TECHNICAL PROGRAM

SPIE's 7th International Symposium on

Smart Structures and Materials, *p. 7*

SPIE's 5th International Symposium on

Nondestructive Evaluation and Health Monitoring of Aging Infrastructure, *p. 243*

FINAL SUMMARY DIGEST

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Welcome!

The organizers and executive committee's welcome you to the 2000 International Symposia on Smart Structures and Materials, and on Non-Destructive Evaluation Techniques for Aging Infrastructure and Manufacturing. We think there will be significant opportunities for mutually beneficial interactions between the two symposia.

Our primary objectives for joining these two symposia are to foster communication across a variety of technical disciplines and to encourage the interaction of disparate groups representing theoretical and experimental research, design, and process and product development, all for a broad range of applications.

Much progress has been made in the creation of structures that will continuously and actively monitor and optimize themselves and their performance though emulation of biological systems with their adaptive capabilities and their integrated designs. The Symposium for Smart Structures and Materials emphasizes the multi-/inter-disciplinary nature of the field and provides in-depth coverage of the most recent results in smart materials, sensing, actuation, communications, power, advanced computer processing, structural design methodologies, and system integration across a variety of applications.

The challenge of inspecting aging structures without impairing their usefulness has produced a variety of technologies for nondestructive evaluation (NDE). The NDE Techniques Symposium addresses the current status and future directions of NDE with respect to the testing and monitoring of high-use structures such as naval vessels; aircraft and airports; and civil structures such as dams, bridges, and highways. Also included in this NDE symposium are presentations on decision-making processes, such as when degradation requires repair or replacement; and possible methods for mitigation including practical technologies, instrumentation, techniques, and case studies.

Please join us along with hundreds of engineers and scientists from the military, commercial, and academic sectors to discuss these technologies and to initiate some collaborative interactions. These symposia provide a unique opportunity for interactions across an immense cross-section of work in these critical fields.

Janet M. Sater, Institute for Defense Analyses

Marc E. Regelbrugge, Rhombus Consultants Group
Smart Structures Symposium Chairs

George Y. Baaklini, NASA Glenn Research Ctr.

Steven R. Doctor, Pacific Northwest National Lab.
NDE Symposium Chairs

5–9 March 2000
Newport Beach Marriott Hotel and Tennis Club
Newport Beach, California USA

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The Society would like to express its deepest appreciation to the program chairs, conference chairs, cochairs, program committee members, and session chairs who have so generously given of their time and advice to make this symposium possible. The symposium, like our other conferences and activities, would not be possible without the dedicated contribution of our participants and members.

This program is based on commitments received up to the time of publication and is subject to change without notice.

Special Events

Sunday

9:00 am to 4:30 pm • Pacific Ballroom D

Smart Structures and Materials Technology Overviews

These Technology Overview sessions are intended to offer a top-level introduction to the various elements of Smart Structures and Materials technologies. Overviews are given by experts in each technical area who are also directly involved in the integration of these technologies into Smart Structures, Smart Materials, and Smart Systems. The overview sessions will cover:

9:00 to 9:45 am
Sensors
Speaker: Richard Claus, Virginia Polytechnic Institute and State Univ.

9:45 to 10:30 am
Smart Structures
Speaker: Jack Jacobs, Honeywell Space Systems

10:30 to 10:45 am • Coffee Break

10:45 to 11:30 am
Actuators
Speaker: Victor Giurgiutiu, University of South Carolina

11:30 to 12:15 am
Power Systems
Speaker: Douglas Lindner,
Virginia Polytechnic Institute and State Univ.

12:15 to 1:30 pm • Lunch

1:30 to 2:15 pm
Controls
Speaker: Daniel Inman, Virginia Polytechnic Institute and State Univ.

2:15 to 3:00 pm
Damping & Isolation
Speaker: Conor Johnson, CSA Engineering, Inc.

3:00 to 3:15 pm • Break

3:15 to 4:00 pm
MEMS
Speaker: Richard Singer, Institute for Defense Analyses

4:00 to 4:30 pm
Directions and Trends
Speaker: Marc Regelbrugge, Rhombus Consultants Group, Inc.

Monday

8:00 to 8:45 am • Pacific Ballroom C/D

Smart Structures and Materials Achievement Award

Presenter: **Janet M. Sater**,
Institute for Defense Analyses

Plenary Presentation

Gazing into the Crystal Ball: A Technologist's View of Future Defense Space Systems

Speaker: **Dr. Alok Das,**
Air Force Research Lab.

Biography: Alok Das received his Bachelor's Degree in Electronics and Communication Engineering at the Indian Institute of Science in Bangalore, India in 1976. He received his Master's Degree in Aeronautical Engineering from the same school in 1978. In 1982 he received his Ph.D. in Aerospace Engineering from the Virginia Polytechnic Institute and State University. Dr. Das, a member of the scientific and professional cadre of senior executives, is currently the senior scientist for space structures and control in the Space Vehicles Directorate at the Air Force Research Laboratory at Kirtland Air Force Base, N.M. He serves as the science and technology advisor to the director of space vehicles in the formulation, planning, and implementation of advanced concepts. Dr. Das is also a Fellow of the AIAA and author of over 50 technical papers and reports.

7:00 to 9:00 pm • Newport North

Technical Group Meeting

Smart Structures & Materials

Chair: **William B. Spillman,** Virginia Polytechnic Institute

Co-chair: **Inderjit Chopra,** Univ. Maryland/ College Park

The Smart Structures & Materials Technical Group will meet to hear presentations from the three finalists in the Best Student Paper Contest, sponsored by BFGoodrich Aerospace. Following the presentation, technical group members will vote to determine the winning paper. The winner will be announced before the plenary session on Thursday morning.

In addition, comments on and suggestions for the Smart Structures and Materials Technical Group web page will be discussed. All conference attendees are cordially invited to attend.

Tuesday

8:00 to 8:45 am • Pacific Ballroom C/D

Smart Structures Product Implementation Award

Presenter: **Dr. Jack H. Jacobs,** Honeywell Space Systems

Plenary Presentation

"20th Century Achievements in Smart Structures in Europe: What We Learned and What We Need to Do"

Speaker: **Dr. Christian Boller,**
DaimlerChrysler Aerospace (Germany)
Biography: Dr. Christian Boller studied civil engineering at Technische Hochschule (TH) at Darmstadt in Germany. He received his diploma in engineering in 1980 followed by a doctoral degree in engineering on a subject related to structural fatigue life evaluation in 1988. During 1984-85 he spent six months with the Fatigue Testing Division at the National Research Institute for Metals (NRIM) in Tokyo/Japan under a scholarship. From 1987-1990 he was a research engineer in materials technology at Battelle in Frankfurt, Germany. In 1990 Dr. Boller became a senior engineer at Daimler-Benz Aerospace (formerly MBB) Military Aircraft, in charge of smart structures and materials technology. He was on leave to the Daimler-Benz Research and Technology Exchange Group from 1994 to 1997. Since 1998 Dr. Boller has been the chief engineer of aircraft structures at DaimlerChrysler Aerospace Military Aircraft in Munich, Germany.

Wednesday

8:00 to 8:45 am • Pacific Ballroom C/D

Plenary Presentation

Recent Advances in University-Industry Collaborative Program on Structural Health Monitoring in Japan

Speaker: **Dr. Nobuo Takeda,** Univ. of Tokyo (Japan)

Biography: Dr. Takeda graduated with Bachelor's and Master's degrees in Aeronautics from The University of Tokyo in 1975 and 1977 respectively. He received a Ph.D. in Engineering Mechanics from the University of Florida in 1980 and a second Ph.D. in Aeronautics from The University of Tokyo in 1982. He has held positions at the Japan Atomic Energy Research Institute, the Research Institute for Applied Mechanics at Kyushu University, the Research Center for Advanced Science and Technology (RCAST) at The University of Tokyo, and the Center for Collaborative Research (CCR) at The University of Tokyo. Dr. Takeda is currently a Professor in the Department of Advanced Energy, Graduate School of Frontier Sciences, as well as in the Department of Aeronautics and Astronautics, Graduate School of Engineering, both at the University of Tokyo. He has published over 100 original journal articles and has received special awards from the Society for Experimental Mechanics, the Japan Society of Composite Materials, and the Reinforced Plastics Society of Japan.

Thursday

8:00 to 9:10 am • Pacific Ballroom C/D

Smart Structures Best Student Paper Award

Presenter: **Dr. William B. Spillman, Jr.,** Virginia Polytechnic Institute and State Univ.

Plenary Presentation

Successful Commercialization of New Technology through System Design Methods

Speaker: **Dr. Kenneth B. Lazarus,** Active Control eXperts, Inc.

Biography: Dr. Lazarus holds a Ph.D. in Aeronautics and Astronautics from MIT with a minor concentration in Strategic Management of Technological Innovation. He received a M.S degree from MIT and a Bachelor's degree in Mechanical Engineering and Material Science from Duke University. He is the author of numerous journal articles describing various aspects of his patented research work. Dr. Lazarus is President, CEO, and co-founder of Active Control eXperts (ACX), Inc. in Cambridge, MA. Under his leadership, the company has grown an average of over 50 percent per year since 1992. He has extensive experience in the design, development and marketing of innovative products which incorporate piezoelectric smart materials and active control technology. Dr. Lazarus is a member of the Tau Beta Pi Engineering Honor Society, the Sigma Xi Scientific Research Society, the AIAA and the ASME. He also participates in Inc.'s Eagles CEO Growth Group and serves on the Washington, DC-based Council on Competitiveness.

Plenary Presentation

Interdisciplinary Design: The Absentee in Smart Structures

Speaker: **Dr. Robert T. Skelton,** Univ. of California/San Diego

Biography: Robert E. Skelton began his career at the Marshall Space Flight Center, working first with Lockheed Missiles and Space Company and then Sperry Rand designing modern controllers for spacecraft. A major focus of his current research is on the integration of structure and control design. For this work he received the 1999 Norman Prize from The American Society of Civil Engineers. He is a Fellow of AIAA and IEEE. He was the 1991 Russell Severence Springer Professor, UC Berkeley. He received a Senior Scientist Award from the Alexander von Humboldt Foundation, and an award from the Japan Society for the Promotion of Science. For five years, he served on the National Research Council's Aeronautics and Engineering Board. He served on the External Independent Review Team for the second servicing mission of the Hubble Space Telescope, and is now serving on this team for the next servicing mission. He holds a patent on the control of tensegrity structures, which is a major focus of his recent work to integrate structures and control design. He has published three books.

8:00 to 9:10 am • Pacific Ballroom E/F

NDE Best Student Paper Award 1999 and NDE Achievement Award

Presenters: **Steven R. Doctor,** Pacific Northwest National Lab.; **George Y. Baaklini,** NASA Glenn Research Ctr.

Plenary Presentation

NDE and Structural Health Monitoring

Speaker: **Prof. Ajit K. Mal,** Univ. of Californai/ Los Angeles

Professor Ajit Mal received his Ph.D. from Calcutta University in 1965 and did post-doctoral research in Seismology (at UCLA) and Applied Mechanics (at UC Berkeley). He joined the UCLA Faculty as an Assistant Professor of Engineering in 1967, was promoted to Full Professor in 1974, and is currently Professor, Above Scale, a special rank reserved for "scholars and teachers of the highest distinction".

Professor Mal has been a teacher for over three decades, and has taught a variety of undergraduate and graduate courses both at UC Berkeley and UCLA. He has supervised 18 Ph. D. students, 18 post-doctoral scholars and over 10 MS students. He is the principal author of a definitive graduate text entitled "*Deformation of Elastic Solids,*" which is currently being used at a number of universities.

Professor Mal has made seminal research contributions in: scattering and diffraction of elastic waves from inclusions, cracks and corners; strong earthquake ground motion; micromechanical theories of wave propagation in fiber-reinforced composites; quantitative nondestructive evaluation (NDE) of composites, thin films and bonded joints, and characterization of materials degradation due to corrosion and fatigue in structural components. His research has been supported by a variety of governmental and industrial agencies. During 1993-1997, he was the Principal Investigator of a Multidisciplinary University Research Initiative (MURI), a major basic research grant awarded by the AFOSR, on "Characterization of Materials Degradation due to Corrosion and Fatigue in Aerospace Structures." Under his direction the MURI team developed a significant knowledge base required for the NDE of aging aircraft and aerospace structures using a variety of ultrasonic techniques. Practical implementation of this knowledge base should lead to the development of more accurate and efficient NDE of aging structures than is available at present. He has authored or co-authored over 150 journal and conference papers and co-edited seven symposium volumes.

Professor Mal is currently a member of the American Society of Mechanical Engineers (ASME), American Academy of Mechanics (AAM), American Society for Composites (ASC), American Society for Nondestructive Testing (ASNT) and the Society of Optical Engineering (SPIE).

Daily Schedule

Sunday	Monday	Tuesday	Wednesday	Thursday
Courses				
SC125 **Electroactive Polymers(EAP) as Emerging Actuators for Devices and Robotic Applications** *(Bar-Cohen)* 8:30 am to 5:30 pm		SC130 **GPR and Ultrasonic Techniques for Bridges, Pavements, and Building Components** *(Halabe)* 8:30 am to 5:30 pm		
SC126 **Active Structures for Vibration and Shape Control** *(Bronowicki)* 8:30 am to 5:30 pm				
SC127 **Microsensors and MEMS for Smart Structures** *(Varadan)* 8:30 am to 5:30 pm				
SC129 **Smart Structures: Theory and Applications** *(Chopra, Wereley)* 8:30am to 5:30 pm				
Conferences				
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	3985 Smart Structures and Integrated Systems, *p. 11*			
	3986 Sensory Phenomena and Measurement Instrumentation for Smart Structures and Materials, *p. 15*			
	3987 Electroactive Polymer Actuators and Devices (EAPAD), *p. 18*			
	3988 Smart Systems for Bridges, Structures, and Highways, *p. 21*			
	3989 Damping and Isolation, *p. 23*			
	3990 Smart Electronics and MEMS, *p. 26*			
		3991 Industrial and Commercial Applications of Smart Structures Technologies, *p. 28*		
	3992 Active Materials: Behavior and Mechanics, *p. 31*			
			3993 Nondestructive Evaluation of Aging Materials and Composites IV, *p.244*	
		3994 Nondestructive Evaluation of Aging Aircraft, Airports, and Aerospace Hardware IV, *p.246*		
		3995A Health Monitoring of the Highway Transportation Infrastructure, *p. 248*		
			3995B Utility and Pipeline Systems and Components, *p. 251*	
Special Events				
Smart Structures and Materials Technology Overviews	**Smart Structures and Materials Achievement Award**	**Smart Structures Product Implementation Award**	*SS/NDE Joint Plenary Presentation:* **Recent Advances in University-Industry Collaborative Program on Structural Health Monitoring in Japan** (Takeda)	**Smart Structures Best Student Paper Award**
	Plenary Presentation: **Gazing into the Crystal Ball: A Technologist's View of Future Defense Space Systems** (Das)	*Plenary Presentation:* **20th Century Achievements in Smart Structures in Europe: What We Learned and What We Need to Do** (Boller)		*Plenary Presentation:* **Successful Commercialization of New Technology through System Design Methods** (Lazarus)
		EXHIBIT • Visit the exhibit Tuesday-Wednesday *California Ballroom* Tuesday . . . . . 8:45 am to 4 pm Wednesday . . . . . 8:45 am to 4 pm		*Plenary Presentation:* **Interdisciplinary Design: The Absentee in Smart Structures** (Skelton)
				NDE Best Student Paper Award 1999 and **NDE Achievement Award**
				Plenary Presentation: **NDE and Structural Health Monitoring** (Mal)

General Information

Registration and Information Hours

Newport Beach Marriott Hotel & Tennis Club, Newport Beach, California

California Ballroom Registration Desk

Sunday 5 March . . . . . 7:30 am to 4 pm
Monday 6 March . . . . . 7:00 am to 4 pm
Tuesday 7 March . . . . . 7:00 am to 4 pm
Wednesday 8 March . . . . . 7:15 am to 4 pm
Thursday 9 March . . . . . 7:30 am to 11am

Speakers Audiovisual Desk Check-In Hours

California Ballroom Registration Area

Sunday through Thursday . . . . . 7:30 am to 5 pm

Speakers who have pre-ordered non-standard equipment are asked to report to the audiovisual desk upon arrival at the meeting to confirm equipment orders. Speakers will be responsible for delivering visual materials to the conference room and may obtain materials from the AV Room Monitor in the conference room immediately following the session.

Exhibit Hours

Two-Day Technical Exhibit • California Ballroom

Tuesday 7 March . . . . . 8:45 am to 4 pm
Wednesday 8 March . . . . . 8:45 am to 4 pm

Continental Breakfast

Breakfast breads and coffee will be served from 8:45 to 9:20 am Monday through Wednesday and 9:10 to 9:45 am Thursday for symposium attendees near SPIE Registration.

Coffee Breaks

Coffee will be served in the California Ballroom Foyer at the following times:

Sunday . . . . . 10 to 10:30 am; and 3 to 3:30 pm
Monday-Wednesday . . . . . 8:45 to 9:20 am, 3:10 to 3:40 pm
Thursday . . . . . 9:10 to 9:45 am, 3:10 to 3:40 pm
(Tuesday and Wednesday the breaks will be in the Exhibit Area)

Lunches

Daily . . . . . Noon to 1:30 pm

Daily lunch specials at the hotel will be available for attendees. You may also order off the regular menu.

Desserts

Dessert snacks will be served in the Exhibit area (California Ballroom) Tuesday and Wednesday from 1 to 1:30 pm. Complimentary tickets for the dessert snacks will be included in attendee registration packets.

Mexican Fiesta

Wednesday 8 March
7:00 pm

All attendees are invited to relax, socialize, and enjoy refreshments and a great Mexican Fiesta buffet-style dinner in the Pacific Ballroom. Dress is casual, and please wear your conference registration badge.

SPIE Bookstore

Open during registration hours, Sunday through Thursday.

SPIE publishes a variety of technical books designed to meet diverse research, reference, and educational needs. *Proceedings of SPIE* technical conferences from this and related meetings may be purchased at the bookstore. Also available are related books in the SPIE PRESS Series, including Tutorial Texts, Milestone Series of Selected Reprints, Critical Reviews in Science & Technology, and Monographs & Handbooks**.**

Poster Sessions

North Tower 3rd Floor

Monday and Tuesday . . . . . 6:00 to 7:30 pm

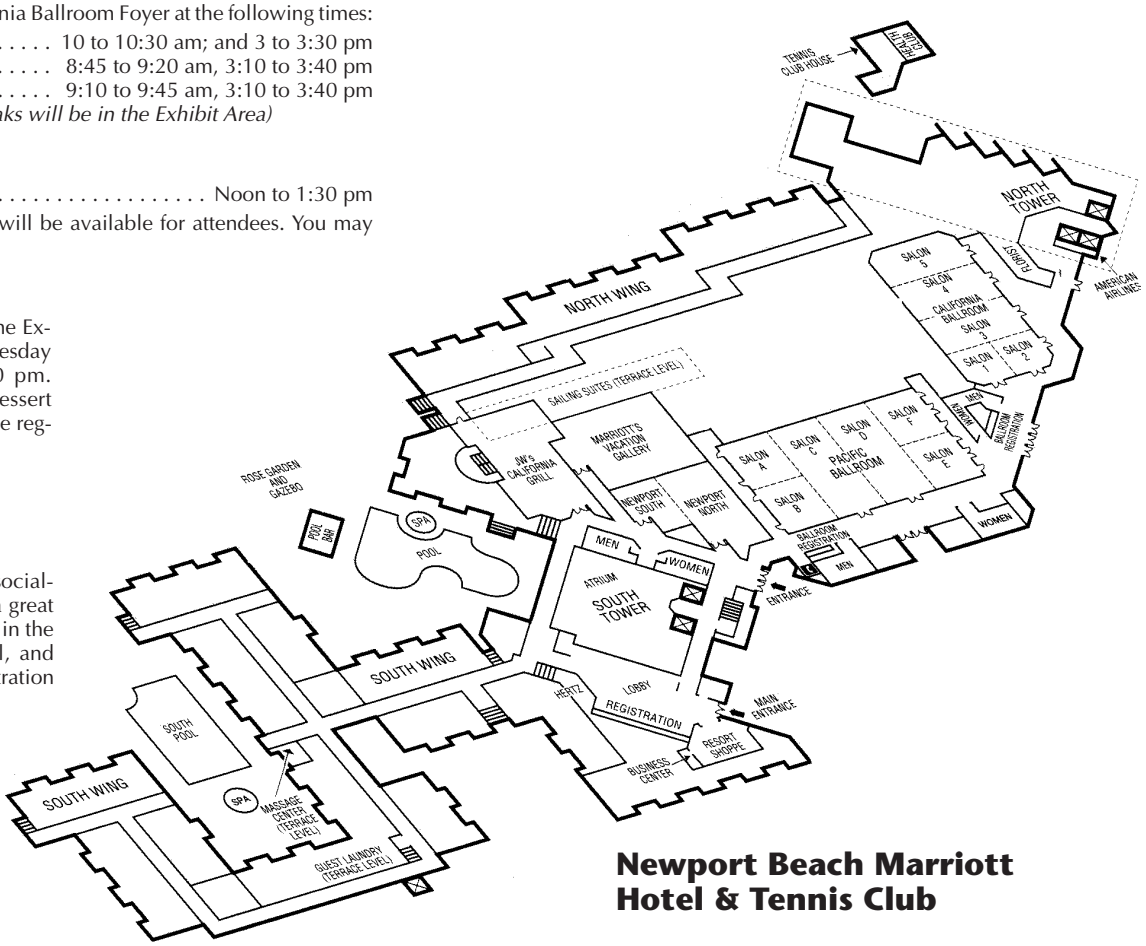
A joint poster session will be held on Monday and Tuesday evenings for all attendees of the Smart Structures and NDE symposia. Attendees will have an opportunity to view the poster papers and meet informally with the authors, who will be available to answer questions. Light Refreshments will be served. Attendees are requested to wear their conference registration badge.

NOTE: Poster authors will be able to set up their poster papers between 9 am and 3 pm on the day of their poster presentations. Poster papers can be previewed after 3 pm before the formal poster session begins at 6 pm.

Message Center

Newport Beach Marriott Hotel . . . . . Phone: 949-640-4000

The Message Center will be located at the Registration Desk. Ask the hotel operator to connect you to SPIE registration to leave a message. Messages will be taken during registration hours Sunday through Thursday. Please check the bulletin board at the message center daily to receive your messages.



Newport Beach Marriott Hotel & Tennis Club

Education Program

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CEUs Offered for Short Courses

The Continuing Education Unit®

SPIE awards CEUs (Continuing Education Units) to registrants who successfully complete short courses offered in this program. The CEU is a nationally recognized unit of measure for continuing education and training programs that meet certain criteria.

Successful completion is based on the participant's attendance and completion of the evaluation form. A record of each individual's completion will remain on file at SPIE.

The Education Services Department of SPIE—The International Society for Optical Engineering has been approved as a CEU User Member of the International Association for Continuing Education and Training (IACET: registration #1001635).

Electroactive Polymers and Artificial Muscle

Instructors: **Mohsen Shahinpoor, Yoseph Bar-Cohen, Siavouche Nemat-Naser, and Paul Calvert**
SC125: $340/$410 CEU 0.65
Sunday 8:30 am to 5:30 pm

Active Structures for Vibration and Shape Control

Instructor: **Allen Bronowicki**
SC126: $340/$410 CEU 0.65
Sunday 8:30 am to 5:30 pm

Microsensors and MEMS for Smart Structures

Instructors: **Vasundara Varadan and Vijay Varadan**
SC127: $445/$515 CEU 0.65
Sunday 8:30 am to 5:30 pm

Smart Structures: Theory and Applications

Instructors: **Inderjit Chopra and Norman Wereley**
SC129: $340/$410 CEU 0.65
Sunday 8:30 am to 5:30 pm

GPR and Ultrasonic Techniques for Bridges, Pavements, and Building Components

Instructor: **Udaya Halabe**
SC130: $340/$410 CEU 0.65
Tuesday 8:30 am to 5:30 pm

Register by Short Courses (SC Number)

1st price = SPIE Member/2nd price = Nonmember
CEU = Continuing Education Unit

Save 10% on Related SPIE Short Courses on Video

SPIE offers multiple access options! Not only do we offer a wide selection of videos related to the courses at Smart Structures, listed below, but any of our live courses can be brought directly to your company at your convenience. Contact **videos@spie.org** for more information.

	Video No.	Individual Price	Site License
Introduction to Optical Fiber Components and Systems (10 hrs., Corke)	VT0692	$650	$1,950
Fiber Optics Sensors: An Introduction for Engineers and Scientists (5 hrs., Udd)	VT1193	$400	$1,300
An Introduction to Fiber Optic Sensors (2 hrs., Udd)	FOV9501	$198	$445
Intensity Based Fiber Optic Sensors and the Fabry-Perot Fiber Sensor (2 hrs., Mitchell)	FOV9502	$198	$445
Fiber Optic Polarization and Bulk Grating Sensors (2 hrs., Spillman)	FOV9503	$198	$445
Optical Fiber Bragg Gratings: Principles and Applications (2 hrs., Brown & Zhang)	FOV9504	$198	$445
Applications of the Fiber Optic Sagnac Interferometer (2 hrs., Udd)	FOV9505	$198	$445
The Mach-Zender and Michelson Interferometers and Multiplexing (2 hrs., Kersey)	FOV9506	$198	$445
Distributed Fiber Optic Sensors (2 hrs., Dakin)	FOV9507	$198	$445
Fiber Optic Current Sensors (2 hrs., Blake)	FOV9508	$198	$445
Fiber Optic Sensors Based on the Faraday Effect (1 hr., Spillman)	FOV9511	$95	$330
Fiber Optic Smart Structures for Natural, Civil, and Aerospace Applications (2 hrs., Udd)	FOV9509	$198	$445
Fiber Optic Smart Civil Structures (2 hrs., Fuhr)	FOV9510	$198	$445

For a complete catalog, listing all of SPIE's available video and CD-ROM short courses and their descriptions, point to "education" on SPIE Web or call SPIE at 360/676-3290 or send e-mail to videos@spie.org

Technical Committee:

Gary L. Anderson, U.S. Army Research Office, *Army Representative*
Yaosheng Chen, Xi'an Institute of Optics and Precision Mechanics (China)
Inderjit Chopra, Univ. of Maryland/College Park
Yoseph Bar-Cohen, Jet Propulsion Lab.
Richard O. Claus, Virginia Polytechnic Institute and State Univ.
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Vasundara V. Varadan, The Pennsylvania State Univ.
Vijay K. Varadan, The Pennsylvania State Univ.
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Cooperating Organizations

Air Force Research Lab.
The Ceramic Society of Japan
Intelligent Materials Forum (Japan)

SPIE's 7th Annual International Symposium on

Smart Structures and Materials

Technical Conferences

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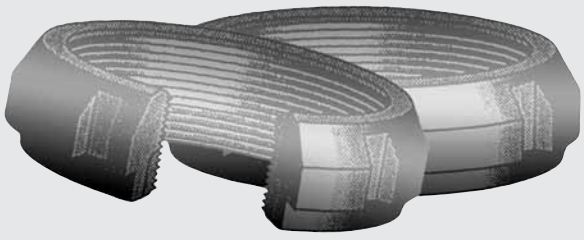

Conference 3984

Room: Pacific A/B

Monday–Thursday 6–9 March 2000 • *Proceedings of SPIE* Vol. 3984

Mathematics and Control in Smart Structures

Conference Chair: **Vasundara V. Varadan,** The Pennsylvania State Univ.

Cochair: **Vittal S. Rao,** Univ. of Missouri/Rolla

Program Committee: **Balakumar Balachandran,** Univ. of Maryland/College Park; **H. Thomas Banks,** North Carolina State Univ.; **Ulrich Gabbert,** Univ. Magdeburg (Germany); **Karolos M. Grigoriadis,** Univ. of Houston; **Hans Irschik,** Johannes Kepler Univ. Linz (Austria); **Qing Jiang,** Univ. of California/Riverside; **Narendra S. Khot,** Air Force Research Lab.; **Noboru Kikuchi,** Univ. of Michigan; **Jae-Kwon Kim,** Inha Univ. (Korea); **Sridhar Kota,** Univ. of Michigan; **Andrew J. Kurdila,** Univ. of Florida; **Reinhard Lerch,** Johannes Kepler Univ. Linz (Austria); **Liviu Librescu,** Virginia Polytechnic Institute and State Univ.; **Robert T. Skelton,** Univ. of California/San Diego; **Ralph C. Smith,** North Carolina State Univ.

Monday 6 March

Opening Remarks . . . . . 9:20 to 10:00 am

Open Problems in the Numerical Modeling of Microsensors
Vasundara V. Varadan, The Pennsylvania State Univ.

