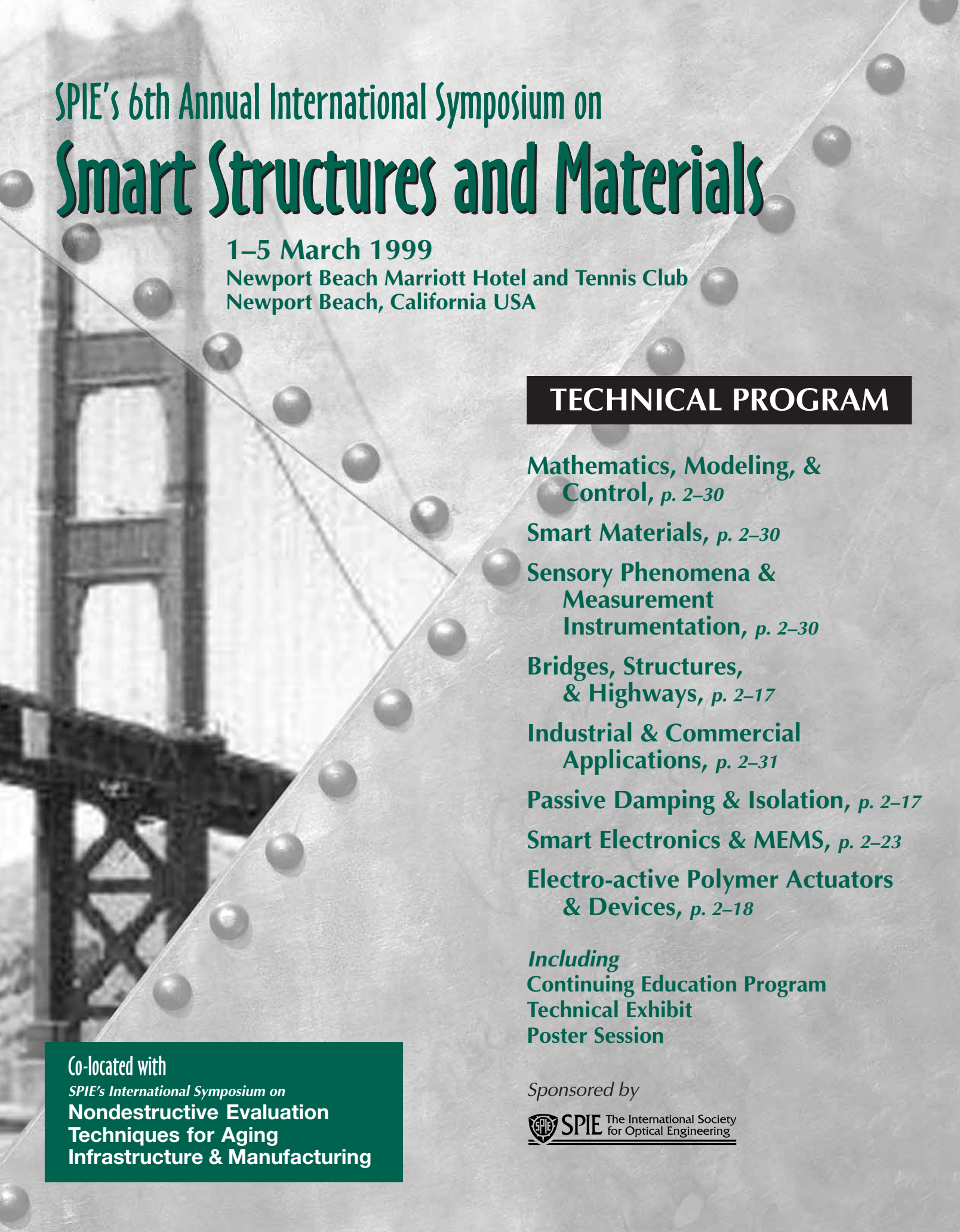

SPIE's 6th Annual International Symposium on

Smart Structures and Materials

1–5 March 1999
Newport Beach Marriott Hotel and Tennis Club
Newport Beach, California USA

TECHNICAL PROGRAM

Including
Continuing Education Program
Technical Exhibit
Poster Session

Co-located with
SPIE's International Symposium on
Nondestructive Evaluation Techniques for Aging Infrastructure & Manufacturing

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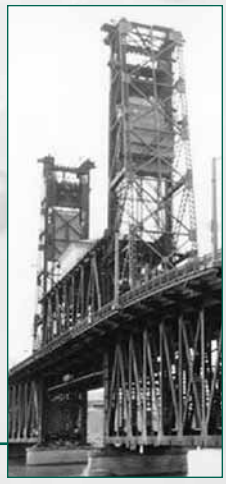
SPIE's 6th Annual International Symposium on

Smart Structures and Materials

1–5 March 1999



SPIE's International Symposium on

Nondestructive Evaluation Techniques for Aging Infrastructure & Manufacturing

3–5 March 1999

You're invited!

The organizers of the **1999 International Symposia on Nondestructive Evaluation Techniques for Aging Infrastructure and Manufacturing** and on **Smart Structures and Materials** invite you to participate in a unique experience. 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.

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.

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.

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.

Inderjit Chopra
Univ. of Maryland/College Park

Janet M. Sater
Institute for Defense Analyses
1999 SS Executive Chairs

Tobey M. Cordell,
Air Force Research Lab.

Steven R. Doctor
Pacific Northwest National Lab.
1999 NDE Executive Chairs

Schedule of Events

Sunday • 1 March	Monday • 2 March	Tuesday • 3 March	Wednesday • 4 March	Thursday • 5 March	Friday • 6 March
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Education Program SC01 **Electroactive Polymers (EAP) as Emerging Actuators and Sensors for Devices and Robotic Applications** (Bar-Cohen, Calvert, Lieber, Liu, Shahinpoor) 8:30 am to 5:30 pm *(Balboa), p. 40* SC02 **Active Structures for Vibration and Shape Control** (Bronowicki) 8:30 am to 5:30 pm *(Catalina), p. 40* SC03 **Microsensors, MEMS, and Their Applications** (Varadan, Varadan) 8:30 am to 5:30 pm *(Santa Rosa), p. 41* SC04 **Smart Structures: Theory and Applications** (Chopra, Wereley) 8:30 am to 5:30 pm *(Santa Cruz), p. 41* SC05 **Fiber Optic Sensors for Smart Structures: Basics and Applications** (Sirkis) 8:30 am to 5:30 pm *(San Clemente), p. 41*	3667 **Mathematics and Control in Smart Structures** *(Newport Ballroom North), p. 2–30* 3668 **Smart Structures and Integrated Systems** *(Pacific Ballroom D), p. 2–30* 3670 **Sensory Phenomena and Measurement Instrumentation for Smart Structures and Materials** *(Schooner), p. 2–30* 3669 **Electro-Active Polymer Actuators and Devices** *(Pacific Ballroom A), p. 2–18* 3671 **Smart Systems for Bridges, Structures, and Highways** *(Pacific Ballroom B), p. 2–17* 3672 **Passive Damping and Isolation** *(Pacific Ballroom E), p. 2–17* 3673 **Smart Electronics and MEMS** *(Pacific Ballroom F), p. 2–23*	3674 **Industrial and Commercial Applications of Smart Structures Technologies** *(Pacific Ballroom C), p. 2–31* 3675 **Smart Materials Technologies** *(Pacific Ballroom E), p. 2–31* **Technical Exhibit,** 8:45 am to 4:00 pm *(California Ballroom, Salons 1-4), p. 48*		
	Evening Plenary Presentation, **MEMS 2003 and Beyond,** *Speaker:* Dr. Albert P. Pisano, 6:00 to 7:00 pm *(Pacific Ballroom C/D), p. 2*	**Poster Session,** 6:00 to 7:30 pm *(California Ballroom 5), p. 48*	**Smart Structures and Materials Awards,** 8:00 to 8:10 am *(Pacific Ballroom C/D), p. 51* **Sunset Cruise,** 5:30 pm and 6:00 pm, *p. 48*		

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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 its subject to change without notice.

Nondestructive Evaluation Techniques for Aging Infrastructure & Manufacturing

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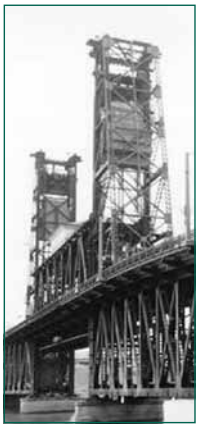
	3585 **Nondestructive Evaluation of Aging Materials and Composites** *(Pacific Ballroom A), p. 32-39* 3586 **Nondestructive Evaluation of Aging Aircraft, Airports, and Aerospace Hardware III** *(Trimaran), p. 32-39* 3587 **Nondestructive Evaluation of Bridges and Highways III** *(Pacific Ballroom B), p. 32-39* 3589 **Process Control and Sensors for Manufacturing** *(Catamaran), p. 32-35*	3588 **Nondestructive Evaluation of Utilities and Pipelines III** *(Schooner), p. 32-36*	

Plenary Presentations

SPIE's 6th Annual International Symposium on

Smart Structures and Materials

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

Monday 1 March

Microscale Thermophysical Engineering

Speaker: **Prof. Chang-Lin Tien,** Univ. of California/Berkeley

Pacific Ballroom C/D •8:00 to 8:45 am

Chang-Lin Tien holds the professorial title of NEC Distinguished Professor of Engineering, a post he assumed on 1 July 1997, after seven years of service as Univ. of California/Berkeley's seventh Chancellor. Concurrent with his Chancellorship, he was also A. Martin Berlin Chair in Mechanical Engineering. A faculty member in Berkeley's Mechanical Engineering Department since 1959, he has been chair of the Department (1974-81) and Vice Chancellor for Research (1983-85). He also served as Executive Vice Chancellor and UCI Distinguished Professor at the Univ. of California/Irvine (1988-90). Dr. Tien is internationally recognized for his scholarly contributions in the field of engineering thermophysics with special emphasis in heat transfer, thermal radiation, and microscale thermophysical engineering. An editor of four leading international journals in his field, he has published several books and monographs as well as over 300 refereed articles. He has been a member of the National Academy of Engineering since 1976 and is a recipient of many honorary doctoral degrees from universities in the U.S. and abroad. Born in Wuhan, China and educated in Shanghai and Taiwan, Dr. Tien completed his undergraduate education at the National Taiwan Univ. He came to the U.S. in 1956, earned a master's degree at the Univ. of Louisville in 1957, and then earned a second masters and a Ph.D. degree at Princeton Univ. in 1959.

Evening Plenary Presentation

MEMS 2003 and Beyond: A DARPA Vision of the Future of MEMS

Speaker: **Dr. Albert P. Pisano,** DARPA

Pacific Ballroom C •6:00 to 7:00 pm

Dr. Albert P. Pisano is the program manager of the MEMS Program in the Electronics Technology Office of DARPA. Dr. Pisano received his Ph.D., M.S., and B.S. degrees in 1981, 1977, and 1976 from Columbia Univ. in the City of New York in Mechanical Engineering. Serving first as a Member of Research Staff at the Xerox Corporation from 1981 to 1983, Dr. Pisano was Professor of Mechanical Engineering at the Univ. of California/ Berkeley from 1983 through 1997. He became affiliated with the Berkeley Sensor & Actuator Center (BSAC) in 1989, and has served as Co-Director of BSAC from 1992 through 1997. He was jointly appointed to the Department of Electrical Engineering and Computer Sciences at the Univ. of California/ Berkeley in 1996.

While at the Univ. of California, Dr. Pisano served as Major Field Advisor for over 160 students in Design and as Faculty Advisor for the Management of Technology Program, a joint effort between the Haas School of Business and the College of Engineering. In his own research, he has supervised and graduated 11 Ph.D. students and over 39 M.S. students. Dr. Pisano is an inventor listed on 4 patents, and he has authored or co-authored over 63 refereed, archival publications. Dr. Pisano was awarded an NSF Presidential Young Investigator Award in 1985 for research on the dynamics of high-speed systems.

Dr. Pisano is a member both of the American Society of Mechanical Engineers and of the Institute of Electronics and Electrical Engineers. He has served as editor of the IEEE/ASME Journal of MEMS, as editor of the Journal of Microsystem Technologies (Springer-Verlag), as member of the Steering Committee, International Symposium on Micro Machine and Human Science, as member of the International MEMS Workshop Steering Committee, as General Conference Co-Chair, Micro Electromechanical Systems (MEMS) Workshop, and as member of the College of Engineering Committee on College Strategic Planning at the University of California at Berkeley.

Tuesday 2 March

Intelligence and Durability of Civil Structures

Speaker: **Prof. Ken Chong,** National Science Foundation

Pacific Ballroom C/D •8:00 to 8:45 am

Prof. Ken P. Chong, F.ASCE, PE, received his MSE and Ph.D. in engineering mechanics from Princeton University in 1969. His professional experience includes: Senior Project Engineer of R&D, National Steel Corporation, in charge of long-range structural research projects related to building systems, steel structures and sandwich panels, 1969-1974; professor and chairman of Structures/ Solid Mechanics Group, University of Wyoming, teaching and research in Structural Mechanics and Solid Mechanics for 15 years. He has been a visiting professor at MIT, Houston, Washington and Hong Kong universities. Since 1989 he has been the director of Structural Systems and Construction Processes, and recently in mechanics and materials at the National Science Foundation (NSF) where he formulates and administers the U.S. policy and research/ educational programs in structures, construction, materials, engineering mechanics, NBE, CAD, and KB. As chair of the NSF Civil Infrastructure Systems Task Committee, 1992-93, he led the development of a major NSF-wide initiative which is changing the university culture in systems approaches and integration. As chair of the ASCE Materials Engineering Division Aecium, he also organized and chaired the 1996 Materials Engineering Conference in November, 1996, with heavy participation by industry, government and universities. He has published over 150 refereed technical papers and co-authored several books. He edits one journal as well as serving on several editorial and technical boards. He was the recipient of the Edmund Friedman Professional Award in 1997.

Wednesday 3 March

Smart Structures and Materials in Japan

Speaker: **Dr. Yuri Matsuzaki,** Nagoya Univ. (Japan)

Pacific Ballroom C/D •8:00 to 8:45 am

Dr. Yuji Matsuzaki received B.S., M.S. and Ph.D. in Aeronautics from University of Tokyo, 1964, 66, and 69, respectively. Worked at National Aerospace Laboratory, Tokyo for 1969-84. Professor, Nagoya University since 1984. Visiting Scholar at UCSD for 1973-75. Currently, Member, Aerospace Research Liaison Committee, Science Council of Japan since 1992. Specialist Member, Japanese Space Activities Commission since 1996. Chair, Japan National Committee on Biomechanics since 1994. Member, World Council on Biomechanics since 1998. Regional Editor for Japan, Smart Materials and Structures Journal since 1995, etc.

Research Area: Aeroelasticity, Structural Dynamics, Space Robotics, Active Vibration Control, Shape Memory Alloys, Biomechanics (Blood Flow, Voice Production), etc.

Thursday 4 March

Micro-Air Vehicles

Speaker: Dr. James McMichael, DARPA

Pacific Ballroom C/D •8:00 to 8:45 am

Dr. James McMichael was appointed Program Manager for Micro Air Vehicles at DARPA in September 1996. Dr. McMichael received his M. S. and Ph.D. degrees in Aerospace Engineering Sciences from the University of Colorado in 1966 and 1971 respectively. He thesis addressed "The Axisymmetric Turbulent Wake Generated by Co-flowing Incompressible Streams". In 1971, Dr. McMichael joined the National Bureau of Standards (now NIST) as a research scientist where he conducted research in turbulence, unsteady aerodynamics, magnetohydrodynamics and reacting flows. In 1984, he joined the Air Force Office of Scientific Research (AFOSR) as the Program Manager for Turbulence and Internal Flows. There he pioneered research in Active Flow Control and in the exploration of Microelectromechanical Systems (MEMS) for aerodynamic measurement and control. Throughout his AFOSR tenure, Dr. McMichael planned and implemented interdisciplinary research initiatives in Unsteady and Separated Flows, Nonlinear Flight Mechanics, Active Flow Control, Turbulence Simulation, Convective Heat Transfer, Chaotic Advection, Aero-Optics and Microflows. His primary program areas included heat transfer and unsteady aerodynamics in gas turbine engines, and the prediction and control of turbulent flows relevant to Air Force flight vehicles.

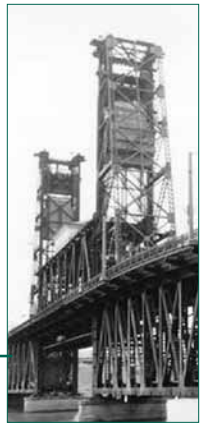
Dr. McMichael is an Associate Fellow of the American Institute of Aeronautics and Astronautics, and a Member of the Association for Unmanned Vehicle Systems International.

Plenary Presentations

SPIE's International Symposium on

Nondestructive Evaluation Techniques for Aging Infrastructure & Manufacturing

Newport Ballroom North • 8:00 to 8:45 am



Wednesday 3 March

Maintaining Older Aircraft: The Pivotal Role for Nondestructive Evaluation and Inspection

Speaker: **Dr. Joseph P. Gallagher,** Technical Advisor, Aging Aircraft
Program Manager, High Cycle Fatigue Univ. of Dayton

Newport Ballroom North •8:00 to 8:45 am

Joseph P. Gallagher is currently a Technical Advisor to the Air Force Research Laboratory (AFRL) Aging Aircraft Program and manages the Univ. of Dayton's high cycle fatigue program. Between September 1996 and September 1998, he led the AFRL Aging Aircraft R&D Program. During this time, his responsibilities included coordinating, facilitating, and promoting technology development to solve aging aircraft problems (principally in the area of structures) for AFRL customers, cooperatively with other federal agencies and AFRL's aging aircraft customers. He led the Aging Aircraft Program while he was on a two year leave-of-absence from the Univ. of Dayton and while working under provisions of the intergovernmental personnel act for the Air Force.

Prior to September 1996, Dr Gallagher managed the Univ. of Dayton Research Institute's Structural Integrity Division. In this capacity, he was responsible for an organization of about 45 full-time staff who developed and applied integrity technology and processes that solved structures-, subsystems- and engine-related durability or safety problems. The integrity technology and process solutions were based on: structural analyses, applied fracture mechanics, aircraft flight loads data collection and characterization methods, nondestructive inspection tools and nondestructive evaluation methods, experimental mechanics and mechanical property characterization, statistical analysis and risk assessments, and database management systems.

