresses obtained from isochromatics to determine the principal stresses.

That was then. What about now? Of course, the experimental methods remain always valid. However, some methods may have been overshadowed by newer more handy and more powerful methods. The advent of computers changed our daily life. Who would have had imagined in the sixties that we would have Internet in the nineties? Submit our papers, and receive reviewers' comments online? It is unthinkable to the new generation that we conducted our communication via regular mail, taking a substantial amount of time, to submit a paper, receive acknowledgement of receipt, reviewers' comments, etc… This is one example of how Internet had changed the way we publish our results, not to mention other applications that have revolutionized our everyday life.

The advent of computer had a tremendous effect on the optical methods of experimental mechanics. Digital photoelasticity taking advantage

Continued

of computer technology and digital image processing techniques emerged in the eighties. Moiré techniques have also tremendously benefited. The specimen grating could be transferred to the computer screen and be superimposed with the reference grating, a task performed previously on the specimen. And, that was the beginning.

Of seismic impact on experimental methods was the development of the digital image correlation (DIC) method for measurement of displacements. We may have forgotten the grid method of old times, a precursor of DIC. Measuring the changes of lengths and the angle of two lines on the specimen after deformation resulted to calculation of the three strain components. That was then done by hand. Now we correlate points before and after deformation with algorithms run by computers. The tremendous advantage of the method is that it can be used in structures covering the macro-micro and nano-scale levels. It has been commercialized and it is relatively easy for the novice experimentalist to set up the optical arrangement, use the software and obtain results.

Going to the issue of educating today's experimentalist, I consider that the following methods should be included in the curriculum of an experimental mechanics course in engineering education:

(i) Strain gages: Although more than 70 years old, strain gages constitute the most convenient and widely used method of strain measurement in laboratory and field applications. They are inexpensive and require minimum instrumentation.

(ii) Photoelasticity: Constitutes the most powerful and widely used method in stress analysis. There is no need for special precautions during the test, it is simple and inexpensive. With just a set of polarizing films one can have a direct full-field image of the residual stresses in a plastic.

(iii) Geometric moiré: The moiré phenomenon appears in our everyday life. The method is simple, easy to apply and needs minimum instrumentation. It constitutes a full field method, like photoelasticity. It is limited by the minimum deformation that can be measured.

(iv) Interferometric moiré: Extends the limits of applicability of geometric moiré in measuring smaller displacements. However, special precautions should be taken during the test.

(v) Interferometry: Can be used to measure displacements of the order of the wavelength of light. It can easily be applied and needs minimum instrumentation.

(vi) Holography: Both the amplitude and phase on a wave can be reconstructed. It can be used in combination with photoelasticity and interferometry. It requires special precautions during the test.

(vii) Speckle methods: The speckle pattern of a specimen carries necessary information for the determination of displacements. The method can be used in combination with photography and interferometry.

(viii) Optical metrology: It constitutes an important component of all optical methods. Images of an object are digitized and stored in a computer. They can be analyzed and processed at a later time.

(ix) Digital image correlation (DIC): It is the most widely used optical method of our times. Most laboratories are equipped with cameras and software. Student can use it as black box for displacement measurements.

(x) Optical fibers: They are widely used in structural applications for in-situ measurement of stresses.

(xi) Thermoelasticity: It is used for the measurement of the sum of the principal stresses. It needs an infrared detector for measuring small temperature changes.

(xii) Nanoindentation: Constitutes a powerful method for measuring the mechanical properties and fracture toughness of materials at the macro- micro- and nano-scale levels. The method has precursors, the Brinell and Vickers tests, used to measure the hardness of materials since the beginning of the twentieth century.

(xiii) Non-destructive testing (NDT): Radiography, ultrasonics and acoustic emission are widely used for non-destructive interrogation of structures. Radiography uses X- or γ-rays, while in ultrasonics ultrasonic waves are transmitted through the specimen. In acoustic emission sensing transducers and sophisticated electronic equipment is used to detect sounds and stress waves emitted inside the material by defects.

Today's experimentalist armed with a strong background in numerical methods and computer techniques and deep understanding of the basic experimental methods as outlined above, should have the tools necessary to solve problems of structural behavior and material characterization at the nano-, micro- and macro-scale levels. Needless to say, that the most valuable virtues of an experimentalists are not his/her technical skills, but honesty and integrity. Experimental results should be presented as obtained from the tests, unbiased of any relations with analytical solutions, in case they exist. This most valuable virtue should be cultivated in classrooms and laboratories.