SESSION 1

Room: Pacific A/B . . . . . Mon. 10:00 am

Hybrid Numerical Methods I

Chair: **Reinhard Lerch,** Johannes Kepler Univ. Linz (Austria)

10:00 am: **Modeling of smart composites controlled by thin piezoelectric fibers,** U. Gabbert, H. Köppe, K. Fuchs, F. Seeger, Univ. Magdeburg (Germany) . [3984-01]

10:20 am: **Finite element analysis of the frequency response of a SAW bandpass filter,** G. Xu, Q. Jiang, Univ. of California/Riverside . . . . . [3984-02]

10:40 am: **Coupled FE/BE analysis for the active interior noise control problem,** G. V. Senthil, V. V. Varadan, V. K. Varadan, The Pennsylvania State Univ. . . . [3984-03]

SESSION 2

Room: Pacific A/B . . . . . Mon.11:00 am

Hybrid Numerical Methods II

Chair: **Ulrich Gabbert,** Univ. Magdeburg (Germany)

Invited Paper . . . . . 11:00 am

Finite element analysis of hysteresis effects in piezoelectric transducers, R. Simkovics, Friedrich Alexander Univ. Erlangen-Nürnberg (Germany); H. Landes, M. Kaltenbacher, R. Lerch, Johannes Kepler Univ. Linz (Austria) . . . . . [3984-04]

11:40 am: **Fuzzy finite element analysis of smart structures,** U. O. Akpan, T. S. Koko, I. R. Orisamolu, B. Gallant, Martec Ltd. (Canada) . . . . . [3984-06]

Lunch Break . . . . . 12:00 to 1:30 pm

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Invited Paper . . . . . 1:30 pm

Open problems in the control of smart structures, H. T. Banks, North Carolina State Univ. . . . . [3984-08]

SESSION 3

Room: Pacific A/B . . . . . Mon. 2:10 pm

Control Applications I

Chair: **Robert T. Skelton,** Univ. of California/San Diego

2:10 pm: **Design of robust controllers for smart structural systems with structured uncertainties,** S. Sana, V. S. Rao, Univ. of Missouri/Rolla . . . . . [3984-09]

2:30 pm: **Robust distrubance rejection for flexible mechanical structures,** M. Enzmann, C. Deschner, Univ. Magdeburg (Germany) . . . . . [3984-10]

2:50 pm: **Frequency weighted optimal vibration controller for smart panels,** W. Chang, V. V. Varadan, V. K. Varadan, The Pennsylvania State Univ. . . . [3984-11]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 4

Room: Pacific A/B . . . . . Mon. 3:40 pm

Noise Control

Chair: **Balakumar Balachandran,** Univ. of Maryland/College Park

3:40 pm: **Active noise suppression of smart panels including piezoelectric devices and absorbing materials,** J. Kim, B. Im, J. Lee, Inha Univ. (Korea) . . . . . [3984-12]

4:00 pm: **Actuator nonlinearities in interior acoustics control,** B. Balachandran, Univ. of Maryland/College Park . . . . . [3984-13]

4:20 pm: **Active structural acoustic control of a thick-walled cylindrical shell,** K. Song, M. J. Atalla, S. R. Hall, Massachusetts Institute of Technology . . [3984-14]

4:40 pm: **Acoustic signature reduction using feedback of piezoelectric layers,** J. Hamberg, A. Malmgren, Defense Research Establishment (Sweden) . . . [3984-15]

5:00 pm: **Broadband active structural-acoustic control of a fuselage testbed,** C. A. Savran, M. J. Atalla, S. R. Hall, Massachusetts Institute of Technology . . . [3984-17]

Tuesday 7 March

Invited Paper . . . . . 9:20 am

Modeling and control of magnetic materials: progress and challenges, P. S. Krishnaprasad, Univ. of Maryland/College Park . . . . . [3984-18]

SESSION 5

Room: Pacific A . . . . . Tues. 10:00 am

Hysteretic Materials I

Chair: **Ralph C. Smith,** North Carolina State Univ.

10:00 am: **Class of dynamic hysteresis operators and young measure representations,** A. J. Kurdila, J. Li, Univ. of Florida . . . . . [3984-19]

10:20 am: **Inverse compensation for hysteresis in smart material systems,** R. C. Smith, North Carolina State Univ.; R. L. Zrostlik, Etrema Products, Inc. . . [3984-20]

10:40 am: **Computational micromagnetics for magnetostrictive actuators,** X. Tan, J. S. Baras, P. S. Krishnaprasad, Univ. of Maryland/College Park . . . . . [3984-21]

SESSION 6

Room: Pacific A . . . . . Tues.11:00 am

Hysteretic Materials II

Chair: **Andrew J. Kurdila,** Univ. of Florida

11:00 am: **Modeling and robust active control of unbalanced rotors in anisotropic magnetic bearings,** O. Song, H. Kang, Choong-Nam National Univ. (Korea); L. Librescu, Virginia Polytechnic Institute and State Univ. . . . . [3984-22]

11:20 am: **Adaptive nonlinear control methodologies for hysteresis in PZT actuated on-blade elevons,** A. J. Kurdila, J. Li, L. Cattafesta, Univ. of Florida . . . . . [3984-23]

11:40 am: **Robust control of piezoelectric actuated systems with unknown hysteresis,** C. Su, J. Svoboda, Concordia Univ. (Canada) . . . . . [3984-24]

Noon: **Fast evaluation of demagnetizing field in three-dimensional micromagentics using multipole approximation,** X. Tan, J. S. Baras, P. S. Krishnaprasad, Univ. of Maryland/College Park . . . . . [3984-25]

Lunch/Exhibit Break . . . . . 12:20 to 1:30 pm

Invited Paper . . . . . 1:30 pm

Effects of electrical boundary conditions on domain switching near the crack tip in piezoceramics, C. Sun, Purdue Univ. . . . . [3984-26]

SESSION 7

Room: Pacific A . . . . . Tues. 2:10 pm

Modeling Applications

Chair: **Jaehwan Kim,** Inha Univ. (Korea)

2:10 pm: **Identification and control of a directly excited structural dynamic model of an F-15 tail section,** A. A. El-Badawy, A. H. Nayfeh, Virginia Polytechnic Institute and State Univ. . . . . [3984-27]

2:30 pm: **New method to obtain GRIN-lenses through numerical modeling,** H. Wern, M. Ringeisen, Univ. des Saarlandes (Germany) . . . . . [3984-07]

2:50 pm: **Evolution of material intelligence and survival strategies based on matter, energy, and geometry,** S. G. Popa, M. Shahinpoor, Univ. of New Mexico [3984-36]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 8

Room: Pacific A . . . . . Tues. 3:40 pm

Neural, Fuzzy, and Genetic Algorithms

Chair: **Seung-Bok Choi,** Inha Univ. (Korea)

3:40 pm: **Neural control and system identification using a similarity approach,** S. Brueckner, S. Rudolph, Univ. Stuttgart (Germany) . . . . . [3984-30]

4:00 pm: **Active vibration control of smart composite plates using self adaptive neuro-controller,** M. T. Valoor, K. Chandrashekhara, S. Agarwal, Univ. of Missouri/Rolla . . . . . [3984-31]

4:20 pm: **Genetic algorithms for optimal design and control of adaptive structures,** R. Ribeiro, S. da Mota Silva, Ctr. for European Nuclear Research (Switzerland) . . . . . [3984-32]

4:40 pm: **Real-time multiple-parameter tuning of PPF controllers for smart structures by genetic algorithm,** M. K. Kwak, S. Heo, Dongguk Univ. (Korea) . . . . . [3984-33]

5:00 pm: **Neuro-fuzzy model-based feedback controller for shape memory alloy actuators,** A. Kumagai, M. Kirkland, Wayne State Univ. . . . . [3984-34]

5:20 pm: **Novel approach to design a stable and robust fuzzy controller for a class of nonlinear systems,** H. Allamehzadeh, Eastern New Mexico Univ.; J. Y. Cheung, Univ. of Oklahoma . . . . . [3984-35]

✔Posters—Tuesday • Session 17

The following posters will be displayed in the formal poster session on Tuesday evening between 6:00 and 7:30 pm. Poster authors will be available at this time for discussion.

✔ **Eigen frequencies of a 3D piezoelectric cylinder,** G. Johansson, A. Bostrom, Chalmers Univ. of Technology (Sweden) . . . . . [3984-74]

✔ **Applications of the crack model to the piezoceramic microactuators with several degrees of freedom,** D. Homentcovschi, C. Dascalu, Romanian Academy (Romania); M. Ignat, Research and Development Institute for Electrical Engineering (Romania) . . . . . [3984-75]

✔ **Adaptive controllable structures using smart materials,** G. A. Amiryants, A. V. Krapivko, Y. M. Mullov, V. V. Nazarov, Central Aerohydrodynamics Institute (Russia) . . . . . [3984-76]

✔ **Sensor of vibrations based on acousto-optic interaction in single-mode optical fibers with birefringence,** I. G. Voitenko, Institute of Applied Optics (Belarus); M. Kimura, Tohoku-Gakuin Univ. (Japan) . . . . . [3984-78]

Wednesday 8 March

Invited Paper . . . . . 9:20 am

Mechanics and modeling of electroactive polymers, M. Shahinpoor, Univ. of New Mexico and Environmental Robots, Inc. . . . . [3984-37]

SESSION 9

Room: Pacific A . . . . . Wed. 10:00 am

Optimization Applications

Chair: **Liviu Librescu,** Virginia Polytechnic Institute and State Univ.

10:00 am: **Optimal design of smart tools for minimally invasive surgery,** D. J. Cappelleri, M. I. Frecker, T. Simpson, The Pennsylvania State Univ. . . . . [3984-38]

SESSION 10

Room: Pacific A . . . . . Wed.10:20 am

Shape Memory Alloys

Chair: **Ram Venkataraman,** Univ. of Maryland/College Park

10:20 am: **Impact loading of shape memory alloy (SMA) rods and their optimized vibration damping,** E. R. Oberaigner, F. D. Fischer, Univ. of Leoben (Austria); K. Tanaka, Tokyo Metropolitan Institute of Technology (Japan) . . . . . [3984-40]

10:40 am: **Design optimization methods for SMA-actuated reconfigurable airfoils,** D. C. Lagoudas, J. Strelec, M. A. Khan, J. Yen, Texas A&M Univ. . . . . [3984-41]

11:00 am: **Low Reynolds number flow control via active material actuators,** B. F. Carroll, L. Cattafesta, A. J. Kurdila, Univ. of Florida . . . . . [3984-42]

11:20 am: **Direct linearization of a mechanical system with pseudoelastic shape memory alloy,** L. D. Duval, M. N. Noori, Z. Hou, Worcester Polytechnic Institute; H. Davoodi, Univ. of Puerto Rico/Mayaguez . . . . . [3984-43]

11:40 am: **Robustness of a finite-strain superelastic model,** F. Auricchio, Univ. di Pavia (Italy) . . . . . [3984-79]

Lunch/Exhibit Break . . . . . Noon to 1:30 pm

SESSION 11

Room: Pacific A . . . . . Wed. 1:30 pm

Device/Systems Applications

Chair: **Karl Grosh,** Univ. of Michigan

1:30 pm: **Position tracking control of an optical pick-up using piezoceramic actuators,** S. B. Choi, H. K. Kim, S. C. Lim, J. H. Kim, Inha Univ. (Korea) . [3984-44]

1:50 pm: **Wing shaping for optimum roll performance using distributed-parameter-control equivalent actuation,** N. S. Khot, Air Force Research Lab.; H. Oz, The Ohio State Univ. . . . . [3984-45]

2:10 pm: **Topology optimization of the piezoelectric transducer element to improve acoustic power,** Y. Lin, K. Grosh, Univ. of Michigan . . . . . [3984-46]

2:30 pm: **Smart structure technology and applications in rotorcraft blades utilizing compliant mechanisms,** H. A. Al-Twaijry, S. Kota, Univ. of Michigan . . . . [3984-47]

2:50 pm: **Optimization of control laws for damage detection in smart structures,** L. R. Ray, S. Marini, Dartmouth College . . . . . [3984-48]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 12

Room: Pacific A . . . . . Wed. 3:40 pm

Control Applications II

Chair: **Gregory Washington,** The Ohio State Univ.

3:40 pm: **H-infinity controller design for a magnetostrictive acuator,** R. Venkataraman, P. S. Krishnaprasad, Univ. of Maryland/College Park . . [3984-49]

4:00 pm: **Uncertainty models for control of distributed MEMS arrays,** D. Gorinevsky, G. Stein, Honeywell Technology Ctr. . . . . [3984-50]

4:20 pm: **Driving linear structured uncertain system robustly to zero in a given time,** O. Ismail, Univ. of Aleppo (Syria) . . . . . [3984-51]

4:40 pm: **Measures of modal controllability and observability in balanced coordinates for optimal placement of sensors/actuators: a flexible structure application,** J. W. Choi, U. S. Park, Pusan National Univ. (Korea) . . . . . [3984-52]

5:00 pm: **Vibration and stability control of rotating smart composite shaft,** O. Song, Choong-Nam National Univ. (Korea); L. Librescu, Virginia Polytechnic Institute and State Univ. . . . . [3984-53]

5:20 pm: **Microcracking in piezoelectrics weakens the electromechanical coupling and changes its directionity,** M. Kachanov, I. Sevostianov, Tufts Univ. . . . [3984-80]

Thursday 9 March

Invited Paper . . . . . 9:45 am

NiTi, NiTiCu, NiTiPd, and NiMnGa based bimorph microactuators, M. Wuttig, Univ. of Maryland/College Park . . . . . [3984-56]

SESSION 13

Room: Pacific A/B . . . . . Thurs. 10:25 am

Materials Modeling

Chair: **Qing Jiang,** Univ. of California/Riverside

10:25 am: **Generation and attenuation of electro-elastic waves in active materials,** Q. Jiang, Univ. of California/Riverside; H. Sosa, Drexel Univ. . . . . [3984-57]

10:45 am: **Shear loss analysis for surface mount piezoceramic actuators,** R. N. Jacques, Active Control eXperts, Inc. . . . . [3984-58]

SESSION 14

Room: Pacific A . . . . . Thurs.11:05 am

Smart Composite Laminates

Chair: **Chin-Teh Sun,** Purdue Univ.

11:05 am: **Active control of sound radiation using surface bonded piezoelectric patches,** G. V. Senthil, V. V. Varadan, V. K. Varadan, The Pennsylvania State Univ. . . . . [3984-59]

11:25 am: **Analytical solution technique for multiple-patch piezoelectric sensor-actuator vibration control problems,** J. M. Sloss, J. C. Bruch, Jr., Univ. of California/Santa Barbara; I. S. Sadek, American Univ. of Sharjah (United Arab Emirates); S. Adali, Univ. of Natal (South Africa) . . . . . [3984-60]

11:45 am: **Vibration and dynamic response control of elastically tailored composite smart aircraft wings of nonuniform cross-section,** L. Librescu, Virginia Polytechnic Institute and State Univ.; S. Na, Korea Polytechnic Univ. (Korea) . . . . . [3984-61]

12:05 pm: **Active composite beam cross-section modeling,** C. E. S. Cesnik, M. Ortega-Morales, Massachusetts Institute of Technology . . . . . [3984-62]

Lunch Break . . . . . 12:25 to 1:30 pm

SESSION 15

Room: Pacific A . . . . . Thurs. 1:30 pm

Control Applications III

Chair: **Vittal S. Rao,** Univ. of Missouri/Rolla

1:30 pm: **Theory of localized vibration control via partitioned LQR synthesis,** K. C. Park, N. Kim, Univ. of Colorado/Boulder . . . . . [3984-63]

1:50 pm: **Implementation of full state derivative feedback control based on the reciprocal state space framework using smart materials,** G. Washington, S. Kwak, The Ohio State Univ. . . . . [3984-64]

2:10 pm: **Reconfigurable arrays of collocated sensors and actuators for modal isolation and feedback control,** M. L. Fripp, M. J. Atalla, N. W. Hagood, Massachusetts Institute of Technology . . . . . [3984-65]

2:30 pm: **Program for vibration control of variable thickness plates with piezoelectric sensors and actuators based on wavelet theory,** Y. Zhou, J. Wang, Lanzhou Univ. (China); Q. Jiang, Univ. of California/Riverside . . . . . [3984-66]

2:50 pm: **Control strategy for smart structures with soft sensor failures,** A. Manitius, N. Mutlu, George Mason Univ. . . . . [3984-67]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 16

Room: Pacific A . . . . . Thurs. 3:40 pm

Control Applications IV

Chair: **Vasundara V. Varadan,** The Pennsylvania State Univ.

3:40 pm: **Hierarchical local-global vibration control,** P. Konstanzer, B. Kroeplin, Univ. Stuttgart (Germany) . . . . . [3984-68]

4:00 pm: **Controlled continuous tuning of an adaptively tunable vibration absorber incorporating shape memory alloy,** K. A. Williams, G. T. Chiu, R. Bernhard, Purdue Univ. . . . . [3984-69]

4:20 pm: **Vibration distribution reconstruction and control of a thin plate by using distributed PVDF sensors affixed to the plate,** K. Nagayasu, N. Uchida, T. Hayashi, H. Takahashi, Toshiba Corp. (Japan) . . . . . [3984-70]

4:40 pm: **Active transmission and reflection coefficients for the control of flexural waves in beams,** R. de la Guardia Gonzalez, F. Orduna Bustamante, Univ. Nacional Autonoma de Mexico . . . . . [3984-71]

5:00 pm: **Adaptive gantry control strategies for x-ray steppers,** G. Sullivan, K. Suiter, D. R. Huston, Univ. of Vermont . . . . . [3984-72]

5:20 pm: **Modeling and simulation of multifunctional adaptive structures,** A. C. P. Furrow, M. B. Miller, R. L. Clark, Jr., Luna Innovations, Inc.; M. Hyer, M. Schultz, Virginia Polytechnic Institute and State Univ. . . . . [3984-73]

Standby Presentation

Eigen frequencies of a 3D piezoelectric cylinder, G. Johansson, A. Bostrom, Chalmers Univ. of Technology (Sweden) . . . . . [3984-74]

Conference 3985

Room: Schooner/Sloop • Thursday Concurrent Sessions in Catamaran
Monday–Thursday 6–9 March 2000 • *Proceedings of SPIE* Vol. 3985

Smart Structures and Integrated Systems

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Monday 6 March

SESSION 1

Room: Schooner/Sloop . . . . . Mon. 9:20 am

Helicopter Applications I

Chair: **Inderjit Chopra,** Univ. of Maryland/College Park

9:20 am: **Hover testing of a Mach-scaled rotor model with trailing-edge flaps,** N. A. Koratkar, I. Chopra, Univ. of Maryland/College Park . . . . . [3985-01]

9:40 am: **Development of a smart trailing-edge flap actuator with multistage stroke amplifier,** T. Lee, I. Chopra, Univ. of Maryland/College Park . . . . . [3985-02]

10:00 am: **Design and testing of a double x-frame piezoelectric actuator,** S. R. Hall, T. Tzianetopoulou, Massachusetts Institute of Technology; F. K. Straub, H. T. Ngo, Boeing Co. . . . . [3985-03]

10:20 am: **Closed-loop hover test results with a neurocontroller on a piezoactuated trailing-edge flap blade,** M. G. Spencer, R. M. Sanner, I. Chopra, Univ. of Maryland/College Park . . . . . [3985-04]

SESSION 2

Room: Schooner/Sloop . . . . . Mon. 10:40 am

Helicopter Applications II

Chair: **Friedrich K. Straub,** Boeing Co.

10:40 am: **Active control system for a rotor blade,** L. Reithler, M. Duvernier, J. Y. Guerrero, Aerospatiale Matra (France); J. Gaffierro, F. Lorin, Eurocopter (Germany) . . . . . [3985-05]

11:00 am: **Development of an SMA actuator for in-flight rotor blade tracking,** D. Kennedy, F. K. Straub, Boeing Co.; L. M. Schetky, Memry Technologies, Inc.; R. Roznoy, RL Design Group; Z. A. Chaudhry, Memry Technologies, Inc. . . [3985-06]

11:20 am: **Analytical and experimental investigations into active control of wave transmission through gearbox struts,** I. Pelinescu, B. Balachandran, Univ. of Maryland/College Park . . . . . [3985-07]

11:40 am: **Improved helicopter aeromechanical stability using segmented constrained layer damping and hybrid optimization,** Q. Liu, A. Chattopadhyay, Arizona State Univ. . . . . [3985-08]

Lunch Break . . . . . Noon to 1:30 pm

SESSION 3

Room: Schooner/Sloop . . . . . Mon. 1:30 pm

Aircraft Applications

Chair: **Aditi Chattopadhyay,** Arizona State Univ.

1:30 pm: **Neural net-based controller for flutter suppression using ASTROS* with smart structures,** C. Nam, Arizona State Univ.; P. C. Chen, ZONA Technology; D. Liu, A. Chattopadhyay, Arizona State Univ. . . . . [3985-10]

1:50 pm: **Belt-rib concept for variable-camber airfoils: recent developments,** L. F. Campanile, O. Seack, D. Sachau, DLR (Germany) . . . . . [3985-11]

2:10 pm: **Active and passive structural design concepts for improved empennage effectiveness of aircraft,** F. Weiss, J. Schweiger, DaimlerChrysler (Germany); T. Kullrich, Univ. der Bundeswehr München (Germany) . . . . . [3985-12]

2:30 pm: **Active control of composite box beams using in-plane piezoelectric actuation and structural coupling,** J. Koldoff, A. Chattopadhyay, C. Nam, Arizona State Univ. . . . . [3985-13]

2:50 pm: **Piezoelectric control of aeroelastic wing in unsteady transonic Euler flow,** S. J. Kim, S. M. Ryu, Seoul National Univ. (Korea) . . . . . [3985-14]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 4

Room: Schooner/Sloop . . . . . Mon. 4:00 pm

Robotics Applications

Chair: **Jahangir S. Rastegar,** SUNY/Stony Brook

4:00 pm: **Smart flexible microrobots for SEM applications,** F. Schmoeckel, S. Fatikow, Univ. Karlsruhe Technische Hochschule (Germany) . . . . . [3985-15]

4:20 pm: **Enhancement of the operating speed and accuracy of parallel and cooperating robots with smart materials,** J. S. Rastegar, L. Yuan, SUNY/Stony Brook . . . . . [3985-16]

4:40 pm: **Design and construction of a rotary ultrasonic motor with free stator,** P. Bouchilloux, Rensselaer Polytechnic Institute and Magsoft Corp.; B. Koc, K. Uchino, The Pennsylvania State Univ.; K. C. Craig, Rensselaer Polytechnic Institute . . . . . [3985-17]

5:00 pm: **Systematic method to enhance the operating speed and precision of mechanical systems with nonlinear dynamics using integrated smart actuators,** J. S. Rastegar, L. Yuan, SUNY/Stony Brook . . . . . [3985-18]

✔Posters—Monday • Session 17

The following posters will be displayed in the formal poster session on Monday evening between 6:00 and 7:30 pm. Poster authors will be available at this time for discussion.

✔ **Modeling and parametric study of a linear magnetorheological damper,** W. H. Li, G. Z. Yao, G. Chen, S. H. Yeo, F. F. Yap, Nanyang Technological Univ. (Singapore) . . . . . [3985-50]

✔ **Smart materials based on polyvinyl alcohol and water-soluble carbohymethyl cellulose,** T. G. Lazareva, S. A. Prodan, Institute of General and Inorganic Chemistry (Belarus) . . . . . [3985-90]

✔ **General theory of arbitrary laminated thin-walled smart actuators,** N. N. Rogacheva, Institute for Problems in Mechanics (Russia) . . . . . [3985-91]

✔ **Smart system for distant measurement of the conditions on sea surface,** I. S. Andriesh, L. M. Panasyuk, T. I. Pasechnik, R. S. Prilepov, D. V. Petruscha, N. G. Gheorghiu, State Univ. of Moldova (Moldova) . . . . . [3985-92]

✔ **Micromachined piezoelectric traveling wave micromotors,** J. Zhang, Nanyang Technological Univ. (Singapore); D. Shen, W. Wang, H. Gong, Shanghai Institute of Metallurgy (China) . . . . . [3985-93]

✔ **Some ultrasonic piezoceramic miniature robots,** M. Ignat, Research and Development Institute for Electrical Engineering (Romania) . . . . . [3985-94]

✔ **Use of piezoceramic transducers for smart structural testing,** B. Wang, R. Chen, National Pingtung Univ. of Science and Technology (Taiwan) . . . . . [3985-95]

✔ **Electrostrictive patches for active vibration control of thinplate host structures,** F. Pablo, B. Petitjean, ONERA (France) . . . . . [3985-96]

✔ **Monolithic iMEMS design for wise smart sensor chip,** S. Lee, M. M. Lee, H. B. Lee, J. Chung, S. Na, Dongshin Univ. (Korea) . . . . . [3985-97]

✔ **Active stabilization of cylindrical shell buckling,** E. P. Calius, Industrial Research Ltd. (New Zealand) . . . . . [3985-98]

✔ **Three-dimensional finite elements analysis of composite patches with structurally integrated fiber optic sensing,** G. J. Tsamasphyros, N. K. Furnarakais, G. N. Kanderakis, National Technical Univ. of Athens (Greece); Z. P. Marioli-Riga, Hellenic Aerospace Industry Ltd. (Greece) . . . . . [3985-99]

✔ **Modeling and electrode optimization for torsional IDE piezoceramics,** D. J. Warkentin, Active Control eXperts, Inc. . . . . [3985-102]

✔ **Use of smart materials technologies in radiation environment and nuclear industry,** V. Giurgiutiu, A. Zagrai, Univ. of South Carolina; K. A. Dunn, Westinghouse Savannah Rivier Co.; M. R. Louthan, Jr., N. C. Iyer, Westinghouse Savannah River Co. . . . . [3985-103]

✔ **Plate vibration modes identification by using piezoelectric sensors,** J. K. Song, G. Washington, The Ohio State Univ. . . . . [3985-104]

✔ **Smart structure-based architectures for the active sound radiation control from plates,** A. Concilio, L. De Vivo, M. Inverno, CIRA SpA (Italy) . . . . . [3985-105]

✔ **Active control strategies for noise transmission into a double-walled enclosure,** A. K. Grewal, D. G. Zimcik, National Research Council Canada . . . . [3985-106]

Tuesday 7 March

SESSION 5

Room: Schooner/Sloop . . . . . Tues. 9:20 am

Magnetostriction

Chair: **Alison B. Flatau,** National Science Foundation

9:20 am: **Model for the delta-E effect in magnetostrictive transducers,** M. J. Dapino, Iowa State Univ.; R. C. Smith, North Carolina State Univ.; A. B. Flatau, National Science Foundation . . . . . [3985-19]

9:40 am: **Flutter suppression of composite skin panels using magnetostrictive material,** A. Barai, Engineering Mechanics Research Corp. (India); M. Kumar, S. Pradeep, Indian Institute of Science (India) . . . . . [3985-20]

10:00 am: **Experimental and numerical activities on damage detection using magnetostrictive actuators and statistical analysis,** E. Monaco, G. Calandra, L. Lecce, Univ. degli Studi di Napoli Federico II (Italy) . . . . . [3985-22]

SESSION 6

Room: Schooner/Sloop . . . . . Tues. 10:20 am

Large Deflection Actuators

Chair: **George A. Lesieutre,** The Pennsylvania State Univ.

10:20 am: **Design and performance of a high-force, high-displacement, rolling wedge actuator,** G. H. Koopmann, J. E. Frank, G. A. Lesieutre, W. Chen, The Pennsylvania State Univ. . . . . [3985-23]

10:40 am: **Experimental validation of an injection-molded d_{31} telescopic piezoelectric actuator,** P. W. Alexander, D. E. Brei, Univ. of Michigan; R. L. Gentilman, G. E. Schmidt, P. T. McGuire, J. R. Hollenbeck, Materials Systems Inc. . . . . [3985-24]

11:00 am: **Design and experimental evaluation of a piezoelectric xy stage,** F. Barillot, R. Le Letty, F. Claeyssen, N. Lhermet, Cedrat Recherche (France); M. Yorck, SI IKOSS BV (Netherlands); P. Bouchilloux, Rensselaer Polytechnic Institute and Magsoft Corp. . . . . [3985-25]

11:20 am: **Large twisting of beams using shape-memory alloy wire,** D. Onipede, Jr., G. Sterlacci, Univ. of Pittsburgh . . . . . [3985-26]

11:40 am: **Impact detection for smart automotive damage mitigation systems,** S. M. Peelamedu, N. G. Naganathan, Univ. of Toledo . . . . . [3985-100]

Lunch/Exhibit Break . . . . . Noon to 1:30 pm

SESSION 7

Room: Schooner/Sloop . . . . . Tues. 1:30 pm

Health Monitoring I

Chair: **Darryll J. Pines,** Univ. of Maryland/College Park

1:30 pm: **Vibration separation methodology for planetary gear health monitoring,** P. Samuel, Univ. of Maryland/College Park; D. Lewicki, Army Research Lab.; D. J. Pines, Univ. of Maryland/College Park . . . . . [3985-27]

1:50 pm: **Damage detection in composite structures using embedded composite piezoelectric sensors,** P. Blanas, E. J. Rigas, Army Research Lab.; D. K. Das-Gupta, Univ. of Wales Bangor (UK) . . . . . [3985-28]

2:10 pm: **Damage detection in composite materials using optical fibers: recent advances in signal processing,** W. J. Staszewski, Univ. of Sheffield (UK); I. J. Read, P. D. Foote, British Aerospace (UK) . . . . . [3985-29]

2:30 pm: **Locating structural damage using operational deflection shapes,** F. Pai, S. Jin, Univ. of Missouri/Columbia . . . . . [3985-30]

2:50 pm: **Damage detection using modal strain energy and laser vibrometer measurements,** A. W. Otieno, B. Tennetti, V. S. Rao, L. R. Koval, Univ. of Missouri/Rolla . . . . . [3985-31]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 8

Room: Schooner/Sloop . . . . . Tues. 3:40 pm

Health Monitoring II

Chair: **Victor Giurgiutiu,** Univ. of South Carolina

3:40 pm: **Active sensors for health monitoring of aging aerospace structures,** V. Giurgiutiu, J. Bao, Univ. of South Carolina; J. M. Redmond, D. P. Roach, K. Rackow, Sandia National Labs. . . . . [3985-32]

4:00 pm: **Fault detection and damage arrest of spur gear pair vibrations,** D. A. Richards, D. J. Pines, Univ. of Maryland/College Park . . . . . [3985-33]

4:20 pm: **Long-term stability of normal condition data for novelty detection,** G. Manson, Univ. of Sheffield (UK); S. G. Pierce, Univ. of Strathclyde (UK); K. Worden, Univ. of Sheffield (UK) . . . . . [3985-34]

4:40 pm: **Application of self-diagnosis FRP to concrete pile for health monitoring,** H. Nishimura, T. Sugiyama, Chubu Electric Power Co., Inc. (Japan); Y. Okuhara, S. Shin, H. Matsubara, Japan Fine Ceramics Ctr. (Japan) . . . . . [3985-36]

5:00 pm: **Damage detection of satellite structures by optical fiber with small diameter,** S. Kabashima, T. Ozaki, Mitsubishi Electric Corp. (Japan); N. Takeda, Univ. of Tokyo (Japan) . . . . . [3985-37]

5:20 pm: **Concurrent use of magnetic bearing for rotor support and force sensing for the nondestructive evaluation of manufacturing processes,** M. Kasarda, Virginia Polytechnic Institute and State Univ.; J. Imlach, Imlach Consulting Engineering; P. A. Balaji, Virginia Polytechnic Institute and State Univ. . . . . [3985-108]

Wednesday 8 March

SESSION 9

Room: Schooner/Sloop . . . . . Wed. 9:20 am

Actuators

Chair: **Seung-Bok Choi,** Inha Univ. (Korea)

9:20 am: **Modeling of a Terfenol-D ultrasonic transducer,** M. J. Dapino, Iowa State Univ.; J. Slaughter, Etrema Products, Inc.; R. C. Smith, North Carolina State Univ.; A. B. Flatau, National Science Foundation . . . . . [3985-38]

9:40 am: **Time response of electron gun strain control of piezoelectric materials,** P. Hadinata, J. A. Main, Univ. of Kentucky . . . . . [3985-39]

10:00 am: **Multi-degree-of-freedom resonance actuators,** R. Bansevicius, Kaunas Univ. of Technology (Lithuania); A. Daugela, Hysitron, Inc.; M. Golbershtein, Galyn Design Co. . . . . [3985-40]

10:20 am: **Modeling the dynamic contact of stator/rotor in normal direction in traveling wave ultrasonic motors,** S. He, I. Chen, S. H. Yeo, Nanyang Technological Univ. (Singapore) . . . . . [3985-41]

SESSION 10

Room: Schooner/Sloop . . . . . Wed. 10:40 am

Space Applications

Chair: **Eric H. Anderson,** CSA Engineering, Inc.