Thursday 4 March

Predictive Engineering for Aging Infrastructure

Speaker: **Dr. Leonard J. Bond,** Pacific Northwest National Laboratory
Senior Program Manager

Pacific Ballroom C/D •8:00 to 8:45 am

Leonard J. Bond is a senior program manager at the Pacific Northwest National Laboratory developing and managing programs dealing with civil and defense aging infrastructure. From 1994 to 1998 he was the chief scientist at the Denver Research Institute (DRI) and a research professor in the Department of Engineering at the Univ. of Denver. At DRI he lead a team of more than 40 staff involved in a variety of NDE interdisciplinary research problems. The problems ranged from improved quality assessment for polymer extrusions in the Hrdra '70 solid-rocket motor, developing ultrasonic technology to grade beef tenderness, characterization of concrete, studying transport through biological membranes with ultrasonics to high power ultrasonic joining. From 1990 to 1994, he was a guest researcher at NIST in Boulder, CO working in diverse research areas such as gas-coupled ultrasonics and also, a research professor at the University of Colorado at Boulder.

Prior to 1990, he led a group of 10 staff in ultrasonic research at the Univ. of London. This group addressed diverse applications in aircraft, submarines, offshore structures, bridges, nuclear power plants and biology developing novel ultrasonic transducers, ultrasonic imaging and acoustic microscopes. In recognition of his outstanding work he was appointed to the post of "Reader in Ultrasonics." In addition, he was editor-in-chief of "Ultrasonics" from 1994-1996, a technical expert to NATO (1985-89) and invited meeting rapporteur to NATO in 1989. He has authored or co-authored more than 130 papers.

Friday 5 March

The Role of Nondestructive Evaluation in Our Infrastructure

Speaker: **Mr. Charles J. Hellier P.E.,** Rockwood Service Corp.
BCFE Vice President

Pacific Ballroom C/D •8:00 to 8:45 am

Charles J. Hellier is the Vice President of Rockwood Service Corp., a multi-disciplined organization that provides nondestructive testing, technical training, and a wide range of consulting services to a broad client base. The company has over 30 locations in North America. Hellier completed his formal education at The Pennsylvania State Univ. and Temple Univ. He holds Level III Certifications in the major NDT methods, is a Registered Professional Engineer, and a Board Certified Forensic Examiner. Hellier has presented and published many papers on various subjects dealing with NDT and Quality Assurance. He is past National President of the American Society for Nondestructive Testing (ASNT), and is currently the Treasurer of the NDT Management Association (NDTMA). He holds memberships in ASME, ASM, AWS, ASNT, ASTM, NDTMA, and ABFE.

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Conference 3667

Room: Newport Ballroom North
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Mathematics and Control in Smart Structures

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

Cochair: **Dimitris C. Lagoudas,** Texas A&M Univ.

Program Committee: **Bala Balachandran,** Univ. of Maryland/College Park; **Gary J. Balas,** Univ. of Minnesota/Twin Cities; **H. Thomas Banks,** North Carolina State Univ.; **Karolos M. Grigoriadis,** Univ. of Houston; **Hans Irschik,** Johannes Kepler Univ. (Austria); **Qing Jiang,** Univ. of California/Riverside; **Narendra S. Khot,** Air Force Research Lab.; **Noboru Kikuchi,** Univ. of Michigan; **Jaehwan Kim,** Inha Univ. (Korea); **Sridhar Kota,** Univ. of Michigan; **Andrew J. Kurdila,** Univ. of Florida; **Liviu Librescu,** Virginia Polytechnic Institute and State Univ.; **Vittal S. Rao,** Univ. of Missouri/Rolla; **Robert E. Skelton,** Univ. of California/San Diego; **Ralph C. Smith,** North Carolina State Univ.

Conference 3668

Room: Pacific Ballroom D
Mon.–Thurs. 1–4 March 1999
Proceedings of SPIE Vol. 3668

Smart Structures & Integrated Systems

Conference Chair: **Norman M. Wereley,** Univ. of Maryland/College Park

Cochairs: **L. Porter Davis,** Honeywell Inc.; **Yuji Matsuzaki,** Nagoya Univ. (Japan)

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Conference 3669

Room: Pacific Ballroom A
Mon.–Tues. 1–2 March 1999
Proceedings of SPIE Vol. 3669

Electro-Active Polymer Actuators and Devices

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

Cochair: **Mohsen Shahinpoor,** Univ. of New Mexico

Program Committee: **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.; **Danilo De Rossi,** Univ. degli Studi di Pisa (Italy); **Michael Goldfarb,** Vanderbilt Univ.; **Joycelyn O. Harrison,** NASA Langley Research Ctr.; **Richard L. Lieber,** Univ. of California/San Diego; **Chang Liu,** Univ. of Illinois/Urbana-Champaign; **Ajit K. Mal,** Univ. of California/Los Angeles; **Jon S. McElvain,** UNIAX Corp.; **Yoshihito Osada,** Hokkaido Univ. (Japan); **Toribio F. Otero,** Univ. del Pais Vasco (Spain); **Frank Patten,** DARPA; **Valery P. Shibaev,** Moscow State Univ. (Russia); **Minoru Taya,** Univ. of Washington; **David B. Wallace,** MicroFab Technologies, Inc.

Conference 3670

Room: Schooner
Mon.–Thurs. 1–4 March 1999
Proceedings of SPIE Vol. 3670

Sensory Phenomena and Measurement Instrumentation for Smart Structures and Materials

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

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

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S. C. Liu, National Science Foundation
Chair: Smart Systems for Bridges, Structures, and Highways, NSF Representative

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Chair: Mathematics and Control in Smart Structures

Vijay K. Varadan, The Pennsylvania State Univ., *Chair:* Smart Electronics and MEMS

Norman M. Wereley, Univ. of Maryland/College Park, *Chair:* Smart Structures and Integrated Systems

Spencer T. Wu, Air Force Office of Scientific Research, Air Force Representative

Manfred Wuttig, Univ. of Maryland/College Park, *Chair:* Smart Materials

Conference 3671

Room: Pacific Ballroom B
Mon.–Tues. 1–2 March 1999
Proceedings of SPIE Vol. 3671

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 DesRoche,** Georgia Institute of Technology; **Koichi Egawa,** Niigata Institute of Technology (Japan); **Maria Q. Feng,** Univ. of California/Irvine; **Yozo Fujino,** Univ. of Tokyo (Japan); **Henri P. Gavin,** Duke Univ.; **Paul E. Grayson,** Strain Monitor Systems Inc.; **Sami F. Masri,** Univ. of Southern California; **Robert Nigbor,** Agbabian Associates; **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)

Conference 3672

Room: Pacific Ballroom E
Mon.–Tues. 1–2 March 1999
Proceedings of SPIE Vol. 3672

Passive Damping and Isolation

Conference Chair: **T. Tupper Hyde,** Honeywell Satellite Systems Operation

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

Program Committee: **Andrew S. Bicos,** McDonnell Douglas Aerospace; **Michael L. Drake,** Univ. of Dayton Research Institute; **Eugene R. Fosness,** Air Force Research Lab.; **Roy Ikegami,** Boeing Information, Space & Defense Systems; **Conor D. Johnson,** CSA Engineering, Inc.; **George A. Lesieutre,** The Pennsylvania State Univ.; **Zahidul H. Rahman,** Jet Propulsion Lab.; **Daniel J. Segalman,** Sandia National Labs.; **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

Conference 3673

Room: Pacific Ballroom F
Mon.–Wed. 1–3 March 1999
Proceedings of SPIE Vol. 3673

Smart Electronics and MEMS

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

Cochairs: **Paul J. McWhorter,** Sandia National Labs.; **Richard A. Singer,** Institute for Defense Analyses; **Julian W. Gardner,** Univ. of Warwick (UK)

Program Committee: **Vasu K. Aatre,** Defence Research & Development Organisation (India); **Pratul K. Ajmera,** Louisiana State Univ.; **Henry Baltes,** ETH Zurich (Switzerland); **John H. Belk,** Boeing Co.; **Stephen M. Bobbio,** Univ. of North Carolina/Charlotte; **John H. Comtois, James G. Grote,** Air Force Research Lab.; **Ahsan Hariz,** Univ. of South Australia (Australia); **Shrinivas Joshi,** Marquette Univ.; **Jan G. Korvink,** ETH Zuerich (Switzerland); **Yuji Matsuzaki,** Nagoya Univ. (Japan); **Gerard C. Meijer,** Delft Univ. of Technology (Netherlands); **Jeffery M. Melzak,** Case Western Reserve Univ.; **Subrata Mukherjee,** Cornell Univ.; **Yukeun E. Pak,** Samsung Advanced Institute of Technology (Korea); **David W. Plummer,** Sandia National Labs.; **Alain Priou,** Univ. of Paris X (France); **Pasqualina M. Sarro,** Delft Univ. of Technology (Netherlands); **Jeffrey N. Schoess,** Honeywell Technology Ctr.; **Norio Shinya,** National Research Institute for Metals (Japan); **James H. Smith,** Sandia National Labs.; **Gregory Washington,** The Ohio State Univ.; **Rob B. Yates,** Univ. of Sheffield (UK)

Conference 3674

Room: Pacific Ballroom C
Tues.–Thurs. 2–4 March 1999
Proceedings of SPIE Vol. 3674

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.; **Bernie F. Carpenter,** Lockheed Martin Astronautics; **William W. Clark,** Univ. of Pittsburgh; **Robert Clifford,** ETREMA Products, Inc.; **Richard Cobb,** Air Force Research Lab.; **C. Robert Crowe,** Virginia Polytechnic Institute and State Univ.; **Peter D. Dean,** Lockheed Martin Missiles & Space; **Donald L. Edberg,** Boeing Phantom Works; **Ursula Herold-Schmidt,** Daimler-Benz Aerospace Dornier (Germany); **Leo Karkkainen,** Nokia Research Ctr. (Finland); **Jayanth N. Kudva,** Northrop Grumman Corp.; **Jih-Fen Lei,** NASA Lewis Research Ctr.; **Douglas K. Lindner,** Virginia Polytechnic Institute and State Univ.; **Craig D. Near,** Materials Systems Inc.; **Janet M. Sater,** Institute for Defense Analyses; **Richard J. Silcox,** NASA Langley Research Ctr.; **William B. Spillman, Jr.,** BFGoodrich Aerospace; **Edward V. White,** Boeing Co.; **Richard W. Wlezien,** NASA Langley Research Ctr.; **Helmut W. Zaglauer,** Daimler-Benz Aerospace Dornier (Germany)

Conference 3675

Room: Pacific Ballroom E
Wed.–Thurs. 3–4 March 1999
Proceedings of SPIE Vol. 3675

Smart Materials Technologies

Conference Chair: **Manfred Wuttig,** Univ. of Maryland/College Park

Program Committee: **Gregory Paul Carman,** Univ. of California/Los Angeles; **Clive A. Randall,** The Pennsylvania State Univ.

SPIE's 6th Annual International Symposium on

Conference 3667 | Conference 3668 | Conference 3669 | Conference 3670

Sunday 28 February 1999 • 1:00 to 6:00 pm • Pacific Ballroom D

Smart Structures and Materials Technology Overviews

The field of smart materials and structures focuses on integration of many technologies—including, for example, sensors and actuators, controls, and smart electronics with MEMS—to achieve some overall system performance goal. The six 45-minute overviews listed below will provide the necessary background information and science for you to develop a basic understanding of the field and its supporting technologies. You will receive a status report on the various supporting technologies and on current applications. In addition, the overviews will provide a sense of how these supporting technologies can be combined to meet the requirements of advanced systems. Finally, you will learn about potential future developments and opportunities in this field.

Who Should Attend?

These overviews will be valuable to a wide range of applied scientists and practicing engineers, including those of you currently unfamiliar with the field. Application/system engineers, project managers, and graduate students already involved in developing smart ma-

Special Events

Smart Structures & Materials Technical Group

Monday 1 March
7 to 9 pm
Boardroom East

The Smart Structures and Materials Technical Group will meet to hear presentations from the three finalists in the Best Student Paper contest, sponsored by SPIE and BFGoodrich Aerospace. Following the presentation, working group members will vote to determine the winning paper; the winner will be announced before the plenary session on Wednesday morning. In addition, comments on and suggestions for the Smart Structures and Materials Working Group web page will be discussed. All conference attendees are cordially invited to attend.

Monday 1 March 1999

Plenary Presentation

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

Microscale Thermophysical Engineering

Speaker: **Prof. Chang-Lin Tien,** Univ. of California/Berkeley

Coffee Break . . . . . 8:45 to 9:20 am

SESSION 1
Room: Newport Ballroom North
Mon. 9:20 am

Finite Element Modeling and Optimization

Chair: **Hans Irschik,** Johannes Kepler Univ. (Austria)

Introduction, ... 9:20 to 9:30 am
Vasundara V. Varadan, The Pennsylvania State Univ.

9:30 am: **Computer-aided optimization of smart structures,** R. Lerch, M. Kaltenbacher, H. Landes, R. Simkovics, Johannes Kepler Univ. Linz (Austria) . . . . . [3667-01]

9:50 am: **Optimization of piezoelectric material distribution in smart structures,** U. Gabbert, C. Weber, Univ. Magdeburg (Germany) . . . . . [3667-02]

10:10 am: **Modeling and design of adaptive composite structures,** V. M. F. Correia, Escolá Nautica Infante D. Henrique (Portugal); A. Suleman, C. M. M. Soares, C. A. M. Soares, Instituto Superior Tecnico (Portugal) . . . . . [3667-03]

10:30 am: **Closed loop finite element modeling and optimization of smart structures,** V. V. Varadan, Y. Lim, S. V. Gopinathan, V. K. Varadan, The Pennsylvania State Univ. [3667-04]

SESSION 1
Room: Pacific Ballroom D
Mon. 9:20 am

Helicopter Applications I

Chair: **Gary L. Anderson,** U.S. Army Research Office

9:20 am: **Active and passive damping control for helicopter systems,** N. M. Wereley, Univ. of Maryland/College Park . . . . . [3668-01]

9:40 am: **Analytic model of a rotor with active blade tips,** A. P. Bernhard, I. Chopra, Univ. of Maryland/College Park . . . . . [3668-02]

10:00 am: **Mach scaled hover testing of an active rotorblade incorporating trailing edge servo-flaps,** E. F. Prechtl, S. R. Hall, Massachusetts Institute of Technology . . . . . [3668-03]

10:20 am: **Development and validation of a refined piezostack-actuated trailing edge flap actuator for a helicopter rotor,** T. Lee, I. Chopra, Univ. of Maryland/College Park . . . . . [3668-04]

SESSION 1
Room: Pacific Ballroom A
Mon. 9:20 am

Electro-Active Polymers as Emerging Actuators

Chairs: **Yoseph Bar-Cohen,** Jet Propulsion Lab.; **Richard L. Lieber,** Univ. of California/San Diego

Keynote Address

9:20 am: Electro-active polymer actuators and devices, Steven G. Wax, DARPA . . . . . [3669-01]

9:50 am: **Intelligent gels: their dynamism and functions** *(Invited Paper),* Y. Osada, J. Gong, Hokkaido Univ. (Japan) . . . . . [3669-02]

10:20 am: **Skeletal muscle as a biological example of a linear electro-active actuator,** R. L. Lieber, Univ. of California/San Diego . . . . . [3669-03]

10:40 am: **EAP as multifunctional and biomimetic materials,** T. F. Otero, I. Cantero, S. Villanueva, Univ. del País Vasco (Spain) . . . . . [3669-04]

11:00 am: **Electro-active polymer (EAP) actuators for planetary applications,** Y. Bar-Cohen, S. P. Leary, Jet Propulsion Lab.; M. Shahinpoor, Univ. of New Mexico; J. O. Simpson, J. Smith, NASA Langley Research Ctr. . . . . [3669-05]

11:20 am: **Linear fully dry polymer actuator,** D. De Rossi, A. Mazzoldi, Univ. degli Studi di Pisa (Italy) . . . . . [3669-06]

11:40 am: **Muscle contraction as a polymer-gel phase transition,** G. H. Pollack, Univ. of Washington . . . . . [3669-07]

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

Introduction
Room: Schooner
Mon. 9:20 am

Sensory phenomena review, R. O. Claus, Virginia Polytechnic Institute and State Univ.; W. B. Spillman, Jr., BF Goodrich Aerospace [3670-01]

Keynote Address

Room: Schooner
Mon. 9:40 am

Early sensors and smart structures in Europe, R. O. Claus, Virginia Polytechnic Institute and State Univ.; W. B. Spillman, Jr., BF Goodrich Aerospace . . [3670-02]

SESSION 1
Room: Schooner
Mon. 10:10 am

Sensors and System Design I

Chairs: **Jeffrey N. Schoess,** Honeywell Technology Ctr.; **Dryver R. Huston,** Univ. of Vermont

10:10 am: **Designing piezoelectric sensors by using fourier transform window functions for structural metrology,** C. T. Lin, C. K. Lee, National Taiwan Univ. (Taiwan) . . . . . [3670-03]

10:30 am: **Higher speed demodulation of fiber grating sensors,** M. Morrell, E. Udd, J. M. Seim, W. L. Schulz, Blue Road Research . . . . . [3670-04]

10:50 am: **Development of miniature load sensor for smart materials and structures by using birefringent fibers,** T. Kosaka, N. Takeda, M. Hara, Univ. of Tokyo (Japan) . . [3670-05]

11:10 am: **Piezoelectric strain sensors for smart structures,** J. Dosch, PCB Piezotronics . . . . . [3670-06]

11:30 am: **Temperature measurements in fiber optic interferometric multichannel automated instrumentation system,** H. Lamela, J. A. Souto, A. J. Varo, J. I. Santos, Univ. Carlos III de Madrid (Spain) . . . . . [3670-07]

11:50 am: **Manufacturing of core mirrors for intrinsic Fabry-Perot interferometers using sol-gel process,** T. Rossmanith, X. Jin, M. K. Park, J. S. Sirkis, Univ. of Maryland/College Park; V. Venkat, B. D. Prasad, Analytical Services & Materials, Inc. . . [3670-08]

Lunch Break . . . . . 12:10 to 1:40 pm

Conference 3671 | Conference 3672 | Conference 3673 | Conference 3674 | Conference 3675

Sunday 28 February 1999 • 1:00 to 6:00 pm • Pacific Ballroom D

terials and structural systems will find this lecture series valuable as an update, as will those working in sensing, processing, and instrumentation for a variety of systems (e.g., air and space vehicles, automobiles, civil structures, manufacturing equipment, etc.).