Emmanuel E. Gdoutos
SEM President

PS: I tried to give a few hints of how I understand the topics of experimental mechanics we should educate today's experimentalist, and include in our syllabus of experimental mechanics courses. This subject is continuously evolving. If this article can trigger a dialogue on the subject it has fulfilled its mission. Please feel free to communicate your views with me or your colleagues.

IMAC-XXXII IS GOING MOBILE

CONNECTING WITH ATTENDEES ON THEIR MOBILE DEVICES

More and more people are relying on their smartphones and tablets for information about what's going on, and how to get the most out of the experience once they get there. SEM realizes this and is trying to make the transition through the Guidebook app.

We have chosen a platform that will provide many benefits to attendees, including:

MOST UP-TO-DATE SESSION SCHEDULES

Your entire schedule is right on your phone/tablet. Pick sessions and add them to your **personalized agenda** with reminders. If you want more details, you can simply click on a session to see images, locations, and detailed descriptions of any item. Anytime we make a change to the guide, it will be instantly available to everyone using the guide.

TO-DO LIST

An interactive to-do list allows you to jot down all of the things you don't want to miss and check them off upon completion. With one touch, you can add an exhibitor, speaker, or sponsor to your list.

EXHIBITOR LISTINGS

Includes a searchable list of exhibitors along with descriptions.

INDOOR MAPS AND FLOOR PLANS

Vivid, high-resolution maps allow you to scroll and zoom in order to navigate your way around the venue.

INSTANT FEEDBACK

Includes tools so you can tell us what you liked most about the event, or how you would improve it for next year.

To get started, download **Guidebook** from the Apple App Store, Android Marketplace, visit guidebook.com/getit or simply scan the QR code below. Our guide will be made available prior to the conference, visit our website for more details!

Scan to download!

A SPECIAL SYMPOSIUM IN HONOR OF PROFESSOR ARUN SHUKLA'S 60TH BIRTHDAY

A special symposium entitled "Performance of Materials and Structures under Extreme Loading Conditions" in honor of Professor Arun Shukla's 60th birthday was convened at the University of Rhode Island (URI), Kingston, RI on 12-13 October 2013.

More than 75 participants consisting of renowned faculty, scientists from national laboratories, and students took part in the symposium's technical and social events. Prof. Shukla was joined by his family members at the various events. The symposium started with opening remarks of Professor Raymond Wright (Dean of College of Engineering at URI). The symposium had 6 sessions with wide range of invited topics from earthquakes to fuel cells given by internationally-respected researchers from around the world. Students from URI and neighboring universities also presented their research in numerous poster sessions on both days of the symposium. Attendees were also given tours of Prof. Shukla's world famous experimental mechanics laboratories.

As a part of symposium, a social event was organized at Narragansett, RI on the evening of 12 October to celebrate Dr. Shukla's 60th birthday with short and inspiring speeches from his academic friends, his former students and also from his family. On 13 October, the symposium was concluded with closing remarks from Professor Guruswami Ravichandran, California Institute of Technology (CALTECH). This symposium was sponsored by Graduate Aeronautical Laboratories at CALTECH, College of Engineering at URI and Society for Experimental Mechanics.

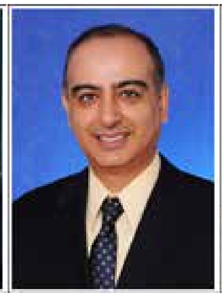
2014 SEM EXECUTIVE BOARD NOMINEES

The SEM National Nominating Committee has announced nominations for 2014–2015 SEM Executive Board officers. Biographies for each nominee appear in this article. If elected, they will join current Board members whose terms extend to 2015: Emmanuel E. Gdoutos, Jonathan D. Rogers, Thomas W. Proulx, Eric N. Brown, Linda Hanagan, Christopher Niezrecki and Robert E. Rowlands.