10:40 am: **Micro-precision interferometer: pointing system solutions for on-orbit disturbance environment,** F. G. Dekens, G. W. Neat, Jet Propulsion Lab. [3985-42]

11:00 am: **Modeling electrostrictive deformable mirrors in adaptive optics systems,** C. L. Hom, S. R. Winzer, P. D. Dean, Lockheed Martin Advanced Technology Ctr. . . . . [3985-43]

11:20 am:**Active damping enhancement of smart space truss structures,** L. Zhang, Nanjing Univ. of Aeronautics and Astronautics (China) . . . . . [3985-45]

Lunch/Exhibit Break . . . . . 11:40 am to 1:30 pm

SESSION 11

Room: Schooner/Sloop . . . . . Wed. 1:30 pm

ER/MR Fluids and Devices

Chair: **John M. Ginder,** Ford Motor Co.

1:30 pm: **Controllable-stiffness devices based on magnetorheological elastomers,** J. M. Ginder, M. E. Nichols, L. D. Elie, S. M. Clark, Ford Motor Co. . . . . [3985-46]

1:50 pm: **Design and fabrication of a magnetorheological fluid automotive shock absorber,** J. E. Lindler, G. Dimock, N. M. Wereley, Univ. of Maryland/College Park . . . . . [3985-47]

2:10 pm: **Control and response characteristics of a magnetorheological fluid damper for passenger vehicles,** S. B. Choi, H. S. Lee, S. R. Hong, H. G. Lee, C. C. Cheong, Inha Univ. (Korea) . . . . . [3985-48]

2:30 pm: **Bingham biplastic analysis of shear thinning and thickening in magnetorheological dampers,** G. Dimock, N. M. Wereley, Univ. of Maryland/College Park . . . . . [3985-49]

2:50 pm: **Optimization and control of a high-speed electro-rheological traversing mechanism,** A. R. Johnson, W. A. Bullough, J. Makin, Univ. of Sheffield (UK) . . . . . [3985-101]

Coffee Break . . . . . 3:10 pm to 3:40 am

SESSION 12

Room: Schooner/Sloop . . . . . Wed. 3:40 pm

Damping Control

Chair: **Roger Stanway,** Univ. of Sheffield (UK)

3:40 pm: **Smart fluid damping: shaping the force/velocity response through feedback control,** N. D. Sims, R. Stanway, D. J. Peel, W. A. Bullough, A. R. Johnson, Univ. of Sheffield (UK) . . . . . [3985-51]

4:00 pm: **Coupled building control using smart damping strategies,** R. E. Christenson, B. F. Spencer, Jr., Univ. of Notre Dame; E. A. Johnson, Univ. of Southern California . . . . . [3985-52]

4:20 pm: **Vibration control of a MR seat damper for commercial vehicles,** S. B. Choi, B. K. Lee, M. H. Nam, C. C. Cheong, Inha Univ. (Korea) . . . . . [3985-53]

4:40 pm: **Active tuning and coupling enhancement of piezoelectric vibration absorbers for variable-frequency harmonic excitations in MDOF mechanical systems,** R. Morgan, K. Wang, The Pennsylvania State Univ. . . . . [3985-54]

Thursday 9 March

Sessions 13A/14A/15A/16A/17A are concurrent with sessions 13B/14B/15B/16B/17B.

SESSION 13A

Room: Schooner/Sloop . . . . . Thurs. 9:45 am

Sensors and Estimation

9:45 am: **Behavior of an embedded piezoceramic actuator for Lamb waves generation in mechanical loading,** C. A. Paget, K. Levin, Aeronautical Research Institute of Sweden (Sweden) . . . . . [3985-55]

10:05 am: **Dynamic shape estimation using Kalman filtering,** P. S. Lively, M. J. Atalla, N. W. Hagood, Massachusetts Institute of Technology . . . . . [3985-56]

10:25 am: **Laser-generated Lamb waves in composite structures using an embedded fiber optic delivery system,** D. L. Balageas, ONERA (France); N. Jaroslavsky, Lambda Comunicacionces Opticas (Spain); M. Dupont, F. X. Lepoutre, D. L. Osmont, ONERA (France) . . . . . [3985-58]

SESSION 13B

Room: Catamaran . . . . . Thurs. 9:45 am

Manufacturing

Chair: **Balakumar Balachandran,** Univ. of Maryland/College Park

9:45 am: **Integrated manufacturing process for low-cost active fiber composites,** H. B. Strock, CeraNova Corp.; A. A. Bent, Continuum Control Corp. . . . . [3985-73]

10:05 am: **Integrated structure/control design of micro-positioner for boring bar tool insert,** G. P. O'Neal, Z. J. Pasek, B. Min, Y. Koren, Univ. of Michigan; P. Szuba, Lamb Technicon . . . . . [3985-74]

10:25 am: **Active deformable sheets: prototype implementation, modeling, and control,** H. Doumanidis, R. Lind, Tufts Univ.; N. Johnson, Visualization Technology Inc. . . . . [3985-75]

10:45 am: **Systematic design of displacement-amplifying mechanism for piezoelectric stacked actuators using topology optimization,** G. K. Lau, H. Du, Nanyang Technological Univ. (Singapore) . . . . . [3985-76]

Sessions 13A/14A/15A/16A/17A are concurrent with sessions 13B/14B/15B/16B/17B.

SESSION 14A

Room: Schooner/Sloop . . . . . Thurs. 11:05 am

Piezoactuators I

Chair: **Shoko Yoshikawa,** Active Control eXperts, Inc.

11:05 am: **Piezoelectrically driven hydraulic amplification microvalve for high-pressure high-frequency applications,** D. C. Roberts, N. W. Hagood, J. Carretero, H. Li, Massachusetts Institute of Technology; R. Mlcak, Boston Microsystems, Inc.; Y. Su, Massachusetts Institute of Technology . . . . . [3985-59]

11:25 am: **Networked rectenna array for smart material actuators,** S. H. Choi, NASA Langley Research Ctr.; K. D. Song, Norfolk State Univ. . . . . [3985-60]

11:45 am: **Experimental validation of an improved ultrasonic traveling-wave motor model that accounts for rotor flexibility,** T. S. Glenn, N. W. Hagood, Massachusetts Institute of Technology . . . . . [3985-61]

12:05 pm: **Piezoelectric motors/rotary inchworm devices based on torsional actuator,** C. Kim, Naval Research Lab.; A. Glazounov, Univ. Karlsruhe Technische Hochschule (Germany); Q. Zhang, The Pennsylvania State Univ. . . . . [3985-62]

Lunch Break . . . . . 12:25 to 1:30 pm

SESSION 15A

Room: Schooner/Sloop . . . . . Thurs. 1:30 pm

Piezoactuators II

Chair: **David J. Warkentin,** Active Control eXperts, Inc.

1:30 pm: **Integration of autonomous fatigue crack detection and vibration control in smart plates,** L. R. Ray, B. Koh, Dartmouth College . . . . . [3985-63]

1:50 pm: **Hysteresis behavior and modeling of piezoceramic actuators,** X. Zhou, A. Chattopadhyay, Arizona State Univ. . . . . [3985-64]

2:10 pm: **Actuator environmental stability,** S. Yoshikawa, M. Farrell, E. Saarmaa, Active Control eXperts, Inc. . . . . [3985-65]

2:30 pm: **Analysis of a smart linear piezoelectric transducer,** K. A. Seffen, Univ. of Manchester (UK) . . . . . [3985-66]

2:50 pm: **Theoretical and experimental investigation of significant characteristic parameters of piezoelectrical actuators,** J. Duparrè, P. Buecker, B. Goetz, T. Martin, Piezosystem Jena GmbH (Germany) . . . . . [3985-67]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 16A

Room: Schooner/Sloop . . . . . Thurs. 3:40 pm

Modeling and Control

Chair: **Gregory P. Carman,** Univ. of California/Los Angeles

3:40 pm: **Modeling of finger-like FGM piezoelectric actuator,** A. Almajid, S. W. Hudnut, M. Taya, Univ. of Washington . . . . . [3985-68]

4:00 pm: **Simulation techniques for piezoelectric composite materials and their application to smart structures,** M. Sester, C. Poizat, Fraunhofer-Institut für Werkstoffmechanik (Germany) . . . . . [3985-69]

4:20 pm: **Application of the modal space self-tuning regulator for flexible structures,** J. F. Schultze, H. Kucuk, Michigan Technological Univ. . . . . [3985-70]

4:40 pm: **FEA-based impedance method for designing active structures,** A. G. Littlefield, K. C. Craig, Rensselaer Polytechnic Institute . . . . . [3985-71]

5:00 pm: **Model reduction for active vibration control,** P. Henriot, M. Verg, G. Coffignal, Ecole Nationale Supérieure d'Arts et Metiers de Paris (France) . [3985-72]

SESSION 14B

Room: Catamaran . . . . . Thurs. 11:05 am

Vibration Control of Panels

Chair: **Gregory Washington,** The Ohio State Univ.

11:05 am: **Sensor/actuator optimal design for active vibration control of shell structure,** S. J. Kim, J. Hwang, J. Mok, Seoul National Univ. (Korea) . . . . [3985-77]

11:25 am: **Modeling, design, and experimental testing of piezoelectric actuator/sensor panel for active vibration control,** A. Curtis, D. Fiore, Materials Systems Inc. . . . . [3985-78]

11:45 am: **Deflection control of a smart composite plate using neural network and genetic algorithm,** A. Jha, Virginia Polytechnic Institute and State Univ.; P. K. Sinha, Indian Institute of Technology (India) . . . . . [3985-79]

12:05 pm: **Integrated structures: control optimization of a smart composite plate with segmented active constrained layer damping,** R. Beri, A. Chattopadhyay, C. Nam, Arizona State Univ. . . . . [3985-80]

Lunch Break . . . . . 12:25 to 1:30 pm

SESSION 15B

Room: Catamaran . . . . . Thurs. 1:30 pm

Novel Actuators and Applications

Chair: **Nesbitt W. Hagood,** Massachusetts Institute of Technology

1:30 pm: **Microhydraulic transducer technology for actuation and power generation,** N. W. Hagood, D. C. Roberts, K. S. Breuer, J. Carretero, K. Chen, F. Ganji, H. Li, Massachusetts Institute of Technology; R. Mlcak, Boston Microsystems, Inc.; S. W. Pulitzer, L. Saggere, M. Schmidt, M. Spearing, Y. Su, Massachusetts Institute of Technology . . . . . [3985-81]

1:50 pm: **Design and realization of frequency agile piezoceramic transducers,** J. Bernard, G. A. Lesieutre, The Pennsylvania State Univ. . . . . [3985-82]

2:10 pm: **Air flow control of miniature fuel cell systems,** D. J. Leo, Virginia Polytechnic Institute and State Univ. . . . . [3985-83]

2:30 pm: **Design and testing of a mesoscale actuator device (MAD),** J. Park, G. P. Carman, H. T. Hahn, Univ. of California/Los Angeles . . . . . [3985-84]

2:50 pm: **Piezoelectric hydraulic pump development,** L. D. Mauck, C. S. Lynch, Georgia Institute of Technology . . . . . [3985-85]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 16B

Room: Catamaran . . . . . Thurs. 3:40 pm

Identification

Chair: **Gregory S. Agnes,** Air Force Institute of Technology

3:40 pm: **Response of graphite/epoxy laminates embedded with piezoelectric sensor under fatigue loading,** S. Mall, Air Force Research Lab. . . . . [3985-86]

4:00 pm: **Structural health monitoring using parameter identification methods,** P. Liu, A. W. Otieno, V. S. Rao, Univ. of Missouri/Rolla . . . . . [3985-87]

4:20 pm: **Modal testing of an inflatable structure using adaptive materials,** G. S. Agnes, J. Rogers, Air Force Institute of Technology . . . . . [3985-88]

4:40 pm: **Three-dimensional swing-free control of shipboard crane payloads in heavy seas,** K. N. Groom, Sandia National Labs.; G. G. Parker, Michigan Technological Univ.; R. D. Robinett III, Sandia National Labs.; F. Leban, Naval Surface Warfare Ctr. . . . . [3985-89]

Conference 3986

Room: Pacific E/F
Monday–Wednesday 6–8 March 2000 • *Proceedings of SPIE* Vol. 3986

Sensory Phenomena and Measurement Instrumentation for Smart Structures and Materials

Conference Chairs: **Richard O. Claus, William B. Spillman, Jr.,** Virginia Polytechnic Institute and State Univ.

Cochairs: **E. J. Friebele,** Naval Research Lab.; **Jeffrey N. Schoess,** Honeywell Technology Ctr.; **James S. Sirkis,** Univ. of Maryland/College Park

Program Committee: **Yaosheng Chen,** Xi'an Institute of Optics and Precision Mechanics (China); **Xiaoyi Bao,** Univ. of New Brunswick (Canada); **Kim D. Bennett,** Lafayette College; **Brian Culshaw,** Univ. of Strathclyde (UK); **Peter D. Dean,** Lockheed Martin Missiles & Space; **Carolyn M. Dry,** Univ. of Illinois/Urbana-Champaign; **Carvel E. Holton,** Virginia Polytechnic Institute and State Univ.; **Dryver R. Huston,** Univ. of Vermont; **Daniele Inaudi,** SMARTEC SA (Switzerland); **Mark S. Miller,** BFGoodrich Aerospace; **Christopher P. Nemarich,** Naval Surface Warfare Ctr./Carderock Div.; **Pieter L. Swart,** Rand Afrikaans Univ. (South Africa); **Eric Udd,** Blue Road Research

Monday 6 March

SESSION 1

Room: Pacific E/F . . . . . Mon. 9:20 am

New Concepts

Chairs: **Richard O. Claus, William B. Spillman, Jr.,** Virginia Polytechnic Institute and State Univ.

9:20 am: **From sensitive textile to distributed wearable sensors,** D. De Rossi, A. Mazzoldi, Univ. degli Studi di Pisa (Italy) . . . . . [3986-01]

9:40 am: **Fuzzy sensors: the development of inexpensive structurally compatible sensor elements,** S. M. Walsh, F. Goetz, E. J. Rigas, Army Research Lab. . [3986-02]

10:00 am: **Generation of a steerable ultrasonic beam using embedded fiber optic delivery and low power laser sources,** C. Swift, S. G. Pierce, B. Culshaw, Univ. of Strathclyde (UK) . . . . . [3986-03]

10:20 am: **Mach-Zehnder optical fiber interferometers for ultrasonic detection,** K. Atherton, F. Dong, S. G. Pierce, B. Culshaw, Univ. of Strathclyde (UK) . . . [3986-04]

10:40 am: **Nanocavity self-assembled interferometric optical sensors,** F. J. Arregui, I. R. Matias, Univ. Publica de Navarra (Spain); Y. Liu, K. Cooper, NanoSonic Inc.; R. O. Claus, W. B. Spillman, Jr., Virginia Polytechnic Institute and State Univ. . [3986-05]

11:00 am: **Electro-optic polymer sampler using the optical probe beam of 0.53-μm wavelength,** M. Yi, D. Zhang, K. Chen, A. Hou, H. Zhang, Jilin Univ. (China) . . . . . [3986-06]

11:20 am: **High-resolution signal demodulator for white light interferometric sensing systems for smart structures,** W. B. Spillman, Jr., Z. Luo, W. Zhao, Virginia Polytechnic Institute and State Univ. . . . . [3986-07]

11:40 am: **Multimode Bragg grating sensors,** W. Zhao, R. O. Claus, Virginia Polytechnic Institute and State Univ. . . . . [3986-08]

Lunch Break . . . . . Noon to 1:30 pm

SESSION 2

Room: Pacific E/F . . . . . Mon. 1:50 pm

Applications and Manufacturing

Chairs: **Jeffrey N. Schoess,** Honeywell Inc.; **Mark S. Miller,** BFGoodrich Aerospace

1:50 pm: **Development and application of stress-wave acoustic diagnostics for roller bearings,** J. N. Schoess, Honeywell Inc. . . . . [3986-09]

2:10 pm: **Wavelet-based acoustic emission detection method with adaptive thresholding,** S. Menon, R. Hamza, D. Busch, J. N. Schoess, Honeywell Technology Ctr. . . . . [3986-11]

2:30 pm: **Acoustic emission classification for failure prediction due to mechanical fatigue,** V. Emamian, M. Kaveh, A. H. Tewfik, Univ. of Minnesota/ Twin Cities . . . . . [3986-12]

2:50 pm: **Damage and damaging impact monitoring by PZT sensors-based HUMS,** D. L. Osmont, M. Dupont, R. Gouyon, M. Lemistre, D. L. Balageas, ONERA (France) . . . . . [3986-13]

Coffee Break . . . . . 3:10 to 3:40 pm

3:40 pm: **Application of ultrasonic Lamb wave techniques to the evaluation of advanced composite structures,** S. G. Pierce, B. Culshaw, Univ. of Strathclyde (UK) . . . . . [3986-14]

4:00 pm: **Development and application of optical MEMS sensors,** M. L. Wilson, Honeywell Inc.; J. F. Korczynski, Jr., S. A. Mastro, Naval Surface Warfare Ctr. . . . . [3986-16]

4:20 pm: **Development of small-diameter optical fiber sensors for damage detection in composite laminates,** K. Satori, Y. Ikeda, Y. Kurosawa, A. Hongo, Hitachi, Ltd. (Japan); N. Takeda, Univ. of Tokyo (Japan) . . . . . [3986-17]

4:40 pm: **Real-time detection of impact load on composite laminates with embedded small-diameter optical fiber,** H. Tsutsui, T. Sanda, Kawasaki Heavy Industries, Ltd. (Japan); Y. Okabe, N. Takeda, Univ. of Tokyo (Japan) . . . . [3986-18]

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Tuesday 7 March

SESSION 3

Room: Pacific E/F . . . . . Tues. 9:20 am

Embedded Sensing and Applications I

Chairs: **Daniele Inaudi,** SMARTEC SA (Switzerland); **James S. Sirkis,** Univ. of Maryland/College Park

9:20 am: **Smart sensing of aviation structures with fiber-optic Bragg grating sensors,** M. N. Trutzel, O. Krumpholz, DaimlerChrysler (Germany); W. Gleine, DaimlerChrysler Aerospace AG (Germany) . . . . . [3986-19]

9:40 am: **Embedding of MEMS pressure and temperature sensors in carbon fiber composites: a manufacturing approach,** A. Javidinejad, S. P. Joshi, Univ. of Texas/Arlington . . . . . [3986-21]

10:00 am: **Characterization of mechanical vibrations in composite materials with a fiber optic multichannel interferometer,** J. A. Garcia-Souto, H. Lamela, Univ. Carlos III de Madrid (Spain) . . . . . [3986-22]

10:20 am: **Shape deposition manufacturing of smart metallic structures with embedded sensors,** X. C. Li, A. Golnas, F. B. Prinz, Stanford Univ. . . . . [3986-23]

10:40 am: **Measurement on corrosion using cladding-etched Bragg grating fiber with metal coating,** Y. L. Lo, H. Y. Lai, V. H. Tsao, National Cheng Kung Univ. (Taiwan) . . . . . [3986-24]

11:00 am: **Monitoring corrosion of steel in reinforced concrete via an optical waveguide sensing method,** X. M. Li, W. Chen, Y. Zhu, S. Huang, Chongqing Univ. (China) . . . . . [3986-25]

11:20 am: **Dynamic measurement of the ground strain with FBG sensors,** T. Sato, R. Honda, S. Shibata, Kyoto Univ. (Japan) . . . . . [3986-26]

Lunch/Exhibit Break . . . . . 11:40 am to 1:30 pm

SESSION 4

Room: Pacific E/F . . . . . Tues. 1:30 pm

Embedded Sensing and Applications II

Chairs: **Daniele Inaudi,** SMARTEC SA (Switzerland); **James S. Sirkis,** Univ. of Maryland/College Park

1:30 pm: **Self-diagnosis function of FRP containing electrically conductive phase,** Y. Okuhara, S. G. Shin, H. Matsubara, H. Yanagida, Japan Fine Ceramics Ctr. (Japan); N. Takeda, Univ. of Tokyo (Japan) . . . . . [3986-27]

1:50 pm: **Optical set-up development for the monitoring of structural dynamic behavior using SOFO sensors,** S. LLoret, Swiss Federal Institute of Technology (Switzerland); D. Inaudi, SMARTEC SA (Switzerland); B. Glisic, P. Kronenberg, S. Vurpillot, Swiss Federal Institute of Technology (Switzerland) . . . . . [3986-28]

SESSION 5

Room: Pacific E/F . . . . . Tues. 2:10 pm

Mechanics and NDE

Chairs: **Richard O. Claus,** Virginia Polytechnic Institute and State Univ.; **Peter D. Dean,** Lockheed Martin Advanced Technology Ctr.

2:10 pm: **Modeling and experimentation of a positioning system of SMA wires,** K. F. Lei, Y. Yam, Chinese Univ. of Hong Kong . . . . . [3986-29]

2:30 pm: **AE monitoring of nano scale fracture events,** A. Daugela, Hysitron, Inc. . . . . [3986-30]

2:50 pm: **Comparison of results from the modal transfer matrix method to coupled mode theory analysis in the simulation of long-period grating optical fiber sensors,** D. W. Nippa, M. C. Hastings, The Ohio State Univ. . . . . [3986-31]

Coffee Break . . . . . 3:10 to 3:40 pm

3:40 pm: **Quantitative evaluation of CFRP and CFGFRP hybrid composites as a maximum strain memory sensor,** D. Y. Song, N. Takeda, Univ. of Tokyo (Japan); K. Yoshioka, A. Kitano, Toray Industries, Inc. (Japan) . . . . . [3986-32]

4:00 pm: **Evaluation of the limit energy to failure in fatigue testing,** A. Risitano, A. L. Geraci, G. A. Fargione, L. Maiolino, Univ. di Catania (Italy) . . . . . [3986-33]

4:20 pm: **Strength and failure mechanisms of polyimide-coated optical fibers,** A. Skontorp, Aeronautical Research Institute of Sweden (Sweden) . . . . . [3986-34]

SESSION 6

Room: Pacific E/F . . . . . Tues. 4:40 pm

Bragg Sensors and Applications I

Chairs: **Eric Udd,** Blue Road Research; **Kim D. Bennett,** Lafayette College

4:40 pm: **Multidimensional strain field measurements using fiber optic grating sensors,** E. Udd, W. L. Schulz, J. M. Seim, Blue Road Research; E. Haugse, A. Trego, P. E. Johnson, Boeing Co./Phantom Works; D. V. Nelson, A. Makino, Stanford Univ. . . . . [3986-35]

5:00 pm: **Optical fiber Bragg gratings for tunnel surveillance,** P. M. Nellen, A. Frank, R. Brönnimann, U. J. Sennhauser, Swiss Federal Labs. for Materials Testing and Research (Switzerland) . . . . . [3986-36]

✔Posters—Tuesday • Session 11

The following posters will be displayed in the formal poster session on Tuesday evening between 6:00 and 7:30 pm. Poster authors will be available at this time for discussion.

✔ **New generation of fiber optic sensors for monitoring of structures,** F. Juneau, P. Choquet, Roctest Ltd. (Canada); B. Benmokrane, Univ. of Sherbrooke (Canada) . . . . . [3986-55]

✔ **Temperature and strain insensitive bending gauge for composite materials based on Bragg gratings written in D-type fibers,** F. M. Araujo, L. A. Ferreira, Instituto de Engenharia de Sistemas e Computadores (Portugal); J. L. Santos, Instituto de Engenharia de Sistemas e Computadores and Univ. do Porto (Portugal); F. Farahi, Univ. of North Carolina/Charlotte . . . . . [3986-56]

✔ **Alcohol detection based on semiconductor properties of SnO_2,** G. Telipan, Institutul de Cercetare si Proiectare Pentru Electrotehnica (Romania) . . [3986-57]

✔ **Infrared fluorescence of marked proteins in Langmuir-Blodgett films,** G. K. Chudinova, Photochemistry Ctr. (Russia); O. Kharitonova, M.V. Lomonosov Moscow State Academy of Fine Chemical Technology (Russia) . . . . . [3986-58]

✔ **Digital fiber optic sensors,** Y. Chen, Virginia Polytechnic Institute and State Univ.; Y. Liu, NanoSonic, Inc.; R. O. Claus, Virginia Polytechnic Institute and State Univ. . . . . [3986-59]

✔ **Signal processing techniques for white light interferometric sensing systems for smart structures,** W. B. Spillman, Jr., Virginia Polytechnic Institute and State Univ. . . . . [3986-60]

✔ **To measure random angles by LUPI and wedge plate,** P. Shu, K. B. Lim, National Univ. of Singapore; Z. Zhang, Harbin Institute of Technology (China) . [3986-61]

✔ **Optical fiber sensors for in-flight health monitoring,** J. Borinski, S. A. Meller, W. J. Pulliam, K. A. Murphy, Luna Innovations Inc.; J. A. Schetz, Virginia Polytechnic Institute and State Univ. and consultant for Luna Innovations Inc. . . . . [3986-62]

✔ **Monitoring of failure locations in ductile members,** K. Ichinose, K. Gomi, Tokyo Denki Univ. (Japan); K. Fukuda, Univ. of Tokyo (Japan); K. Taniuchi, Meiji Univ. (Japan) . . . . . [3986-63]

✔ **High-frequency ultrasonic wave detection using fiber Bragg gratings,** I. M. Perez, Naval Air Warfare Ctr.; H. Cui, Naval Air Warfare Ctr. and Stevens Institute of Technology; E. Udd, Blue Road Research . . . . . [3986-64]

✔ **High-sensitivity electrical TDR distributed strain sensor,** M. W. Lin, A. O. Abatan, Y. Zhou, Clark Atlanta Univ. . . . . [3986-65]

✔ **Investigation of transverse stress measurements by using embedded optical fiber sensors subjected to Host Poisson's Effect,** C. C. Chang, M. LeBlanc, Naval Research Lab.; S. T. Vohra, Lucent Technologies/Bell Labs. . . . . [3986-66]

✔ **Development of fiber Bragg grating-based soil pressure transducer for pavement response meausrement,** C. C. Chang, G. Johnson, B. Althouse, Naval Research Lab.; S. T. Vohra, Lucent Technologies/Bell Labs. . . . . [3986-67]

✔ **Signal processing algorithm of newly developed transmission-type extrinsic Fabry-Perot interometric optical fiber sensor,** S. H. Kim, J. J. Lee, Korea Advanced Institute of Science and Technology (Korea); I. B. Kwon, Korea Research Institute of Standards and Science (Korea) . . . . . [3986-68]

✔ **Reliability of ultrahigh sensitivity optical fiber sensors embedded in graphite composites,** K. R. Uleck, M. J. Fox, A. J. Vizzini, Univ. of Maryland/College Park; E. J. Friebele, H. J. Patrick, B. M. Wright, A. S. Greenblatt, E. A. Bolden, Naval Research Lab. . . . . [3986-69]

Wednesday 8 March

SESSION 7

Room: Pacific E/F . . . . . Wed. 9:20 am

Bragg Sensors and Applications II

Chairs: **Eric Udd,** Blue Road Research; **Kim D. Bennett,** Lafayette College

9:20 am: **Bragg grating-based multiaxial strain sensing: its application to residual strain measurement in composite laminates,** J. Guemes, J. M. Menendez, Univ. Politecnica de Madrid (Spain) . . . . . [3986-37]

9:40 am: **Detection of transverse cracks in composite by using embedded FBG sensors,** Y. Okabe, S. Yashiro, Univ. of Tokyo (Japan); T. Kosaka, Osaka City Univ. (Japan); N. Takeda, Univ. of Tokyo (Japan) . . . . . [3986-38]

10:00 am: **Fiber optic Bragg grating-based sensor for liquid hydrocarbon leak detection and localization,** V. V. Spirin, M. G. Shlyagin, S. V. Miridonov, E. Mitrani, J. Mendieta-Jiminez, A. M. Lucero, Centro de Investigacion Cientifica y de Educacion Superior de Ensenada . . . . . [3986-39]

10:20 am: **Integrated Bragg gratings for on-line characterization of a thermoset polymer-matrix composite,** G. Breglio, Univ. degli Studi di Napoli Federico II (Italy); A. Calabro, Italian Aerospace Research Ctr. (Italy); M. Giordano, L. Nicolais II, G. Coppola, A. Cusano, A. Cutolo, Univ. degli Studi di Napoli Federico II (Italy) . . . . . [3986-40]

10:40 am: **Low-cost high-response fiber optic strain/temperature sensor with stabilization,** A. S. Parfenov, J. P. Singh, K. Balasubramaniam, Mississippi State Univ. . . . . [3986-41]

SESSION 8

Room: Pacific E/F . . . . . Wed. 11:00 am

Distributed Sensing and Applications I

Chairs: **Xiaoyi Bao,** Univ. of New Brunswick (Canada); **Brian Culshaw,** Univ. of Strathclyde (UK)

11:00 am: **New polarimetry for fully-distributed optical-fiber strain and temperature sensing,** A. J. Rogers, King's College London (UK) . . . . . [3986-42]

11:20 am: **Structural health monitoring of IACC yachts using fiber optic distributed strain sensors: a technical challenge for America's cup 2000,** H. Murayama, K. Kageyama, I. Kimpara, Univ. of Tokyo (Japan); A. Shimada, H. Naruse, Nippon Telegraph and Telephone Corp. (Japan) . . . . . [3986-43]

11:40 am: **Development of integrated damage detection system for international America's cup class yacht structures using a fiber optic distributed sensor,** A. Shimada, H. Naruse, Nippon Telegraph and Telephone Corp. (Japan); H. Murayama, K. Kageyama, Univ. of Tokyo (Japan); K. Uzawa, GH Craft Ltd. (Japan) . . . . . [3986-44]

Lunch/Exhibit Break . . . . . Noon to 1:30 pm

SESSION 9

Room: Pacific E/F . . . . . Wed. 1:30 pm

Distributed Sensing and Applications II

Chairs: **Xiaoyi Bao,** Univ. of New Brunswick (Canada); **Brian Culshaw,** Univ. of Strathclyde (UK)

1:30 pm: **Novel macrobend sensor structure base on selective launch of the fundamental mode in graded index multimode fiber,** D. Donlagic, Univ. of Maribor (Slovenia); B. Culshaw, Univ. of Strathclyde (UK) . . . . . [3986-45]

1:50 pm: **Distributed fiber optic sensors for humidity and hydrocarbon detection,** A. MacLean, S. G. Pierce, G. Thursby, B. Culshaw, C. Moran, N. B. Graham, Univ. of Strathclyde (UK) . . . . . [3986-46]

2:10 pm: **Optical frequency domain reflectometry for the interrogation of microbend-based optical fiber sensors,** S. G. Pierce, A. MacLean, B. Culshaw, Univ. of Strathclyde (UK) . . . . . [3986-47]

2:30 pm: **Characterization and application of FMCW coherence addressed quasi-distributed absorption sensors,** M. Zavrsnik, Univ. of Maribor (Slovenia); G. Stewart, Univ. of Strathclyde (UK) . . . . . [3986-48]

SESSION 10

Room: Pacific E/F . . . . . Wed. 2:50 pm

Signal Processing and Applications

Chairs: **William B. Spillman, Jr.,** Virginia Polytechnic Institute and State Univ.; **E. J. Friebele,** Naval Research Lab.