Avail yourself of the opportunity to get a technology update for no/low cost! These technology overviews are **FREE TO all REGISTERED symposium ATTENDEES.** Others wishing to attend will be charged a fee of $50. Please preregister for this session on the registration form.

1:00 to 1:45 pm **Sensors**, *Speaker*: Richard O. Claus, Virginia Polytechnic Institute and State Univ.

1:45 to 2:30 pm **Actuators**, *Speaker*: Craig A. Rogers, Univ. of South Carolina/Columbia

2:30 to 3:15 pm **Passive Damping,** *Speaker*: Conor D. Johnson, CSA Engineering, Inc.

3:15 to 3:45 pm Coffee Break

3:45 to 4:30 pm **Control Systems**, *Speaker*: Daniel J. Inman, Virginia Polytechnic Institute and State Univ.

4:30 to 5:15 pm **Structures**, *Speaker*: To be determined

5:15 to 6:00 pm **Future Directions**, *Speaker*: William B. Spillman, Jr., BF Goodrich Aerospace

Monday 1 March 1999

Plenary Presentation

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

Microscale Thermophysical Engineering

Speaker: **Prof. Chang-Lin Tien,** Univ. of California/Berkeley

Coffee Break . . . . . 8:45 to 9:20 am

SESSION 1
Room: Pacific Ballroom B
Mon. 9:20 am

Active/Passive Devices for Civil Structures

Chair: **Henri P. Gavin,** Duke Univ.

9:20 am: **Heating of magneto-rheological fluid dampers,** D. Breese, F. Gordaninejad, Univ. of Nevada/Reno . . . . . [3671-01]

9:40 am: **Seismic mitigation of bridges using smart restrainers,** R. DesRoches, Georgia Institute of Technology . . . . . [3671-02]

10:00 am: **Analytical study of structural control with toggle mechanism for retrofiting existing R/C structures,** M. Kubota, Tobishima Corp. (Japan) . . . . . [3671-03]

10:20 am: **Development of shape memory alloy damper for intelligent bridge systems,** Y. Adachi, S. Unjoh, Ministry of Construction/Public Works Research Institute (Japan) [3671-04]

10:40 am: **Resonance suppression through variable stiffness and damping mechanism,** N. S. Doke, H. P. Gavin, Duke Univ. . [3671-05]

SESSION 1
Room: Pacific Ballroom E
Mon. 9:20 am

Modeling of Various Damping Systems

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

9:20 am: **Nonlinear models with hysteresis for elastomers,** H. T. Banks, G. A. Pinter, L. K. Potter, North Carolina State Univ.; L. Yanyo, M. Gaitens, Lord Corp. . . [3672-01]

9:40 am: **Nonlinear damping identification from transient data,** C. Smith, N. M. Wereley, Univ. of Maryland/College Park . . [3672-02]

10:00 am: **Measurement and modeling of particle impact damping,** R. D. Friend, V. K. Kinra, Texas A&M Univ. . . . . [3672-03]

10:20 am: **Modeling particle damping via 3D molecular dynamics simulations,** C. Saluenya, T. Poeschel, D. Rosenkranz, Humboldt-Univ. of Berlin (Germany); S. E. Esipov, Ctr. Risk Advisors . . . . . [3672-04]

Keynote Address
Room: Pacific Ballroom F
Mon. 9:20 am

CMOS Integrated Microsystems and Nanosystems, Henry Baltes, ETH Zurich (Switzerland) . . . . . [3673-01]

Invited Paper
Room: Pacific Ballroom F
Mon. 10:00 am

Opportunities and challenges for MEMS technology in Army missile systems applications, P. B. Ruffin, U.S. Army Aviation and Missile Command . . . . . [3673-02]

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Conference 3667

Conference 3668

Conference 3669

Conference 3670

Monday 1 March 1999

SESSION 2
Room: Newport Ballroom North
Mon.10:50 am
Control Theory and Techniques I

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

10:50 am: **Roll maneuvering of flexible aircraft with distributed actuation via modal systhesis,** H. Oz, The Ohio State Univ. . . . [3667-05]

11:10 am: **Design of an optimum smart wing to enhance roll performance,** N. S. Khot, Air Force Research Lab. . . . . [3667-06]

11:30 am: **Reduced models for low Reynolds number flow control,** A. J. Kurdila, B. F. Carroll, Univ. of Florida . . . . . [3667-07]

11:50 am: **Control and controllability of a fluid-structure interaction problem using piezoelectric actuators,** P. Destuynder, CNAM/IAT (France) . . . . . [3667-08]

Standby Presentation

Reduced-order transition control via optimal projection, G. Webb, O. Rediniotis, D. Darmofal, Texas A&M Univ. . . . . [3667-74]

Lunch Break . . . . . 12:10 to 1:30 pm

SESSION 2
Room: Pacific Ballroom D
Mon.10:40 am
Helicopter Applications II

Chair: **Yung H. Yu,** NASA Ames Research Ctr.

10:40 am: **Design of an active twist smart rotor for blade-vortex interaction noise reduction,** R. A. Evans, Systems Planning and Analysis, Inc.; J. D. Baeder, Univ. of Maryland/College Park; P. C. Chen, J. Niemczuk, P. A. Ross, Systems Planning and Analysis, Inc.; L. Tang, Univ. of Maryland/College Park . . . . . [3668-05]

11:00 am: **Design and testing of a leading-edge flap actuator,** M. C. Shaner, I. Chopra, Univ. of Maryland/College Park . . . . . [3668-06]

11:20 am: **Rotary-wing aeroelastic scaling and its implications for adaptive materials based actuation,** P. P. Friedmann, Univ. of California/Los Angeles . . . . . [3668-07]

11:40 am: **Control of wave transmission through struts,** I. Pelinescu, B. Balachandran, Univ. of Maryland/College Park [3668-08]

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

SESSION 3
Room: Newport Ballroom North
Mon. 1:30 pm
Magnetic Materials

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

1:30 pm: **Dynamics simulations and effective properties for magnetorheological fluids,** H. T. Banks, K. Ito, H. V. Ly, North Carolina State Univ.; M. R. Jolly, Lord Corp.; F. L. Reitich, Univ. of Minnesota/Twin Cities . . . . . [3667-09]

1:50 pm: **Numerical approximation of unstressed or prestressed magnetostrictive materials,** M. J. Bernadou, Pôle Univ. Léonard de Vinci and INRIA (France); S. He, Pôle Univ. Léonard de Vinci (France) . . . . . [3667-10]

2:10 pm: **Advanced magnetostrictive finite element method (FEM) modeling development,** G. N. Weisensel, R. L. Zrostlik, ETREMA Products, Inc.; G. P. Carman, Univ. of California/Los Angeles . . . [3667-11]

2:30 pm: **Modeling and computation of the effective magnetic properties of magnetorheological fluids,** T. M. Simon, H. T. Banks, K. Ito, North Carolina State Univ.; M. R. Jolly, Lord Corp.; F. L. Reitich, Univ. of Minnesota/Twin Cities . . [3667-12]

2:50 pm: **Thermomagnetic optimization of solenoidal magnetostrictive actuators,** D. M. Dozor, Mechatronic Technology Co.; D. C. Meeker, Foster-Miller, Inc. . . . . [3667-13]

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

SESSION 3
Room: Pacific Ballroom D
Mon. 1:30 pm
Aircraft Applications

Chair: **Michael S. Torok,** Sikorsky Aircraft Corp.

1:30 pm: **Smart aircraft panels: the effects of internal pressure loading on panel dynamics,** J. K. Henry, R. L. Clark, Duke Univ. . . . . [3668-09]

1:50 pm: **Smart wing concept for reducing gust loads and delaying the onset of flutter,** B. D. Hall, S. Preidikman, D. T. Mook, Virginia Polytechnic Institute and State Univ. . . . . [3668-10]

2:10 pm: **Needs for the analysis and integrated design optimization of active and passive structure for active aeroelastic wings,** J. Schweiger, E. Coetzee, Daimler-Benz Aerospace AG (Germany) . . . . . [3668-11]

2:30 pm: **Aeroelastic control of smart composite plate with delaminations,** C. Nam, A. Chattopadhyay, Arizona State Univ.; Y. Kim, Seoul National Univ. (Korea) . . . . . [3668-12]

2:50 pm: **Smart structural fasteners for the aircraft and construction industries,** L. D. Thompson, B. D. Westermo, W. Law, R. Trombi, Strain Monitor Systems, Inc.; R. Waldbusser, Robins Air Force Base . . [3668-13]

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

SESSION 2
Room: Pacific Ballroom A
Mon. 1:30 pm
Modeling and Parametric Studies

Chairs: **Mohsen Shahinpoor,** Univ. of New Mexico; **Minoru Taya,** Univ. of Washington

1:30 pm: **Model polymers for polymer actuators,** O. Inganäs, S. Ghosh, Linköping Univ. (Sweden) . . . . . [3669-08]

1:50 pm: **Equivalent circuit of ionic polymeric metal composites,** S. P. Leary, Jet Propulsion Lab.; M. Shahinpoor, Univ. of New Mexico; Y. Bar-Cohen, Jet Propulsion Lab. . . . . [3669-09]

2:10 pm: **Performance of polymer-based actuators: the three-layer model,** M. Benslimane, P. Gravesen, Danfoss A/S (Denmark); K. West, S. Skaarup, Denmark Technical Univ. (Denmark); E. Smela, P. Sommer-Larsen, Risø National Lab. (Denmark) . . . . . [3669-10]

2:30 pm: **Artificial muscles working in both aqueous solution or air,** T. F. Otero, J. M. Sansiñena, Univ. del País Vasco (Spain); M. De Paoli, Univ. Estadual de Campinas (Brazil) . . . . . [3669-11]

2:50 pm: **Electro-mechanics of iono-elastic beams as electrically controllable artificial muscles,** M. Shahinpoor, Univ. of New Mexico . . . . . [3669-12]

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

SESSION 2
Room: Schooner
Mon. 1:40 pm
Sensors and System Design II

Chairs: **James S. Sirkis,** Univ. of Maryland/College Park; **Kim D. Bennett,** Lafayette College

1:40 pm: **Hydrogen sensors based on electroplated palladium-coated fiber Bragg gratings,** T. Peng, Y. Tang, J. S. Sirkis, Univ. of Maryland/College Park; B. A. Childers, J. P. Moore, L. D. Melvin, NASA Langley Research Ctr. . . . . [3670-09]

2:00 pm: **Towards realization of a smart polarimetric sensor,** V. M. Murukeshan, P. Y. Chan, O. L. Seng, A. K. Asundi, Nanyang Technological Univ. (Singapore) . . . . . [3670-10]

2:20 pm: **Simple methods to compensate intensity variations in Bragg grating sensors,** Y. Lo, J. Huang, M. Yang, National Cheng Kung Univ. (Taiwan) . . . . . [3670-11]

2:40 pm: **Curvature gauges in smart structures,** A. Djordjevich, City Univ. of Hong Kong; J. K. Kim, Hong Kong Univ. of Science and Technology (Hong Kong); Y. Z. He, City Univ. of Hong Kong . . . . . [3670-12]

Coffee Break . . . . . 3:00 to 3:40 pm

Conference 3671

SESSION 2
Room: Pacific Ballroom B
Mon.11:00 am

Smart Materials: Modeling, Analysis and Application

Chair: **Reginald DesRoches,** Georgia Institute of Technology

11:00 am: **New empirical expression for transformation kinetics of shape memory alloys under quasi-static thermomechanical loading,** S. Saadat, L. Duval, M. N. Noori, Worcester Polytechnic Institute; H. Davoodi, Univ. of Puerto Rico/Mayaguez; Z. Hou, Worcester Polytechnic Institute . . . . . [3671-06]

11:20 am: **Simplified algorithm for seismic control of civil structures using smart dampers,** S. Sarkani, The George Washington Univ.; L. D. Lutes, Texas A&M Univ.; S. Jin, The George Washington Univ. [3671-07]

11:40 am: **Application of smart materials at the Savannah River site,** K. A. Dunn, M. R. Louthan, N. C. Iyer, Westinghouse Savannah River Co.; V. Giurgiutiu, M. F. Petrou, D. E. Laub, Univ. of South Carolina/Columbia . . . . . [3671-08]

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

SESSION 3
Room: Pacific Ballroom B
Mon. 1:30 pm

Smart Sensors

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

1:30 pm: **Optimal sensor locations for structures with multiple loading conditions,** M. M. Ettouney, R. Daddazio, A. Hapij, Weidlinger Associates, Inc. . . . . [3671-09]

1:50 pm: **Development of a PVDF film sensor for infrastructure monitoring,** D. Satpathi, J. Victor, M. L. Wang, H. Yang, Univ. of Illinois/Chicago . . . . . [3671-10]

2:10 pm: **Smart optical waveguide sensors for cumulative damage assessment,** O. J. Gregory, W. Euler, E. E. Crisman, H. Mogawer, Univ. of Rhode Island . . . . . [3671-11]

2:30 pm: **Traffic monitoring/control and road condition monitoring using fiber optic- based systems,** W. L. Schulz, E. Udd, M. Morrell, J. M. Seim, Blue Road Research; H. M. Laylor, G. E. McGill, R. Edgar, Oregon Dept. of Transportation . . [3671-12]

2:50 pm: **Monitoring micro floor vibrations with distributed fiber optic sensors for use in auto adaptive smart buildings,** D. R. Huston, W. B. Spillman, Jr., Univ. of Vermont; T. E. Neary, IBM Microelectronics Div.; K. Suiter, Univ. of Vermont . [3671-13]

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

Conference 3672

SESSION 2
Room: Pacific Ballroom E
Mon.10:40 am

MR-ER Dampers

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

10:40 am: **Magnetorheological fluid dampers for off-road vehicles,** S. Kelso, F. Gordaninejad, Univ. of Nevada/Reno . . . . . [3672-05]

11:00 am: **Design issues for magnetorheological fluid actuators,** M. G. Muriuki, W. W. Clark, Univ. of Pittsburgh . . . . . [3672-06]

11:20 am: **ERF-based control and regulation system in technical processes,** E. V. Korobko, A.V. Luikov Heat and Mass Transfer Institute (Belarus) . . . . . [3672-07]

11:40 am: **Feedback control of an ER long-stroke vibration damper,** N. Sims, R. Stanway, A. R. Johnson, D. J. Peel, W. A. Bullough, Univ. of Sheffield (UK) . . . . . [3672-08]

Noon: **Frequency reshaping LQ control of an MR damper for vibration isolation,** D. Jeon, Sogang Univ. (Korea) . . . . . [3672-09]

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

SESSION 3
Room: Pacific Ballroom E
Mon. 1:30 pm

Passive Piezoceramic Treatments

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

1:30 pm: **Reduction of mode localization on a bladed disk using piezoelectric coupling,** G. S. Agnes, Air Force Institute . . . . . [3672-10]

1:50 pm: **Semi-passive damping using continuous switching of a piezoelectric device,** C. Richard, D. Guyomar, D. Audigier, LPM-INSA (France); G. Ching, Techsonic (France) . . . . . [3672-11]

2:10 pm: **Multiple PZT transducers implemented with multiple-mode piezoelectric shunting for passive vibration damping,** S. Wu, Boeing Company . . . . . [3672-12]

2:30 pm: **Semi-active vibration control with piezoelectric materials as variable stiffness actuators,** W. W. Clark, Univ. of Pittsburgh . . . . . [3672-13]

2:50 pm: **Improvement of aeroelastic stability of hingeless helicopter rotor blade by passive piezoelectric damping,** S. Kim, C. Han, C. Yun, Seoul National Univ. (Korea) . . . . . [3672-14]

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

Conference 3673

SESSION 1
Room: Pacific Ballroom F
Mon.10:30 am

Simulation, Modeling, and Design

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

10:30 am: **Analysis of coupled diaphragms using coupled mode theory,** A. Selvarajan, T. Srinivas, S. Anand, Indian Institute of Science/Bangalore (India) . . . . . [3673-03]

10:50 am: **Digital readout CMOS design for capacitive sensors using on-chip variable sense capacitor arrays,** A. Srivastava, D. Wildhaber, J. Wang, M. Hasan, F. Pouralborz, H. Yong, V. Gongalreddy, P. K. Ajmera, Louisiana State Univ. . . . [3673-04]

11:10 am: **Numerical simulation of a new generation of high-temperature micropower gas and odor sensors based on SOI technology,** J. W. Gardner, Univ. of Warwick (UK); F. Udrea, Univ. of Cambridge (UK) . . . . . [3673-05]

11:30 am: **Noise analysis and a comparative study of noise in MEMS and MOEMS,** A. Selvarajan, S. Anand, Indian Institute of Science/Bangalore (India) . . . . . [3673-06]

Lunch Break . . . 11:50 am to 1:30 pm

Invited Paper
Room: Pacific Ballroom F
Mon. 1:30 to 2:00 pm

Design of compliant mechanisms: application to MEMS, S. Kota, Univ. of Michigan . . . [3673-07]

SESSION 2
Room: Pacific Ballroom F
Mon. 2:00 pm

Technology and Fabrication

Chairs: **Norio Shinya,** National Research Institute for Metals (Japan); **P. Xavier,** DSO National Labs. (Singapore)

2:00 pm: **Design of LIGA structures used as host taggents for MEMS sensors,** A. Cox, M. D. Brookshire, C. Graham, M. Graham, Vanderbilt Univ.; E. Garcia, DARPA/DSO . . . . . [3673-08]

2:20 pm: **LIGA-like process for high-aspect-ratio PZT microstructures,** P. K. Ajmera, G. S. Lee, S. J. Park, Solid State Lab. & Ctr. for Adv. Microstructures & Devices [3673-09]

2:40 pm: **Novel method to make three-dimensional arrangements of particles,** M. Hase, M. Egashira, N. Shinya, National Research Institute for Metals (Japan) . . . . . [3673-10]

3:00 pm: **Fast, uniform, anisotropic, and flexible process for deep silicon etching for MEMS fabrication using Alcatel's ICP technology,** T. Pandhumsoporn, M. Feldbaum, K. Yu, P. Gadgil, Alcatel Comptech, Inc. . . . . [3673-11]

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

Conference 3674

Conference 3675

Monday 1 March 1999

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Monday 1 March 1999

Conference 3667

SESSION 4
Room: Newport Ballroom North
Mon. 3:40 pm

Relaxor Ferroelectrics

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

3:40 pm: **Simple phenomenological analysis of the strain behavior in reflexor ferroelectric lead zinc niobate lead titanate single crystals,** L. E. Cross, S. Park, S. Liu, The Pennsylvania State Univ. [3667-14]