Nancy R. Sottos

Guruswami Ravichandran

Peter Avitabile



F. Necati Catbas

Robert Goldstein

Daniel Rixen

Satoru Yoneyama

PRESIDENT

NANCY R. SOTTOS

Nancy Sottos is the Donald B. Willet Professor of Engineering in the Department of Materials Science and Engineering at the University of Illinois Urbana-Champaign. She is also a co-chair of the Molecular and Electronic Nanostructures Research Theme at the Beckman Institute. Sottos started her career at Illinois in 1991 after earning a Ph.D. in mechanical engineering from the University of Delaware. Her research group studies the mechanics of complex, heterogeneous materials such as self-healing polymers, advanced composites, and thin film microelectronic devices, specializing in micro and nanoscale characterization of deformation and failure in these material systems. Sottos' research and teaching awards include the ONR Young Investigator Award (1992), Outstanding Engineering Advisor Award (1992, 1998, 1999 and 2002), the R.E. Miller award for Excellence in Teaching (1999), University Scholar (2002), the University of Delaware Presidential Citation for Outstanding Achievement (2002), the Hetényi Award from the Society for Experimental Mechanics (2004), Scientific American's SciAm 50 Award (2008), Fellow of the Society of Engineering Science Fellow (2007), and the M.M. Frocht and B.J. Lazan awards from the Society for Experimental Mechanics. She served as Associate Editor (1999-2002) and as Technical Editor (2003-2006) for Experimental Mechanics and currently chairs the International Advisory Board. She has also been a member of the SEM Executive Committee (2007-2009).

PRESIDENT-ELECT

GURUSWAMI (RAVI) RAVICHANDRAN

Guruswami (Ravi) Ravichandran is the John E. Goode, Jr. Professor of Aerospace and Professor of Mechanical Engineering, and Director of the Graduate Aerospace Laboratories (GALCIT) at the California Institute of Technology. He received his B.E. (Honors) in Mechanical Engineering from the University of Madras, Sc.M. in Engineering and Applied Mathematics, and Ph.D. in Engineering (Solid Mechanics and Structures) from Brown University. After a year of post-doctoral work at Caltech, he joined the faculty of the University of California, San Diego in 1987 and returned to Caltech in 1990 where he has been ever since. He is a Fellow of the SEM and ASME. His awards and honors include, B. J. Lazan and M. Hetényi Awards from SEM and Charles Russ Richards Memorial Award from Pi, Tau, Sigma and ASME. He received Doctor honoris causa (Dhc) from Paul Verlaine University and was awarded Chevalier dans l'ordre des Palmes Académiques by the Republic of France. His research interests are in the area of mechanical behavior of materials with emphasis on dynamic deformation and failure, biomaterials and cell mechanics, and experimental mechanics. He has served as an associate editor of SEM's Journal, Experimental Mechanics, and ASME's Journal of Engineering Materials and Technology.

VICE-PRESIDENT

PETER AVITABILE

Dr. Peter Avitabile - Professor, Mechanical Engineering, Co-Director, Structural Dynamics and Acoustic Systems Laboratory, B.S.M.E., Manhattan College, M.S.M.E., University of Rhode Island, D.Eng., University of Massachusetts Lowell, Professional Engineer, Rhode Island. Pete has close to 40 years of experience in design and analysis using FEM and experimental techniques. His main area of research is structural dynamics specializing in the areas of modeling, testing and correlation of analytical and experimental models along with advanced applications for developing structural dynamic models. Pete has contributed over 200 technical papers in the area as well as his "Modal Space" article series in the Experimental Techniques magazine published by the Society for Experimental Mechanics. He is the 2004 recipient of the prestigious SEM DeMichele Award. He is recognized worldwide as an expert in structural dynamic modeling applications. He often provides consulting services for a wide variety industries in these specialty areas of expertise.

MEMBERS-AT-LARGE

F. NECATI CATBAS

Dr. F. Necati Catbas is a Professor in the Civil, Environmental and Construction Engineering Department of the University of Central Florida (UCF). He received B.S. and M.S. degrees from Bogazici University, Istanbul, Turkey and a Ph.D. degree from the University of Cincinnati where he started his involvement with SEM as a graduate student. Dr. Catbas spent more than five years at Drexel University in Philadelphia conducting research in the area of civil infrastructure systems before joining UCF in 2003. Dr. Catbas' research interests span theoretical, experimental and applied aspects of structural identification, structural health monitoring, non-destructive evaluation, condition assessment of structural systems. He has publications and research projects on the development, integration and implementation of sensing, information, modeling and simulation technologies, parametric and nonparametric structural identification, image-based monitoring technologies for structures such as bridges, buildings, aerospace structures and components, stadium structures. He serves as the Chair of SEM Dynamics of Civil Structures Technical Division. In addition, he is also the Chair of the American Society of Civil Engineers (ASCE) Structural Identification Technical Committee. He serves as the Secretary of Bridge Health Monitoring Committee of International Association for Bridge Maintenance and Safety (IABMAS), committee member of Transportation Research Board (TRB). He is an associate editor for the ASCE Journal of Structural Engineering and for the Structure and Infrastructure Engineering Journal. Dr. Catbas received several awards and honors for his research, teaching and service activities such as Selection for NAE EU-US Frontiers of Engineering Meeting; University Excellence in Graduate Teaching Award; Certificate of Recognition from the NASA Glenn Research Center; Inducted into the UCF Research Millionaire's Club. Dr. Catbas is a registered professional engineer in the State of Florida, and he is a Fellow of the American Society of Civil Engineers.