2:50 pm: **Instrumentation of a high-speed surface effect ship for structural response characterization during seatrials,** K. Pran, Forsvarets forskningsinstitutt (Norway); G. Johnson, Naval Research Lab.; A. E. Jensen, FiReCo AS (Norway); K. A. Hegstad, Marintek (Norway); G. Sagvolden, Y. Farsund, Forsvarets forskningsinstitutt (Norway); C. C. Chang, L. Malsawma, Naval Research Lab.; G. W. Wang, Forsvarets forskningsinstitutt (Norway) . . . . . [3986-49]

Coffee Break . . . . . 3:10 to 3:40 pm

3:40 pm: **Fiber optic sensor network for structural health monitoring,** A. Reutlinger, R. Graue, Kayser-Threde GmbH (Germany) . . . . . [3986-50]

4:00 pm: **Biaxial optical fiber accelerometer for machine monitoring,** C. T. Doyle, G. F. Fernando, Cranfield Univ. (UK) . . . . . [3986-51]

4:20 pm: **Wavelet edge detection to be used with composite embedded fiber optic sensors,** K. J. Jones, Rice Univ. . . . . [3986-52]

4:40 pm: **Signal conditioning technique for magnetoelastic sensors,** R. Sorrentino, M. Inverno, C. Constantin, Italian Aerospace Research Ctr. (Italy) . . . . . [3986-53]

Conference 3987

Room: Pacific C

Monday–Wednesday 6–8 March 2000 • *Proceedings of SPIE* Vol. 3987

Electroactive Polymer Actuators and Devices (EAPAD)

Conference Chair: **Yoseph Bar-Cohen,** Jet Propulsion Lab.

Cochair: **Steven G. Wax,** DARPA

Program Committee: **Ray H. Baughman,** AlliedSignal Inc.; **Carol A. Becker,** Space and Naval Warfare Systems Ctr., San Diego; **Paul D. Calvert,** Univ. of Arizona; **Richard O. Claus,** Virginia Polytechnic Institute and State Univ.; **Michael Goldfarb,** Vanderbilt Univ.; **Richard L. Lieber,** Univ. of California/San Diego; **Chang Liu,** Univ. of Illinois/Urbana-Champaign; **Ajit K. Mal,** Univ. of California/Los Angeles; **Benjamin R. Mattes,** Sante Fe Science and Technology; **Jon S. McElvain,** UNIAX Corp.; **Edward D. McCullough,** Boeing Co.; **Siavouche Nemat-Nasser,** Univ. of California/San Diego; **Keisuke Oguro,** Osaka National Research Institute (Japan); **Yoshihito Osada,** Hokkaido Univ. (Japan); **Toribio F. Otero,** Univ. del Pais Vasco (Spain); **Danilo De Rossi,** Univ. degli Studi di Pisa (Italy); **Mohsen Shahinpoor,** Univ. of New Mexico; **Randall R. Sands,** Technical Consultant; **Valery P. Shibaev,** Moscow State Univ. (Russia); **Joycelyn S. Harrison,** NASA Langley Research Ctr.; **Minoru Taya,** Univ. of Washington; **David B. Wallace,** MicroFab Technologies, Inc.; **Gordon G. Wallace,** Univ. of Wollongong (Australia); **Qiming Zhang,** The Pennsylvania State Univ.; **Miklos Zrinyi,** Technical Univ. of Budapest (Hungary)

Monday 6 March

SESSION 1

Room: Pacific C . . . . . Mon. 9:20 am

Electroactive Polymers as Emerging Actuators

Chairs: **Yoseph Bar-Cohen,** Jet Propulsion Lab.; **Steven G. Wax,** DARPA

Keynote Address . . . . . 9:20 am

Artificial muscles versus natural actuators from frogs to flies, B. Full, Univ. of California/Berkeley . . . . . [3987-01]

10:00 am: **Twenty years of conducting polymers: from fundamental science to unique application,** A. J. Heeger, Univ. of California/Santa Barbara and Uniax Corp. . . . . [3987-02]

10:30 am: **Opportunities for electroactive polymers,** S. G. Wax, DARPA; R. R. Sands, Technology Consultant . . . . . [3987-03]

11:00 am: **Electroactive polymers (EAP) charaterization methods,** Y. Bar-Cohen, S. P. Leary, Jet Propulsion Lab. . . . . [3987-04]

11:20 am: **Conducting polymer and carbon-based micro-actuators** *(Invited Paper),* D. De Rossi, Univ. degli Studi di Pisa (Italy) . . . . . [3987-05]

Lunch Break . . . . . Noon to 1:30 pm

SESSION 2

Room: Pacific C . . . . . Mon. 1:30 pm

Nanotubes

Chairs: **Qiming Zhang,** The Pennsylvania State Univ.; **Roy D. Kornbluh,** SRI International

1:30 pm: **Carbon nanotube electromechanical macro-actuators and micro-actuators** *(Invited Paper),* R. H. Baughman, C. Cui, A. A. Zakhidov, W. Kuhn, AlliedSignal Inc.; J. N. Barisci, G. M. Spinks, G. G. Wallace, Univ. of Wollongong (Australia); A. Mazzoldi, D. De Rossi, Univ. degli Studi di Pisa (Italy); A. Rinzler, Univ. of Florida; S. Roth, Max-Planck-Institut für Festkoerperforschung (Germany); L. Fifield, L. R. Dalton, Univ. of Washington . . . . . [3987-06]

2:10 pm: **Electrochemical properties of aligned nanotubes: a basis for new electromechanical actuators,** G. G. Wallace, G. M. Spinks, Univ. of Wollongong (Australia); L. Dai, M. Gao, CSIRO (Australia); R. H. Baughman, AlliedSignal Inc. . . . . [3987-07]

2:30 pm: **Electromechanical behavior of carbon nanotube sheets in electrochemical actuators,** A. Mazzoldi, D. De Rossi, Univ. degli Studi di Pisa (Italy); R. H. Baughman, AlliedSignal Inc. . . . . [3987-08]

2:50 pm: **Microfiber actuators based on carbon nanotubes,** L. Fifield, L. R. Dalton, Univ. of Washington; R. H. Baughman, A. Lobovsky, AlliedSignal Inc.; G. M. Spinks, Univ. of Wollongong (Australia) . . . . . [3987-09]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 3

Room: Pacific C . . . . . Mon. 3:40 pm

Ferroelectrics and Electrostriction

Chairs: **Ray H. Baughman,** AlliedSignal Inc.; **Danilo De Rossi,** Univ. degli Studi di Pisa (Italy)

3:40 pm: **Electrostrictive P(VDF-TrFE) copolymer-based high-strain actuators** *(Invited Paper),* Q. M. Zhang, V. Bharti, Z. Y. Cheng, M. Chung, The Pennsylvania State Univ.; R. Y. Ting, Univ. of Central Florida . . . . . [3987-10]

4:00 pm: **Ultra-high strain response of field-actuated elastomeric polymers,** R. Pelrine, R. D. Kornbluh, Q. Pei, J. Joseph, SRI International . . . . . [3987-11]

4:20 pm: **Electromechanically-active polymer blends for actuation,** J. Su, Z. Ounaies, J. S. Harrison, NASA Langley Research Ctr.; Y. Bar-Cohen, S. P. Leary, Jet Propulsion Lab. . . . . [3987-12]

4:40 pm: **Characterization of electrostrictive poly(vinylidene fluoride-trifluorethylene) copolymer films for high-frequency and high-load applications,** Z. Y. Cheng, T. B. Xu, V. Bharti, Q. Zhang, The Pennsylvania State Univ.; T. Ramotowski, Naval Undersea Warfare Ctr.; R. Y. Ting, Univ. of Central Florida . . . . . [3987-13]

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Tuesday 7 March

SESSION 4

Room: Pacific C . . . . . Tues. 9:20 am

Ion-Exchange EAP

Chairs: **Toribio F. Otero,** Univ. del Pais Vasco (Spain); **Richard O. Claus,** Virginia Polytechnic Institute and State Univ.

9:20 am: **Electromechanical response of ionic polymer-metal composites,** S. Nemat-Nasser, J. Y. Li, Univ. of California/San Diego . . . . . [3987-14]

9:40 am: **Modeling of Nafion-Pt composite actuators (ICPF) by ionic motion,** S. Tadokoro, S. Yamagami, T. Takamori, Kobe Univ. (Japan); K. Oguro, Osaka National Research Institute (Japan) . . . . . [3987-15]

10:00 am: **Micromechanical analysis of ionic clustering in Nafion perfluorinated membrane,** J. Y. Li, S. Nemat-Nasser, Univ. of California/San Diego . . . . . [3987-16]

10:20 am: **Reinforced bimorph actuators of electroactive polymers,** K. Oguro, Osaka National Research Institute (Japan); S. Tadokoro, Kobe Univ. (Japan); Y. Bar-Cohen, Jet Propulsion Lab. . . . . [3987-17]

10:40 am: **Effects of counter-ions on the performance of IPMCs,** M. Shahinpoor, K. J. Kim, Univ. of New Mexico and Environmental Robots, Inc. . . . . [3987-18]

11:00 am: **Bending response of polymer electrolyte actuator,** K. Onishi, S. Sewa, Japan Chemical Innovation Institute (Japan); K. Asaka, N. Fujiwara, K. Oguro, Osaka National Research Institute (Japan) . . . . . [3987-19]

11:20 am: **Electro-transport and deformation model of ion exchange membrane-based actuators,** E. T. Enikov, B. J. Nelson, Univ. of Minnesota/Twin Cities [3987-20]

11:40 am: **Challenges to the application of IPMC as actuators of planetary mechanisms,** Y. Bar-Cohen, S. P. Leary, Jet Propulsion Lab.; K. Oguro, Osaka National Research Institute (Japan); S. Tadokoro, Kobe Univ. (Japan); J. S. Harrison, J. G. Smith, J. Su, NASA Langley Research Ctr. . . . . [3987-21]

Lunch/Exhibit Break . . . . . Noon to 1:30 pm

SESSION 5

Room: Pacific C . . . . . Tues. 1:30 pm

EAP Materials I

Chairs: **Siavouche Nemat-Nasser,** Univ. of California/San Diego; **Keisuke Oguro,** Osaka National Research Institute (Japan)

1:30 pm: **Modulation of EAP properties through the variables of synthesis** *(Invited Paper),* T. F. Otero, I. Cantero, F. Huerta, S. Cheng, S. Villanueva, Univ. del Pais Vasco (Spain) . . . . . [3987-22]

2:10 pm: **Optimal electrode design for electroactive polymer actuators,** K. Bhattacharya, X. Yu, J. Li, California Institute of Technology . . . . . [3987-23]

2:30 pm: **Mechanical characterization of active polymer gels,** S. P. Marra, K. T. Ramesh, A. S. Douglas, Johns Hopkins Univ. . . . . [3987-24]

2:50 pm: **Electrostatically self-assembled piezoelectric thin films,** T. Zeng, F. Zhang, W. Du, Virginia Polytechnic Institute and State Univ.; Y. Liu, K. Cooper, NanoSonic Inc.; R. O. Claus, Virginia Polytechnic Institute and State Univ. and NanoSonic Inc. . . . . [3987-25]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 6

Room: Pacific C . . . . . Tues. 3:40 pm

EAP Materials II

Chairs: **Siavouche Nemat-Nasser,** Univ. of California/San Diego; **Keisuke Oguro,** Osaka National Research Institute (Japan)

3:40 pm: **Mechanical testing of hydrogels and PAN gel fibers,** S. Popovic, H. Tamagawa, M. Taya, Univ. of Washington . . . . . [3987-26]

4:00 pm: **Electrically-activated artificial muscles made with liquid crystal elastomers,** M. Shahinpoor, Univ. of New Mexico; P. E. Cladis, Advanced Liquid Crystal Technologies, Inc.; H. Finkelmann, H. Wermter, Albert-Ludwigs-Univ. Freiburg (Germany); H. R. Brand, Univ. of Bayreuth (Germany) . . . . . [3987-27]

4:20 pm: **Polyelectrolyte gels in electric fields: a theoretical and experimental approach,** R. W. Gülch, J. Holdenried, A. Weible, Eberhard-Karls-Univ. Tübingen (Germany); T. Wallmersberger, B. Kröplin, Univ. Stuttgart (Germany) . . . . [3987-28]

4:40 pm: **Electroactive papers: its possibility as actuators,** J. Kim, J. Y. Kim, S. J. Choi, Inha Univ. (Korea) . . . . . [3987-29]

5:00 pm: **Electric field sensitive polymer gels based on electrorheological principles,** M. Zrínyi, J. Fehér, G. Filipcsei, Technical Univ. of Budapest (Hungary) . . . . . [3987-30]

✔Posters—Tuesday • Session 11

The following posters will be displayed in the formal poster session on Tuesday evening between 6:00 and 7:30 pm. Poster authors will be available at this time for discussion.

✔ **Characterization of light-weight electroactive polyelectrolyte Composite Artificial Muscles (CAM) as biomimetic propulsion fins for remote-controlled aquatic vehicles,** M. Mojarrad, Biomimetic Products, Inc. . . . . [3987-47]

✔ **Structural control with polymeric glycolipids,** L. L. Matz, Matz & Associates . . . . . [3987-48]

✔ **Charaterization and modeling of display devices using artificial intelligence (AI): an investigation towards development of an integrated AI display device,** A. Talaie, Univ. of Sydney (Australia) and Kyung Hee Univ. (Korea) (Australia); J. Y. Lee, Univ. of New South Wales (Australia); Y. K. Lee, J. Jang, D. J. Choo, S. H. Park, G. Huh, Kyung Hee Univ. (Korea); J. A. Romagnoli, Univ. of Sydney (Australia) . . . . . [3987-49]

✔ **Solid polymer electrolytes: their role in polymer actuator performance,** T. W. Lewis, B. Kim, G. M. Spinks, G. G. Wallace, Univ of Wollongong (Australia). . . . . [3987-52]

Wednesday 8 March

SESSION 7

Room: Pacific C . . . . . Wed. 9:20 am

Real and Biologically Inspired Muscles

Chairs: **Gerald H. Pollack,** Univ. of Washington; **Sean P. Leary,** Jet Propulsion Lab.

9:20 am: **Toward single-molecule electromechanical actuators,** M. J. Marsella, R. J. Reid, Univ. of California/Riverside . . . . . [3987-51]

9:40 am: **Artificial eyelid for protection of optical sensors,** P. H. Holloway, Univ. of Florida; G. McGuire, S. Goodwin-Johansson, MCNC; L. J. Buckley, R. F. Cozzens, Naval Research Lab.; R. W. Schwartz, Clemson Univ.; G. J. Exarhos, Pacific Northwest National Lab. . . . . [3987-32]

10:00 am: **Muscle contraction as a polymer gel phase-transition,** G. H. Pollack, Univ. of Washington . . . . . [3987-33]

10:20 am: **Artificial sarcomere and muscle made with conductive polyacrylonitrile (C-PAN) fiber bundles,** M. Shahinpoor, H. B. Schreyer, K. J. Kim, Univ. of New Mexico . . . . . [3987-34]

10:40 am: **Electrochemical characterization and control of triple layer muscles,** T. F. Otero, M. T. Cortés, Univ. del Pais Vasco (Spain) . . . . . [3987-35]

SESSION 8

Room: Pacific C . . . . . Wed. 11:00 am to Noon

Open Discussion

Moderators: **Yoseph Bar-Cohen,** Jet Propulsion Lab.; **Ray I. Baughman,** AlliedSignal Inc.; **Siavouche Nemat-Nasser,** Univ. of California/San Diego; **Toribio F. Otero,** Univ. del Pais Vasco (Spain); **Danilo De Rossi,** Univ. degli Studi di Pisa (Italy); **Steven G. Wax,** DARPA; **Qiming Zhang,** The Pennsylvania State Univ.

Lunch/Exhibit Break . . . . . Noon to 1:30 pm

SESSION 9

Room: Pacific C . . . . . Wed. 1:30 pm

Applications I

Chairs: **Constantinos Mavroidis,** Rutgers Univ.; **Gordon G. Wallace,** Univ. of Wollongong (Australia)

1:30 pm: **CAE approach in application of Nafion-Pt composite (ICPF) actuators: analysis for surface wipers of NASA MUSES-CN nanorover,** S. Tadokoro, M. Fukuhara, Kobe Univ. (Japan); Y. Bar-Cohen, Jet Propulsion Lab.; K. Oguro, Osaka National Research Institute (Japan); T. Takamori, Kobe Univ. (Japan) . . . . [3987-36]

1:50 pm: **Active polyaniline fibers for a steerable catheter,** A. Mazzoldi, D. De Rossi, Univ. degli Studi di Pisa (Italy) . . . . . [3987-37]

2:10 pm: **Electroactive non-ionic gels and their applications,** T. Hirai, J. Zheng, M. Yamaguchi, M. Watanabe, Shinshu Univ. (Japan) . . . . . [3987-46]

2:30 pm: **Fabrication of electroactive polymer actuator composed of polypyrrole and solid-polymer electrolyte and its application to micropump,** S. K. Lee, Y. Choi, Dankook Univ. (Korea); S. S. Yang, Ajou Univ. (Korea); J. J. Pak, Korea Univ. (Korea) . . . . . [3987-39]

2:50 pm: **Controlled compliance haptic interface using electrorheological fluids,** C. Mavroidis, C. Pfeiffer, Rutgers Univ.; Y. Bar-Cohen, Jet Propulsion Lab. . . . . [3987-40]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 10

Room: Pacific C . . . . . Wed. 3:40 pm

Applications II

Chairs: **Constantinos Mavroidis,** Rutgers Univ.; **Gordon G. Wallace,** Univ. of Wollongong (Australia)

3:40 pm: **Preparation of IPMCs for use in fuel cells, electrolysis, and hydrogen sensors,** K. J. Kim, M. Shahinpoor, A. Razani, Univ. of New Mexico . . . . [3987-41]

4:00 pm: **Development of electric environment to control mollusk-shaped gel robots made of electroactive polymer PAMPS gel,** M. Otake, M. Inaba, H. Inoue, Univ. of Tokyo (Japan) . . . . . [3987-42]

4:20 pm: **Carbon nanotube: polyelectrolyte composites for actuators and supercapacitors,** D. Chattopadhyay, F. Papadimitrakopoulos, Univ. of Connecticut; R. H. Baughman, AlliedSignal Inc.; G. M. Spinks, Univ. of Wollongong (Australia) . . . . . [3987-43]

4:40 pm: **Piezoelectric polymer actuators in a vibration isolation application,** G. Bohannan, V. H. Schmidt, R. J. Conant, J. Hallenberg, C. Nelson, A. Childs, C. Lukes, J. Ballensky, J. Wehri, B. Tikalsky, E. McKenzie, Montana State Univ./ Bozeman . . . . . [3987-44]

5:00 pm: **EAP smart system using hybrid control to apply noise reduction,** T. L. Yang, National Tsing Hua Univ. and Industrial Technology Research Institute (Taiwan) . . . . . [3987-45]

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Conference 3988

Room: Catamaran
Monday–Tuesday 6–7 March 2000 • *Proceedings of SPIE* Vol. 3988

Smart Systems for Bridges, Structures, and Highways

Conference Chair: **S. C. Liu,** National Science Foundation

Cochair: **Darryll J. Pines,** Univ. of Maryland/College Park

Program Committee: **Satoru Aizawa,** Takenaka Corp. (Japan); **Ken P. Chong,** National Science Foundation; **Reginald DesRoches,** Georgia Institute of Technology; **Shirley J. Dyke,** Washington Univ.; **Maria Q. Feng,** Univ. of California/Irvine; **Yozo Fujino,** Univ. of Tokyo (Japan); **Gabriel V. Garcia,** New Mexico State Univ.; **Henri P. Gavin,** Duke Univ.; **Faramarz Gordaninejad,** Univ. of Nevada/Reno; **Paul E. Grayson,** Strain Monitor Systems Inc; **Sami F. Masri,** Univ. of Southern California; **Robert L. Nigbor,** Agbabian Associates, Inc.; **Isao Nishimura,** Kobori Research Complex (Japan); **Shunsuke Otani,** Univ. of Tokyo (Japan); **Roberto A. Osegueda,** Univ. of Texas/El Paso; **Charles S. Sikorsky,** California Dept. of Transportion; **Mete Sozer,** Purdue Univ.; **Billie F. Spencer, Jr.,** Univ. of Notre Dame; **Norris Stubbs,** Texas A&M Univ.; **Ming L. Wang,** Univ. of Illinois/Chicago; **Kazuo Yoshida,** Keio Univ. (Japan)

Monday 6 March

SESSION 1

Room: Catamaran . . . . . Mon. 9:20 am

Smart Structure Technology Applied to Civil Infrastructure

Chair: **S. C. Liu,** National Science Foundation

9:20 am: **Development of smart systems for building structures** *(Invited Paper),* S. Otani, Univ. of Tokyo (Japan); H. Hiraishi, M. Midorikawa, M. Teshigawara, T. Saito, H. Fujitani, Building Research Institute (Japan) . . . . . [3988-01]

10:00 am: **I-5/Gilman advanced technology bridge project,** F. Seible, Univ. of California/San Diego . . . . . [3988-02]

10:20 am: **Analytical and numerical study of a smart sliding base isolation system for seismic protection of buildings,** M. D. Symans, G. J. Madden, N. Wongprasert, Washington State Univ. . . . . [3988-03]

10:40 am: **New type of passive seismic response control system,** M. Kubota, Tobishima Corp. (Japan); S. Ishimaru, T. Niiya, Nihon Univ. (Japan); I. Hata, Tobishima Corp. (Japan) . . . . . [3988-04]

SESSION 2

Room: Catamaran . . . . . Mon. 11:00 am

Sensors and Actuators I

Chair: **Darryll J. Pines,** Univ. of Maryland/College Park

11:00 am: **Corrosion monitoring sensors for durability assessment of concrete structures,** R. Bäler, J. Mietz, Bundesanstalt für Materialforschung und Prüfung (Germany); M. Raupach, S + R Sensortec (Germany); O. Klinghoffer, Force Institute (Denmark) . . . . . [3988-06]

11:20 am: **Embedded micro-sensor for monitoring pH in concrete structures,** R. Srinivasan, T. E. Phillips, C. Bargeron, M. A. Carlson, Johns Hopkins Univ. . . . . [3988-07]

Lunch Break . . . . . Noon to 1:30 pm

SESSION 3

Room: Catamaran . . . . . Mon. 1:10 pm

Passive, Active, or Semi-Active Damping Devices

Chair: **Billie F. Spencer, Jr.,** Univ. of Notre Dame

1:10 pm: **Single-input/multi-output strategies for floor vibration control,** L. M. Hanagan, The Pennsylvania State Univ.; K. Premaratne, Univ. of Miami . [3988-44]

1:30 pm: **Behavior of piezoelectric fiction dampers under dynamic loading,** G. Chen, C. Chen, Univ. of Missouri/Rolla . . . . . [3988-08]

1:50 pm: **Parameters influencing new friction damper device,** I. H. Mualla, Technical Univ. of Denmark (Denmark) . . . . . [3988-09]

2:10 pm: **Semi-active variable damping liquid column dampers,** S. K. Yalla, A. Kareem, J. C. Kantor, Univ. of Notre Dame . . . . . [3988-10]

2:30 pm: **Heat transfer of magneto-rheological dampers,** M. B. Dogruoz, F. Gordaninejad, E. L. Wang, Univ. of Nevada/Reno . . . . . [3988-11]

2:50 pm: **Performance of smart structures,** S. J. Dyke, F. Yi, Washington Univ. . . . . [3988-12]

Coffee Break . . . . . 3:10 to 3:40 pm

3:40 pm: **Adaptive fuzzy control for a structure-MR damper system,** L. Zhou, C. Chang, Hong Kong Univ. of Science and Technology (Hong Kong) . . . [3988-13]

SESSION 4

Room: Catamaran . . . . . Mon. 4:00 pm

Structural Health Monitoring

Chair: **Gabriel V. Garcia,** New Mexico State Univ.

4:00 pm: **Application of electromagnetic waves in damage detection of concrete structures,** M. Q. Feng, Univ. of California/Irvine; C. R. Liu, Univ. of Houston; M. Shinozuka, Univ. of Southern California . . . . . [3988-14]

4:20 pm: **Concept of dereverbation and its application to damage detection in civil structures,** J. Ma, D. J. Pines, Univ. of Maryland/College Park . . . . . [3988-15]

4:40 pm: **Combining damage detection methods to improve probability of detection,** G. V. Garcia, New Mexico State Univ.; R. A. Osegueda, Univ. of Texas/El Paso . . . . . [3988-16]

5:00 pm: **Experimental application of a structural health monitoring methodology,** G. W. Reich, K. C. Park, Univ. of Colorado/Boulder . . . . . [3988-17]

5:20 pm: **Systematic numerical analysis of the damage index method used for bridge diagnostics,** F. L. Xu, M. L. Wang, G. M. Lloyd, Univ. of Illinois/Chicago . [3988-18]

5:40 pm: **Feasibility of damage/change detection in civil structures by SAR imagery: proof of concept study using SAR simulation,** M. Shinozuka, Univ. of Southern California; R. Ghanem, Johns Hopkins Univ.; B. Houshmand, Univ. of California/Los Angeles; B. Mansouri, Univ. of Southern California . . . . . [3988-19]

6:00 pm: **Fiber optic micro-interferometer vibration sensor system for monitoring of traffic and traffic-induced vibrations of bridges,** M. Schmidt, N. Fürstenau, DLR (Germany) . . . . . [3988-20]

SPECIAL LECTURE . . . . . 6:20 to 7:20 pm

Smart Structures and Future Construction

Speaker: **Dr. Toshiaki Fujimori,** Executive Officer, Institute of Technology, Shimizu Corp. (Japan)

✔Posters—Monday • Session 9

The following posters will be displayed in the formal poster session on Monday evening between 6:00 and 7:30 pm. Poster authors will be available at this time for discussion.