4:00 pm: **Constitutive modeling of relaxor ferroelectrics,** C. L. Hom, N. Shankar, Lockheed Martin Palo Alto Advanced Technology Ctr. . [3667-15]

4:20 pm: **J-integral and fracture of ferroelectric ceramics,** C. S. Lynch, Georgia Institute of Technology . . . . . [3667-16]

4:40 pm: **Domain wall model for ferroelectric hysteresis,** R. C. Smith, North Carolina State Univ.; C. L. Hom, Lockheed Martin Palo Alto Advanced Technology Ctr. [3667-17]

5:00 pm: **Effects of the heat generated during a ferroelectric domain switching,** S. J. Kim, Univ. of Seoul (Korea) . . . . . [3667-18]

5:20 pm: **Self consistent models for domain switching in polycrystalline ferroelectrics,** C. M. Landis, R. M. McMeeking, Univ. of California/ Santa Barbara . . . . . [3667-19]

5:40 pm: **Crack extension and kinking in piezoceramics,** X. L. Xu, R. K. N. D. Rajapakse, Univ. of Manitoba (Canada) . . . . . [3667-20]

Conference 3668

SESSION 4
Room: Pacific Ballroom D
Mon. 3:40 pm

Robotics Applications

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

3:40 pm: **Optimized quadruped robotic insect driven by elastodynamic locomotion,** N. O. Lobontiu, M. K. Gordon, M. Goldfarb, E. Garcia, Vanderbilt Univ. [3668-14]

4:00 pm: **Position control of a two-link flexible manipulator using piezoelectric actuators,** S. B. Choi, H. C. Shin, J. H. Kim, Inha Univ. (Korea) . . . . . [3668-15]

4:20 pm: **Robust adaptive control of a slewing active structure,** D. G. Wilson, Univ. of New Mexico; G. G. Parker, Michigan Technological Univ.; G. P. Starr, Univ. of New Mexico; R. D. Robinett III, Sandia National Labs. . . . . [3668-16]

4:40 pm: **Robot manipulator technologies for planetary exploration,** H. Das, Y. Bar-Cohen, X. Bao, R. Bonitz, R. A. Lindemann, M. Maimone, I. A. Nesnas, C. J. Voorhees, Jet Propulsion Lab. . . . . [3668-17]

5:00 pm: **Avoiding obstacle for a new type of smart parallel-series robot mechanism,** Y. Bo, Ecole de Technologie Supérieure (Canada) . . . . . [3668-18]

Conference 3669

SESSION 3
Room: Pacific Ballroom A
Mon. 3:40 pm

Ferroelectrics and Electrostriction

Chairs: **Danilo De Rossi,** Univ. degli Studi di Pisa (Italy); **Joycelyn O. Simpson,** NASA Langley Research Ctr.

3:40 pm: **Electromechanical behavior of electrostrictive poly(vinylidene fluoridetrifluoroethylene) copolymers,** Q. M. Zhang, V. Bharti, Z.-Y. Cheng, X. Z. Zhao, The Pennsylvania State Univ.; T. S. Romotowski, F. A. Tito, Naval Undersea Warfare Ctr.; R. Y. Ting, Univ. of Central Florida . [3669-13]

4:00 pm: **High performance of all-polymer electrostrictive systems,** Z.-Y. Cheng, J. Su, Q. M. Zhang, The Pennsylvania State Univ.; P. C. Wang, A. G. MacDiarmid, Univ. of Pennsylvania . . . . . [3669-14]

4:20 pm: **High-field electrostriction of elastomeric polymer dielectrics for actuation,** R. D. Kornbluh, R. Pelrine, Q. Pei, J. Joseph, SRI International . . . . . [3669-15]

4:40 pm: **Piezoelectric polymer actuators for vibration suppression,** V. H. Schmidt, R. J. Conant, G. Bohannan, J. Eckberg, J. Hallenberg, N. Peterson, C. Reagor, C. Smith, C. Streich, B. Tikalsky, Montana State Univ./ Bozeman . . . . . [3669-16]

5:00 pm: **Structure-property study of piezoelectricity in polyimides,** Z. Ounaies, National Research Council; J. S. Harrison, J. G. Smith, NASA Langley Research Ctr. . . . [3669-17]

5:20 pm: **Cold hibernated elastic memory (CHEM) self-deployable structures,** W. M. Sokolowski, A. B. Chmielewski, Jet Propulsion Lab.; S. Hayashi, Mitsubishi Heavy Industry, Ltd. (Japan) . . . . [3669-18]

Conference 3670

SESSION 2 *(conintued)*
Room: Schooner
Mon. 3:40 pm

3:40 pm: **Self-assembled optical fiber sensors,** F. J. Arregui, Univ. Publica de Navarra (Spain) and Virginia Polytechnic Institute and State Univ.; K. M. Lenahan, Y. Liu, Virginia Polytechnic Institute and State Univ.; I. R. Matias, Univ. Publica de Navarra (Spain); R. O. Claus, Virginia Polytechnic Institute and State Univ. . . . . [3670-13]

4:00 pm: **Strain monitoring and fatigue life of Bragg grating fiber optic sensors,** N. Mrad, S. Sparling, J. P. Komorowski, National Research Council Canada; J. Laliberte, Carleton Univ. (Canada) . . . . . [3670-14]

4:20 pm: **Simultaneous measurement of distributed temperature and strain using single fiber Bragg grating,** P. Sivanesan, J. S. Sirkis, Univ. of Maryland/College Park; V. Venkat, Y. Shi, C. J. Reddy, S. Sankaran, Analytical Services & Materials, Inc. . . . . [3670-15]

SESSION 3
Room: Schooner
Mon. 4:40 pm

Biological Sensors

Chairs: **William B. Spillman, Jr.,** BF Goodrich Aerospace; **Dryver R. Huston,** Univ. of Vermont

4:40 pm: **Surface characteristics of sterilized NiTi shape memory alloys as biomaterials,** M. Tabrizian, B. Thierry, O. Savadogo, L. Yahia, Ecole Polytechnique de Montréal (Canada) . . . . . [3670-16]

5:00 pm: **Nonperturbing E and H field sensors for the near field measurement in biological bodies,** F. Cecelja, Brunel Univ. (UK) . . . . . [3670-17]

5:20 pm: **Basic principle of optical immunosensor using fluorescence anisotropy,** S. Suzuki, Seikei Univ. (Japan); M. Iida, Olympus Optical Co., Ltd. (Japan) . . . . . [3670-18]

5:40 pm: **Real-time acquisition of thumb-index pinch forces with application to robotic manipulators,** A. Ulloa-Perez, Boston Univ.; F. Garcia Cordova, Escuela Politecnica Superior de Cartagena (Spain); J. J. Villalba Fernandez, Univ. de Valladolid (Spain); J. Lopez Coronado, Escuela Politecnica Superior de Cartagena (Spain) . . . . . [3670-19]

Evening Plenary Presentation
Pacific Ballroom C/D . . . . . 6:00 to 7:00 pm
MEMS 2003 and Beyond:
A DARPA Vision of the Future of MEMS
Speaker: **Dr. Albert P. Pisano,** DARPA

Conference 3671

SESSION 4
Room: Pacific Ballroom B
Mon. 3:40 pm

Structural Health Monitoring

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

3:40 pm: **Health monitoring of an Oregon historical bridge with fiber grating strain sensors,** J. M. Seim, E. Udd, W. L. Schulz, M. Morrell, Blue Road Research; H. M. Laylor, Oregon Dept. of Transportation . . [3671-14]

4:00 pm: **Health monitoring for intelligent transportation systems,** A. E. Aktan, C. J. Tsikos, Drexel Univ.; A. J. Helmicki, Univ. of Cincinnati Infrastructure Institute . . . [3671-15]

4:20 pm: **Long-term health monitoring of an advanced polymer composite bridge,** H. W. Shenton III, M. J. Chajes, Univ. of Delaware . . . . . [3671-16]

4:40 pm: **Fiber optic study in steel bridge girders during transportation and erection: a preliminary study to facilitate smart structure systems in bridge girders,** D. O. Peterson, T. C. Kirkpatrick, P. J. Rossi, Dartmouth College . . . . . [3671-17]

5:00 pm: **Dynamic monitoring of structural health in cable-supported bridges,** J. M. Ko, Y. Q. Ni, T. H. T. Chan, Hong Kong Polytechnic Univ. (Hong Kong) . . . . . [3671-18]

5:20 pm: **Wireless monitoring of highways,** B. Hayes-Gill, J. A. Crowe, R. Armitage, D. Rodgers, A. Hendroff, Univ. of Nottingham (UK) [3671-19]

Conference 3672

SESSION 4
Room: Pacific Ballroom E
Mon. 3:40 pm

Isolation

Chair: **Roy Ikegami,** Boeing Information, Space & Defense Systems

3:40 pm: **Robust passive-active mounts for vibration isolation,** J. Su, Naval Surface Warfare Ctr. [3672-15]

4:00 pm: **Noise and vibration isolation across sandwich structures,** P. Thamburaj, J. Q. Sun, Univ. of Delaware . . . . . [3672-16]

4:20 pm: **Semi-active control of flexural vibrations with an MR fluid actuator,** J. Lee, W. W. Clark, Univ. of Pittsburgh . . . . . [3672-17]

4:40 pm: **Whole-spacecraft vibration isolation system for the GFPO/Taurus Mission,** P. S. Wilke, C. D. Johnson, CSA Engineering, Inc.; P. J. Grosserode, Orbital Sciences Corp. . . . . [3672-18]

5:00 pm: **Hubble Space Telescope solar array damper,** S. C. Pendleton, J. R. Maly, CSA Engineering, Inc. . . . . [3672-19]

Conference 3673

SESSION 2 *(continued)*
Room: Pacific Ballroom F
Mon. 3:40 pm

3:40 pm: **Focused microsized particle beam technology and its application to microfabrication,** M. Egashira, N. Shinya, National Research Institute for Metals (Japan); H. Saito, APCO Ltd. (Japan) . . . . . [3673-12]

SESSION 3
Room: Pacific Ballroom F
Mon. 4:00 pm

Smart Antenna and Wireless Telemetry

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

4:00 pm: **Remotely powered, multichannel, microprocessor-based telemetry systems for smart implantable devices and smart structures,** C. P. Townsend, M. Hamel, S. W. Arms, MicroStrain, Inc. . . . . [3673-13]

4:20 pm: **Project update: applied research on remotely queried embedded microsensors,** D. G. Krantz, MTS Systems Corp.; J. H. Belk, Boeing Co.; P. Biermann, Johns Hopkins Univ.; J. Dubow, Univ. of Utah; R. Harjani, S. C. Mantell, D. L. Polla, Univ. of Minnesota/Twin Cities; P. R. Troyk, Illinois Institute of Technology . . . . . [3673-14]

4:40 pm: **Design of ferroelectric microstrip patch antennas,** G. Washington, The Ohio State Univ.; R. R. Romanofsky, NASA Lewis Research Ctr. . . . . [3673-15]

5:00 pm: **Design and development of 150-MHz wireless telemetry system for MEMS-IDT based sensor,** D. Piscotty, K. A. Jose, V. V. Varadan, V. K. Varadan, The Pennsylvania State Univ. . . . . [3673-16]

5:20 pm: **Testing and development of doubly curved piezoceramic aperture antennae,** H. Yoon, G. Washington, The Ohio State Univ. . . . [3673-17]

Conference 3674

Conference 3675

Monday 1 March 1999

Evening Plenary Presentation
Pacific Ballroom C/D . . . . . 6:00 to 7:00 pm
MEMS 2003 and Beyond:
A DARPA Vision of the Future of MEMS
Speaker: **Dr. Albert P. Pisano,** DARPA

SPIE's 6th Annual International Symposium on

Special Events

Poster Session

Smart Structures and Materials

Tuesday 2 March
6 to 7:30 pm
California Ballroom

A poster session will be held on Tuesday evening for all attendees of the Smart Structures and Materials symposium. Attendees will have an opportunity to view the poster papers and meet informally with the authors, who will be available to answer questions. Refreshments and light hors d'oeuvres 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 8:30 am and 3:00 pm Tuesday. Poster papers can be previewed after 3 pm before the formal poster session begins at 6 pm.

Conference 3667 | Conference 3668 | Conference 3669 | Conference 3670

Tuesday 2 March 1999

Plenary Presentation

Pacific Ballroom C/D . . . . . **8:00 to 8:45 am**

Intelligence and Durability of Civil Structures

Speaker: **Prof. Ken Chong,** National Science Foundation

Coffee/Exhibit Break . . . . . 8:45 to 9:20 am

SESSION 5
Room: Newport Ballroom North
Tues. 9:20 am
Control Theory and Techniques II

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

9:20 am: **Peak-to-peak control of an adaptive tensegrity space telescope,** C. Sultan, M. Corless, Purdue Univ.; R. E. Skelton, Univ. of California/San Diego . . . . . [3667-21]

9:40 am: **Control designs which respect characteristic length scales in smart systems and smart structures,** J. Baillieul, Boston Univ. . [3667-22]

10:00 am: **Position control of a two-link flexible manipulator using piezoelectric actuators,** S. B. Choi, H. C. Shin, J. H. Kim, Inha Univ. (Korea) . . . . . [3667-23]

10:20 am: **Control system design for structural systems under statistical parametric uncertainty,** R. Huerta-Ochoa, S. H. Johnson, Lehigh Univ. . . . . [3667-24]

SESSION 6
Room: Newport Ballroom North
Tues.10:40 am
Optimization Methods

Chair: **Sridhar Kota,** Univ. of Michigan

10:40 am: **Design of flextensional transducers using homogenization design method,** E. C. N. Silva, Univ. de São Paulo (Brazil); S. Nishiwaki, N. Kikuchi, Univ. of Michigan [3667-25]

11:00 am: **Size and shape optimization of multiple input and output compliant mechanisms,** J. A. Hetrick, S. Kota, Univ. of Michigan . . . . . [3667-26]

11:20 am: **Homogenization of an active distributed electrical network coupled with a continuous medium,** S. Bereksi, M. Lenczner, Univ. de Franche-Comte (France) . [3667-27]

11:40 am: **Optimization of actuator placement and structural parameters in smart structures,** H. Baier, G. Locatelli, Technische Univ. München (Germany) . . . . . [3667-28]

Lunch/Exhibit Break . Noon to 1:30 pm

SESSION 5
Room: Pacific Ballroom D
Tues. 9:20 am
Magnetostriction I

Chair: **Alison B. Flatau,** Iowa State Univ.

9:20 am: **Blocked-force investigation of a Terfenol-D transducer,** R. Kellogg, A. B. Flatau, Iowa State Univ. . . . . [3668-19]

9:40 am: **Initial control experiments on a magnetostrictive wire clamp,** D. M. Dozor, Mechatronic Technology Co. . . . . [3668-20]

10:00 am: **Hybrid linear motor design issue analysis,** B. J. Lund, L. E. Faidley, A. B. Flatau, Iowa State Univ. . . . . [3668-21]

10:20 am: **Acoustic panels using magnetostrictive metglas,** M. J. Gerver, Independent Consultant; J. H. Goldie, S. Makseyn, J. Oleksy, SatCon Technology Corp.; J. J. Doherty, P. Remington, BBN Technologies . . . . . [3668-22]

SESSION 6
Room: Pacific Ballroom D
Tues.10:40 am
Acoustic Control

Chair: **Michael S. Torok,** Sikorsky Aircraft Corp.

10:40 am: **Performance comparison of feedback and feedforward structural-acoustic control,** B. S. Bingham, N. W. Hagood, Massachusetts Institute of Technology . . . . . [3668-23]

11:00 am: **Fabry-Perot strain sensors for noise control applications,** P. Masson, A. Berry, Univ. de Sherbrooke (Canada) . . . [3668-24]

11:20 am: **Active and passive noise control using the electro-active polymer actuator (EAPA),** K. Ramanathan, B. Zhu, W. Chang, V. V. Varadan, V. K. Varadan, The Pennsylvania State Univ. [3668-25]

11:40 am: **Architecture definition of a piezoceramic-based ANN system for multiple tone vibration and sound radiation suppression,** A. Concilio, L. De Vivo, A. Sorrentino, CIRA SCpA (Italy) . . . . . [3668-26]

Lunch/Exhibit Break . Noon to 1:30 pm

SESSION 4
Room: Pacific Ballroom A
Tues. 9:20 am
PAN, Gels, and Polypyrrole-Based EAD

Chairs: **Toribio F. Otero,** Univ. del País Vasco (Spain); **Carol A. Becker,** Space and Naval Warfare Systems Ctr., San Diego

9:20 am: **Electrical activation of PAN artificial muscles,** H. B. Schreyer, M. Shahinpoor, Univ. of New Mexico . . . . . [3669-19]

9:40 am: **Shape memory gels with multi-stimuli-responses,** T. Kaneko, T. Miyazaki, K. Yamaoka, Y. Katayama, A. Matsuda, J. P. Gong, Y. Osada, Hokkaido Univ. (Japan) . . . . . [3669-20]

10:00 am: **Solvent-drag bending motion of polymer gel induced by electric field,** T. Hirai, K. Tei, M. Watanabe, H. Morikawa, Shinshu Univ. (Japan) . . . . . [3669-21]

10:20 am: **Friction of polymer gels and their potential application as artificial cartilage,** J. Gong, Y. Iwasaki, G. Kagata, Y. Osada, Hokkaido Univ. (Japan) . [3669-22]

10:40 am: **Mechanical properties of active polyacrylonitrile gels,** S. P. Marra, K. T. Ramesh, A. S. Douglas, Johns Hopkins Univ. . . . [3669-23]

11:00 am: **Electrically stimulated bilayer hydrogels as muscles,** P. D. Calvert, Z. Liu, Univ. of Arizona . . . . . [3669-24]

11:20 am: **Development of polypyrrole-based electromechanical actuators,** G. M. Spinks, T. W. Lewis, G. G. Wallace, Univ. of Wollongong (Australia) . . . . . [3669-25]

11:40 am: **Phase transition behavior of an amphoteric polymer gel,** H. Tamagawa, M. Taya, S. Popovic, Univ. of Washington . . . [3669-26]

Lunch/Exhibit Break Noon to 1:30 pm

SESSION 4
Room: Schooner
Tues. 9:20 am
Processing and Characterization I

Chairs: **Peter D. Dean,** Lockheed Martin Missiles & Space; **Carolyn M. Dry,** Univ. of Illinois/Urbana-Champaign