ROBERT GOLDSTEIN

Dr. Robert V. Goldstein is the head of the Laboratory on Mechanics of Strength and Fracture of Materials and Structures at the A.Yu. Ishlinsky Institute for Problems in Mechanics of the Russian Academy of Sciences, Moscow, Russia. He is also a Professor of Physics and the Soros Professor in Mathematics, Head of the Chair on Mechanics and Physics of Technological Processes in the K.E. Tsialkovsky State Technological University. His research activities have been essentially focused on mechanics of solids and its engineering applications, including elasticity, fracture mechanics, mechanics of materials, mechanics of large scale structures and components micro- and nanoelectronics, mechanics of ice and ice cover, rock mechanics. He was an invited scientist at the University of Stuttgart, Germany; University Pierre and Marie Curie (Paris VI), France; University of Helsinki, Finland; Politecnico di Torino, Italy; Clarkson University, Potsdam, USA; Royal Institute of Technology, Stockholm, Sweden. He has been a member of the editorial board of six scientific journals and has edited books and special issues of international scientific journals. He was recognized as the Honored scientist of the Russian Federation (2008); State Prize of the Russian Federation in Science and Techniques (2000); Order of Honor (1999); Medal "For Labor Powers" (1986). Robert Goldstein was elected as Corresponding Member of the Russian Ac. of Sci. (2008) and as Fellow Member of the European Ac. of Sci. (2009). Vice-President, International Congress on Fracture (2005-2009); Scientific Secretary, Scientific Council on Mechanics of the Russian Academy of Sciences (2004); Member, Executive Committee, International Congress on Fracture (2001); Member, Executive Committee, The European Structural Integrity Society (ESIS) (1997); Russian National Committee on the Theoretical and Applied Mechanics (1995); Honorary Fellow of the International Congress on Fracture (1993); Gesellschaft fur Angewandte Mathematik und Mechanik (1991); Int. Society for the Interaction of Mechanics and Mathematics (1990); Deputy - Head of the All-Union (now Russian) Scientific Council of Academy of Sciences on Strength and Plasticity (1985)

DANIEL RIXEN

Daniel Rixen received his Engineering and PhD degree in Electro-mechanics from the University of Liège (Belgium) and holds a MSc degree in Aerospace Vehicle Design from the Institute of Aeronautics in Cranfield (UK). He has worked as full Professor for twelve years at the Delft University of Technology (The Netherlands), on the chair for Engineering Dynamics. In 2012 he joined the Technische Universität München (Germany) where he is leading the Institute for Applied Mechanics.

SATORU YONEYAMA

Satoru Yoneyama is an Associate Professor in the Department of Mechanical Engineering at Aoyama Gakuin University, Japan. He received his B.S. and M.S. degrees in Mechanical Engineering from Aoyama Gakuin University in 1995 and 1997 respectively and Ph.D. degree in Mechanical and Control Engineering from Tokyo Institute of Technology in 2000. After several years of research assistant work at Wakayama University and Tokyo University of Science, he joined the faculty of Osaka Prefecture University in 2004 and returned to Aoyama Gakuin University in 2007 where he has been ever since. He received several awards from professional societies including the R.E. Peterson Award from SEM in 2002. His research interests include optical methods, image processing, viscoelasticity, inverse problems, fracture mechanics and contact mechanics. He was an Executive Board Member of the Japanese Society for Experimental Mechanics from 2007 to 2013. He has served as an associate technical editor of SEM's Journal, Experimental Mechanics, and the Journal of Japanese Society for Experimental Mechanics.

SEM

Experimentally Speaking...

EXECUTIVE BOARD NOMINATIONS

The individuals listed are the official choice of the SEM Nominating Committee. The Society's bylaws also provide for alternate nominations. Article IX, Section 4, of the SEM constitution states that, "A member may also be nominated by written petition of at least 75 members of the Society, and submitted to the Secretary, together with the member's consent to serve, if elected, at least 90 days prior to the Annual Business Meeting," (June 1, 2014 in Greenville, SC).

The Bylaws also provide that, if no additional nominations are submitted by the membership at large, the Secretary of the Society (in this case, the Executive Director) shall cast an affirmative vote on behalf of the membership at the Society's Annual Business Meeting.

7 School Street • Bethel, CT 06801

SEM