✔ **Stochastic model of suspension bridges and their stability,** N. U. Ahmed, Univ. of Ottawa (Canada) . . . . . [3988-42]

✔ **Failure detection of reinforced concrete xbeams with embedded fiber optic Michelson sensors,** I. B. Kwon, P. Park, Y. H. Huh, D. J. Kim, H. Moon, S. H. Hong, D. C. Lee, C. Titin, Korea Research Institute of Standards and Science (Korea) . . . . . [3988-43]

✔ **Earthquake-protective pneumatic foundation,** V. Shustov, California State Univ./ Northridge . . . . . [3988-45]

✔ **Placement of feedback controllers on civil structures using genetic algorithms,** M. M. Abdullah, Florida Agricultural and Mechanical Univ. . . . . [3988-46]

✔ **Temperature insensitive smart optical strain sensor,** K. A. Thomas, E. E. Crisman, O. J. Gregory, W. B. Euler, Univ. of Rhode Island . . . . . [3988-47]

✔ **Fiber reinforced composites as protective coverings for bridge elements,** P. Balaguru, J. Rudolph, Rutgers Univ.; K. W. Lee, Y. Cao, Univ. of Rhode Island . . . . . [3988-48]

✔ **Heat generation of magneto-rheological fluid dampers: a theoretical study utilizing fluid dynamics approach,** D. G. Breese, F. Gordaninejad, E. Ericksen, Univ. of Nevada/Reno . . . . . [3988-49]

✔ **Damage detection and location of water delivery systems by on-line water pressure monitoring,** M. Shinozuka, Univ. of Southern California; J. Liang, Tianjin Univ. (China) . . . . . [3988-50]

✔ **Energy flow in semi-active control systems,** H. P. Gavin, Duke Univ. . [3988-51]

Tuesday 7 March

SESSION 5

Room: Catamaran . . . . . Tues. 9:20 am

Active Control Using Passive/Semi-Active/Hybrid Devices

Chair: **Faramarz Gordaninejad,** Univ. of Nevada/Reno

9:20 am: **Active tendon control of cable-stayed bridges,** A. Preumont, F. Bossens, Univ. Libre de Bruxelles (Belgium) . . . . . [3988-21]

9:40 am: **Semi-active control of a bridge using controllable magneto-rheological dampers,** Y. Liu, F. Gordaninejad, C. A. Evrensel, X. Wang, Univ. of Nevada/ Reno . . . . . [3988-24]

10:00 am: **Mitigating stay cable vibration using semi-active damping,** E. A. Johnson, Univ. of Southern California; G. A. Baker, B. F. Spencer, Jr., Univ. of Notre Dame; Y. Fujino, Univ. of Tokyo (Japan) . . . . . [3988-23]

10:20 am: **Seismic control of civil structures utilizing semi-active magneto-rheological bracing systems,** G. J. Hiemenz, N. M. Wereley, Univ. of Maryland/ College Park . . . . . [3988-22]

10:40 am: **Recent development in structural control including soil-structure interaction effect,** G. Chen, Univ. of Missouri/Rolla . . . . . [3988-25]

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SESSION 6

Room: Catamaran . . . . . Tues. 11:00 am

Shape Memory Alloys: Modeling, Analysis, and Application

Chair: **Mohammad N. Noori,** Worcester Polytechnic Institute

11:00 am: **Guaranteed behavior on SMA: mesoscopic and microscopic analysis of Cu-based alloys,** V. Torra, A. Isalgue, F. C. Lovey, Polytechnical Univ. of Catalonia (Spain) . . . . . [3988-26]

11:20 am: **Effect of section size on properties of NiTi bar,** S. C. Gupta, F. E. Sczerzenie, Special Metals Corp. . . . . [3988-27]

11:40 am: **Experimental study and computer simulation of changes of residual stresses of structure defects in shape memory alloys,** T. Breczko, K. Kus, Olsztyn Agriculture and Technology Univ. (Poland) . . . . . [3988-28]

Lunch/Exhibit Break . . . . . Noon to 1:30 pm

SESSION 7

Room: Catamaran . . . . . Tues. 1:30 pm

System Identification and Damage Detection

Chair: **Charles S. Sikorsky,** California Dept. of Transportion

1:30 pm: **Damage assessment of state highway networks in Los Angeles and Orange County under scenario earthquakes,** M. Shinozuka, Univ. of Southern California; M. Q. Feng, Univ. of California/Irvine; X. Dong, Univ. of Southern California; T. Uzawa, T. Ueda, Taisei Corp. (Japan) . . . . . [3988-29]

1:50 pm: **Crack detection of structures using optical time domain reflectometry (OTDR) method,** J. Jang, S. Chang, Seoul National Univ. (Korea); N. Cho, N. Kim, Hyundai Institute of Construction Technology (Korea) . . . . . [3988-30]

2:10 pm: **Identification of civil structures with nonproportional damping,** J. N. Yang, Y. Lei, Univ. of California/Irvine . . . . . [3988-31]

2:30 pm: **Damage detection system of a real steel truss bridge by neural networks,** M. Choi, I. Kwon, Korea Research Institute of Standards and Science (Korea) . . . . . [3988-32]

2:50 pm: **Correlational analysis of remotely sensed pre- and post-disaster images for damage detection,** M. Shinozuka, A. Rejaie, Univ. of Southern California [3988-33]

Coffee Break . . . . . 3:10 to 3:40 pm

3:40 pm: **Transverse shear response monitoring of concrete cylinder using embedded high-sensitivity electrical TDR sensor,** M. W. Lin, A. O. Abatan, Y. Zhou, Clark Atlanta Univ. . . . . [3988-34]

SESSION 8

Room: Catamaran . . . . . Tues. 4:00 pm

Sensors and Actuators II

Chair: **Shirley J. Dyke,** Washington Univ.

4:00 pm: **Development of piezoelectric transducers for a railway integrity monitoring system,** P. W. Loveday, Ctr. for Integrated Sensing Systems (South Africa) . . . . . [3988-35]

4:20 pm: **Estimation of deflection curve of bridges using fiber optic strain sensors,** N. Cho, N. Kim, Hyundai Institute of Construction Technology (Korea); J. Jang, S. Chang, Seoul National Univ. (Korea) . . . . . [3988-36]

4:40 pm: **Analysis of pile load transfer using optical fiber sensor,** J. Oh, W. Lee, Korea Univ. (Korea); S. B. Lee, Korea Institute of Science and Technology (Korea); J. Paik, Baytech Korea Inc. (Korea); W. Lee, Korea Univ. (Korea) . . . . . [3988-37]

5:00 pm: **Semi-active control strategies for buildings subject to near-field earthquakes,** A. K. Agrawal, CUNY/City College . . . . . [3988-53]

5:20 pm: **Strain monitoring of smart bridges using fiber Bragg grating sensor system with wavelength-swept fiber laser,** C. S. Hong, C. Y. Ryu, B. Y. Ku, C. G. Kim, S. H. Yun, Korea Advanced Institute of Science and Technology (Korea) . . . . . [3988-40]

5:40 pm: **Fiber optic health monitoring system for composite bridge decks,** A. P. C. Furrow, R. L. Clark, Jr., Luna Innovations, Inc.; J. J. Lesko, Virginia Polytechnic Institute and State Univ. . . . . [3988-41]

Conference 3989

Room: Newport North

Monday–Wednesday 6–8 March 2000 • *Proceedings of SPIE* Vol. 3989

Damping and Isolation

Conference Chair: **T. Tupper Hyde,** Honeywell Space Systems

Cochair: **Daniel J. Inman,** Virginia Polytechnic Institute and State Univ.

Program Committee: **Gregory S. Agnes,** Air Force Institute of Technology; **H. Thomas Banks,** North Carolina State Univ.; **Amr M. Baz,** Univ. of Maryland/College Park; **William W. Clark,** Univ. of Pittsburgh; **L. Porter Davis,** Honeywell Inc.; **Michael L. Drake,** Univ. of Dayton Research Institute; **Eugene R. Fosness,** Air Force Research Lab.; **Roy Ikegami,** Boeing Phantom Works; **Conor D. Johnson,** CSA Engineering, Inc.; **Vikram K. Kinra,** Texas A&M Univ.; **Donald J. Leo,** Virginia Polytechnic Institute and State Univ.; **George A. Lesieutre,** The Pennsylvania State Univ.; **Joseph R. Maly,** CSA Engineering, Inc.; **Zahidul H. Rahman,** Jet Propulsion Lab.; **Iyen Shen,** Univ. of Washington; **Roger Stanway,** Univ. of Sheffield (UK); **J. Q. Sun,** Univ. of Delaware; **Geoffrey R. Tomlinson,** Univ. of Sheffield (UK); **Kon Well Wang,** The Pennsylvania State Univ.; **Norman M. Wereley,** Univ. of Maryland/College Park

Monday 6 March

SESSION 1

Room: Newport North . . . . . Mon. 9:20 am

Viscoelastic Material Damping

Chair: **Roger Stanway,** Univ. of Sheffield (UK)

9:20 am: **Direct method for experimental characterization of viscoelastic materials,** R. G. Faisca, N. Roitman, C. Magluta, Univ. Federal do Rio de Janeiro (Brazil) . . . . . [3989-01]

9:40 am: **Improved constrained layer damping treatment design for high damping and low-interlaminar stresses,** A. Badre-Alam, F. Gandhi, K. W. Wang, The Pennsylvania State Univ. . . . . [3989-02]

10:00 am: **Flight hardware for the Hubble Space Telescope solar array damper,** J. R. Maly, S. C. Pendleton, CSA Engineering, Inc.; S. Anandakrishnan, Lockheed Martin Technical Operations . . . . . [3989-03]

SESSION 2

Room: Newport North . . . . . Mon. 10:20 am

Active Contrained Layer Damping

Chair: **Gregory S. Agnes,** Air Force Institute of Technology

10:20 am: **Control of sound radiation from an active constrained layer damping treated plate into an acoustic cavity using structural intensity approach,** M. S. Azzouz, J. Ro, Old Dominion Univ. . . . . [3989-04]

10:40 am: **Piezoelectric shunting parameter estimation using electrical impedance models,** J. Kim, Y. Ryu, C. C. Cheong, Inha Univ. (Korea) . . . . . [3989-58]

11:00 am: **Application of passive and active constrained layer damping for the vibration suppression of a flexible four-bar mechanism,** H. Ghoneim, Rochester Institute of Technology; M. A. Karkoub, Kuwait Univ. (Kuwait) . . . . . [3989-06]

11:20 am: **Comparison of the mechanism and effectiveness of position and velocity feedback in active constrained layer damping treatments,** F. Gandhi, B. Munsky, The Pennsylvania State Univ. . . . . [3989-07]

11:40 am: **Active-passive hybrid constrained layer damping treatment: an integrated approach,** Y. Liu, K. Wang, The Pennsylvania State Univ. . . . . [3989-08]

Lunch Break . . . . . Noon to 1:30 pm

SESSION 3

Room: Newport North . . . . . Mon. 1:30 pm

Modeling of Damping

Chair: **Donald J. Leo,** Virginia Polytechnic Institute and State Univ.

1:30 pm: **Analysis of damping in finite shearing and finite torsional deformations,** R. C. Batra, J. H. Yu, Virginia Polytechnic Institute and State Univ. . . . . [3989-09]

1:50 pm: **Modal strain energy method critically revised,** W. Dewulf, G. De Roeck, Katholieke Univ. Leuven (Belgium) . . . . . [3989-10]

2:10 pm: **Damping and isolation of the GHM mini-oscillators,** W. Liao, Chinese Univ. of Hong Kong . . . . . [3989-11]

2:30 pm: **Finite element modeling for the flexural vibration of damped sandwich beams considering complex modulus of the adhesive layer,** Y. Xu, Maxtor Corp. . . . . [3989-12]

2:50 pm: **Rheological modeling of viscoelastic dampers for structural and vibration control,** S. W. Park, Federal Highway Administration . . . . . [3989-13]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 4

Room: Newport North . . . . . Mon. 3:40 pm

Structural Design for Damping and Identification

Chair: **H. Thomas Banks,** North Carolina State Univ.

3:40 pm: **Analytical model for a one-dimensional slotted stand-off layer damping treatment,** J. M. Yellin, I. Y. Shen, P. G. Reinhall, Univ. of Washington . . [3989-14]

4:00 pm: **Constrained substructure approach to strain energy analysis,** D. J. Leo, E. M. Austin, C. A. Beattie, Virginia Polytechnic Institute and State Univ. . . . [3989-15]

4:20 pm: **Low- and high-frequency energy absorbing composite joints,** B. Bhattacharya, Univ. of Sheffield (UK); J. R. House, S. E. Mercy, Defence Evaluation and Research Agency (UK); G. R. Tomlinson, Univ. of Sheffield (UK) . . . . [3989-16]

4:40 pm: **Closed-form exact solution to H-infinity optimization of dynamic vibration absorbers (Second report: application to different performance indexes for vibration isolation),** T. Asami, Univ. of Maryland/College Park; O. Nishihara, Kyoto Univ. (Japan) . . . . . [3989-17]

5:00 pm: **Digital image processing for system identification,** M. Shinozuka, H. Chung, J. Liang, Univ. of Southern California . . . . . [3989-18]

Tuesday 7 March

SESSION 5

Room: Newport North . . . . . Tues. 9:20 am

ER/MR Fluid Damping

Chair: **Kon-Well Wang,** The Pennsylvania State Univ.

9:20 am: **Modeling and control of a magnetorheological vibration isolator,** R. Stanway, N. D. Sims, A. R. Johnson, P. Mellor, Univ. of Sheffield (UK) . . . [3989-19]

9:40 am: **Dynamic characteristics of magnetorheological fluid damper,** H. Fujitani, Building Research Institute (Japan); K. Sunakoda, Sanwa Tekki Corp. (Japan); S. Soda, Waseda Univ. (Japan) . . . . . [3989-20]

10:00 am: **Optimization of the orifice flow in shock absorbers using shape memory alloy wire,** N. A. Mohamed, A. K. Arifin, S. Abdullah, Univ. Kebangsaan (Malaysia) . . . . . [3989-26]

10:20 am: **Characterization and analysis of magnetorheological damper behavior due to sinusoidal loading,** R. A. Snyder, N. M. Wereley, Univ. of Maryland/College Park . . . . . [3989-22]

SESSION 6

Room: Newport North . . . . . Tues.10:40 am

Fluid Damping

Chair: **Vikram K. Kinra,** Texas A&M Univ.

10:40 am: **Controllable fluid dampers in flow mode using Herschel-Bulkley model,** X. Wang, F. Gordaninejad, Univ. of Nevada/Reno . . . . . [3989-23]

11:00 am: **Analysis of electro- and magnetorheological flow mode dampers using Herschel-Bulkley model,** D. Lee, Taegu Univ. (Korea); N. M. Wereley, Univ. of Maryland/College Park . . . . . [3989-24]

11:20 am: **Viscous heating of fluid dampers: experimental studies,** C. Black, N. Makris, Univ. of California/Berkeley . . . . . [3989-25]

11:40 am: **Magentorheological fluid shock absorbers for HMMWV,** F. Gordaninejad, Univ. of Nevada/Reno; S. P. Kelso, CSA Engineering, Inc. and Univ. of Nevada/Reno . . . . . [3989-21]

Lunch/Exhibit Break . . . . . Noon to 1:30 pm

SESSION 7

Room: Newport North . . . . . Tues. 1:30 pm

Piezoelectric Damping

Chair: **Roy Ikegami,** Boeing Phantom Works

1:30 pm: **Piezoelectric shunt vibration damping of an F-15 panel under high-acoustic excitation,** S. Wu, Boeing Co.; T. L. Turner, S. A. Rizzi, NASA Langley Research Ctr. . . . . [3989-27]

1:50 pm: **Passive suppression of composite panel flutter using piezoelectric materials with resonant circuit shunts,** S. J. Kim, S. H. Moon, Seoul National Univ. (Korea) . . . . . [3989-28]

2:10 pm: **Enhanced semi-passive damping using continuous switching of a piezoelectric device on an inductor,** C. Richard, D. Guyomar, D. Audigier, H. Bassaler, Institut National des Sciences Appliquees de Lyon (France) . . [3989-29]

2:30 pm: **Semi-active control of a thin piezoactuated structure,** P. Bisegna, G. Caruso, Univ. degli Studi di Roma Tor Vergata (Italy); D. Del Vescovo, Univ. degli Stufi di Roma La Sapienza (Italy); S. Galeani, L. Menini, Univ. degli Studi di Roma Tor Vergata (Italy) . . . . . [3989-30]

2:50 pm: **Experimental investigation of hybrid damping for flexible structures by using surface bonded piezoelements,** K. Adachi, Y. Awakura, T. Iwatsubo, Kobe Univ. (Japan) . . . . . [3989-31]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 8

Room: Newport North . . . . . Tues. 3:40 pm

SMA and Novel Material Damping

Chair: **Geoffrey R. Tomlinson,** Univ. of Sheffield (UK)

3:40 pm: **Time-domain mechanical models for SMA pseudoelastic damping behavior,** F. Gandhi, B. Malovrh, The Pennsylvania State Univ. . . . . [3989-32]

4:00 pm: **Full-scale tests of steel connections with SMA components,** R. Leon, R. DesRoches, Georgia Institute of Technology . . . . . [3989-33]

4:20 pm: **Damping modelization of auxetic foams,** F. Scarpa, C. Remillat, G. R. Tomlinson, Univ. of Sheffield (UK) . . . . . [3989-35]

4:40 pm: **Enhanced dumping of hat-stiffened composite panels using continuous wave fiber composites,** J. D. Marshall, D. W. Jensen, Brigham Young Univ. . . . . [3989-36]

✔Posters—Tuesday

The following posters will be displayed in the formal poster session on Tuesday evening between 6:00 and 7:30 pm. Poster authors will be available at this time for discussion.

✔ **Closed-form exact solution to H-infinity optimization of dynamic vibration absorbers (First report: development of an algebraic approach and its application to standard problem),** O. Nishihara, Kyoto Univ. (Japan); T. Asami, Himeji Institute of Technology . . . . . [3989-55]

✔ **Optimal design of a piezoelectric passive damper for vibrating plates,** S. J. Kim, C. Y. Yun, B. J. Paek, Seoul National Univ. (Korea) . . . . . [3989-56]

✔ **Temperature effect on ER-fluid dynamics,** E. V. Korobko, Z. P. Shulman, A.V. Luikov Heat and Mass Transfer Institute (Belarus) . . . . . [3989-57]

✔ **Thermophysical properties and rheological behavior of electrorheological fluids at different temperature regimes,** E. V. Korobko, J. Korobko, A.V. Luikov Heat and Mass Transfer Institute (Russia) . . . . . [3989-59]

✔ **Novel methods of embedding viscoelastic damping materials in graphite/epoxy composites,** J. M. Biggerstaff, J. B. Kosmatka, Univ. of California/San Diego . . . . . [3989-60]

✔ **Analysis models on the behavior of a smart squeeze film damper operating with electrorheological/magnetorheologoc fluid,** C. Zhu, D. A. Robb, D. J. Ewins, Imperial College of Science, Technology and Medicine (UK) . . . . . [3989-62]

✔ **Experimental investigation on the behavior of a magnetorheologic fluid squeeze film damper,** C. Zhu, D. A. Robb, D. J. Ewins, Imperial College of Science, Technology and Medicine (UK) . . . . . [3989-63]

Wednesday 8 March

SESSION 9

Room: Newport North . . . . . Wed. 9:20 am

Particle, Hysteretic, and Nonlinear Damping

Chair: **Amr M. Baz,** Univ. of Maryland/College Park

9:20 am: **Influence of particle materials and radius on particle impact damping,** V. K. Kinra, R. D. Friend, Texas A&M Univ. . . . . [3989-37]

9:40 am: **Effectiveness and predictability of particle damping,** B. L. Fowler, E. Flint, CSA Engineering, Inc.; S. E. Olson, Univ. of Dayton Research Institute . . . [3989-38]

10:00 am: **Influence of fractional derivatives upon the stability of nonlinear damped vibrations of suspension bridges,** Y. A. Rossikhin, M. V. Shitikova, Voronezh State Academy of Construction and Architecture (Russia) . . . . . [3989-39]

10:20 am: **Active vibration control of an oscillating rigid bar using nonlinear output regulation techniques,** B. Vazquez, G. Silva, J. Alvarez, Ctr. de Investigacion de Estudios Avanzados (Mexico) . . . . . [3989-40]

10:40 am: **Mitigation of seismic pounding effect on bridges using steel shock absorbers,** M. Shinozuka, Univ. of Southern California; F. Nagashima, Tokyo Metropolitan Univ. (Japan); H. Kim, Univ. of Southern California . . . . . [3989-41]

11:00 am: **Modeling of nonlinear hysteresis in elastomers in simple extension and shear,** H. T. Banks, G. A. Pinter, North Carolina State Univ. . . . . [3989-42]

11:20 am: **Torsional vibration reduction using passive nonlinear absorbers,** S. W. Shaw, A. Alsuwaiyan, Michigan State Univ. . . . . [3989-43]

11:40 am: **Design and application of energy dissipating dampers on a new concrete bridge in California,** H. Strandgaard, CH2M HILL . . . . . [3989-44]

Lunch/Exhibit Break . . . . . Noon to 1:30 pm

SESSION 10

Room: Newport North . . . . . Wed. 1:30 pm

Passive Isolation

Chair: **Joseph R. Maly,** CSA Engineering, Inc.

1:30 pm: **Experimental and numerical evaluation of model structures using the stiffness decoupler seismic isolation system,** K. Hu, H. Zhu, P. G. Kirmser, Kansas State Univ. . . . . [3989-45]

1:50 pm: **Vibration testing and dynamic modeling of automotive shock absorbers,** M. D. Rao, S. Gruenberg, Michigan Technological Univ.; H. Torab, D. Griffiths, Ford Motor Co. . . . . [3989-61]

2:10 pm: **ESPA (EELV secondary payload adapter): whole-spacecraft launch isolation for primary and secondary payloads,** J. R. Maly, C. D. Johnson, CSA Engineering, Inc.; S. Haskett, U.S. Air Force Space Test Program; D. Sciulli, T. Meink, Air Force Research Lab. . . . . [3989-47]

2:30 pm: **Whole-spacecraft vibration isolation on small launch vehicles,** P. S. Wilke, C. D. Johnson, CSA Engineering, Inc.; P. J. Grosserode, Orbital Sciences Corp.; D. Sciulli, Air Force Research Lab. . . . . [3989-48]

2:50 pm: **Advanced isolation design for launch vehicles and their payloads,** B. R. Allen, CSA Engineering, Inc. . . . . [3989-49]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 11

Room: Newport North . . . . . Wed. 3:40 pm

Active Isolation and Vibration Control

Chair: **William W. Clark,** Univ. of Pittsburgh

3:40 pm: **Active alignment and vibration control system for a large airborne optical system,** D. A. Kienholz, CSA Engineering, Inc. . . . . [3989-50]

4:00 pm: **Vibration isolation and control of beamwalk in space interferometer systems,** J. F. Shields, Z. H. Rahman, Jet Propulsion Lab. . . . . [3989-51]

4:20 pm: **Semi-active vibration suppression of an impulsively excited machine on a flexible foundation,** W. W. Clark, J. S. Vipperman, Univ. of Pittsburgh . . . [3989-52]

4:40 pm: **Adaptive vibration isolation using a piezoinertial actuator,** G. Song, Univ. of Akron . . . . . [3989-53]

5:00 pm: **Electromechanic lever blocks for active vibration isolation,** L. Zago, P. M. Genequand, Ctr. Suisse d'Electronique et de Microtechnique (Switzerland) . . . . . [3989-54]

5:20 pm: **Cryocooler disturbance reduction with single and multiple axis active/passive vibration control systems,** E. Flint, P. Flannery, M. E. Evert, E. H. Anderson, CSA Engineering, Inc. . . . . [3989-64]

Conference 3990

Room: Pacific D

Monday–Wednesday 6–8 March 2000 • *Proceedings of SPIE* Vol. 3990

Smart Electronics and MEMS

Conference Chair: **Vijay K. Varadan,** The Pennsylvania State Univ.

Cochair: **Richard A. Singer,** Institute for Defense Analyses

Program Committee: **Vasu K. Aatre,** Defence Research & Development Organisation (India); **Harold D. Ackler,** Lawrence Livermore National Lab.; **Pratul K. Ajmera,** Louisiana State Univ.; **Steven W. Arms,** MicroStrain, Inc.; **Henry Baltes,** ETH Zurich (Switzerland); **John H. Belk,** Boeing Co.; **Thomas G. Bifano,** Boston Univ.; **Stephen M. Bobbio,** Univ. of North Carolina/Charlotte; **Judah Goldwasser,** Office of Naval Research; **William J. Kaiser,** Univ. of California/Los Angeles; **Jan G. Korvink,** Albert-Ludwig-Univ. Freiburg (Germany); **Henry O. Marcy,** Rockwell International Corp.; **Michael S. Mattice,** U.S. Army Armament Research, Development and Engineering Ctr.; **Y. Eugene Pak,** Samsung Advanced Institute of Technology & CRI (Korea); **Charles H. Robinson,** U.S. Army Tank-Automotive Command; **Jeffrey N. Schoess,** Honeywell Technology Ctr.; **Norio Shinya,** National Research Institute for Metals (Japan); **James L. Sitomer,** Charles Stark Draper Lab., Inc.; **James H. Smith,** Sandia National Labs.; **Yuji Matsuzaki,** Nagoya Univ. (Japan); **Robert B. Yates,** Sheffield Hallam Univ. (UK)

Monday 6 March

Keynote Address . . . . . 9:20 am

Progress in the development of gyroscopes for use in tactical weapon systems, P. B. Ruffin, U.S. Army Aviation and Missile Command . . [3990-01]

Invited Paper . . . . . 10:00 am

MEMS sensing and control: an aerospace perspective, J. N. Schoess, Honeywell Inc. . . . . [3990-02]

SESSION 1

Room: Pacific D . . . . . Mon. 10:40 am

Smart Electronics and RF MEMS

Chairs: **Pratul K. Ajmera,** Louisiana State Univ.; **Robert B. Yates,** Sheffield Hallam Univ. (UK)

10:40 am: **New technique for direct integration of mechanical motion with electronics on a chip,** P. K. Ajmera, Louisiana State Univ.; X. Wang, Motorola; J. Ross, G. Nallapati, H. M. Manohara, Louisiana State Univ. . . . . [3990-03]

11:00 am: **Accurate DEM SC amplification of small differential voltage signal with CM level from ground to VDD,** G. Wang, G. C. Meijer, Delft Univ. of Technology (Netherlands) . . . . . [3990-04]

11:20 am: **Comparison of silicon and polymer-based rf MEMS,** V. K. Varadan, V. V. Varadan, The Pennsylvania State Univ. . . . . [3990-05]

11:40 am: **Photosensitive sol-gel waveguides on silicon substrates as MOEM devices,** A. Selvarajan, A. Anilkumar, G. M. Hegde, Indian Institute of Science (India) . . . . . [3990-06]

Noon: **Microelectromechanical bandpass filters for signal processing by standard CMOS process,** T. Huang, P. Chang, National Taiwan Univ. (Taiwan) . . . [3990-07]

Lunch Break . . . . . 12:20 to 1:30 pm

Invited Paper . . . . . 1:30 pm

Smart isolation mount for army guns Part 1: preliminary results, D. Allaei, D. J. Tarnowski, QRDC, Inc.; M. S. Mattice, R. C. Testa, U.S. Army Armament Research, Development and Engg. Ctr. . . . . [3990-08]

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SESSION 2

Room: Pacific D . . . . . Mon. 2:00 pm

Sensors and Actuators I

Chairs: **Ananth Selvarajan,** Indian Institute of Science (India); **Robert B. Yates,** Sheffield Hallam Univ. (UK)

2:00 pm: **Micro-opto-electro-mechanical (MOEM) vibration sensor,** A. Selvarajan, P. K. Pattnaik, V. M. Gupta, Indian Institute of Science (India) . . . . . [3990-09]

2:20 pm: **Large-area multiplexed sensing using MEMS and fiber optics,** R. L. Clark, Jr., M. B. Miller, C. R. Bell, P. M. Russler, Luna Innovations, Inc. . . . . [3990-10]

2:40 pm: **Development and application of optical MEMS sensors,** M. L. Wilson, Honeywell Inc.; J. F. Korczynski, Jr., S. A. Mastro, Naval Surface Warfare Ctr. . . . . [3990-41]

3:00 pm: **Smart sensors: lessons learned from computer vision,** R. B. Yates, S. Meikle, Sheffield Hallam Univ. (UK) . . . . . [3990-11]

Coffee Break . . . . . 3:20 to 3:40 pm

SESSION 3

Room: Pacific D . . . . . Mon. 3:40 pm

Smart Antenna and Wireless Telemetry

Chairs: **John H. Belk,** Boeing Co.; **Gregory Washington,** The Ohio State Univ.

3:40 pm: **Micropower peak strain detection systems for remote interrogation,** M. J. Hamel, C. P. Townsend, S. W. Arms, MicroStrain, Inc. . . . . [3990-12]

4:00 pm: **Project summary: applied research on remotely queried embedded microsensors,** D. G. Krantz, MTS Systems Corp.; J. H. Belk, Boeing Co.; P. J. Biermann, Applied Physics Lab. . . . . [3990-13]

4:20 pm: **Reconfigurable contour beam generation using a smart subreflector antenna system,** H. Yoon, G. Washington, W. Theunissen, The Ohio State Univ. . . . . [3990-14]

4:40 pm: **Conformal fractal antenna for sensors,** K. J. Vinoy, K. A. Jose, V. K. Varadan, V. V. Varadan, The Pennsylvania State Univ. . . . . [3990-15]

5:00 pm: **Conformal fractal antenna for FSS and low RCS,** V. K. Varadan, K. J. Vinoy, K. A. Jose, V. V. Varadan, The Pennsylvania State Univ. . . . . [3990-16]

Tuesday 7 March

**** Please note conference moves to Pacific B.****

Keynote Address . . . . . 9:20 am

Structural health monitoring: demands and challenges, F. Chang, Stanford Univ. . . . . [3990-17]

Invited Paper . . . . . 10:00 am

Design and path planning contributions for snake robots, H. M. Choset, Carnegie Mellon Univ. . . . . [3990-18]

SESSION 4

Room: Pacific B . . . . . Tues.10:40 am

Monitoring and Control

Chairs: **Vittal S. Rao,** Univ. of Missouri/Rolla; **K. A. Jose,** The Pennsylvania State Univ.