9:20 am: **Measurement of the quadratic electroopic coefficient of lead zirconate titanate thin film by a two-beam polarization interferometer,** V. V. Spirin, K. No, Korea Advanced Institute of Science and Technology (Korea); M. G. Shlyagin, S. V. Miridonov, CICESE Research Ctr. . . . . [3670-20]

9:40 am: **On-line monitoring of amine concentration in the processing of amine/epoxy based thermosets,** T. Liu, G. F. Fernando, Cranfield Univ. (UK) . . . . [3670-21]

10:00 am: **Multi-functional fiber optic sensor for cure and temperature monitoring,** M. Singh, T. Liu, A. Crosby, G. F. Fernando, Cranfield Univ. (UK) . . . . [3670-22]

10:20 am: **Freeform fabrication of composites with embedded sensors,** P. D. Calvert, Univ. of Arizona; H. B. Denham, Sandia National Labs. . . . . [3670-23]

10:40 am: **Electrically passive level gauge,** D. Donlagic, Univ. of Maribor (Slovenia) . . . . . [3670-24]

11:00 am: **Sensitivity and selectivity issues of chemical sensing: porosity control,** P. M. Faia, C. S. Furtado, Univ. of Coimbra (Portugal) [3670-25]

11:20 am: **Design issues of acoustic contact impedance evaluation technique,** A. Daugela, Univ. of California/San Diego; R. Bansevicius, Kaunas Univ. of Technology (Lithuania) . . . . . [3670-26]

11:40 am: **In-situ measurements of thermoset resins degree of cure using embedded fiber optic,** G. Di Vita, S. Cantoni, A. Calabrú, CIRA Scpa (Italy); V. Buonocore, M. Giordano, L. Nicolais II, A. Cusano, A. Cutolo, Univ. degli Studi di Napoli Federico II (Italy) . . . . . [3670-27]

Lunch/Exhibit Break Noon to 1:30 pm

Smart Structures and Materials

Tuesday 2 March 1999

Plenary Presentation

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

Intelligence and Durability of Civil Structures

Speaker: **Prof. Ken Chong,** National Science Foundation

Coffee/Exhibit Break . . . . . 8:45 to 9:20 am

Conference 3671

SESSION 5
Room: Pacific Ballroom B
Tues. 9:20 am

Active Control

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

9:20 am: **Active control of heave motion for TLP type offshore platform under random waves,** R. C. Batista, R. Alves, Federal Univ. of Rio de Janeiro (Brazil) . . . . . [3671-20]

9:40 am: **Active energy control for civil structures,** J. Scruggs, D. K. Lindner, Virginia Polytechnic Institute and State Univ. . . . . [3671-21]

10:00 am: **Robust control for structural systems with uncertainties,** S. G. Wang, Univ. of North Carolina/Charlotte; P. Roschke, Texas A&M University; H. Y. Yeh, Prairie View A&M Univ. . . . . [3671-22]

10:20 am: **Seismic response of adjacent buildings connected by active tendon devices,** W. S. Zhang, Y. L. Xu, Hong Kong Polytechnic Univ. (Hong Kong) . . . . . [3671-23]

10:40 am: **Development of active 6DOF microvibration control system using giant magnetostrictive actuator,** Y. Nakamura, M. Nakayama, K. Masuda, K. Tanaka, Fujita Corp. (Japan); M. Yasuda, Tokkyokiki Corp. (Japan); T. Fujita, Univ. of Tokyo (Japan) . . . . . [3671-24]

SESSION 6
Room: Pacific Ballroom B
Tues.11:00 am

Damage Integrity/Repair

Chair: **Justin Berman,** U.S. Army CERL

11:00 am: **Accelerated aging of polymer composite bridge materials,** N. M. Carlson, L. L. Torres, J. G. Rodriguez, Idaho National Engineering and Environmental Lab. . . . . [3671-25]

11:20 am: **Repair and prevention of damage due to transverse shrinkage cracks in bridge decks,** C. M. Dry, Univ. of Illinois/Urbana-Champaign . . . . . [3671-26]

11:40 am: **Modeling of crack growth and life time prediction in post-tensioned segmental bridges,** M. L. Wang, D. Satpathi, J. G. Lim, Univ. of Illinois . . . . . [3671-38]

Lunch/Exhibit Break . Noon to 1:30 pm

Conference 3672

SESSION 5
Room: Pacific Ballroom E
Tues. 9:20 am

Passive-Active Damping Treatments I

Chair: **Jem A. Rongong,** Univ. of Sheffield (UK)

9:20 am: **Vibration control of plates using self-sensing active constrained layer damping networks,** J. Ro, Old Dominion Univ.; A. M. Baz, Univ. of Maryland/College Park . . [3672-20]

9:40 am: **Piezo-actuation of sandwich plates with viscoelastic cores,** G. Wang, N. M. Wereley, Univ. of Maryland/College Park . . [3672-21]

10:00 am: **Combined active/passive control of a guideway subjected to a travelling mass,** S. Imeilowski, R. Bogacz, Institute of Fundamental Technological Research (Poland); K. Popp, Univ. of Hannover (Germany) . . . . . [3672-22]

10:20 am: **Frequency noise reducing structures using passive and active damping methods,** Y. Tao, D. G. Morris, F. Spann, E. Haugse, Boeing Information, Space & Defense Systems . . . . . [3672-23]

SESSION 6
Room: Pacific Ballroom E
Tues.10:40 am

Passive-Active Damping Treatments II

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

10:40 am: **Analytical approach for estimating the total damping in a one-dimensional passive stand-off layer damping treatment,** J. M. Yellin, I. Y. Shen, P. G. Reinhall, Univ. of Washington . . . [3672-24]

11:00 am: **Experimental investigation of the electrochemical surface damping technique,** R. F. Orsagh, H. Ghoneim, Rochester Institute of Technology . [3672-25]

11:20 am: **Enhanced self-sensing active constrained layer damping treatment,** W. H. Liao, Chinese Univ. of Hong Kong . . . [3672-26]

11:40 am: **Vibration suppression performance of piezoceramic and magnetostrictive materials in hybrid constrained layer damping,** B. Bhattacharya, J. A. Rongong, G. R. Tomlinson, Univ. of Sheffield (UK) . . . . . [3672-27]

Noon: **Effects of modeling assumptions on loss factors predicted for viscoelastic sandwich beams,** E. M. Austin, D. J. Inman, Virginia Polytechnic Institute and State Univ. . . . . [3672-28]

Lunch/Exhibit Break . 12:20 to 1:50 pm

Conference 3673

Keynote Address
Pacific Ballroom F
Tues. 9:20 am

Wireless Integrated Network Sensors (WINS), William J. Kaiser, Univ. of California/Los Angeles . . . . . [3673-18]

Invited Paper

10:00 am: **Micromechanical filters for miniaturized low-power communications,** C. T. Nguyen, Univ. of Michigan . . . [3673-19]

SESSION 4
Room: Pacific Ballroom F
Tues.10:30 am

Wireless Telemetry and Applications

Chairs: **Donald G. Krantz,** MTS Systems Corp.; **K. A. Jose,** The Pennsylvania State Univ.

10:30 am: **Remotely queried microsensor needs for aerospace applications,** J. H. Belk, E. V. White, Boeing Co.; D. G. Krantz, MTS Systems Corp. . . . . [3673-20]

10:50 am: **Applications of wireless MEMS-IDT strain sensors, accelerometers, and gyroscopes,** V. K. Varadan, The Pennsylvania State Univ.; P. Xavier, DSO National Labs. (Singapore); V. V. Varadan, The Pennsylvania State Univ. [3673-21]

11:10 am: **Early demonstrations of remotely queried microsensors,** L. W. Gause, Naval Research Lab.; D. G. Krantz, MTS Systems Corp.; P. Biermann, Johns Hopkins Univ.; J. H. Belk, Boeing Co. . . [3673-22]

11:30 am: **Tunable and electronically steerable microstrip antenna,** K. A. Jose, V. K. Varadan, V. V. Varadan, The Pennsylvania State Univ. . . . . [3673-23]

Lunch/
Exhibit Break . 11:50 am to 1:30 pm

Conference 3674

SESSION 1
Room: Pacific Ballroom C
Tues. 9:20 am

Airvehicle Applications I

Chairs: **Helmut W. Zaglauer,** Daimler-Benz Aerospace Dornier (Germany); **Jack H. Jacobs,** Honeywell Space Systems

9:20 am: **Advanced aircraft structures program: an overview,** J. Becker, H. W. Schröder, Daimler-Benz Aeorspace (Germany) [3674-01]

9:40 am: **Fin-buffet alleviation via distributed piezoelectric actuators: full-scale demonstrator tests,** R. Manser, J. Simpson, J. Becker, Daimler-Benz Aerospace (Germany); J. K. Dürr, E. Flöth, U. Herold-Schmidt, H. Stark, H. W. Zaglauer, Daimler-Benz Aerospace Dornier (Germany) . . . . . [3674-02]

10:00 am: **Fin-buffet alleviation via distributed piezoelectric actuators: materials qualification program,** K. Dittrich, J. Simpson, J. Becker, Daimler-Benz Aerospace (Germany); J. K. Dürr, E. Flöth, E. Ihler, U. Herold-Schmidt, H. W. Zaglauer, Daimler-Benz Aerospace Dornier (Germany) . . . . . [3674-03]

10:20 am: **Adaptive damping of vibrations of fin-structures,** M. Stuwing, D. Sachau, DLR Institute of Structural Mechanics (Germany); J. Simpson, R. Manser, Daimler-Benz Aerospace (Germany) . . . [3674-04]

10:40 am: **Nondestructive testing of surface bonded piezoelectric patch actuators,** J. K. Dürr, Daimler-Benz Aerospace Dornier (Germany); N. Krohn, K. Nixdorf, C. Doettinger, Univ. of Stuttgart (Germany); U. Herold-Schmidt, Daimler-Benz Aerospace Dornier (Germany); G. Busse, Univ. of Stuttgart (Germany) . . . . . [3674-05]

11:00 am: **Structural dynamic health monitoring of adaptive CFRP-structures,** S. Kaiser, D. Sachau, DLR Institute of Structural Mechanics (Germany) . . . . . [3674-06]

11:20 am: **Fiber optic sensors for health monitoring of morphing aircraft,** T. L. Brown, K. Wood, B. A. Childers, R. J. Cano, B. Jensen, R. S. Rogowski, NASA Langley Research Ctr. . . . . [3674-07]

11:40 am: **Overview of the Portuguese research and development programs in the smart structures area,** A. Suleman, Instituto Superior Tecnico (Portugal); P. Costa, Portuguese Air Force Academy (Portugal) . . . . . [3674-08]

Lunch/Exhibit Break . Noon to 1:30 pm

Conference 3675

SPIE's 6th Annual International Symposium on

Tuesday 2 March 1999

Conference 3667

SESSION 7
Room: Newport Ballroom North
Tues. 1:30 pm

Shape Memory Alloys I

Chair: **Dimitris C. Lagoudas,** Texas A&M Univ.

1:30 pm: **Role of the spinodal region in Falk's model,** K. Lazopoulous, National Technical Univ. (Greece) . . . . . [3667-29]

1:50 pm: **Modeling dynamics of shape memory alloys via computer algebra,** R. V. N. Melnik, A. J. Roberts, K. A., Thomas, Univ. of Southern Queensland (Australia) . . [3667-30]

2:10 pm: **Computational aspects of solid-solid phase transformations modeling with a Gibbs function,** S. Govindjee, G. Hall, Univ. of California/Berkeley . . . . . [3667-31]

2:30 pm: **Thermomechanical representation of shape memory behavior,** D. Helm, P. Haupt, Univ. of Kassel (Germany) . . . . . [3667-32]

2:50 pm: **Three-dimensional homogenization of SMA wires in a linear incompressible matrix,** J. P. Briggs, P. P. Castaneda, J. P. Ostrowski, Univ. of Pennsylvania . . . . . [3667-33]

Standby Presentations

Thermoelectric control of shape memory alloy microactuators: thermal model, J. Abadie, N. Chaillet, Lab. d' Automatique de Besançon (France); C. Lexcellent, Lab. de Mecanique Appliquée R. Chaléat (France); A. Bourjault, Lab. d' Automatique de Besançon (France) . . . . . [3667-75]

Nonlinear motion and force control of shape memory alloys actuators, H. Benzaoui, N. Chaillet, Lab. d' Automatique de Besançon (France); C. Lexcellent, Lab. de Mecanique Appliquée R. Chaléat (France); A. Bourjault, Lab. d' Automatique de Besançon (France) . . . . . [3667-76]

Coffee/Exhibit Break 3:10 to 3:40 pm

Conference 3668

SESSION 7
Room: Pacific Ballroom D
Tues. 1:30 pm

Health Monitoring I

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

1:30 pm: **TPS health monitoring on X-38,** R. Graue, A. Reutlinger, Kayser-Threde GmbH (Germany) [3668-27]

1:50 pm: **Structural damage monitoring based on an actuator-sensor system,** C. Boller, Daimler-Benz Aerospace (Germany); C. Biemans, Daimler-Benz Research and Technology (Germany); W. J. Staszewski, K. Worden, G. R. Tomlinson, Univ. of Sheffield (UK) . . . . . [3668-28]

2:10 pm: **Real-time impact identification of stiffened composite panels,** R. E. Seydel, F. K. Chang, Stanford Univ. . . . . [3668-29]

2:30 pm: **Structural integrity of composites with embedded piezoelectric ceramic,** C. Paget, K. Levin, Aeronautical Research Institute of Sweden . . . . . [3668-30]

2:50 pm: **Damage detection in smart structures through sensitivity enhancing feedback control,** L. R. Ray, L. Tian, Dartmouth College . . . . . [3668-31]

Coffee/Exhibit Break 3:10 to 3:40 pm

Conference 3669

SESSION 5
Room: Pacific Ballroom A
Tues. 1:30 pm

EAP Processing Techniques

Chairs: **Yoshihito Osada,** Hokkaido Univ. (Japan); **Chang Liu,** Univ. of Illinois/Urbana-Champaign

1:30 pm: **Self-assembled flexible electrodes on electroactive polymer actuators,** Y. X. Wang, A. Rosidian, Y. Liu, R. O. Claus, Virginia Polytechnic Institute and State Univ. . . . . [3669-27]

1:50 pm: **Force optimization of ionic polymeric platinum composite artificial muscles by means of an orthogonal array manufacturing method,** T. Rashid, M. Shahinpoor, Univ. of New Mexico . . . [3669-28]

2:10 pm: **Processability of poly 2,5-di-(-2-thienyl) pyrrole, poly(SNS),** T. F. Otero, S. Villanueva, E. Brillas, Univ. del País Vasco (Spain); J. Carrasco, Univ. de Barcelona (Spain) . . . . . [3669-29]

SESSION 6
Room: Pacific Ballroom A
Tues. 2:30 pm

EAP Applications

Chairs: **Jon S. McElvain,** UNIAX Corp.; **Paul D. Calvert,** Univ. of Arizona

2:30 pm: **Microgripper design using electro-active polymers,** R. Lumia, M. Shahinpoor, Univ. of New Mexico . . . . . [3669-30]

2:50 pm: **Organic polymer light-emitting diodes on plastic substrates,** Y. He, S. Gong, R. Hattori, J. Kanicki, Univ. of Michigan . . . . . [3669-31]

Coffee/Exhibit Break 3:10 to 3:40 pm

Conference 3670

SESSION 5
Room: Schooner
Tues. 1:30 pm

Processing and Characterization II

Chairs: **E. J. Friebele,** Naval Research Lab.; **Richard O. Claus,** Virginia Polytechnic Institute and State Univ.

1:30 pm: **Submicron displacement measurements by laser spectrometry,** S. Chu, S. H. Choi, NASA Langley Research Ctr.; M. Kwak, A. D. Cutler, George Washington Univ. [3670-28]

1:50 pm: **Influence of process route on mechanical and sensing performance of fiber Bragg grating optic fiber sensors,** C. Y. Wei, S. W. James, C. C. Ye, R. P. Tatam, P. E. Irving, Cranfield Univ. (UK) [3670-29]

2:10 pm: **Study on drag forces of the molding flow in IC packaging using optical fiber sensors,** Y. Lo, H. Lai, M. Tsai, National Cheng Kung Univ. (Taiwan) . . . . . [3670-30]

SESSION 6
Room: Schooner
Tues. 2:30 pm

Embedded Sensors I

Chairs: **Kim D. Bennett,** Lafayette College; **Mark S. Miller,** BF Goodrich Aerospace

2:30 pm: **Strain measurements inside thick CFRP laminates at the vicinity of bolted joints,** J. M. Menendez, J. A. Guemes, Univ. Politecnica de Madrid (Spain) . . . . . [3670-31]

2:50 pm: **Measurement of stress concentrations using embedded optical fiber Bragg grating sensors,** K. Peters, M. Studer, J. Botsis, A. Iocco, H. G. Limberger, R. Salathé, Swiss Federal Institute of Technology (Switzerland) . . . . . [3670-32]

Coffee/Exhibit Break 3:10 to 3:40 pm

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Conference 3671

Conference 3672

Conference 3673

Conference 3674

Conference 3675

Tuesday 2 March 1999

SESSION 7
Room: Pacific Ballroom B
Tues. 1:30 pm

Damage Detection I

Chair: **Norris Stubbs,** Texas A&M Univ.