10:40 am: **Distributed sensing and computing for structural health monitoring systems,** K. Mitchell, S. Sana, J. Burnett, V. S. Rao, H. J. Pottinger, Univ. of Missouri/Rolla . . . . . [3990-20]

11:00 am: **Conformal and embedded IDT sensors for health monitoring of structures and composites,** V. K. Varadan, V. V. Varadan, The Pennsylvania State Univ. . . . . [3990-21]

11:20 am: **Optimally curved electrodes for a rotary microactuator,** S. Jung, J. U. Jeon, J. Choi, Y. E. Pak, S. Lee, Samsung Advanced Institute of Technology . . . . . [3990-48]

11:40 am: **Microelectromechanical systems (MEMS)-based fiber optic grating sensor for improving weapon stabilization and fire control,** S. Z. Zhang, G. Xu, W. Qui, F. S. Lin, Physical Optics Corp.; R. C. Testa, M. S. Mattice, U.S. Army Armament Research, Development and Engineering Ctr. . . . . [3990-43]

Lunch/Exhibit Break . . . . . Noon to 1:30 pm

Invited Paper . . . . . 1:30 pm

Intelligent sensing and wireless communications in extreme harsh environments, C. Pereira, R. C. Testa, M. S. Mattice, U.S. Army Armament Research, Development and Engineering Ctr.; T. E. Viel, GE Aircraft Engines; E. Niver, New Jersey Institute of Technology . . . . . [3990-44]

Invited Paper . . . . . 2:00 pm

Dynamics and control of micro-cantilever arrays, B. Bamieh, Univ. of Illinois . . . . . [3990-23]

SESSION 5

Room: Pacific B . . . . . Tues. 2:30 pm

Sensors and Actuators II

Chairs: **Stephen M. Bobbio,** Univ. of North Carolina/Charlotte; **Vijay K. Varadan,** The Pennsylvania State Univ.

2:30 pm: **Scalable synthetic muscle actuator,** S. M. Bobbio, Univ. of North Carolina/Charlotte; M. Pennington, Integrated Electronic Innovations Inc.; S. W. Smith, J. Zara, Duke Univ.; J. Hudak, J. Pagan, P. Elliot, Univ. of North Carolina/Charlotte . . . . . [3990-24]

2:50 pm: **Thin film windows for use in a bulge tester and as a piezoelectric actuator,** D. R. Huston, W. Sauter, C. Broetz, Univ. of Vermont; W. J. Varhue, Arizona State Univ. . . . . [3990-25]

Coffee Break . . . . . 3:10 to 3:40 pm

3:40 pm: **Novel diffuser-nozzle micropump actuated by thermal bubble,** M. A. Rahman, F. Ahmed, Y. Zhao, T. H. Gong, Nanyang Technological Univ. (Singapore) . . . . . [3990-26]

4:00 pm: **Valveless micropump by Micro Stereo Lithography,** V. K. Varadan, V. V. Varadan, The Pennsylvania State Univ. . . . . [3990-27]

SESSION 6

Room: Pacific B . . . . . Tues. 4:20 pm

Fabrication and Characterization

Chairs: **Norio Shinya,** National Research Institute for Metals (Japan); **Srinivasa Ramanathan,** The Pennsylvania State Univ.

4:20 pm: **Microwelding method using a tungsten probe for microfabrication,** T. Konno, M. Egashira, M. Kobayashi, N. Shinya, National Research Institute for Metals (Japan) . . . . . [3990-28]

4:40 pm: **Fabrication of a microelectromagnetic flow sensor for micro flow rate measurement,** H. J. Yoon, S. Y. Kim, O. C. Jeong, S. Yang, Ajou Univ. (Korea) . . . . . [3990-29]

5:00 pm: **Fabrication of electromagnetic microactuator with an electroplated coil on a parylene diaphragm,** H. G. Jeong, O. C. Jeong, S. Yang, Ajou Univ. (Korea) . . . . . [3990-30]

5:20 pm: **Electromechanical properties of novel sensors and actuator designs fabricated by layered manufacturing techniques,** A. Safari, Rutgers Univ. [3990-31]

5:40 pm: **Rotorblade deicing using a shear wave interdigital transducer,** S. Ramanathan, V. K. Varadan, V. V. Varadan, The Pennsylvania State Univ. [3990-32]

Wednesday 8 March

Keynote Address . . . . . 9:20 am

Toward intracellular neuronal recording with implantable probe chips, K. F. Böhringer, Univ. of Washington . . . . . [3990-33]

Invited Paper . . . . . 10:00 am

Micro-engineering of magnetic bearings and actuators, M. K. Ghantasala, Royal Melbourne Institute of Technology (Australia) . . . . . [3990-34]

SESSION 7

Room: Pacific B . . . . . Wed. 10:40 am

Sensors and Actuators III

Chair: **Vijay K. Varadan,** The Pennsylvania State Univ.

10:40 am: **64 x 64 smart pixel array for deformable membrane devices,** K. Seunarine, I. Underwood, S. Graham, D. G. Vass, Univ. of Edinburgh (UK) [3990-35]

11:00 am: **Development of novel method to create two-dimensional photonic crystals,** M. Hase, M. Egashira, National Research Institute for Metals (Japan); K. M. Kojima, S. Uchida, Univ. of Tokyo (Japan); T. Ueta, K. Ohtaka, Chiba Univ. (Japan) . . . . . [3990-36]

11:20 am: **Phase synchronization of micromirror arrays using elastic linkages,** P. Chang, C. Liu, S. Pao, J. Chen, National Taiwan Univ. (Taiwan) . . . . . [3990-37]

11:40 am: **Conformal MEMS-IDT gyroscopes and their performance comparison with fiber optic gyro,** V. K. Varadan, K. A. Jose, P. Xavier, D. Suh, V. V. Varadan, The Pennsylvania State Univ. . . . . [3990-38]

Noon: **Micromachined convective accelerometer and inclinometer,** L. Li, C. Liang, Hebei Semiconductor Research Institute (China) . . . . . [3990-39]

12:20 pm: **Novel silicon cap package technology for monolithic micro-inertial measurement unit,** Z. Li, D. Zhang, T. Li, G. Wu, Peking Univ. (China) . . [3990-40]

Lunch/Exhibit Break . . . . . 12:40 to 2:10 pm

SESSION 8

Room: Pacific B . . . . . Wed. 2:10 pm

Sensors and Actuators IV

Chair: **Vijay K. Varadan,** The Pennsylvania State Univ.

2:10 pm: **Electrokinesis in periodic laminar flow in microtubes,** A. Bhattacharyya, Univ. of Alberta (Canada) . . . . . [3990-45]

2:30 pm: **Solid state MOSFET-based pressure sensor,** B. Zhu, V. K. Varadan, V. V. Varadan, The Pennsylvania State Univ. . . . . [3990-46]

2:50 pm: **Static deflections of cantilevers in a micropump,** S. Esteves, A. M. Robinson, A. Bhattacharyya, Univ. of Alberta (Canada) . . . . . [3990-47]

3:10 pm: **Evaluation and failure of commercial MEMS accelerometers,** A. Béliveau, Applied Research Associates; G. T. Spencer, K. A. Thomas, S. L. Roberson, Air Force Research Lab. . . . . [3990-49]

Conference 3991

Room: Pacific D

Tuesday–Thursday 7–9 March 2000 • *Proceedings of SPIE* Vol. 3991

Industrial and Commercial Applications of Smart Structures Technologies

Conference Chair: **Jack H. Jacobs,** Honeywell Space Systems

Cochair: **Anna-Maria Rivas McGowan,** NASA Langley Research Ctr.

Program Committee: **Grigory Adamovsky,** NASA Lewis Research Ctr.; **Eric H. Anderson,** CSA Engineering, Inc.; **Adam Bogue,** Active Control eXperts, Inc. - ACX; **Bernie F. Carpenter,** Lockheed Martin Astronautics; **William W. Clark,** Univ. of Pittsburgh; **Robert Clifford,** ETREMA Products, Inc.; **Keith K. Denoyer,** Air Force Research Lab.; **C. Robert Crowe,** Virginia Polytechnic Institute and State Univ.; **Peter D. Dean,** Lockheed Martin Advanced Technology Ctr.; **Donald L. Edberg,** Boeing Phantom Works; **Ursula Herold-Schmidt,** DaimlerChrysler Aerospace (Germany); **Leo Karkkainen,** Nokia Research Ctr. (Finland); **Jayanth N. Kudva,** Northrop Grumman Corp.; **Douglas K. Lindner,** Virginia Polytechnic Institute and State Univ.; **Craig D. Near,** Materials Systems Inc.; **Brian P. Sanders,** Air Force Research Lab.; **Janet M. Sater,** Institute for Defense Analyses; **Travis L. Turner,** NASA Langley Research Ctr.; **Edward V. White,** Boeing Phantom Works; **William K. Wilkie,** NASA Langley Research Ctr.; **Helmut W. Zaglauer,** DaimlerChrysler Aerospace (Germany)

Tuesday 7 March

SESSION 1

Room: Pacific D . . . . . Tues. 9:20 am

The German Industrial Research Program

Chairs: **Ursula Herold-Schmidt, Helmut W. Zaglauer,** DaimlerChrysler Aerospace (Germany)

9:20 am: **Overview of the German industrial research project ADAPTRONIK** *(Invited Paper),* H. Hanselka, Univ. of Magdeburg (Germany) . . . . . [3991-01]

10:00 am: **High-performance piezoelectric thin fibers and sheets as functional components for smart materials,** A. Schönecker, Fraunhofer Institut für Keramische Technologien und Sinterwerkstoffe (Germany); D. Sporn, W. Watzka, Fraunhofer Institut für Silicatforschung (Germany); L. Seffner, Fraunhofer Institut für Keramische Technologien und Sinterwerkstoffe (Germany); K. Pannkoke, Fraunhofer Institut für Fertigungstechnik und Angewandte Materialforschung (Germany); P. Wierach, DLR (Germany) . . . . . [3991-02]

10:20 am: **Adaptronics applications in satellite components,** J. K. Dürr, U. Herold-Schmidt, D. Scheulen, H. W. Zaglauer, DaimlerChrysler Aerospace (Germany) . . . . . [3991-03]

10:40 am: **Actuator and sensor components for adaptronic optics,** M. Ross-Messemer, F. S. Höller, T. Möller, A. Menck, Carl Zeiss (Germany) . . . . . [3991-04]

11:00 am: **New finescaled piezoelectric composites for ultrasound transducers,** H. von Garflen, W. Gebhardt, H. Meixner, Siemens AG (Germany) . . . . . [3991-05]

11:20 am: **Use of adhesives in adaptronic microsystems,** T. Gesang, K. Pannkoke, M. Cluever, H. Knebel, A. Battermann, J. Perl, H. Joachimi, Fraunhofer Institut für Fertigungstechnik und Angewandte Materialforschung (Germany) . . . . . [3991-06]

Lunch/Exhibit Break . . . . . 11:40 am to 1:30 pm

SESSION 2

Room: Pacific D . . . . . Tues. 1:30 pm

Sensor Technologies and Applications

Chairs: **Edward V. White,** Boeing Phantom Works; **Jack H. Jacobs,** Honeywell Space Systems

1:30 pm: **Integrated wireless piezoelectric sensors,** E. Ihler, H. W. Zaglauer, U. Herold-Schmidt, K. Dittrich, DaimlerChrysler Aerospace (Germany) . . [3991-07]

1:50 pm: **Fiber optic sensors for cure/health monitoring of composite materials,** K. H. Wood, R. S. Rogowski, B. J. Jensen, NASA Langley Research Ctr. . . [3991-08]

2:10 pm: **Progress on monitoring of adhesive joints using multiaxis fiber grating sensors,** W. L. Schulz, E. Udd, J. M. Seim, M. Morrell, Blue Road Research; E. Haugse, A. Trego, P. E. Johnson, Boeing Phantom Works; I. M. Perez, Naval Air Warfare Ctr. . . . . [3991-09]

2:30 pm: **Development of damage monitoring and suppression system using embedded SMA foil in CFRP laminates,** T. Ogisu, M. Nomura, Fuji Heavy Industries Ltd. Utsunomiya Plant (Japan); N. Takeda, Univ. of Tokyo (Japan) . . . . . [3991-10]

2:50 pm: **THUNDER piezoelectric actuators as a method of stretch-tuning an optical fiber grating,** S. G. Allison, R. L. Fox, M. E. Froggatt, B. A. Childers, NASA Langley Research Ctr. . . . . [3991-11]

Coffee Break . . . . . 3:10 to 3:40 pm

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SESSION 3

Room: Pacific D . . . . . Tues. 3:40 pm

System Test and Demonstrations

Chairs: **Jayanth N. Kudva,** Northrop Grumman Corp.; **Anna-Maria Rivas McGowan,** NASA Langley Research Ctr.

3:40 pm: **Evaluation of SMA actuator performance for tab-assisted control applications,** T. D. Nguyena, S. Gowinga, D. Bochinskia, Naval Surface Warfare Ctr.; B. F. Carpenter, Lockheed Martin Astronautics . . . . . [3991-12]

4:00 pm: **Smart materials for turbomachinery quieting,** M. L. Jonson, P. Lysak, The Pennsylvania State Univ. . . . . [3991-13]

4:20 pm: **Adaptive control of radiated noise from a cylindrical shell using active fiber composite actuators,** G. Goddu, D. McDowell, Naval Undersea Warfare Ctr. . . . . [3991-14]

4:40 pm: **Ground demonstration of the smart inlet,** J. P. Dunne, M. A. Hopkins, D. M. Pitt, E. V. White, Boeing Phantom Works; E. Garcia, DARPA . . . . . [3991-15]

✔Posters—Tuesday • Session 10

The following posters will be displayed in the formal poster session on Tuesday evening between 6:00 and 7:30 pm. Poster authors will be available at this time for discussion.

✔ **Node in a 3-section waveguide driven by Terfenol-D,** C. B. Bright, ETREMA Products, Inc. . . . . [3991-49]

✔ **Optimization of switching amplifiers for piezoelectric actuators,** D. K. Lindner, S. Chandrasekaran, Virginia Polytechnic Institute and State Univ. . . . . [3991-50]

✔ **Integrated design environment for biomimetic underwater vehicles,** O. K. Rediniotis, D. C. Lagoudas, V. Srinivasen, N. Wilson, R. E. Allen, Texas A&M Univ. . . . . [3991-53]

Wednesday 8 March

SESSION 4

Room: Pacific D . . . . . Wed. 9:20 am

Space Vehicle Lessons Learned and Applications

Chairs: **Keith K. Denoyer,** Air Force Research Lab.; **Jack H. Jacobs,** Honeywell Space Systems

9:20 am: **Lessons learned from 20th Century AFRL smart structures space experiments** *(Invited Paper),* K. K. Denoyer, Air Force Research Lab. . . . . [3991-16]

10:00 am: **1000 days on orbit: lessons learned from the ACTEX-I flight experiment,** R. S. Erwin, K. K. Denoyer, Air Force Research Lab. . . . . [3991-17]

10:20 am: **Experiences with smart structures for on-orbit vibration isolation,** R. S. Erwin, K. K. Denoyer, Air Force Research Lab.; L. Sullivan, Nichols Research Corp. . . . . [3991-18]

10:40 am: **Middeck active control experiment: lessons learned and reflight status,** K. K. Denoyer, R. R. Ninneman, Air Force Research Lab. . . . . [3991-19]

11:00 am: **Feasibility of using piezoelectric actuators to control launch vehicle acoustics and structural vibrations,** C. Niezrecki, Univ. of Florida; H. H. Cudney, Virginia Polytechnic Institute and State Univ. . . . . [3991-20]

11:20 am: **Multifunctional composites for space structure applications,** M. B. Miller, R. L. Clark, Jr., A. C. Furrow, C. R. Bell, Luna Innovations, Inc. . . . . [3991-21]

11:40 am: **Three degree-of-freedom adaptive-passive isolator for launch vehicle payloads,** F. Khorrami, J. S. Rastegar, OmniTek Research & Development, Inc.; R. S. Erwin, Air Force Research Lab. . . . . [3991-22]

Lunch/Exhibit Break . . . . . Noon to 1:30 pm

SESSION 5

Room: Pacific D . . . . . Wed. 1:30 pm

Enabling Actuator and Manufacturing Technologies I

Chairs: **Bernie F. Carpenter,** Lockheed Martin Astronautics; **Robert Clifford,** ETREMA Products, Inc.

1:30 pm: **Shape memory alloy consortium and demonstration,** A. D. Jacot, D. J. Clingman, Boeing Phantom Works . . . . . [3991-23]

1:50 pm: **Development of shape memory alloy spacecraft release devices,** B. F. Carpenter, Lockheed Martin Astronautics; E. R. Fosness, A. Peffer, K. K. Denoyer, Air Force Research Lab. . . . . [3991-24]

2:10 pm: **Thermal and mechanical characterization of NASA high-displacement actuators,** R. G. Bryant, NASA Langley Research Ctr.; S. A. Evans, St. Olaf College; R. L. Fox, NASA Langley Research Ctr. . . . . [3991-25]

2:30 pm: **Piezoelectric actuators and motors based on shell structures,** F. Claeyssen, N. Lhermet, R. Le Letty, F. Barillot, M. Debarnot, Cedrat Recherche (France); M. F. Six, Cedrat Recherche and Ctr. National d'Etudes Spatiales (France); G. Thomin, M. Privat, Ctr. National d'Etudes Spatiales (France); P. Bouchilloux, Magsoft Corp. . . . . [3991-26]

Coffee Break . . . . . 2:50 to 3:40 pm

SESSION 6

Room: Pacific D . . . . . Wed. 3:40 pm

Wing Control Applications

Chairs: **Eric H. Anderson,** CSA Engineering, Inc.; **Grigory Adamovsky,** NASA Lewis Research Ctr.

3:40 pm: **Boeing active flow control system (BAFCS),** A. D. Jacot, F. T. Calkins, Boeing Phantom Works . . . . . [3991-28]

4:00 pm: **Investigation PVdF active diaphragms for synthetic jets,** K. C. Bailo, D. E. Brei, Univ. of Michigan; F. T. Calkins, Boeing Phantom Works . . . . . [3991-29]

4:20 pm: **Active control of wind-tunnel model aeroelastic response using neural networks,** R. C. Scott, NASA Langley Research Ctr. . . . . [3991-30]

4:40 pm: **Recent advances in active fiber composites for structural control,** A. A. Bent, Continuum Control Corp. . . . . [3991-52]

Thursday 9 March

SESSION 7

Room: Pacific D . . . . . Thurs. 9:45 am

Commercial Lessons Learned and Applications

Chairs: **Adam Bogue,** Active Control Experts, Inc. - ACX; **William W. Clark,** Univ. of Pittsburgh

9:45 am: **Commercializing a U.S. piezoceramic linear motor** *(Invited Paper),* R. W. Diehl, Strategic Technology Group . . . . . [3991-32]

10:25 am: **Self-contained active damping system for pneumatic isolation tables,** L. P. Fowler, S. P. Buchner, Lord Corp.; V. Ryaboy, Newport Corp. . . . . [3991-33]

10:45 am: **Application of stuctural control to robotic assembly equipment,** R. N. Jacques, Active Control eXperts, Inc. . . . . [3991-34]

11:05 am: **Magnetorheological fluid shock absorbers for the rear suspension of an off-road motircycle: a theoretical study,** E. O. Ericksen, F. Gordaninejad, Univ. of Nevada/Reno . . . . . [3991-35]

11:25 am: **Semi-active controllable magneto-rheological fluid dampers for a mountain bicycle,** D. G. Breese, F. Gordaninejad, Univ. of Nevada/Reno . . . . . [3991-36]

11:45 am: **Development of a piezoelectrically-actuated cell stretching device,** W. W. Clark, K. Janes, R. Smith, Univ. of Pittsburgh . . . . . [3991-37]

12:05 pm: **Multiparameter sensors for smart oil wells,** Y. Chen, PhotoSonic Inc.; Y. Liu, NanoSonic Inc.; H. Ruan, PhotoSonic Inc.; R. O. Claus, Virginia Polytechnic Institute and State Univ. . . . . [3991-38]

Lunch Break . . . . . 12:25 to 1:30 pm

SESSION 8

Room: Pacific D . . . . . Thurs. 1:30 pm

Enabling Actuator and Manufacturing Technologies II

Chairs: **Brian P. Sanders,** Air Force Research Lab.; **Anna-Maria Rivas McGowan,** NASA Langley Research Ctr.

1:30 pm: **High-authority telescoping actuators with single crystal piezoelectric materials,** C. C. Wu, D. Lewis III, Naval Research Lab.; S. Park, The Pennsylvania State Univ. . . . . [3991-39]

1:50 pm: **Design of smart composite material multiple-layer EB-piezoelectric transformer MEMs,** J. H. Chung, S. M. Lee, M. M. O. Lee, Dongshin Univ. (Korea); Y. H. Moon, Samsung Electro-Mechanics Co., Ltd. (Korea) . . . . . [3991-40]

2:10 pm: **Compact piezohydraulic actuation system,** K. Nasser, O. Parrot, D. J. Leo, H. H. Cudney, Virginia Polytechnic Institute and State Univ. . . . . [3991-41]

2:30 pm: **Low-cost piezocomposite actuator for structural control applications,** W. K. Wilkie, J. W. High, NASA Langley Research Ctr.; P. H. Mirick, Army Research Lab.; R. L. Fox, B. D. Little, R. G. Bryant, R. F. Hellbaum, A. Jalink, Jr., NASA Langley Research Ctr. . . . . [3991-42]

2:50 pm: **Industrial and commercial applications of bi-stable reeled composites,** Q. M. Compton-Bishop, R. G. Curry, A. J. Daton-Lovett, RolaTube Technology Ltd. (UK) . . . . . [3991-43]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 9

Room: Pacific D . . . . . Thurs. 3:40 pm

Integrated Modeling and SMA Control Concepts

Chairs: **Travis L. Turner, William K. Wilkie,** NASA Langley Research Ctr.

3:40 pm: **Suppression of post-buckling deflection and panel flutter using shape memory alloy,** M. Tawfik, B. Duan, J. Ro, C. Mei, Old Dominion Univ. . . [3991-44]

4:00 pm: **Analysis and control of large thermal deflection of composite plates using shape memory alloy,** B. Duan, M. Tawfik, J. J. Ro, C. Mei, Old Dominion Univ.; S. N. Goek, Ecole Superieure de Mecanique de Marseille (France) . . . . . [3991-45]

4:20 pm: **Vibration of laminated composite plates embedded with SMA at elevated temperatures,** B. Duan, M. Tawfik, J. J. Ro, C. Mei, Old Dominion Univ.; S. N. Goek, Ecole Superieure de Mecanique de Marseille (France) . . . . . [3991-46]

4:40 pm: **Dynamic response tuning of composite beams by embedded shape memory alloy actuators,** T. L. Turner, NASA Langley Research Ctr. . . . . [3991-47]

5:00 pm: **Control of wave propagation in periodic rods using shape memory inserts,** M. Ruzzene, Catholic Univ. of America; A. M. Baz, Univ. of Maryland/ College Park . . . . . [3991-48]

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Conference 3992

Room: Trimaran/Brigatine

Monday–Thursday 6–9 March 2000 • *Proceedings of SPIE* Vol. 3992

Active Materials: Behavior and Mechanics

Conference Chair: **Christopher S. Lynch,** Georgia Institute of Technology

Cochair: **Dimitris C. Lagoudas,** Texas A&M Univ.

Program Committee: **Gary L. Anderson,** U.S. Army Research Office; **William D. Armstrong,** Binghamton Univ.; **Roshdy G. Barsoum,** Office of Naval Research; **James G. Boyd,** Univ. of Illinois/Chicago; **Gregory P. Carman,** Univ. of California/Los Angeles; **Tord Cedell,** Lund Institute of Technology (Sweden); **Martin L. Dunn,** Univ. of Colorado/Boulder; **Craig L. Hom,** Lockheed Martin Palo Alto Advanced Technology Ctr.; **Qing Jiang,** Univ. of California/Riverside; **Marc Kamlah,** Forschungszentrum Karlsruhe GmbH (Germany); **Doru C. Lupascu,** Univ. of Technology/Darmstadt (Germany); **Robert M. McMeeking,** Univ. of California/Santa Barbara; **Robert C. O'Handley,** Massachusetts Institute of Technology; **Thomas R. Shrout,** Ctr. for Medical Ultrasonic Transducer Engineering/The Pennsylvania State Univ.; **G. N. Weisensel,** ETREMA Products, Inc.; **Quanshui Zheng,** Tsinghua Univ. (China)

Monday 6 March

SESSION 1

Room: Trimaran/Brigatine . . . . . Mon. 9:20 am

Active Materials and Smart Structures

Chairs: **Christopher S. Lynch,** Georgia Institute of Technology;
Dimitris C. Lagoudas, Texas A&M Univ.

9:20 am: **Research in active composite materials and structures: an overview** *(Invited Paper),* G. L. Anderson, Army Research Office; D. P. Garg, Army Research Office and Duke Univ. . . . . [3992-01]

10:00 am: **Active fiber composites for structural health monitoring,** M. J. Schulz, M. J. Sundaresan, A. Ghoshal, North Carolina A&T State Univ.; P. F. Pai, Univ. of Missouri/Columbia . . . . . [3992-02]

10:20 am: **Analysis of deformable electroelastic devices: cumulative effects of weak electric conduction,** J. E. Harper, N. W. Hagood, Massachusetts Institute of Technology . . . . . [3992-03]

10:40 am: **Occurence of ferromagnetic shape memory alloys,** M. Wuttig, L. Liu, Univ. of Maryland/College Park; K. Tsuchiya, Toyahashi Univ. of Technology (Japan); R. D. James, Univ. of Minnesota/Twin Cities . . . . . [3992-04]

11:00 am: **Enhancement of the dynamic response characteristics of classical drives with smart actuators for high speed and precision machinery applications,** J. S. Rastegar, L. Yuan, SUNY/Stony Brook . . . . . [3992-05]

11:20 am: **Development of lightweight THUNDER with fiber composite layers,** K. J. Yoon, S. Shin, Konkuk Univ. (Korea) . . . . . [3992-06]

11:40 am: **Feasibility study of microfabrication by coextrustion (MFCX) hollow fibers for active composites,** B. J. Cannon, D. E. Brei, Univ. of Michigan . [3992-07]

Lunch Break . . . . . Noon to 1:30 pm

SESSION 2

Room: Trimaran/Brigatine . . . . . Mon. 1:30 pm

Ferroelectric and Electrostrictive Materials

Chairs: **Qing Jiang,** Univ. of California/Riverside;
Gregory P. Carman, Univ. of California/Los Angeles;
Doru C. Lupascu, Univ. of Technology/Darmstadt (Germany);
Christopher S. Lynch, Georgia Institute of Technology

1:30 pm: **Phase switching perovskites for actuator applications** *(Invited Paper),* L. E. Cross, The Pennsylvania State Univ. . . . . [3992-08]

2:10 pm: **Development of advanced piezoelectric actuators,** W. S. Hackenberger, M. J. Pan, J. P. Kucera, TRS Ceramics, Inc. . . . . [3992-09]

2:30 pm: **Processing and application of solid state converted high-strain materials,** K. McNeal, R. L. Gentilman, C. D. Near, Materials Systems Inc.; M. P. Harmer, H. M. Chan, A. Scotch, Lehigh Univ.; V. S. Venkataramani, C. Greskovich, General Electric Co. . . . . [3992-10]

2:50 pm: **Electromechanical characterization of PMN-PT ceramics for sonar projectors,** E. A. McLaughlin, J. M. Powers, Naval Undersea Warfare Ctr. . [3992-11]

Coffee Break . . . . . 3:10 to 3:40 pm

3:40 pm: **Recent materials meausrements on PMN-PT and PZN-PT single crystal materials for sonar applications,** J. M. Powers, M. B. Moffett, Naval Undersea Warfare Ctr. . . . . [3992-12]

4:00 pm: **Large signal dielectric losses in electrostrictive materials,** H. C. Robinson, M. B. Moffett, Naval Undersea Warfare Ctr. . . . . [3992-13]

4:20 pm: **Characterization of fine grain piezoceramic stack actuators,** C. L. Davis, D. G. Morris, F. T. Calkins, Boeing Phantom Works . . . . . [3992-14]

4:40 pm: **Stress dependence of the piezoelectric charge coefficient of piezoelectric and electrostrictive ceramics,** G. Yang, B. K. Mukherjee, Royal Military College (Canada) . . . . . [3992-15]

5:00 pm: **Mechanical compression in PMN and PZT,** L. Ewart, E. A. McLaughlin, K. Gittings, Naval Undersea Warfare Ctr. . . . . [3992-16]

5:20 pm: **Compressive depolarization of PZT piezoelectric ceramics under high-electromechanical driving levels,** C. Y. Lin, N. W. Hagood, Massachusetts Institute of Technology . . . . . [3992-17]

✔Posters—Monday • Session 9

The following posters will be displayed in the formal poster session on Monday evening between 6:00 and 7:30 pm. Poster authors will be available at this time for discussion.