1:30 pm: **Selection of input parameters for artificial neural networks in structural damage identification,** Y. Q. Ni, Hong Kong Polytechnic Univ. (Hong Kong); B. S. Wang, Zhejiang Univ. (China); J. M. Ko, Hong Kong Polytechnic Univ. (Hong Kong) . . . . . [3671-27]

1:50 pm: **Damage assessment across hybrid laminates using an array of embedded fiber optic sensors,** T. S. P. Austin, M. M. Singh, P. J. Gregson, J. P. Dakin, Univ. of Southampton (UK); P. M. Powell, Defence Evaluation and Research Agency Farnborough (UK) [3671-28]

2:10 pm: **Damage detection system of a real steel truss bridge by neural networks,** M. Y. Choi, I. B. Kwon, Korea Research Institute of Standards and Science (Korea) . . . . [3671-29]

2:30 pm: **Damage detection using ARMA model coefficients,** G. V. Garcia, New Mexico State Univ.; R. A. Osegueda, D. Meza, Univ. of Texas/El Paso . . . . . [3671-30]

2:50 pm: **Crack damage detection of concrete structures using distributed electrical time domain reflectometry (ETDR) sensors,** M. W. Lin, W. Zhang, A. O. Abatan, Clark Atlanta Univ. . . . . [3671-31]

Coffee/Exhibit Break 3:10 to 3:40 pm

SESSION 7
Room: Pacific Ballroom E
Tues. 1:50 pm

Passive Elements

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

1:50 pm: **Steady state sinusoidal behavior of elastomeric lag dampers,** V. Madhavan, N. M. Wereley, Univ. of Maryland/College Park; T. Sieg, Paulstra Vibrachoc (France) [3672-29]

2:10 pm: **Microstructural modelization of viscoelastic auxetic polymers,** F. Scarpa, C. Remillat, G. R. Tomlinson, Univ. of Sheffield (UK) . . . . . [3672-30]

2:30 pm: **Novel strain energy dissipation mechanism for composite joint structure,** S. E. Mercy, J. R. House, Defence Evaluation and Research Agency (UK); I. D. Grant, Defence Research Agency (UK) . . . . . [3672-31]

2:50 pm: **Damped joints for thin-plate structures,** J. A. Rongong, G. R. Tomlinson, Univ. of Sheffield (UK) . . . . . [3672-32]

Coffee/Exhibit Break 3:10 to 3:40 pm

Invited Paper

1:30 pm: **MEMS: a system for sensing-logic actuation,** C. Ho, Univ. of California/Los Angeles . . . . . [3673-24]

SESSION 5
Room: Pacific Ballroom F
Tues. 2:00 pm

Sensors and Actuators

Chairs: **Anand K. Asundi,** Nanyang Technological Univ. (Singapore); **Arun Seraphin,** Institute for Defense Analysis

2:00 pm: **Micromachined optical angular rate sensor,** L. Zheng, A. K. Asundi, Nanyang Technological Univ. (Singapore); F. Chollet, X. Tang, A. Liu, National Univ. of Singapore . . . . . [3673-25]

2:20 pm: **FET Accelerometer for lateral acceleration detection,** J. Chung, H. Lee, J. J. Pak, Korea Univ. (Korea) . . . . . [3673-26]

2:40 pm: **Microelectromechanical actuator with extended range and enhanced force-fabrication, test and application as a mechanical scanner,** S. M. Bobbio, Univ. of North Carolina/Charlotte; S. W. Smith, J. Zara, Duke Univ.; S. Goodwin-Johansson, MCNC; J. Hudak, T. D. DuBois, H. Leamy, J. Godwin, Univ. of North Carolina/Charlotte [3673-27]

3:00 pm: **Two-input axis angular rate sensor,** S. An, Y. Oh, C. Song, Samsung Advanced Institute of Technology (Korea) . . . . [3673-28]

Coffee/Exhibit Break 3:20 to 3:40 pm

SESSION 2
Room: Pacific Ballroom C
Tues. 1:30 pm

Marine and Commerical System Applications

Chairs: **Bernie F. Carpenter,** Lockheed Martin Astronautics; **Anna-Maria R. McGowan,** NASA Langley Research Ctr.

1:30 pm: **SMA actuator for flap-assisted control surface for submarine application,** T. D. Nguyen, Naval Surface Warfare Ctr.; B. F. Carpenter, Lockheed Martin Astronautics . . . . . [3674-09]

1:50 pm: **Test results for a SMA-actuated vortex wake control system,** T. R. Quackenbush, A. J. Bilanin, Continuum Dynamics, Inc.; B. F. Carpenter, Lockheed Martin Astronautics . . . . . [3674-10]

2:10 pm: **Spatially distributed smart skin seat sensor for high-resolution real-time occupant position tracking,** J. E. Hubbard, Jr., PhotoSense, Inc.; S. E. Burke, Boston Univ. . . . [3674-11]

2:30 pm: **Smart temperature sensors for food and pharmaceutical products,** M. Shahinpoor, Univ. of New Mexico; D. R. Martinez, Sandia National Labs. . . . . [3674-12]

2:50 pm: **Active seat isolation for hybrid-electric vehicles,** D. J. Leo, Virginia Polytechnic Institute and State Univ.; S. J. Buckley, Chrysler Corp.; N. G. Naganathan, Univ. of Toledo . . . . . [3674-13]

Coffee/Exhibit Break 3:10 to 3:40 pm

SPIE's 6th Annual International Symposium on

Tuesday 2 March 1999

Conference 3667

SESSION 8
Room: Newport Ballroom North
Tues. 3:40 pm
Control Theory and Techniques III

Chair: **Narendra S. Khot,** Air Force Research Lab.

3:40 pm: **Robust control of input limited smart structural systems,** S. Sana, V. S. Rao, Univ. of Missouri/Rolla . . . . . [3667-34]

4:00 pm: **Dissipativity-based control of plate vibrations by piezoelectric sensors and actuators,** K. Schlacher, A. Kugi, Johannes Kepler Univ. Linz (Austria) . . . . . [3667-35]

4:20 pm: **Nonlinear control of PZT actuated trailing edge flaps,** A. J. Kurdila, J. Li, Univ. of Florida; M. Fulton, NASA Ames Research Ctr. . . . . [3667-36]

4:40 pm: **Nonlinear structural identification based on H infinity filter algorithm,** T. Sato, K. Qi, Kyoto Univ. (Japan) . . . . . [3667-37]

5:00 pm: **Approximation of distributed control laws using distributed electronic devices for vibration control,** M. Lenczner, M. Kadar, Univ. de Franche-Comte (France) . . . . . [3667-38]

5:20 pm: **Reducing the effect of out-of-bandwidth modes in assumed modes modeling of piezoelectric laminates,** O. R. Moheimany, Univ. of Newcastle (Australia) . . . [3667-39]

Conference 3668

SESSION 8
Room: Pacific Ballroom D
Tues. 3:40 pm
Health Monitoring II

Chair: **David J. Haas,** Naval Surface Warfare Ctr.

3:40 pm: **Wave propogation in tapered beams,** A. Purekar, D. J. Pines, Univ. of Maryland/College Park . . . . . [3668-32]

4:00 pm: **Longitudinal wave propagation measuring technique for structural health monitoring,** Z. Jiang, Tohoku Univ. (Japan); K. Kabeya, NKK Corp. (Japan); S. Chonan, Tohoku Univ. (Japan) . . . . . [3668-33]

4:20 pm: **Electromechanical impedance health monitoring of spot-welded structural joints,** V. Giurgiutiu, A. P. Reynolds, C. A. Rogers, Univ. of South Carolina/Columbia . . . . . [3668-34]

4:40 pm: **Structural health monitoring using active sensors and wavelet transforms,** X. Deng, Q. Wang, V. Giurgiutiu, Univ. of South Carolina/Columbia [3668-35]

5:00 pm: **Lamb wave assessment of fatigue damage in aluminum plates,** S. Grondel, C. Delebarre, E. Moulin, Univ. de Valenciennes (France) . . . . . [3668-36]

Conference 3669

SESSION 6 *(continued)*
Room: Pacific Ballroom A
Tues. 3:40 pm

3:40 pm: **Spatial frequency filtering using hybrid polymer/VLSI technology,** J. S. McElvain, J. D. Langan, R. Behm, M. Costolo, A. J. Heeger, UNIAX Corp.; J. A. Finch, Raytheon Infrared Ctr. of Excellence . . . . . [3669-32]

4:00 pm: **Scaling laws of micro-actuators and potential applications of electroactive polymers in MEMS,** C. Liu, Univ. of Illinois/Urbana-Champaign; Y. Bar-Cohen, Jet Propulsion Lab.; M. Shahinpoor, Univ. of New Mexico . . . . . [3669-33]

4:20 pm: **MEMS device systems design and verification tools for smart structures,** Y. Xu, H. J. Lee, M. Perez-Maher, Tanner Research, Inc. . . . . [3669-34]

4:40 pm: **Design and analysis of elastodynamic locomotion for robotic insects,** N. O. Lobontiu, M. K. Gordon, G. Fischer, E. Garcia, M. Goldfarb, Vanderbilt Univ. [3669-35]

5:00 pm: **Blood pressure, pulse rate, and rhythm measurement using ionic polymeric metal composite artificial muscles,** A. Keshavarzi, J. W. Lantz, M. Shahinpoor, Univ. of New Mexico . . . . . [3669-36]

5:20 pm: **Applications of polypyrrole micro-actuators,** E. W. H. Jager, Linköping Univ. (Sweden); E. Smela, Risø National Lab. (Denmark); O. Inganäs, I. Lundström, Linköping Univ. (Sweden) . . . . . [3669-37]

Conference 3670

SESSION 6 *(continued)*
Room: Schooner
Tues. 2:30 pm

3:40 pm: **Low-cost optical fiber-based strain sensor,** D. Inder, T. Liu, G. F. Fernando, Cranfield Univ. (UK) . . . . . [3670-33]

4:00 pm: **Wireless measurement of tire pressure with passive quartz sensors,** R. Grossmann, Technische Univ. München (Germany) [3670-34]

4:20 pm: **Miniature fiber optic loop sub-component for compact sensors and dense routing,** F. J. Gillham, D. W. Stowe, Thomas & Betts Aster Corp. . . . . [3670-35]

4:40 pm: **Effect of surface modification on the interfacial bonding of optical fiber with inorganic and organic matrices,** P. L. Swart, L. Tu, A. A. Chtcherbakov, Rand Afrikaans Univ. (South Africa) . . . . . [3670-36]

5:00 pm: **Embedding and testing of optical fiber sensors in prototype graphite composite spacecraft strut tubes,** E. J. Friebele, H. Patrick, B. Wright, M. LeBlanc, W. Simon, Naval Research Lab.; D. Giles, B. Catanzaro, Composite Optics, Inc.; M. Maher, Cytec Fiberite, Inc.; G. Ruthven, K. Gottschalck, M. Hackowski, Raytheon Optical Systems, Inc. . . . . [3670-75]

✔Posters—Tuesday

The following posters will be displayed in the formal poster session on Tuesday evening between 6:00 and 7:30 pm in the California Ballroom 5. Poster authors will be able to set up their posters between 8:30 am and 3:00 pm.

✔**Comparison of a few shape memory alloy constitutive models,** V. G. DeGiorgi, Naval Research Lab.; H. Saleem, George Washington Univ. . . . . [3667-78]

✔**Evaluation criteria for THUNDER actuators,** K. Mossi, Face International Corp.; R. C. Smith, H. T. Banks, North Carolina State Univ. . . . . [3667-79]

✔**Wavelets transform for boundary control of smart thin-walled beam cantilever,** V. F. Poterasu, Technical Univ. Iasi (Romania); L. Librescu, Virginia Polytechnic Institute and State Univ. . . . . [3667-80]

✔**Active position control of a shape memory alloy wire actuated composite beam,** G. Song, Univ. of Akron; B. Kelly, B. N. Agrawal, Naval Postgraduate School . . . . . [3667-81]

✔**NiTi behavior under quasi-static thermomechanical loading,** L. Duval, S. Saadat, M. N. Noori, Worcester Polytechnic Institute; H. Davoodi, Univ. of Puerto Rico/Mayaguez; Z. Hou, Worcester Polytechnic Institute . . . [3667-82]

✔**Vibration active control of smart structures incorporating ER actuators and fiber optic vibration sensor based on speckle detection,** J. Leng, A. K. Asundi, Nanyang Technological Univ. (Singapore) . . . . . [3668-89]

✔**System design of distributed modal transducer by adjusting spatial gain distribution,** S. J. Kim, J. S. Hwang, J. Kim, Seoul National Univ. (Korea) . . . . . [3668-90]

✔**Active microvibration control system by pole assignment method using genetic algorithm,** H. Yoshioka, N. Murai, Takenaka Corp. (Japan) . . . . . [3668-91]

✔**Structural testing of fatigued structures,** J. Dual, T. Leutenegger, D. H. Schlums, Swiss Federal Institute of Technology (Switzerland) . . . . . [3668-92]

✔**Flexible low-mass devices and mechanisms actuated by electro-active polymers,** Y. Bar-Cohen, S. P. Leary, Jet Propulsion Lab.; M. Shahinpoor, Univ. of New Mexico; J. O. Simpson, J. Smith, NASA Langley Research Ctr. . . [3669-38]

✔**Polymer electrolyte actuator with gold electrodes,** K. Oguro, N. Fujiwara, K. Asaka, Osaka National Research Institute (Japan); K. Onishi, S. Sewa, Japan Chemical Innovation Institute (Japan) . . . . . [3669-39]

✔**Chemomechanical behaviors of polymer gels by surfactant binding,** T. Narita, J. Gong, Y. Osada, Hokkaido Univ. (Japan) . . . . . [3669-40]

✔**Electro-statically stricted polymers (ESSP),** C. Liu, Univ. of Illinois/Urbana-Champaign; Y. Bar-Cohen, S. P. Leary, Jet Propulsion Lab.; J. O. Simpson, NASA Langley Research Ctr. . . . . [3669-41]

✔**Micro thermal flowsensor for use in microfluidic control system,** H. Cai, Tsinghua Univ. (China) . . . . . [3670-69]

✔**Coupled wave theory of Bragg grating modified for stressed vibrated fiber sensors,** T. V. Tulaikova, Institute for Problems in Mechanics (Russia) . . . . [3670-70]

✔**Sensors based on fiber optical cantilever micromechanical vibrations: grating's registration,** A. L. Popov, T. V. Tulaikova, Institute for Problems in Mechanics (Russia) . . . . . [3670-71]

✔**Optico-electronic collecting and parallel data processing systems for monitoring, measurement, and lifetime prediction of critical components in smart structures and materials,** V. C. Sainov, Bulgarian Academy of Sciences (Bulgaria); A. Irving, Rutherford Appleton Lab. (UK) . . . [3670-72]

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Smart Structures and Materials

Tuesday 2 March 1999

Conference 3671

SESSION 8
Room: Pacific Ballroom B
Tues. 3:40 pm
Damage Detection II

3:40 pm: **Damage assessment in a scaled framed building structure,** J. Ma, D. J. Pines, Univ. of Maryland/College Park . . . . . [3671-32]

4:00 pm: **Damage assessment of bridges with jacketed RC columns using vibration test,** M. Q. Feng, E. Y. Bahng, Univ. of California/Irvine . . . . . [3671-33]

4:20 pm: **Modal testing of a multi-span continuous segmental prestressed concrete bridge,** M. L. Wang, D. Satpathi, P. Dixit, F. Xu, Z. L. Chen, Univ. of Illinois/Chicago . . . . . [3671-34]

4:40 pm: **Structural monitoring by system identification in time domain,** C. G. Koh, C. Y. Liaw, B. Hong, National Univ. of Singapore[3671-35]

5:00 pm: **Stochastic finite element applications in rigid pavement performance,** N. O. Attoh-Okine, Florida International Univ. [3671-36]

5:20 pm: **Vibration characteristics of plate featuring ERF,** W. Yang, J. Leng, Y. Lui, D. Wang, Harbin Institute of Technology (China) . . . . [3671-37]

3671 ends ■

Conference 3672

SESSION 8
Room: Pacific Ballroom E
Tues. 3:40 pm
Absorption

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

3:40 pm: **Finite element modeling and performance estimation of 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) . . . . . [3672-33]

4:00 pm: **Effect of shapes of viscoelastic inserts on vibration absorption in laminated composites,** B. Bhattacharya, G. R. Tomlinson, Univ. of Sheffield (UK); J. R. House, Defence Evaluation and Research Agency (UK) . . . . . [3672-34]

4:20 pm: **Different methods for the derivation of control laws for multi-degrees-of-freedom systems,** J. Moosheimer, LuK GS Buehl (Germany); H. Waller, Ruhr-Univ. Bochum (Germany) . . . . [3672-35]

4:40 pm: **Control of narrowband vibration transmission in beams using tunable inserts,** N. Harland, B. R. Mace, R. W. Jones, Univ. of Auckland (New Zealand) . . . . . [3672-36]

Conference 3673

3:40 pm: **Composite polyelectrolyte self-assembled films for optical biosensors,** A. Nabok, A. K. Ray, A. K. Hassan, R. B. Yates, Z. F. Ghassemlooy, Sheffield Hallam Univ. (UK) . . . . . [3673-29]

SESSION 6
Room: Pacific Ballroom F
Tues. 4:00 pm
Sensors, Interface Electronics, and Controllers

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

4:00 pm: **On-chip circuitry for a CMOS parallel scanning AFM,** C. Hagleitner, D. Lange, ETH Zurich (Switzerland); T. Akiyama, Univ. of Neuchâtel (Switzerland); A. Tonin, Univ. of Basel (Switzerland); R. Vogt, H. Baltes, ETH Zurich (Switzerland) . . . . [3673-30]

4:20 pm: **Distributed arithmetic implementation of multivariable controllers using field programmable gate arrays,** L. Yuan, H. J. Pottinger, V. S. Rao, Univ. of Missouri/Rolla . . . . . [3673-31]

4:40 pm: **Five-port equivalent electric circuit of piezoelectric bimorph beam,** Y. Cho, Hanyang Univ. (Korea); H. M. Jeong, Y. E. Pak, Samsung Advanced Institute of Technology (Korea); S. K. Ha, Hanyang Univ. (Korea) . . . . . [3673-32]

5:00 pm: **Realization of self-diagnosis and sel- calibration strategies using conventional signal processing and fuzzy approach for distributed intelligent sensor systems,** S. S. Rezeki, W. Chan, M. R. Haskard, D. E. Mulcahy, D. E. Davey, Univ. of South Australia . . . . . [3673-33]

5:20 pm: **Fabrication and testing of IDT microsensor for ice detection,** S. Gangadaran, V. K. Varadan, V. V. Varadan, The Pennsylvania State Univ. . . . . [3673-34]

Conference 3674

SESSION 3
Room: Pacific Ballroom C
Tues. 3:40 pm
Enabling Sensor and Health Monitoring Technologies

Chairs: **Jürgen Becker,** Daimler-Benz Aerospace (Germany); **Edward V. White,** Boeing Co.

3:40 pm: **Industrial and commercial applications of optical fiber physical sensors,** J. A. Greene, S. A. Meller, T. A. Wavering, S. H. Poland, W. J. Pulliam, A. C. Furrow, J. L. Elster, M. Petzold, M. E. Jones, F&S, Inc. . . . . [3674-14]

4:00 pm: **Fiber optic distributed sensing systems for harsh aerospace environments,** E. Udd, W. Shulz, J. Seim, M. Morrell, Blue Road Research; T. L. Weaver, Boeing Co.; I. J. Bush, Optiphase, Inc.; G. Adamovsky, NASA Lewis Research Ctr. . . . . [3674-15]

4:20 pm: **Electromagnetically coupled embedded sensors,** K. H. Jung, J. W. Bredow, S. P. Joshi, Univ. of Texas/Arlington . [3674-16]

4:40 pm: **Evolution and outlook for smart health and usage monitoring systems for helicopters and fixed wing aircraft,** R. E. Hayden, BF Goodrich . . . . . [3674-59]

5:00 pm: **Use of remote measurements of structural response to infer and optimize adjustments for balancing a multi-degree of freedom rotor system,** C. S. Ventres, BF Goodrich Aerospace . . . [3674-60]

5:20 pm: **Optimization of mechanical fault detection in helicopter drive trains through use of embedded sensors and pattern recognition techniques,** J. Gottwald, H. Chin, BF Goodrich Specialty Chemical . . . . . [3674-61]

Conference 3675

✔Posters—Tuesday

The following posters will be displayed in the formal poster session on Tuesday evening between 6:00 and 7:30 pm in the California Ballroom 5. Poster authors will be able to set up their posters between 8:30 am and 3:00 pm.

✔**Damping matrix identification and experimental verification,** D. F. Pilkey, G. Park, D. J. Inman, Virginia Polytechnic Institute and State Univ. . . . . [3672-37]

✔**Experimentally measured vibrational response of spinning damped composite fan blades,** J. B. Kosmatka, Univ. of California/San Diego . . . . . [3672-38]

✔**Directional damping material for damped composite plates,** J. M. Biggerstaff, J. B. Kosmatka, Univ. of California/San Diego . . [3672-39]

✔**Shear measurements of viscoelastic damping material concured in composite plates,** J. M. Biggerstaff, J. B. Kosmatka, Univ. of California/San Diego . . . . . [3672-40]

✔**Equations of motion of structures with elastic and viscoelastic components,** J. Escobedo-Torres, Composite Optics Inc.; J. M. Ricles, Lehigh Univ. . . . . [3672-41]

3672 ends ■

✔**Piezocomposite SmartPanels and SmartPads for active control of noise and vibration,** D. Fiore, R. L. Gentilman, R. Torri, J. Glynn, Materials Systems Inc. . [3674-53]

✔**Modeling of a piezomagnetic transducer using commercial finite element code,** R. L. Zrostlik, G. N. Weisensel, D. Tibbs, N. Hammer, ETREMA Products, Inc. . [3674-54]

✔**Predicting actuation efficiency of structurally integrated active materials,** C. L. Davis, T. J. Leeks, D. G. Morris, Boeing Information, Space & Defense Systems[3674-55]

✔**Intelligent manufacturing system for composite materials cure process,** B. Zhang, Harbin Institute of Technology (China) . [3674-56]

✔**Processing and application of solid state converted high strain materials,** K. McNeal, C. D. Near, R. L. Gentilman, Materials Systems, Inc.; M. P. Harmer, H. M. Chan, Lehigh Univ.; V. S. Venkataramani, C. Greskovich, GE Corporate Research and Development Ctr. . . . . [3675-38]

✔**Tunable elastic stiffness of plasma sprayed zirconia coatings,** J. Bamberg, C. Schwaminger, Technical Univ. München (Germany) . . . . . [3675-39]

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Conference 3667

Conference 3668

Conference 3669

Conference 3670

Tuesday 2 March 1999

✔ **Class of quasi-distributed vibration damping and micro-positioning piezoceramic actuators and applications to active damping in machines,** J. Rastegar, SUNY/Stony Brook; F. Khorrami, Polytechnic Univ.; R. Rothchild, V. Pappano, OmniTek Research & Development, Inc. . . . . [3667-83]

✔ **Dynamic behavior of NiTi under cyclic loading,** S. Saadat, L. Duval, M. N. Noori, Worcester Polytechnic Institute; H. Davoodi, Univ. of Puerto Rico/Mayaguez; Z. Hou, Worcester Polytechnic Institute . . . . . [3667-84]

✔ **Wavelet identification in Preisach modeling of hysteresis,** Y. Yu, Z. Xiao, N. G. Naganathan, E. Lin, R. V. Dukkipati, Univ. of Toledo . . . . . [3667-85]

✔ **Modeling of electrodynamic properties control in liquid impregnated porous ferrite media,** A. T. Ponomarenko, N. G. Ryvkina, N. E. Kazantseva, I. A. Tchmutin, V. G. Shevchenko, Institute of Synthetic Polymeric Materials (Russia); I. Catton, V. S. Travkin, Univ. of California/Los Angeles . . . . . [3667-86]

✔ **Inverse problems for determining of piezoelectric and elastic materials loss factor,** N. N. Rogacheva, Institute for Problems in Mechanics (Russia) . . [3667-87]

✔ **Excitation of acoustic surface waves by piezoelectric actuator in elastic half-space,** N. N. Rogacheva, Institute for Problems in Mechanics (Russia) . . [3667-88]

✔ **Analysis and comparison of different applied theories of thin-walled piezoelectric transducers,** N. N. Rogacheva, Institute for Problems in Mechancis (Russia) . . . . . [3667-89]

✔ **Dynamic model reduction for control of molecular beam expitaxy,** D. Kan, Univ. of California/Los Angeles . [3667-90]

✔ **New shape memory alloys composite constitutive relationship,** X. Wu, G. Sun, J. Wu, Shanghai Jiao Tong Univ. (China) . . . . . [3667-91]

✔ **Thermomechanical behavior of shape memory alloy reinforced glass/epoxy composite beam,** G. Sun, X. Wu, J. Wu, Shanghai Jiao Tong Univ. (China) . [3667-92]

✔ **Control of forced vibrations by the help of magnetic field,** G. Y. Bagdasarian, M. A. Mikilian, Yerevan State Univ. (Armenia) . . . . . [3667-93]

✔ **Impact analysis of automotive structures with distributed smart material systems,** S. M. Peelamedu, N. G. Naganathan, Univ. of Toledo; S. J. Buckley, Chrysler Corp. . . . . [3667-94]

✔ **Recovery stresses generated by shape memory wires,** D. Vokoun, R. Stalmans, Katholieke Univ. Leuven (Belgium) . . . . . [3667-95]

✔ **Probabilistic characterization of the performance of actively controlled smart structures,** U. O. Akpan,I. R. Orisamolu, Martec Ltd. (Canada) . . . . . [3667-96]

✔ **Modeling stresses in piezoelectric smart structures under combines thermal and mechanical ecitation,** T. S. Koko, M. J. Smith, I. R. Orisamolu, Martec Ltd. (Canada) . . . . . [3667-97]

✔ **Strength of composite structures with embedded piezoceramic actuators,** J. K. Dürr, Daimler-Benz Aerospace Dornier (Germany); J. Haas, Univ. Stuttgart (Germany); U. Herold-Schmidt, H. W. Zaglauer, Daimler-Benz Aerospace Dornier (Germany); F. J. Arendts, Univ. Stuttgart (Germany) [3668-93]

✔ **Design of constraints for an Euler beam subject to a moving mass using space-time finite elements,** E. Kathe, U.S. Army Benet Labs. . . . . [3668-94]

✔ **Enhanced pointing of telescopes by smart structure concepts based on modal observers,** H. J. Kaercher, MAN Technologie (Germany) . . . . . [3668-95]

✔ **Actuator-based vibration control using position feedback,** D. R. Smith, J. P. D'Angelo, Univ. of Massachusetts/Lowell; K. R. Lee, NASA Goddard Space Flight Ctr.; R. Sturmfels, Univ. of Wisconsin/ Madison . . . . . [3668-96]

✔ **High precision and stability structures for particle detectors,** R. F. Ribeiro, S. da Mota Silva, C. Hauviller, Ctr. for European Nuclear Research (Switzerland) . . . . . [3668-97]

✔ **Towards realization of a smart polarimetric sensor,** V. M. Murukeshan, P. Y. Chan, O. L. Seng, A. K. Asundi, Nanyang Technological Univ. (Singapore) . . . . . [3668-98]

✔ **Active control of structural buckling instability: practical tradeoffs and design considerations,** A. A. Berlin, J. G. Chase, M. H. Yim, Xerox Palo Alto Research Ctr. . . . . [3668-99]

✔ **Finite element simulation and optimization of piezoelectric suspensions,** Z. He, W. Guo, Q. Li, E. Ong, T. Huang, Data Storage Institute (Singapore) . . [3668-100]

✔ **Electro-active polymer materials for solid polymer fuel cells,** K. J. Kim, M. Shahinpoor, A. Razani, Univ. of New Mexico . . [3669-42]

✔ **Effect of the surface-electrode resistance on the actuation of the ionic polymer-metal composite's (IPMCs) artificial muscles,** K. J. Kim, M. Shahinpoor, Univ. of New Mexico . . . . . [3669-43]

✔ **Gel-electrolyte with polysaccharide polymers and its battery applications,** H. Yoshida, F. Takei, Fujitsu Labs. Ltd. (Japan) . . . . . [3669-44]

✔ **Use of ionic polymer-metal composites (IPMC) as a pressure transducer in the human spine,** J. W. Lantz, L. Ferrara, H. Schreyer, A. Keshavarzi, M. Shahinpoor, Univ. of New Mexico . . [3669-45]

✔ **Polymer ceramic composite which mimics bone formation,** C. M. Dry, Univ. of Illinois/Urbana-Champaign . . . . . [3669-46]

✔ **Muscles and artificial muscles: electrochemically stimulated conformational relaxation model,** T. F. Otero, H. Grande, I. Cantero, J. M. Sansiñena, Univ. del País Vasco (Spain) . . . . . [3669-47]

3669 ends ■

✔ **Progress toward an orthogonal strain sensor-based optical fiber technology,** X. D. Jin, T. Rossmanith, J. S. Sirkis, Univ. of Maryland/College Park; V. Venkat, Analytical Services & Materials, Inc. . . . . [3670-73]

✔ **Characterization of fiber Bragg grating-based palladium tube hydrogen sensors,** Y. Tang, T. Peng, J. S. Sirkis, Univ. of Maryland/ College Park; B. A. Childers, J. P. Moore, L. D. Melvin, NASA Langley Research Ctr. . . [3670-74]

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About the Smart Structures and Materials Technical Group

Research in Smart Structures and Materials is one of the most challenging and exciting activities to be involved in today. The highly interdisciplinary nature of this new field of endeavor, located at the intersection of a number of different technical disciplines, has room for significant contributions at all levels of experience, since it is new to all. The search to create new active structures and materials that cost less than their passive counterparts and yet perform better, offers a wonderful opportunity for students to participate at the beginning of a new field while letting experts grow beyond the boundaries of their established disciplines.

This multidisciplinary technical group covers the field of smart structures and materials from enabling technologies such as materials, sensing, actuation and adaptive computational techniques through integrated structural systems to final applications. Research in smart structures and materials attempts to apply the optimized designs and functionalities found in the biological world to non-biologically based structures. Much exciting work has been done and much remains. We invite you to join us as an active participant. There is much to learn and much to do.

Chair: **William B. Spillman, Jr.,**
BFGoodrich Aerospace
wspillma@aisvt.bfg.com

Vice-Chair: **Inderjit Chopra,**
University of Maryland
chopra@eng.umd.edu

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Wednesday, 3 March
5:30 pm and 6:00 pm

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Awards

Wednesday 3 March
8 to 8:10 am
Pacific Ballroom C/D

Smart Structures & Materials Achievement Award

Smart Structures Product Implementation Award

Smart Structures & Materials Best Paper Award

See page 51 for more information.

Conference 3667

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Conference 3670

Wednesday 3 March 1999

Plenary Presentation

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

Smart Structures and Materials in Japan

Speaker: **Dr. Yuji Matsuzaki,** Nagoya Univ. (Japan)

Coffee/Exhibit Break . . . . . 8:45 to 9:20 am

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

Piezoelectric Laminates

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

9:20 am: **Shaping of distributed piezoelectric sensors for flexural vibrations of smart beams,** H. Irschik, M. Krommer, U. Pichler, Johannes Kepler Univ. Linz (Austria) [3667-40]

9:40 am: **Numerical model for the optimal design of composite laminated structures with piezoelectric laminae,** V. M. F. Correia, Escola Nautica Infante D. Henrique (Portugal); C. M. Soares, C. A. Soares, Instituto Superior Tecnico (Portugal) . . . . . [3667-41]

10:00 am: **Detailed study of electromechanical fields in smart laminates during closed loop control,** S. V. Gopinathan, V. V. Varadan, V. K. Varadan, The Pennsylvania State Univ. . . . . [3667-42]

10:20 am: **Mixed multi-field finite element formulation for thermopiezoelectric composite shells,** H. Lee, D. A. Saravanos, NASA Lewis Research Ctr. . . . . [3667-43]

SESSION 10
Room: Newport Ballroom North
Wed.10:40 am

Vibration Control

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

10:40 am: **Performance limitations in the control of helicopter vibration,** P. Konstanzer, B. Kroeplin, Univ. of Stuttgart (Germany) . . . . [3667-44]

11:00 am: **Vibration feedback control of adaptive composite cantilevers featuring imperfect bonding interfaces and subjected to thermomechanical loading,** U. Icardi, M. Di Sciuva, Politecnico di Torino (Italy); L. Librescu, Virginia Polytechnic Institute and State Univ. . . . . [3667-45]

11:20 am: **Flexural vibrations of piezolaminated slender beams: a balanced model,** H. Abramovich, Technion—Israel Institute of Technology (Israel) . . . . . [3667-46]

11:40 am: **Collocated sensing and actuation for optimal vibration control of adaptive anisotropic thin-walled beams,** O. Song, J. B. Kim, Chungnam National Univ. (Korea); L. Librescu, Virginia Polytechnic Institute and State Univ. . . . . [3667-47]

Noon: **Optimal vibration control of adaptive aircraft wings carrying externally mounted stores and exposed to blast loadings,** S. Na, Korea Polytechnic Univ. (Korea); L. Librescu, Virginia Polytechnic Institute and State Univ. . . . . [3667-48]

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

SESSION 9
Room: Pacific Ballroom D
Wed. 9:20 am

Magnetostriction II

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

9:20 am: **Active vibration control of a compliant structure using a magnetostrictive transducer,** R. L. Zrostlik, A. B. Flatau, Iowa State Univ.; R. C. Smith, North Carolina State Univ. . . . . [3668-37]

9:40 am: **Using magnetostrictive actuators for damage analysis experiences,** E. Monaco, F. Franco, L. Lecce, Univ. di Napoli (Italy) . . . . . [3668-38]

10:00 am: **Coupled structural-magnetic strain model for magnetostrictive transducers,** M. J. Dapino, Iowa State Univ.; R. C. Smith, North Carolina State Univ.; A. B. Flatau, Iowa State Univ. . . . . [3668-39]

10:20 am: **Development of novel magnetic field monolithic sensors with standard CMOS compatible MEMS technology,** S. Baglio, Univ. di Catania (Italy); L. Latorre, P. Nouet, Univ. Montpellier II (France) . . . . . [3668-40]

SESSION 10
Room: Pacific Ballroom D
Wed.10:40 am

Space Applications

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

10:40 am: **Force and strain feedback for distributed actuation,** A. Makarenko, E. F. Crawley, Massachusetts Institute of Technology . . . . . [3668-41]

11:00 am: **Tuning of active vibration controllers for ACTEX by genetic algorithm,** M. K. Kwak, Dongguk Univ. (Korea); K. K. Denoyer, Air Force Research Lab. . . . . [3668-42]

11:20 am: **Active structural-acoustic control for composite payload fairings,** R. M. Glaese, E. H. Anderson, CSA Engineering, Inc. . . . . [3668-43]

11:40 am: **Control of the ultraLITE precision deployable test article using adaptive spatio-temporal filtering based control,** K. K. Denoyer, S. F. Griffin, Air Force Research Lab.; A. B. Bosse, Sheet Dynamics, Ltd.[3668-44]

Lunch/Exhibit Break Noon to 1:30 pm

SESSION 7
Room: Schooner
Wed. 9:20 am

Embedded Sensors II

Chairs: **William B. Spillman, Jr.,** BF Goodrich Aerospace; **Dryver R. Huston,** Univ. of Vermont

9:20 am: **Detection of transverse cracks by embedded plastic optical fiber in FRP laminates,** N. Takeda, T. Kosaka, T. Ichiyama, Univ. of Tokyo (Japan) . . . . . [3670-37]

9:40 am: **Recent developments in the use of plastic optical fiber for an embedded wear sensor,** E. I. Cohen, J. Korczynski, W. C. Jones, A. Jarrett, S. Mastro, Naval Surface Warfare Ctr.; C. P. Nemarich, GEO-CENTERS Inc. . . . . [3670-38]

10:00 am: **Dynamic response in carbon fiber composite material,** J. I. Santos, A. J. Varo, J. A. Souto, H. Lamela, Univ. Carlos III de Madrid (Spain); E. del Olmo, A. Jimenez, C.A.S.A. (Spain) . . . . . [3670-39]

10:20 am: **Investigations into an embedded probe for hazardous material shelf life monitoring,** G. A. Gordon, The Pennsylvania State Univ. . . . . [3670-40]

10:40 am: **Embedded fiber optic sensor arrays for structural health monitoring of filament wound composite pressure vessels,** R. Foedinger, D. Rea, Technology Development Associates, Inc.; J. S. Sirkis, J. Troll, Univ. of Maryland/College Park; R. Grande, C. Davis, Carleton Technologies Inc.; T. L. Vandiver, U.S. Army Aviation and Missile Command . . . . . [3670-41]

SESSION 8
Room: Schooner
Wed.11:00 am

Distributed and Multiplexed Sensors I

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

11:00 am: **Coherence addressing of quasi-distributed absorption sensors by the FMCW method,** M. Zavrsnik, Univ. of Maribor (Slovenia); G. Stewart, Univ. of Strathclyde (UK) . . . . . [3670-42]

11:20 am: **Distributed optical fiber based damage detection in composites,** I. P. Giles, M. Mondanos, ProtoDel International Ltd. (UK); R. A. Badcock, P. A. Lloyd, Defence Evaluation and Research Agency Farnborough (UK) . . . . . [3670-43]

11:40 am: **Novel interrogation system for multiplexed fiber Fabry-Perot etalons for strain metrology,** M. Singh, C. J. Tuck, G. F. Fernando, Cranfield Univ. (UK) . . . . [3670-44]

Lunch/Exhibit Break Noon to 1:30 pm

Conference 3673

Conference 3674

Conference 3675

Wednesday 3 March 1999

Plenary Presentation

Pacific Ballroom C/D . . . . . **8:00 to 8:45 am**

Smart Structures and Materials in Japan

Speaker: **Dr. Yuji Matsuzaki,** Nagoya Univ. (Japan)

Coffee/Exhibit Break . . . . . 8:45 to 9:20 am

Keynote Address
Pacific Ballroom F
Wed. 9:20

Multiparameter MEMS Sensor Networks for Smart Structures, Stephen C. Jacobsen, Brian J. Maclean, Univ. of Utah; Mark R. Whittaker, Marc Olivier, Sarcos Research Corp.; Mike G. Mladejovsky, Univ. of Utah . . . . . [3673-36]

Invited Paper
Pacific Ballroom F

10:00 am: **"Smart Tongue" and "Electronic Noise" and their applications,** V. K. Varadan, The Pennsylvania State Univ.; J. W. Gardner, Univ. of Warwick (UK) . . . . . [3673-37]

SESSION 7
Room: Pacific Ballroom F
Wed.10:30 am

Chemical Sensors and Electronic Noise

Chairs: **Julian W. Gardner,** Univ. of Warwick (UK); **Vijay K. Varadan,** The Pennsylvania State Univ.