✔ **Structure and properties of the PMN-PT solid solutions,** S. Vakhrushev, A.F. Ioffe Physico-Technical Institute (Russia); B. Dkhil, J. Kiat, Ecole Centrale Paris (France); S. Zhukov, V. Chernyshov, Moscow State Univ. (Russia) . . . . . [3992-77]

✔ **Hydrogen-bonded ferroelectrics: high-resolution NMR data and theoretical modeling suggest completely new aspects of their phase transition mechanism,** A. Bussmann-Holder, Max-Planck-Institut für Festkoerperforschung (Germany); N. Dalal, Florida State Univ. . . . . [3992-78]

✔ **Active materials for ultrasonic imaging,** T. Hahn-Jose, P. Weber, Fraunhofer Institute (Germany) . . . . . [3992-79]

✔ **Fabrication of high-performance PZT actuators using microwave sintering process,** H. Takahashi, Fuji Ceramics Corp. (Japan); J. Qiu, J. Tani, Tohoku Univ. (Japan) . . . . . [3992-80]

✔ **Ferroelectric thin films and heterostructures created by sol-gel method,** A. Poghosyan, R. K. Hovsepyan, E. S. Vartanyan, Institute for Physical Research (Armenia); A. L. Manukyan, S. G. Grigoryan, R. S. Vardanyan, Armenian Institute of Applied Chemistry (Armenia) . . . . . [3992-81]

✔ **Nonstoichiometry as a powerful tool for the optimization of material properties: lithium niobate crystals,** G. Malovichko, Univ. Osnabrück (Germany) [3992-82]

✔ **Shape memory effect in ferroelastics,** S. Gridnev, A. Biryukov, Voronezh State Technical Univ. (Russia) . . . . . [3992-83]

✔ **Giant electrostriction in relaxor ferroelectrics,** S. Gridnev, N. V. Pavlova, S. Rogova, A. Tsotsorin, Voronezh State Technical Univ. (Russia) . . . . . [3992-84]

✔ **Investigation of thin film NiTi shape memory alloy microactuator,** J. J. Gill, G. P. Carman, Univ. of California/Los Angeles . . . . . [3992-86]

✔ **General constitutive equation of ER suspensions,** Y. Liu, B. Wang, Z. Xiao, Nanyang Technological Univ. (Singapore) . . . . . [3992-87]

✔ **Simulation of magnetostrictive actuators for ultrasonic applications,** Z. Wei, F. Stillesjo, G. Engdahl, Royal Institute of Technology (Sweden) . . . . . [3992-88]

✔ **Active nanocomposite of layer-structured ferroelectrics,** M. V. Shankar, K. B. R. Varma, Indian Institute of Science (India) . . . . . [3992-89]

✔ **Electrostatically self-assembled electro-optic thin film devices,** Y. Liu, K. Cooper, NanoSonic Inc.; R. O. Claus, Virginia Polytechnic Institute and State Univ. and NanoSonic Inc.; W. Zhao, Virginia Polytechnic Institute and State Univ. . . . . [3992-90]

✔ **Piezoelectric property of sol-gel derived composite gels,** K. Sinkó, Eötvös Lorand Univ. (Hungary); N. Huesing, Technische Univ. Wien (Austria); M. Zrinyì, Technical Univ. of Budapest (Hungary) . . . . . [3992-91]

✔ **Mechanical characterization of shape memory alloy composites for designing smart structures,** H. A. Bruck, C. L. Moore, H. Surendranath, Univ. of Maryland . . . . . [3992-92]

✔ **Deployable structures using bi-stable reeled composites,** A. J. Daton-Lovett, R. G. Curry, Q. M. Compton-Bishop, RolaTube Technology Ltd. (UK) . . . . . [3992-93]

✔ **Development of a metal-based composite actuator,** H. Asanuma, H. Kurihara, T. Ishii, J. Ohira, O. Haga, Chiba Univ. (Japan) . . . . . [3992-94]

✔ **Constitutive modeling of fiber optics in nanotechnology,** T. C. Fan, International Open Univ. . . . . [3992-95]

✔ **Light-weight polymeric sound generator,** R. D. Corsaro, Naval Research Lab. . . . . [3992-96]

✔ **Shape control of a space membrane/inflatable using active polymers,** C. H. Jenkins, D. M. Fitzgerald, J. T. Ash, South Dakota School of Mines and Technology . . . . . [3992-100]

✔ **Ultrasonic.sonic drilling/coring (USDC) for in-situ planetary applications,** Y. Bar-Cohen, S. Sherrit, B. P. Dolgin, D. S. Pal, Jet Propulsion Lab.; T. Peterson, Cybersonics, Inc. . . . . [3992-101]

✔ **Piezoelectrically actuated miniature peristalic pump,** Y. Bar-Cohen, Z. Chang, Jet Propulsion Lab. . . . . [3992-102]

✔ **Complete modeling of rotary ultrasonic motors actuated by traveling flexural waves,** X. Bao, Y. Bar-Cohen, Jet Propulsion Lab. . . . . [3992-103]

Tuesday 7 March

SESSION 3

Room: Trimaran/Brigatine . . . . . Tues. 9:20 am

Domain Effects in Ferroelectrics I

Chairs: **Quanshui Zheng,** Tsinghua Univ (China); **Qing Jiang,** Univ. of California/Riverside; **Craig L. Hom,** Lockheed Martin Palo Alto Advanced Technology Ctr.; **Gregory P. Carman,** Univ. of California/Los Angeles

9:20 am: **Use of domain motion to determine grain orientation in PZT thin films** *(Invited Paper),* J. L. Hertz, J. E. Blendell, G. S. White, National Institute of Standards and Technology . . . . . [3992-18]

10:00 am: **Domain wall model for hysteresis in piezoelectric materials,** R. C. Smith, North Carolina State Univ.; Z. Ounaies, NASA Langley Research Ctr. . . . [3992-19]

10:20 am: **Structure-property relations in compostitionally modified ferroelectrics,** D. D. Viehland, Naval Undersea Warfare Ctr. . . . . [3992-20]

10:40 am: **Optical control of domain structures in ferroelectrics: mechanisms and applications,** A. Poghosyan, Institute for Physical Research (Armenia) . . . [3992-21]

11:00 am: **Effects of thickness on the piezoelectric an dielectric properties of PZT (52/48) thin films,** L. Lian, N. R. Sottos, Univ. of Illinois/ Urbana-Champaign . . . . . [3992-22]

11:20 am: **Kinetics of domain orientation processes in ferroelectric ceramics,** C. Heilig, K. Härdtl, Univ. Karlsruhe Technische Hochschule (Germany) . . . [3992-23]

11:40 am: **Thin ferroelectric bodies with large domains,** F. Davì, Univ. di Ancona (Italy) . . . . . [3992-24]

Noon: **Structured deformations of a bar,** K. Lazopoulous, National Technical Univ. (Greece) . . . . . [3992-25]

Standby Presentation

TBD, V. Y. Shur, Ural State Univ. (Russia) . . . . . [3992-26]

Lunch/Exhibit Break . . . . . 12:20 to 1:30 pm

SESSION 4

Room: Trimaran/Brigatine . . . . . Tues. 1:30 pm

Domain Effects in Ferroelectrics II

Chairs: **Robert M. McMeeking,** Univ. of California/Santa Barbara; **Christopher S. Lynch,** Georgia Institute of Technology

1:30 pm: **Electrical crack driving force and ferroelectric/elastic toughening in piezoelectric ceramics** *(Invited Paper),* G. A. Schneider, V. Heyer, A. Kolleck, Technische Univ. Hamburg-Harburg (Germany) . . . . . [3992-27]

2:10 pm: **Comparison of R-curve behavior in ferroelastic ceramics materials produced by SCF and SEVNB,** T. Karastamatis, Georgia Institute of Technology; D. C. Lupascu, J. Roedel, Technische Univ. Darmstadt (Germany); C. S. Lynch, Georgia Institute of Technology . . . . . [3992-28]

2:30 pm: **Electrically driven cracks in PZT,** S. L. dos Santos e Lucato, D. C. Lupascu, Technische Univ. Darmstadt (Germany); H. A. Bahr, Technische Univ. Dresden (Germany); J. Roedel, Technische Univ. Darmstadt (Germany) . . . . . [3992-29]

2:50 pm: **Piezoceramic multilayer actuators for fuel injection systems in automotive area,** C. Schuh, K. Lubitz, T. Steinkopff, A. Wolff, Siemens AG (Germany) [3992-30]

Coffee Break . . . . . 3:10 to 3:40 pm

3:40 pm: **Modeling of fracture in ferroelectric ceramics,** C. M. Landis, Harvard Univ.; R. M. McMeeking, Univ. of California/Santa Barbara . . . . . [3992-31]

4:00 pm: **Theoretical investigation on the cracking of ferroelectric ceramics,** M. Kuna, A. Ricoeur, Technische Univ. Bergakademie Freiberg (Germany) [3992-32]

4:20 pm: **Strength of a PZT ceramic under different test conditions,** T. Fett, M. Kamlah, D. Munz, G. Thun, Forschungszentrum Karlsruhe GmbH (Germany) . . . . . [3992-33]

4:40 pm: **Damage monitoring in piezoceramics using acoustic emission,** D. C. Lupascu, J. Nuffer, J. Roedel, Technische Univ. Darmstadt (Germany) . . . [3992-34]

5:00 pm: **Response of piezoelectric stack actuators under combined electro-mechanical-thermal loading,** M. Mitrovic, G. P. Carman, Univ. of California/Los Angeles; F. K. Straub, Boeing Co. . . . . [3992-35]

Wednesday 8 March

SESSION 5

Room: Trimaran/Brigatine . . . . . Wed. 9:20 am

Ferroelectric Material Characterization and Modeling

Chairs: **Martin L. Dunn,** Univ. of Colorado/Boulder; **Marc Kamlah,** Forschungszentrum Karlsruhe GmbH (Germany)

9:20 am: **Modeling of stable and unstable polarization switching,** H. Kessler, Technische Univ. Dresden (Germany); J. Nuffer, Technische Univ. Darmstadt (Germany); E. R. Fuller, Jr., National Institute of Standards and Technology; H. Balke, Technische Univ. Dresden (Germany) . . . . . [3992-36]

9:40 am: **Multiaxial constitutive behavior of ferroelectric materials,** C. S. Lynch, W. Chen, Georgia Institute of Technology . . . . . [3992-37]

10:00 am: **Nonlinear finite element method for piezoelectric structures made of hysteretic ferroelectric ceramics,** M. Kamlah, U. Böhle, Forschungszentrum Karlsruhe GmbH (Germany) . . . . . [3992-38]

10:20 am: **Thermal model for relaxor ferroelectric materials,** R. C. Smith, North Carolina State Univ.; C. L. Hom, Lockheed Martin Advanced Technology Ctr. . . . . [3992-39]

10:40 am: **Effective properties of piezoelectric polycrystals,** A. Froehlich, S. Weyer, A. Brueckner-Foit, Forschungszentrum Karlsruhe GmbH (Germany) . . . . [3992-40]

11:00 am: **Multiaxial models and experiments with ferroelectrics,** J. E. Huber, N. A. Fleck, Univ. of Cambridge (UK) . . . . . [3992-41]

11:20 am: **Electromechanical constitutive laws for the nonlinear switching of ferroelastics,** R. M. McMeeking, Univ. of California/Santa Barbara; C. M. Landis, Harvard Univ. . . . . [3992-42]

11:40 am: **Mechanics of large electrostriction in ferroelectrics,** E. Burcsu, G. Ravichandran, K. Bhattacharya, California Institute of Technology . . . [3992-43]

Lunch/Exhibit Break . . . . . Noon to 1:30 pm

SESSION 6
Room: Trimaran/Brigatine . . . . . Wed. 1:30 pm

Constitutive Modeling of Ferroelectric Ceramics

Chairs: **William D. Armstrong,** Binghamton Univ.; **Robert M. McMeeking,** Univ. of California/Santa Barbara; **Christopher S. Lynch,** Georgia Institute of Technology; **Martin L. Dunn,** Univ. of Colorado/Boulder

1:30 pm: **Finite element analysis of electric field assisted bonding,** J. G. Boyd, Univ. of Illinois/Chicago; E. T. Enikov, Univ. of Minnesota/Twin Cities . . . . . [3992-44]

1:50 pm: **Nonlinear behavior of polycrystalline piezoceramics,** Y. Fotinich, G. P. Carman, Univ. of California/Los Angeles . . . . . [3992-45]

2:10 pm: **Viscoelectroelastic behavior of heterogeneous piezoelectric solids,** J. Li, Univ. of California/San Diego; M. L. Dunn, Univ. of Colorado/Boulder . . [3992-46]

2:30 pm: **Construction of the electroelastic Green's function of the hexagonal infinite medium and its application to inclusion problems,** T. Michelitsch, Univ. Stuttgart (Germany); V. M. Levin, Petrozavosk State Univ. (Russia) . . . . . [3992-47]

2:50 pm: **Modeling of domain wall contribution to the effective properties of polycrystalline ferroelectric ceramics,** J. Roedel, W. Kreher, Technische Univ. Dresden (Germany) . . . . . [3992-48]

Coffee Break . . . . . 3:10 to 3:40 pm

3:40 pm: **Understanding mechanics and stress effects in rainbow and thunder stress-biased actuators,** R. W. Schwartz, J. M. Ballato, W. D. Nothwang, P. Laoratanakul, Clemson Univ. . . . . [3992-49]

4:00 pm: **Functionally gradient piezoelectric bimorph type actuator,** S. W. Hudnut, A. Almajid, M. Taya, Univ. of Washington . . . . . [3992-50]

4:20 pm: **Modeling and testing of materials performance in Ni-Mn-Ga ferromagnetic shape memory alloy,** R. C. O'Handley, Massachusetts Institute of Technology . . . . . [3992-99]

4:40 pm: **Gyroscopic effect on surface acoustic waves in piezoelectric materials,** Y. Zhou, Lanzhou Univ. (China); Q. Jiang, Univ. of California/Riverside . . [3992-52]

5:00 pm: **Multifunctionality in glasses containing ferroelectric microcrystallites,** M. V. Shankar, K. B. R. Varma, Indian Institute of Science (India) . . . . . [3992-53]

5:20 pm: **Finite element model of ferroelectric/ferroelastic polycrystals,** S. C. Hwang, Forschungszentrum Jülich GmbH (Germany); R. M. McMeeking, Univ. of California/Santa Barbara . . . . . [3992-54]

Thursday 9 March

SESSION 7
Room: Trimaran/Brigatine . . . . . Thurs. 9:45 am

Shape Memory Alloys I

Chairs: **Dimitris C. Lagoudas,** Texas A&M Univ.; **Abhijit Bhattacharyya,** Univ. of Alberta (Canada)

9:45 am: **Thermomechanical fatigue of SMA actuators,** D. C. Lagoudas, D. A. Miller, Texas A&M Univ.; L. Rong, Institute of Metal Research (China) . . . . . [3992-55]

10:05 am: **Image analysis of high-cycle fatigue strains of SMAs,** Y. Xi, Y. Roh, Univ. of Colorado/Boulder . . . . . [3992-56]

10:25 am: **Characterizaton and modeling of shape NiTi thin films for functionally graded MEMS,** H. A. Bruck, H. Q. Jin, Univ. of Maryland . . . . . [3992-57]

10:45 am: **Mechanism of improvement of shape memory effect by ausforming in Fe-Mn-Si-Cr shape memory alloy,** D. Z. Liu, National Research Institute for Metals (Japan) and Tianjin Univ. (China) (Japan); S. Kajiwara, N. Shinya, T. Kikuchi, National Research Institute for Metals (Japan); D. F. Wang, W. Y. Ji, M. Hang, D. Jia, W. X. Liu, Tianjin Univ. (China) . . . . . [3992-58]

11:05 am: **Special feature of the SMA composite materials deformation,** S. Lurie, Institute of Applied Mechanics and Institute of Smart Materials Mechanics (Russia); N. Poluhina, Moscow State Aviation Institute (Russia); D. Efimov, Institute of Applied Mechanics (Russia) . . . . . [3992-59]

11:25 am: **Modeling of transformations of shape memory alloys in various temperature ranges,** Y. Matsuzaki, H. Naito, T. Ikeda, Nagoya Univ. (Japan) . . . . . [3992-60]

11:45 am: **Deformation of NiTi single crystals in compression,** H. Sehitoglu, R. Anderson, I. Karaman, Univ. of Illinois/Urbana-Champaign; K. Gall, Univ. of Colorado; Y. Chumlyakov, Siberian Physical-Technical Institute (Russia) . [3992-61]

12:05 pm: **Recent developments in modeling and simulation of adaptive structures with SMA actuators,** S. Seelecke, Technische Univ. Berlin (Germany) . . . [3992-62]

Lunch Break . . . . . 12:25 to 1:30 pm

SESSION 8
Room: Trimaran/Brigatine . . . . . Thurs. 1:30 pm

Shape Memory Alloys II

Chairs: **Gregory P. Carman,** Univ. of California/Los Angeles; **Robert C. O'Handley,** Massachusetts Institute of Technology; **Dimitris C. Lagoudas,** Texas A&M Univ.; **William D. Armstrong,** Binghamton Univ.

1:30 pm: **Simulation of the thremo-mechanical behavior of shape memory alloys under multiaxial non-proportional loading,** H. Andrä, L. Juhasz, Univ. Karlsruhe Technische Hochschule (Germany) . . . . . [3992-63]

1:50 pm: **Dynamic behavior and shock absorption properties of porous shape memory alloys,** D. C. Lagoudas, Texas A&M Univ.; Y. C. Chen, K. Ravi-Chandar, Univ. of Houston; V. G. DeGiorgi, M. A. Qidwai, Naval Research Lab. . . [3992-64]

2:10 pm: **High-passive structural damping in a NiTi shape memory alloy fiber aluminum metal matrix composite,** W. D. Armstrong, Binghamton Univ.; P. G. Reinhall, Univ. of Washington . . . . . [3992-65]

2:30 pm: **SMA single crystal experiments and micromechanical modeling for complex thermomechanical loading,** L. C. Brinson, X. Zhang, X. Gao, Northwestern Univ. . . . . [3992-66]

2:50 pm: **One-dimensional sharp phase front-based continuum models of phase transformations in shape memory alloys,** V. Stoilov, A. Bhattacharyya, Univ. of Alberta (Canada) . . . . . [3992-67]

Coffee Break . . . . . 3:10 to 3:40 pm

3:40 pm: **NiTi experiments versus modeling: where do we stand?** K. Gall, Univ. of Colorado; H. Sehitoglu, Univ. of Illinois/Urbana-Champaign; Y. Chumlyakov, Siberian Physical-Technical Institute (Russia) . . . . . [3992-85]

4:00 pm: **Shape memory alloys: thermomechanical modeling and finite element simulations at finite strains,** D. Helm, P. Haupt, Univ. Gesamthochschule Kassel (Germany) . . . . . [3992-69]

4:20 pm: **Anisotropy of detwinning process in textured NiTi shape memory alloy,** Q. S. Zheng, Tsinghua Univ. (China); Y. Liu, The Hong Kong Polytechnic Univ. (Hong Kong) . . . . . [3992-70]

4:40 pm: **Magnetoelastic damping in hybrid Terfenol-D polymer composites,** G. McKnight, G. P. Carman, Univ. of California/Los Angeles . . . . . [3992-71]

5:00 pm: **Cyclic strain behavior of magnetostrictive polymer composite transducer materials,** W. D. Armstrong, Binghamton Univ.; W. M. Dougherty, Univ. of Washington . . . . . [3992-72]

5:20 pm: **Characterization of structure/property relationships for smart ferromagnetic sensor materials,** J. S. Dunning, U.S. Dept. of Energy . . . . [3992-73]

5:40 pm: **Dynamic simulation and performance study of magnetostrictive transducers for ultrasonic applications,** F. Stillesjo, Z. Wei, G. Engdahl, Royal Institute of Technology (Sweden); T. Cedell, Lunds Tekniska Hoegskola (Sweden) . . . . . [3992-74]

6:00 pm: **Theory of deforming the polycrystals with martensitic transforamtions based on structured-analytical concepts physical mesomechanic,** V. Malinin, N. Malinina, G. Malinin, Novgorod State Univ. (Russia) . . . . . [3992-76]

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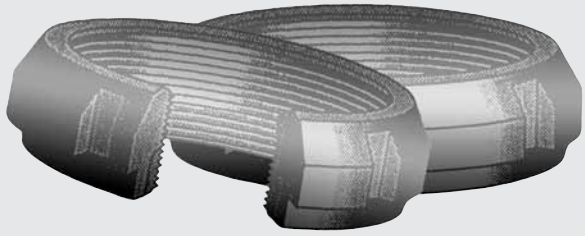

Conference 3993

Room: Balboa
Wednesday–Thursday 8–9 March 2000 • *Proceedings of SPIE* Vol. 3993

Nondestructive Evaluation of Aging Materials and Composites IV

Conference Chairs: **George Y. Baaklini,** NASA Glenn Research Ctr.; **Carol A. Lebowitz,** Air Force Research Lab.; **Eric S. Boltz,** Marathon Sensors Inc.

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Wednesday 8 March

SESSION 1

Room: Balboa . . . . . Wed. 9:20 am

NDE for Composites

Chairs: **Ali Abdul-Aziz,** NASA Glenn Research Ctr.

9:20 am: **Rapid NDT of composite aircraft components using lock-in ultrasonic and halogen lamp thermography,** D. Bates, G. F. Smith, D. Lu, Univ. of Warwick (UK); J. Hewitt, British Aerospace (UK) . . . . . [3993-01]

9:40 am: **Systems-based approach to thermographic NDE,** S. M. Shepard, T. Ahmed, J. R. Lhota, B. A. Rubadeux, Thermal Wave Imaging, Inc. . . . . [3993-02]

10:00 am: **Spatial and temporal control/monitoring of the degree of cure in polymer composite,** P. J. Shull, The Pennsylvania State Univ.; D. H. Hurley, J. B. Spicer, J. W. Spicer, Johns Hopkins Univ. . . . . [3993-04]

10:20 am: **Application of acoustography to the ultrasonic NDE of aerospace composites,** A. Bond-Thorley, British Aerospace (UK); H. Wang, J. S. Sandhu, Santec Systems, Inc. . . . . [3993-06]

10:40 am: **Challenges of nondestructive evaluation and its relation to finite element analysis,** A. Abdul-Aziz, G. Y. Baaklini, NASA Glenn Research Ctr.; D. Zagidulin, Allegheny College . . . . . [3993-07]

11:00 am: **Blind deconvolution of acoustic emission signals for damage identification of composites,** G. T. Zheng, M. A. Buckley, G. F. Fernando, Cranfield Univ. (UK) . . . . . [3993-08]

Lunch/Exhibit Break . . . . . 11:20 am to 1:30 pm

SESSION 2

Room: Balboa . . . . . Wed. 1:30 pm

NDE Technology for Health Monitoring

Chairs: **Andrew L. Gyekenyesi,** NASA Glenn Research Ctr.; **Bernhard R. Tittmann,** The Pennsylvania State Univ.

1:30 pm: **Real-time monitoring of acoustic linear and nonlinear behavior of titanium alloys during low-cycle fatigue and high-cycle fatigue,** J. Frouin, S. Sathish, T. E. Matikas, J. K. Na, Univ. of Dayton . . . . . [3993-10]

1:50 pm: **Laser interferometry for measurement of displacement at hostile enviroment in real time,** M. Aslan, B. R. Tittmann, The Pennsylvania State Univ. . . . . [3993-11]

2:10 pm: **Quantifying residual stresses by means of thermoelastic stress analysis,** A. L. Gyekenyesi, G. Y. Baaklini, NASA Glenn Research Ctr. . . . . [3993-12]

2:30 pm: **Fiber optic acoustic emission sensors and detection,** R. L. Clark, Jr., A. P. C. Furrow, Luna Innovations, Inc. . . . . [3993-13]

Coffee Break . . . . . 2:50 to 3:40 pm

SESSION 3

Room: Balboa . . . . . Wed. 3:40 pm

NDE for Concrete Asphalt and Wood

Chairs: **Minh P. Luong,** CNRS-LMS (France); **Steve Thackery,** BT Labs. (UK)

3:40 pm: **Nondestructive damage evaluation of reinforced concrete structure using infrared thermography,** M. P. Luong, CNRS-LMS (France) . . . . . [3993-14]

4:00 pm: **Feasibility study of IE-SASW method for nondestructive testing of concrete,** D. Kim, W. Seo, Korea Advanced Institute of Science and Technology (Korea); K. Lee, Sung Kyun Kwan Univ. (Korea) . . . . . [3993-15]

4:20 pm: **Backcalculation of temperature parameters for determination of asphalt layer modulus,** Q. Dong, K. Matsui, K. Yamamoto, Tokyo Denki Univ. (Japan) . . . . . [3993-16]

4:40 pm: **Assessment of structural integrity of wooden poles,** I. A. Craighead, Univ. of Strathclyde (UK); S. Thackery, M. Redstall, M. R. Thomas, BT Labs. (UK) . . . . . [3993-17]

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Thursday 9 March

SESSION 4

Room: Balboa . . . . . Thurs. 9:45 am

Improved NDE Techniques

Chairs: **Chiaki Miyasaka,** The Pennsylvania State Univ.;
Alain A. Deom, ONERA (France)

9:45 am: **Shearographic imaging of the interaction of ultrasonic waves and defects in plates,** D. Devillers, F. Taillade, D. L. Osmont, J. Krapez, M. Lemistre, F. X. Lepoutre, A. A. Deom, ONERA (France) . . . . . [3993-18]

10:05 am: **Nondestructive characterization of corrosion protective coatings on aluminum alloy substrates,** J. Hoffmann, S. Sathish, M. Khobaib, Univ. of Dayton . . . . . [3993-19]

10:25 am: **Experimental study and prediction of frequency shift of piezoelectric ceramic packages,** W. Zhang, CTS Wireless Components, Inc.; Y. Xi, Y. S. Roh, Univ. of Colorado/Boulder . . . . . [3993-20]

10:45 am: **Implementation of temporal phase unwrapping in a real-time phase stepped shearing speckle interferometer,** P. A. A. M. Somers, H. H. van Brug, Delft Univ. of Technology (Netherlands) . . . . . [3993-21]

11:05 am: **Development of new V(z) curve technique for soft material,** C. Miyasaka, The Pennsylvania State Univ.; K. Komaki, Nihon Univ. (Japan); B. R. Tittmann, The Pennsylvania State Univ. . . . . [3993-22]

11:25 am: **New developments in acoustography for fast full-field large-area ultrasonic NDE,** J. S. Sandhu, H. Wang, W. J. Popek, Santec Systems, Inc.; P. Sincebaugh, U.S. Army Research Lab. . . . . [3993-23]

11:45 am: **Simple fiber optic technique for in-situ corrosion sensing in structures,** N. Singh, S. C. Jain, A. K. Aggarwal, M. L. Singla, M. Singh, Central Scientific Instruments Organisation (India) . . . . . [3993-24]

12:05 pm: **Research on image preprocessing techniques for real-time radiography inspection,** D. Ren, Z. You, Tsinghua Univ. (China) . . . . . [3993-25]

Lunch Break . . . . . 12:25 to 1:30 pm

SESSION 5

Room: Balboa . . . . . Thurs. 1:30 pm

Process Control and Sensors for Manufacturing

Chairs: **Eric S. Boltz,** Marathon Sensors Inc.; **Peter Shull,**
Penn State Altoona

1:30 pm: **Cure monitoring of composite laminates used in the manufacture of snowboards,** N. V. Pelczarski, D. R. Huston, Univ. of Vermont . . . . . [3993-26]

1:50 pm: **Long period gratings as a flow sensor for resin transfer molding,** S. R. M. Kueh, S. G. Advani, Univ. of Delaware; R. S. Parnas, J. P. Dunkers, National Institute of Standards and Technology; A. P. C. Furrow, M. E. Jones, T. A. Bailey, Luna Innovations, Inc. . . . . [3993-27]

2:10 pm: **Supervision of pharmaceutical glass container's manufacturing process,** F. J. Meca Meca, F. J. Rodrìguez Sanchez, J. A. Jimenez Calvo, D. Lillo Rodrìguez, Univ. of Alcala (Spain) . . . . . [3993-28]

2:30 pm: **Relational database model for improving quality assurance and process control in a composite manufacturing environment,** J. D. Gentry, Concept Software, Inc. . . . . [3993-29]

2:50 pm: **Non-contact ultrasound studies of composite materials: new developments,** S. B. Palmer, S. Dixon, C. Edwards, Univ. of Warwick (UK) . . . . . [3993-30]

3:10 pm: **Linear DC resistance measurement for on-line LCM-process monitoring,** T. Luthy, G. Barandun, P. Ermanni, Swiss Federal Institute of Technology (Switzerland) . . . . . [3993-31]

3:30 pm: **Novel front surface thermal diffusivity measurement method based on phase analysis,** A. Braggiotti, S. Marinetti, CNR (Italy) . . . . . [3993-32]

Conference 3994

Room: Yawl
Tuesday–Wednesday 7–8 March 2000 • *Proceedings of SPIE* Vol. 3994

Nondestructive Evaluation of Aging Aircraft, Airports, and Aerospace Hardware IV

Conference Chair: **Ajit K. Mal,** Univ. of California/Los Angeles

Cochairs: **Yoseph Bar-Cohen,** Jet Propulsion Lab.; **Tribikram Kundu,** Univ. of Arizona

Program Committee: **Cetin Cetinkaya,** Clarkson Univ.; **Neil J. Goldfine,** JENTEK Sensors, Inc.; **Percy Hilderbrand,** HD Labs, Inc.; **Roy Ikegami,** Boeing Phantom Works; **Roger F. Johnson,** QUEST Integrated, Inc.; **Jiann W. Ju,** Univ. of California/Los Angeles; **Vikram K. Kinra,** Texas A&M Univ.; **Carl A. Lenngren,** National Swedish Road Administration (Sweden); **Shaker A. Meguid,** Univ. of Toronto (Canada); **Roberto A. Osegueda,** Univ. of Texas/El Paso; **Walter N. Podney,** SQM Technology, Inc.; **Michael Rooney,** Johns Hopkins Univ.; **William W. Shurtleff,** Iowa State Univ.; **William P. Winfree,** NASA Langley Research Ctr.; **Shi-Chang Wooh,** Massachusetts Institute of Technology

Tuesday 7 March

SESSION 1

Room: Yawl . . . . . Tues. 9:20 am

Session I

Chairs: **Ajit A. Mal,** Univ. of California/Los Angeles; **Roberto A. Osegueda,** Univ. of Texas/El Paso;

9:20 am: **Low-frequency electromagnetic technique for nondestructive evaluation,** P. V. Czipott, Quantum Magnetics, Inc.; W. F. Avrin, W.F. Avrin Applied Physics; Y. Dalichaouch, S. Kumar, A. R. Perry, Quantum Magnetics, Inc.; A. L. Singsaas, Concept Technologies Inc. . . . . [3994-01]

9:40 am: **Evaluating material integrity using reduced-order computational modeling,** M. L. Joyner, H. T. Banks, North Carolina State Univ.; B. Wincheski, W. P. Winfree, NASA Langley Research Ctr. . . . . [3994-02]

10:00 am: **Detection of cracks in multilayer aircraft structures with fasteners using remote-field eddy-current method,** Y. Sun, S. S. Udpa, Iowa State Univ.; T. Ouyang, Innovative Materials Testing Technologies, Co. . . . . [3994-03]

10:20 am: **Eddy-current measurements with magnetoresistive sensors: third-layer flaw detection in a wing-splice structure 25-mm thick,** W. F. Avrin, W.F. Avrin Applied Physics . . . . . [3994-04]

10:40 am: **NDE of aircraft structure using lock-in thermography,** W. Bai, B. S. Wong, Nanyang Technological Univ. (Singapore) . . . . . [3994-05]

11:00 am: **Role of data fusion in NDE for aging aircraft,** D. S. Forsyth, J. P. Komorowski, National Research Council Canada . . . . . [3994-06]

11:20 am: **Feasibility of optical interference-based NDE methods to inspect helicopter rotor blades,** D. Findeis, J. Gryzagoridis, Univ. of Cape Town (South Africa) . . . . . [3994-07]

Lunch/Exhibit Break . . . . . 11:40 am to 1:30 pm

SESSION 2

Room: Yawl . . . . . Tues. 1:30 pm

Session II

Chairs: **Eric Haugse, Roy Ikegami,** Boeing Phantom Works

1:30 pm: **Ultrasonic detection of corrosion between riveted plates,** K. Shiloh, Israel Atomic Energy Commission (Israel); A. Bartos, QMI Inc.; A. Frain, Johns Hopkins Univ.; E. A. Lindgren, Industrial Quality, Inc. . . . . [3994-09]

1:50 pm: **Air-coupled ultrasonic detection of corrosion between riveted plates by lamb waves,** J. Strycek, H. Loertscher, A. Bartos, QMI Inc. . . . . [3994-10]

2:10 pm: **ASIP W-16/16A fuel tank NDI interval extension,** P. S. Rutherford, Boeing Phantom Works . . . . . [3994-11]

2:30 pm: **Technology assessment of MEMS for NDE,** G. A. Matzkanin, Nondestructive Testing Information Analysis Center . . . . . [3994-30]

2:50 pm: **Optical device based on thermoplastic recording,** R. S. Prilepov, T. I. Pasechnik, L. M. Panasiuk, State Univ. of Moldova (Moldova) . . . . . [3994-13]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 3

Room: Yawl . . . . . Tues. 3:40 pm

Session III

Chairs: **Eric Haugse, Roy Ikegami,** Boeing Phantom Works

3:40 pm: **Use of transversely loaded fiber grating strain sensors for aerospace applications,** E. Udd, W. L. Schulz, J. M. Seim, Blue Road Research; A. Trego, E. Haugse, P. E. Johnson, Boeing Phantom Works . . . . . [3994-17]

4:00 pm: **Durability patch and damage dosimeter: a portable battery-powered data acquisition computer and damped repair design process,** E. Haugse, P. E. Johnson, Boeing Phantom Works; D. L. Smith, Boeing Electronics; R. Ikegami, Boeing Phantom Works . . . . . [3994-15]

4:20 pm: **Fusion of modal strain energy for health monitoring of aircraft structures,** R. A. Osegueda, G. C. Andre, C. M. Ferregut, C. J. Carrasco, L. R. Pereyra, H. Lopez, Univ. of Texas/El Paso . . . . . [3994-16]

4:40 pm: **Acoustic emission structural health management system (AE-SHMS),** R. D. Finlayson, Physical Acoustic Corp.; M. A. Friesel, M. F. Carlos, R. Miller, Physical Acoustics Corp. . . . . [3994-14]

5:00 pm: **Applying thermoelasticity to impact-damaged structural components,** G. Horn, T. Mackin, Univ. of Illinois/Urbana-Champaign . . . . . [3994-18]

5:20 pm: **External wall thickness evaluation of turbine blades by eddy current sensor,** Y. Le Bihan, P. Joubert, D. Placko, Ecole Normale Superieure de Cachan (France) . . . . . [3994-27]

Wednesday 8 March

SESSION 4

Room: Yawl . . . . . Wed. 9:20 am

Session IV

Chairs: **George A. Matzkanin,** Texas Research Institute;
Tribikram Kandu, Univ. of Arizona

9:20 am: **Nondestructive evaluation of the crack propagation rate under a composite patch repair using the eddy-current method,** Z. P. Marioli-Riga, Hellenic Aerospace Industry Ltd. (Greece); G. J. Tsamasphyros, G. N. Kanderakis, National Technical Univ. of Athens (Greece) . . . . . [3994-19]

9:40 am: **Ultrasonic evaluation of a co-cured composite wing,** G. E. Georgeson, Boeing Phantom Works . . . . . [3994-20]

10:00 am: **Near Lamb mode imaging of multilayered composite plates,** T. Kundu, Univ. of Arizona; C. Potel, Univ. de Technologie de Compiegne and Univ. Picardie Jules Verne (France); J. F. de Belleval, Univ. Picardie Jules Verne (France) [3994-21]

10:20 am: **Effects of exciting frequency, grain size, and damage in ultrasonic nondestructive evaluation of concrete,** J. W. Ju, L. Weng, Y. Liu, Univ. of California/ Los Angeles . . . . . [3994-22]

10:40 am: **Detection of voids inside concrete using radar,** H. C. Rhim, Yonsei Univ. (Korea) . . . . . [3994-23]

11:00 am: **Evaluating pavement layer properties with a high-speed rolling deflectometer,** P. Andrén, Swedish National Road and Transport Research Institute (Sweden); C. A. Lenngren, National Swedish Road Administration (Sweden) . . . . . [3994-24]

11:20 am: **Ultrasonic materials evaluation of automotive inflator components,** T. Chung, C. Fischer, TRW Inc. . . . . [3994-25]

11:40 am: **Detection of cracks near sharp edges by using giant magnetoresistance-based eddy current probe,** T. Dogaru, S. T. Smith, Univ. of North Carolina/ Charlotte . . . . . [3994-28]

Noon: **Long-range laser ultrasonic nondestructive evaluation of offshore structures,** V. K. Kinra, K. Maslov, Texas A&M Univ. . . . . [3994-29]

12:20 pm: **CC (class contrast): a robust method for classification of homogeneous zones in solids applied to thermal images,** A. Braggiotti, S. Marinetti CNR (Italy) . . . . . [3994-31]

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Conference 3995A

Room: Newport South

Tuesday–Thursday 7–9 March 2000 • Part of *Proceedings of SPIE* Vol. 3995: Nondestructive Evaluation of Highways, Utilities, and Pipelines IV

Health Monitoring of the Highway Transportation Infrastructure

Conference Chair: **Ahmet E. Aktan,** Drexel Univ.

Cochair: **Dryver R. Huston,** Univ. of Vermont

Program Committee: **Steven B. Chase,** Federal Highway Administration; **Ken P. Chong,** National Science Foundation; **Maria Q. Feng,** Univ. of California/Irvine; **Dan Frangopol,** Univ. of Colorado/Boulder; **Hamid Ghasemi,** Federal Highway Administration; **Nick Jones,** Johns Hopkins Univ.; **S. C. Liu,** National Science Foundation; **Madhwesh Raghavendrachar,** CALTRANS; **Erdal Safak,** U.S. Geological Survey; **Ray Starsman,** ITS America; **Glenn A. Washer,** Federal Highway Administration

Tuesday 7 March

SESSION 1

Room: Newport South . . . . . Tues. 9:20 am

Basic Concerns in Health Monitoring

Chair: **Steven B. Chase,** Federal Highway Administration

Keynote Address . . . . . 9:20 am

Reliability based lifetime maintenance of aging highway bridges, Michael P. Enright, Southwest Research Institute; **Dan Frangopol,** Univ. of Colorado/Boulder . . . . . [3995A-01]

10:00 am: **Evaluating the utility of global damage detection methods for highway bridges,** D. M. McCann, N. P. Jones, J. H. Ellis, Johns Hopkins Univ. . . . [3995A-03]

10:20 am: **Remote wireless sensing and model-based signal processing for structural evaluations,** D. B. McCallen, G. C. Burnett, Lawrence Livermore National Lab. . . . . [3995A-04]

10:40 am: **Durability assessment precedure for concrete bridge decks,** H. Aktan, O. Yaman, Wayne State Univ.; O. Udegbunam, Michigan Dept. of Transportation [3995A-05]

11:00 am: **Energy index approach for damage detection in nonlinear highway structures,** S. Jin, R. A. Livingston, Federal Highway Administration[3995A-06]

11:20 am: **Experimental investigation into the use of vibration data for the quality control and long-term monitoring of an all-composite bridge,** C. P. Ratcliffe, U.S. Naval Academy; J. W. Gillespie, Jr., D. Heider, D. A. Eckel II, Univ. of Delaware; R. M. Crane, Naval Surface Warfare Ctr. . . . . [3995A-07]

Lunch/Exhibit Break . . . . . 11:40 am to 1:30 pm

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SESSION 2

Room: Newport South . . . . . Tues. 1:30 pm

Health Monitoring of Delaware River Port Authority Infrastructure

Chair: **Robert Box,** Delaware River Port Authority

1:30 pm: **Introduction to Delaware River Port Authority's (DRPA) "Smart Bridges" Initiative,** R. Box, Delaware River Port Authority; A. E. Aktan, Drexel Univ. . . . . [3995A-08]

1:50 pm: **Structural identification of Commodore Barry Bridge,** F. N. Catbas, Drexel Univ. . . . . [3995A-09]

2:10 pm: **Information technology issues for health monitoring of Commodore Barry Bridge,** E. Kulcu, Drexel Univ. . . . . [3995A-10]

2:30 pm: **Information technology issues for data management for health monitoring,** X. Qin, C. J. Tsikos, Drexel Univ. . . . . [3995A-11]

2:50 pm: **Health monitoring of the Commodore Barry Bridge,** K. A. Grimmelsman, R. Barrish, Drexel Univ. . . . . [3995A-12]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 3

Room: Newport South . . . . . Tues. 3:40 pm

Highway Infrastructure Health Monitoring

Chair: **Madhwesh Raghavendrachar,** CALTRANS

3:40 pm: **Instrumentation of bridges for long-term performance monitoring,** M. Q. Feng, Y. Kim, Univ. of California/Irvine; L. Sheng, CalTrans . . . . . [3995A-13]

4:00 pm: **Automated tiltmeter monitoring of bridge response to compaction grouting,** J. N. Schuyler, Applied Geomechanics; F. Gularte, Hayward Baker . . . . . [3995A-14]

4:20 pm: **Remote monitoring of landslides adjacent to Highway 50,** D. Speer, L. Turner, CalTrans . . . . . [3995A-15]

4:40 pm: **Finite element modeling of a six span bridge,** A. Gottipati, M. W. Halling, K. C. Womack, Utah State Univ. . . . . [3995A-17]

5:00 pm: **Modal analysis of a three-span curved steel girder bridge,** B. G. Nielson, K. C. Womack, M. W. Halling, Utah State Univ. . . . . [3995A-18]

5:20 pm: **Acoustic emission for monitoring of fatigue crack in steel bridge members,** D. J. Yoon, J. C. Jung, P. Park, S. S. Lee, Korea Research Institute of Standards and Science . . . . . [3995A-72]

✔Posters—Tuesday • Session 9

The following posters will be displayed in the formal poster session on Tuesday evening between 6:00 and 7:30 pm. Poster authors will be available at this time for discussion.

✔ **Damage detection in concrete using Lamb waves,** Y. Jung, T. Kundu, M. Ehsani, Univ. of Arizona; P. Karpur, Allied Signal . . . . . [3995A-49]

✔ **Long-term monitoring of highway deformations,** P. Anderegg, C. Raab, R. Broennimann, M. Partl, Swiss Federal Labs. for Materials Testing and Research (Switzerland) . . . . . [3995A-50]

✔ **Electrochemical evaluation of corrosion inhibitors for repairing of the highway trasportation infrastructure,** K. W. Lee, Y. Cao, R. Brown, R. Guo, Univ. of Rhode Island . . . . . [3995A-51]

✔ **Development and deployment of fiber optic highway and bridge monitoring sensor systems,** J. M. Seim, W. L. Schulz, E. Udd, M. Morrell, Blue Road Research; H. M. Laylor, S. M. Soltesz, R. Edgar, Oregon Dept. of Transportation . . . . . [3995A-52]

✔ **Nondestructive evaluation of highway pavements structural capacity,** S. A. Qudais, Jordan Univ. of Science and Technology (Jordan) . . . . . [3995A-53]

✔ **GPR signal analysis techniques for condition assessment of concrete structures,** U. B. Halabe, West Virginia Univ.; R. Liu, Texas A&M Univ. . . . . [3995A-54]

✔ **Damage assessment in roadways with ground-penetrating radar,** D. R. Huston, N. V. Pelczarski, B. Esser, Univ. of Vermont; K. R. Maser, Infrasense, Inc.; W. H. Weedon, Applied Radar Analysis . . . . . [3995A-55]

✔ **Magnetoelastic permeability measurement for stress monitoring in steel tendons and cables,** Z. L. Chen, G. M. Lloyd, M. L. Wang, Univ. of Illinois/ Chicago . . . . . [3995A-56]

✔ **Nonlinear acoustic nondestructive testing for concrete durability,** H. Wu, K. Warnemuende, Wayne State Univ. . . . . [3995A-57]

Wednesday 8 March

SESSION 4

Room: Newport South . . . . . Wed. 9:20 am

Health Monitoring Applications from Europe

Chair: **Peter Schwesinger,** Bauhaus Univ. (Germany)

Keynote Address . . . . . 9:20 am

Global monitoring concept for bridges, Konrad Bergmeister, Ulrich Santa, Univ. of Applied Sciences (Austria) . . . . . [3995A-19]

10:00 am: **Geo-structural monitoring with long-gage interferometric sensors,** D. Inaudi, N. Casanova, SMARTEC SA (Switzerland) . . . . . [3995A-20]

10:20 am: **Monitoring of harbor piers with fiber optic displacement sensors,** D. Inaudi, SMARTEC SA (Switzerland); G. Brunetti, Tecniter s.r.l. (Italy); A. E. Del Grosso, Univ. degli Studi di Genova (Italy); M. Fedolino, Autorità Portuale di Genova (Italy) . . . . . [3995A-21]

10:40 am: **EXTRA: a new experiment supported condition assessment method for concrete bridges,** P. Schwesinger, G. Bolle, Bauhaus Univ. (Germany) . [3995A-22]

11:00 am: **Controlled lifetime extension of endangered concrete structures by health monitoring,** P. Schwesinger, Bauhaus Univ. (Germany); R. Berndt, Infokom GmbH Neubrandenburg (Germany) . . . . . [3995A-23]

11:20 am: **Main limitations in infrared temperature measurement of train hot points,** F. J. Meca Meca, F. J. Rodríguez Sanchez, M. Mazo Quintas, J. A. Jimenez Calvo, D. Lillo Rodríguez, Univ. of Alcala (Spain) . . . . . [3995A-24]

11:40 am: **Vigilance system in rails for train hot point temperatures during circulation,** F. J. Meca Meca, F. J. Rodríguez Sanchez, M. Mazo Quintas, J. J. Garcia Dominguez, J. A. Jimenez Calvo, E. Sebastian, D. Lillo Rodríguez, M. A. Garcia Rodríguez, Univ. of Alcala (Spain) . . . . . [3995A-25]

Lunch/Exhibit Break . . . . . Noon to 1:30 pm

SESSION 5

Room: Newport South . . . . . Wed. 1:30 pm

Bridge Health Monitoring Applications from Japan

Chair: **Yozo Fujino,** Univ. of Tokyo (Japan)

1:30 pm: **Inspection and monitoring of Hanshin Expressway for structural maintenance,** H. Hayashi, Hanshin Road Technology Ctr. (Japan); M. Sugimoto, Fuji Engineering Co., Ltd. (Japan) . . . . . [3995A-26]

1:50 pm: **Monitoring of Akashi Kaikyo Bridge,** Y. Fujino, S. Kashima, Univ. of Tokyo (Japan) . . . . . [3995A-27]

2:10 pm: **Monitoring of Hakucho Suspension Bridge by ambient vibration measurement,** M. Abe, Y. Fujino, Univ. of Tokyo (Japan) . . . . . [3995A-28]

2:30 pm: **Monitoring of railway bridges in Japan,** M. Abe, BMC Corp. (Japan) . . . . . [3995A-29]

2:50 pm: **Application of smart materials and systems to long-term bridge health monitoring,** T. Oshima, M. S. Rahman, S. Mikami, T. Yamazaki, N. Takada, Kitami Institute of Technology (Japan); J. J. Lesko, R. D. Kriz, Virginia Polytechnic Institute and State Univ. . . . . [3995A-41]

Coffee Break . . . . . 3:10 to 3:40 pm

SESSION 6

Room: Newport South . . . . . Wed. 3:40 pm

Bridge Health Monitoring Applications from Hong Kong I

Chair: **Jan Ming Ko,** Hong Kong Polytechnic Univ. (Hong Kong)

3:40 pm: **Planning and implementation of the structural health monitoring system for cable-supported bridges in Hong Kong,** K. Y. Wong, C. K. Lau, Hong Kong SAR Government (Hong Kong); A. R. Flint, Flint & Neill Partnership (UK) . . . [3995A-31]

4:00 pm: **Large-scale structural monitoring systems,** I. Solomon, Furgo Geotechnical Services Ltd. (Hong Kong); J. Cunnane, P. Stevenson, Furgo Structural Monitoring (UK); K. Y. Wong, W. Y. Chan, K. L. Man, Hong Kong SAR Government (Hong Kong) . . . . . [3995A-32]

4:20 pm: **Structural health monitoring results on Tsing Ma, Kap Shui Mun, and Ting Kau bridges,** K. Y. Wong, W. Y. Chan, K. L. Man, W. L. N. Mak, C. K. Lau, Hong Kong SAR Government (Hong Kong) . . . . . [3995A-33]

4:40 pm: **Modal sensitivity analysis of Tsing Ma Bridge for structural damage detection,** J. Y. Wang, J. M. Ko, Y. Q. Ni, Hong Kong Polytechnic Univ. (Hong Kong) . . . . . [3995A-34]

5:00 pm: **Simulation studies of damage location in Tsing Ma Bridge deck,** Y. Q. Ni, Hong Kong Polytechnic Univ. (Hong Kong); B. S. Wang, Zhejiang Univ. (China); J. M. Ko, Hong Kong Polytechnic Univ. (Hong Kong) . . . . . [3995A-35]

5:20 pm: **Monitoring system and ambient vibration test of the Namhae Suspension Bridge,** C. Y. Kim, Myongji Univ. (Korea); N. S. Kim, Hyundai Institute of Construction Technology (Korea); J. G. Yoon, Seoul National Univ. (Korea); D. S. Jung, Myongji Univ. (Korea) . . . . . [3995A-36]

Thursday 9 March

SESSION 7

Room: Newport South . . . . . Thurs. 9:45 am

Bridge Health Monitoring Applications from Hong Kong II

Chair: **Hung-tin Tommy Chan,** Hong Kong Polytechnic Univ. (Hong Kong)

9:45 am: **Iterative constrained optimization scheme for model updating of long-span bridges,** C. C. Chang, T. Y. P. Chang, Hong Kong Univ. of Science and Technology (Hong Kong); Q. W. Zhang, Tongji Univ. (China) . . . . . [3995A-37]

10:05 am: **Health monitoring and fatigue damage assessment of the bridge-deck sections,** Z. Y. Li, H. T. Chan, J. M. Ko, Hong Kong Polytechnic Univ. (Hong Kong) . . . . . [3995A-38]

10:25 am: **Fatigue analysis for bridge-deck sections under blocked cycles of traffic loading,** T. H. T. Chan, Z. Y. Li, J. M. Ko, Hong Kong Polytechnic Univ. (Hong Kong) . . . . . [3995A-39]

10:45 am: **Feasibility of damage detection of Tsing Ma Bridge using vibration measurements,** J. M. Ko, Y. Q. Ni, T. H. T. Chan, Hong Kong Polytechnic Univ. (Hong Kong) . . . . . [3995A-40]

11:05 am: **Application of neural networks to health monitoring of bridge structures,** C. Loh, National Ctr. for Research on Earthquake Engg. and National Taiwan Univ. (Taiwan); S. Yeh, National Ctr. for Research on Earthquake Engg. (Taiwan) . . . . . [3995A-42]

11:20 am: **Modeling curvature gauge for vibration decoupling measurement,** Y. He, A. Djorjevich, City Univ. of Hong Kong . . . . . [3995A-43]

Lunch Break . . . . . 11:45 to 1:30 pm

SESSION 8

Room: Newport South . . . . . Thurs. 1:30 am

Various Health Monitoring Applications by Vibration Testing

Chair: **Kevin C. Womack,** Utah State Univ.

1:30 pm: **Full-scale reinforced concrete bridge bent condition assessment using forced-vibration testing,** J. L. Achter, M. W. Halling, K. C. Womack, Utah State Univ. . . . . [3995A-44]

1:50 pm: **Condition assessement of a six-span full-scale bridge using forced vibration,** M. J. Robinson, M. W. Halling, K. C. Womack, Utah State Univ. . . . . [3995A-45]

2:10 pm: **Use of velocity transducers in low-frequency modal testing of structures,** M. S. Huber, J. A. Bay, M. W. Halling, K. C. Womack, Utah State Univ. . [3995A-46]

2:30 pm: **Comparison of an impact source and a monochromatic source for modal testing of bridge structures,** M. S. Huber, J. A. Bay, M. W. Halling, K. C. Womack, Utah State Univ. . . . . [3995A-47]

2:50 pm: **Remote data acquisition and engineering analysis utilizing an internet delivery system,** J. Lemke, GE2, Inc. . . . . [3995A-48]

Conference 3995B

Room: Santa Cruz

Wednesday 8 March 2000 • Part of *Proceedings of SPIE* Vol. 3995: Nondestructive Evaluation of Highways, Utilities, and Pipelines IV

Utility and Pipeline Systems and Components

Conference Chair: **Stephen R. Gosselin,** Pacific Northwest National Lab.

Cochair: **Walter G. Reuter,** Idaho National Engineering and Environmental Lab./Lockheed Martin Idaho Technologies Co.

Program Committee: **Michael Anderson,** Idaho National Engineering and Environmental Lab.; **Steven R. Doctor,** Pacific Northwest National Lab.; **Tom Esselman,** Altran Corp.; **Karl Fleming,** ERIN Engineering; **Lloyd Mager,** Abbott Labs.; **Peter O. Paulson,** Pure Technologies, Inc. (Canada); **Gary J. Weil,** EnTech Engineering, Inc.

Wednesday 8 March

SESSION 10

Room: Santa Cruz . . . . . Wed. 10:00 am

Effective Utility and Pipeline NDE and Integrity Assessments

Chair: **Walter G. Reuter,** Idaho National Engineering and Environmental Lab./Lockheed Martin Idaho Technologies Co.

10:00 am: **Density and distribution of fabrication flaws in the Shoreham reactor vessel,** S. R. Doctor, G. J. Schuster, F. A. Simonen, Pacific Northwest National Lab. . . . . [3995B-59]

SESSION 11

Room: Santa Cruz . . . . . Wed. 10:20 am

Condition Monitoring of Utility and Pipelines Systems and Components I

Chair: **Stephen R. Gosselin,** Pacific Northwest National Lab.

10:20 am: **Development of an information management architecture for coping with aging infrastructure,** D. B. Jarrell, Pacific Northwest National Lab. [3995B-60]

10:40 am: **Aerial infrared thermographic pipeline mapping and leak detection system for site acquisition and construction programs,** G. J. Weil, EnTech Engineering, Inc. . . . . [3995B-61]

11:00 am: **20 years of life integrity of a high-pressure natural gas pipeline using strain-gages,** H. D. Joas, TUeV Süddeutschland (Germany) . . . . . [3995B-62]

11:20 am: **Nondestructive control of stress-strained state for gas pipelines using surface displacements data,** A. Olijnik, L. Zamikhovsky, Ivano-Frankivsk State Technical Univ. of Oil and Gas (Ukraine); V. Ivanyshyn, Dolina UMG Co. (Ukraine) . . . . . [3995B-63]

Lunch/Exhibit Break . . . . . 11:40 am to 1:30 pm

SESSION 12

Room: Santa Cruz . . . . . Wed. 1:30 pm

Condition Monitoring of Utility and Pipeline Systems and Components II

Chair: **Gary J. Weil,** EnTech Engineering, Inc.

1:30 pm: **Satellites and solid state electronics test concrete pressure water pipelines,** J. Fumo, Trisys Inc.; W. Worthington, Pipeline Technologies, Inc. . . . . [3995B-64]

1:50 pm: **Optical methodology for the health assessment of power transformers,** J. A. Palmer, X. Wang, R. A. Shoureshi, Colorado School of Mines; A. A. Mander, Tri-State Generation and Transmission Association, Inc.; D. R. Torgerson, Western Area Power Administration . . . . . [3995B-65]

2:10 pm: **Intelligent monitoring and communication system,** G. Banavas, D. Burkhart, D. Cohen, T. Levi, B. Soffer, M. K. Barnoski, G2 Systems Corp. . . . . [3995B-66]

2:30 pm: **Numerical modeling and experimental study of motion induced remote field current effect and its applications to online inspection and quality examination of rolling metallic strips,** Y. Sun, S. S. Udpa, Iowa State Univ.; T. Ouyang, Innovative Materials Testing Technologies, Co. . . . . [3995B-67]

Coffee Break . . . . . 2:50 to 3:40 pm

SESSION 13

Room: Santa Cruz . . . . . Wed. 3:40 pm

Advancements in NDE Technology for Utility and Pipeline Applications

Chair: **Walter G. Reuter,** Idaho National Engineering and Environmental Lab./Lockheed Martin Idaho Technologies Co.

3:40 pm: **In-situ inspection of fasteners for detecting small cracks,** M. S. Good, Pacific Northwest National Lab.; J. D. Adamson, Associated Western Universities . . . . . [3995B-68]

4:00 pm: **Aerial infrared thermographic cooling water pipeline leak detection systems for nuclear power generating plants,** G. J. Weil, EnTech Engineering, Inc. . . . . [3995B-69]

4:20 pm: **Thermographic imaging of material loss in boiler waterwall tubing by application of scanning line source,** K. Cramer, W. P. Winfree, NASA Langley Research Ctr. . . . . [3995B-70]

4:40 pm: **Lamb wave sensors for detecting wall defects in pipes,** D. Guo, T. Kundu, Univ. of Arizona . . . . . [3995B-71]

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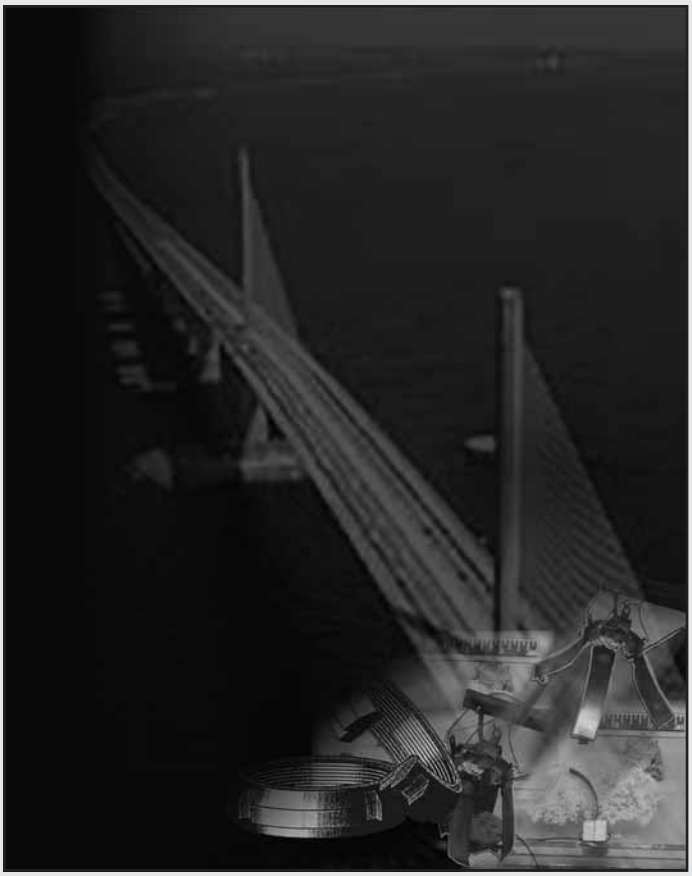

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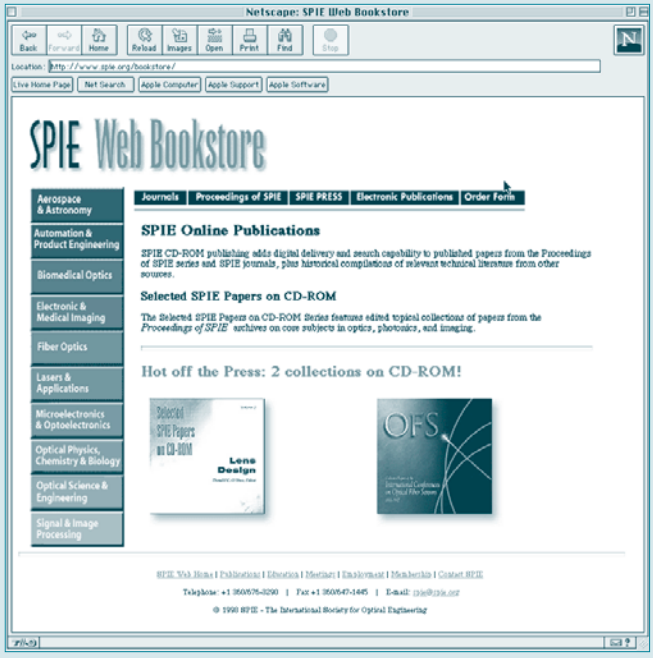

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