10:30 am: **Conducting polymer FET devices for vapor sensing,** J. W. Gardner, J. Covington, Univ. of Warwick (UK); J. V. Hatfield, Univ. of Manchester/Institute of Science & Technology (UK) . . . . . [3673-38]

10:50 am: **Discrimination of volatile organic compounds using CMOS capacitive chemical microsensors with thickness adjusted polymer coating,** A. Koll, A. Kummer, O. Brand, H. Baltes, ETH Zurich (Switzerland) . . . . . [3673-39]

11:10 am: **Chemical sensors for the detection of organic polutants,** A. K. Hassan, M. V. Molina, A. K. Ray, A. Nabok, Z. F. Ghassemlooy, R. B. Yates, R. Saatchi, Sheffield Hallam Univ. (UK) . . . . . [3673-40]

11:30 am: **Smart structures for the detection of environmental pollution,** T. Wilkop, R. B. Yates, A. K. Ray, A. K. Hassan, Sheffield Hallam Univ. (UK) . . . . . [3673-41]

Lunch/
Exhibit Break . 11:50 am to 1:30 pm

SESSION 4
Room: Pacific Ballroom C
Wed. 9:20 am

Enabling Actuator Technologies

Chairs: **Douglas K. Lindner,** Virginia Polytechnic Institute and State Univ.; **Robert Clifford,** ETREMA Products, Inc.

9:20 am: **Shape memory alloy consortium and actuators,** A. D. Jacot, Boeing Information, Defense & Space Systems . . . . . [3674-18]

9:40 am: **Active fiber composite material systems for structural control applications,** A. A. Bent, Continuum Control Corp. [3674-19]

10:00 am: **Feasibility study of using shunted piezoelectrics to reduce aeroelastic response,** A. R. McGowan, NASA Langley Research Ctr. . . . . [3674-20]

10:20 am: **Active piezoceramic-driven flexure actuator,** C. T. Wood, W. W. Clark, Univ. of Pittsburgh; G. C. Horner, NASA Langley Research Ctr. . . . . [3674-21]

10:40 am: **Linear traveling wave motor,** C. Hyder, W. W. Clark, Univ. of Pittsburgh; G. C. Horner, NASA Langley Research Ctr. . . . [3674-22]

11:00 am: **High-authority telescoping actuators,** C. C. Wu, D. Lewis III, Naval Research Lab.; M. Kahn, M. T. Chase, Potomac Research International . . . . . [3674-23]

11:20 am: **Precision cryogenic magnetostrictive actuator using a persistant high-temperature superconduction magnet,** C. Horner, NASA Langley Research Ctr.; L. Bromberg, Massachusetts Institute of Technology; J. P. Teter, Naval Surface Warfare Ctr. . . . . [3674-24]

11:40 am: **Piezoelectric synthetic jets for aircraft control surfaces,** R. G. Bryant, J. T. Lachowicz, R. L. Fox, NASA Langley Research Ctr.[3674-25]

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

SESSION 1
Room: Pacific Ballroom E
Wed. 9:20 am

Materials for Piezoelectric Actuators and Sensors I

Chair: **Manfred Wuttig,** Univ. of Maryland/College Park

9:20 am: **Crystallographic engineering in high-performance piezoelectric crystals** *(Invited Paper),* S. E. Park, Ctr. for Medical Ultrasonic Transducer Engineering/The Pennsylvania State Univ. [3675-01]

10:00 am: **Magnetic particle doping for anisotropic matrix materials in active fiber composites,** B. Z. Janos, N. W. Hagood, Massachusetts Institute of Technology . . [3675-02]

10:20 am: **PZT active fibers: a commercial production process,** H. B. Strock, M. R. Pascucci, M. V. Parish, CeraNova Corp.; A. A. Bent, Continuum Control Corp.; T. R. Shrout, The Pennsylvania State Univ. . . . . [3675-03]

10:40 am: **PZT/polymer flexible composites for embedded actuator and sensor applications,** W. Kowbel, X. Xia, J. C. Withers, Materials and Electrochemical Research Corp.; B. K. Wada, Jet Propulsion Lab. [3675-04]

11:00 am: **Characterization of differing types of high-performance THUNDER actuators and sensors,** K. Mossi, R. Bishop, Face International Corp. . . . . [3675-05]

11:20 am: **Piezoelectric ceramic assembly tubes for torsional actuators,** C. Kim, Naval Research Lab.; A. E. Glazounov, The Pennsylvania State Univ.; L. Flippen, A. Pattnaik, Naval Research Lab.; Q. Zhang, The Pennsylvania State Univ.; D. Lewis III, Naval Research Lab. . . . . [3675-06]

11:40 am: **Experimental study of THUNDER: a new generation of piezoelectric actuators,** C. Shakeri, Worcester Polytechnic Institute; C. M. Bordonaro, Jamesbury Corp.; M. N. Noori, Worcester Polytechnic Institute . . . . . [3675-07]

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

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Wednesday 3 March 1999

Conference 3667

SESSION 11
Room: Newport Ballroom North
Wed. 1:30 pm

Noise Control

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

1:30 pm: **Matrix method for analyzing structural-acoustic power efficiency,** R. Cao, Univ. of Toledo; D. J. Leo, Virginia Polytechnic Institute & State Univ. . . . . [3667-49]

1:50 pm: **Modeling of piezoelectric smart structures including absorbing materials for cabin noise problems,** J. Kim, J. Lee, B. Im, C. Chung, Inha Univ. (Korea) . . . . . [3667-50]

2:10 pm: **Modeling and control of sound transmitted into a cavity through a composite plate with piezoelectric actuators using coupled FE/BE methods,** C. Mei, Old Dominion Univ.; Y. Shi, Analytical Services & Materials, Inc. [3667-51]

2:30 pm: **Compact, inexpensive, robust analog controllers for cabin noise control,** K. Ramanathan, W. Chang, V. V. Varadan, V. K. Varadan, The Pennsylvania State Univ. . . . . [3667-52]

2:50 pm: **Active control of the sound transmission through plate by the multiple adaptive feedforward with feedback control algorithm,** Y. Kim, I. Kim, C. Lee, C. Y. Moon, Kumoh National Univ. of Technology (Korea) . . . . . [3667-53]

Coffee/Exhibit Break 3:10 to 3:40 pm

Conference 3668

SESSION 11
Room: Pacific Ballroom D
Wed. 1:30 pm

ER/MR Fluids and Devices

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

1:30 pm: **Parametric analysis and testing of an electrorheological fluid damper,** J. E. Lindler, N. M. Wereley, Univ. of Maryland/College Park . . . . . [3668-45]

1:50 pm: **Position control of a cylinder system using ER valve actuators,** S. B. Choi, D. W. Park, M. S. Cho, C. C. Cheong, Inha Univ. (Korea) . . . . . [3668-46]

2:10 pm: **Thermal equilibrium in a dynamic electrorheological fluid model of a high-speed traversing/positioning mechanism,** A. R. Johnson, W. A. Bullough, J. Makin, Univ. of Sheffield (UK) . . [3668-47]

2:30 pm: **Characterization of a magnetorheological fluid damper using a quasi-steady model,** R. Snyder, N. M. Wereley, Univ. of Maryland/College Park . . [3668-48]

2:50 pm: **Vibration isolation using a magnetorheological damper in the squeeze-flow mode,** R. Stanway, N. Sims, A. R. Johnson, Univ. of Sheffield (UK) . . . . . [3668-49]

Coffee/Exhibit Break 3:10 to 3:40 pm

Conference 3670

SESSION 9
Room: Schooner
Wed. 1:30 pm

Distributed and Multiplexed Sensors II

Chairs: **Brian Culshaw,** Univ. of Strathclyde (UK); **William B. Spillman, Jr.,** BF Goodrich Aerospace

1:30 pm: **DFB fiber laser sensor for simultaneous strain and temperature measurements in concrete structures,** O. Hadeler, J. P. Dakin, D. Lillistone, M. Lovegrove, Univ. of Southampton (UK) . . . . . [3670-45]

1:50 pm: **Sensory and calibration issues associated with Brillouin optical time domain reflectometry measurements in wound optical fibers,** S. J. Burgett, P. B. Ruffin, U.S. Army Aviation and Missile Command; R. L. Light, Morgan Research Corp. . . . . [3670-46]

2:10 pm: **Bragg grating-based multiplexed Fabry-Perot sensor system for acoustic measurements,** C. S. Baldwin, J. S. Sirkis, Univ. of Maryland/College Park . . [3670-47]

2:30 pm: **Brillouin scattering-based strain sensing,** M. D. DeMerchant, A. W. Brown, X. Bao, T. W. Bremner, Univ. of New Brunswick (Canada) . . . . . [3670-48]

2:50 pm: **Precision of a Brillouin scattering-based distributed strain sensor,** A. W. Brown, M. D. DeMerchant, X. Bao, T. W. Bremner, Univ. of New Brunswick (Canada) . . . . . [3670-49]

Coffee/Exhibit Break 3:10 to 3:40 pm

Smart Structures and Materials

Wednesday 3 March 1999

Conference 3673

Invited Paper
Pacific Ballroom F

1:30 pm: **Integrated MEMS-based IQ intelligent tire applications,** W. F. Dunn, Goodyear Tire and Rubber Co. . . . . [3673-42]

SESSION 8
Room: Pacific Ballroom F
Wed. 2:00 pm

Health Monitoring

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

2:00 pm: **Embedded cure monitor and strain gauge,** J. Dubow, W. Zhang, Y. Lu, J. Bingham, Univ. of Utah; D. G. Krantz, MTS Systems Corp.; J. H. Belk, Boeing Co.; P. Biermann, Johns Hopkins Univ.; R. Harjani, S. C. Mantell, D. L. Polla, Univ. of Minnesota/Twin Cities; P. R. Troyk, Illinois Institute of Technology . . . . . [3673-43]

2:20 pm: **Microsensors for health monitoring of smart structures,** V. Srivatsan, V. S. Rao, H. J. Pottinger, Univ. of Missouri/Rolla . . [3673-44]

2:40 pm: **Microsensors and smart systems for in-flight health monitoring of aircraft structures,** V. K. Varadan, V. V. Varadan, The Pennsylvania State Univ. [3673-45]

3:00 pm: **Micro-machined ultrasonic transducers for damage detection in CFRP composites,** R. A. Noble, A. R. D. Jones, R. J. Bozeat, Defence Evaluation and Research Agency Malvern (UK); D. A. Hutchins, Univ. of Warwick (UK) . . . . . [3673-46]

3673 ends ■

Conference 3674

SESSION 5
Room: Pacific Ballroom C
Wed. 1:30 pm

Smart Wing Program

Chairs: **Anna-Maria R. McGowan,** NASA Langley Research Ctr.; **Jayanth N. Kudva,** Northrop Grumman Corp.

1:30 pm: **Overview of the DARPA/AFRL/NASA Smart Wing program,** J. N. Kudva, C. A. Martin, L. B. Scherer, A. P. Jardine, Northrop Grumman Corp.; B. P. Sanders, Air Force Office of Scientific Research; G. P. Sendeckyj, Air Force Research Lab.; A. R. McGowan, R. C. Lake, NASA Langley Research Ctr. . . . [3674-26]

1:50 pm: **Design and fabrication of Smart Wing model and SMA control surfaces,** C. A. Martin, J. Bartley-Cho, J. Flanagan, Northrop Grumman Corp.; B. F. Carpenter, Lockheed Martin Astronautics . . . . [3674-27]

2:10 pm: **DARPA/ARFL/NASA Smart Wing second wind tunnel test results,** C. A. Martin, L. B. Scherer, Northrop Grumman Corp.; M. N. West, Mission Research Corp.; J. Florance, C. Wieseman, A. W. Burner, G. A. Fleming, NASA Langley Research Ctr. . . . . [3674-28]

2:30 pm: **Improved design and performance of the SMA torque tube for the DARPA/AFRL/NASA Smart Wing program,** A. P. Jardine, J. Bartley-Cho, J. Flanagan, Northrop Grumman Corp. . . . . [3674-29]

2:50 pm: **Smart TERFENOL-D powered trailing-edge development,** F. Austin, T. Schultheiss, M. J. Siclari, M. Kesselman, C. Y. Huang, Northrop Grumman Corp.; G. N. Weisensel, ETREMA Products, Inc. . . [3674-30]

Coffee/Exhibit Break 3:10 to 3:40 pm

Conference 3675

SESSION 2
Room: Pacific Ballroom E
Wed. 1:30 pm

Materials for Piezoelectric Actuators and Sensors II

Chair: **Seung Eek Park,** The Pennsylvania State Univ.

1:30 pm: **Electrostatic self-assembly processes for multilayer optical filters,** K. M. Lenahan, Y. Liu, R. O. Claus, Virginia Polytechnic Institute and State Univ. . . . . [3675-08]

1:50 pm: **Domain structure of ferroelectric PZT films,** C. E. Zybill, H. Boubekeur, M. Schwartzkopff, F. Koch, Technical Univ. München (Germany); G. Groos, B. Rezek, Walter Schottky Institute (Germany); R. Bruchhaus, W. Wersing, Siemens AG (Germany) . . . . . [3675-09]

2:10 pm: **Formation and observation of ferroelectric domains in $PbZr_{1-x}Ti_xO_3$(PZT) thin films using atomic force microscopy,** H. Shin, K. Lee, G. Lim, J. U. Jeon, Y. E. Pak, Samsung Advanced Institute of Technology (Korea); S. Hong, K. No, Korea Advanced Institute of Science and Technology (Korea) . [3675-10]

SESSION 3
Room: Pacific Ballroom E
Wed. 2:30 pm

Self-assembled Material

Chair: **Richard O. Claus,** Virginia Polytechnic Institute and State Univ.

2:30 pm: **Electrostatic self-assembly processes for noncentrosymmetric thin films and devices,** K. M. Lenahan, Y. Liu, Y. X. Wang, R. O. Claus, Virginia Polytechnic Institute and State Univ. . . . . [3675-11]

2:50 pm: **Formation of ultrahard metal oxide nanocluster coatings at room temperature by electrostatic self-assembly,** Y. Liu, A. Rosidian, R. O. Claus, Virginia Polytechnic Institute and State Univ. . [3675-12]

Coffee/Exhibit Break 3:10 to 3:40 pm

Conference 3667

Conference 3668

Conference 3670

Wednesday 3 March 1999

Panel Discussion
Room: Newport Ballroom North
Wed. 3:40 to 5:30 pm

Challenges in Modeling Smart Materials and Structures

Panelists: **H. Thomas Banks,** North Carolina State Univ.; **Ulrich Gabbert,** Univ. Magdeburg (Germany); **Qing Jiang,** Univ. of California/Riverside; **Dimitris C. Lagoudas,** Texas A&M Univ.; **Robert E. Skelton,** Univ. of California/San Diego . [3667-300]

SESSION 12
Room: Pacific Ballroom D
Wed. 3:40 pm

Piezoelectric Actuation Systems

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

3:40 pm: **Fundamental understanding of piezoelectric strain sensors,** J. Sirohi, I. Chopra, Univ. of Maryland/College Park . . . . . [3668-50]

4:00 pm: **Structural control using nonlinear piezoelectric actuation at high electrical fields,** J. Tang, K. W. Wang, The Pennsylvania State Univ. . . . . [3668-51]

4:20 pm: **Nonlinear finite element modeling of THUNDER piezoelectric actuators,** B. K. Taleghani, Army Research Lab. . . . . [3668-52]

4:40 pm: **Control of flexural wave transmission through struts,** D. Ortel, Lockheed Martin Technical Operations Co.; B. Balachandran, Univ. of Maryland/College Park . . . . . [3668-53]

5:00 pm: **Monolithic piezoelectric actuators and sensors with interdigital electrodes (IDE),** S. Yoshikawa, M. Farrell, E. Saarmaa, Active Control eXperts, Inc. . . . . [3668-54]

5:20 pm: **Electro-mechanical characterization of stack actuators,** M. Mitrovic, G. P. Carman, Univ. of California/Los Angeles . . [3668-101]

3:40 pm: **Simultaneous strain and temperature measurement using a Brillouin scattering-based distributed sensor,** J. Smith, X. Bao, M. D. DeMerchant, Univ. of New Brunswick (Canada) . . . . . [3670-50]

4:00 pm: **Novel distributed fiber optic microbend sensors structure based on dispersion addressing,** D. Donlagic, Univ. of Maribor (Slovenia); B. Culshaw, Univ. of Strathclyde (UK); B. Pezdirc, Fontona D.D. (Slovenia) . . . . . [3670-51]

4:20 pm: **Network configuration of the distributed sensor array consisting of discrete sensors,** Y. Wen, P. Li, S. Huang, Chongqing Univ. (China) . . . . . [3670-52]

4:40 pm: **Multiplexed fiber optic strain sensor system,** M. R. Sayeh, L. Gupta, D. Kagaris, R. Viswanathan, Southern Illinois Univ./Carbondale . . . . . [3670-53]

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Wednesday 3 March 1999

Conference 3674

SESSION 6
Room: Pacific Ballroom C
Wed. 3:40 pm

Enabling Manufacturing and Electronic Technologies

Chairs: **Craig D. Near,** Materials Systems Inc.; **William W. Clark,** Univ. of Pittsburgh

3:40 pm: **Magnetostrictive pressure device for thermoplastic fiber placement process,** M. Ahrens, V. Mallick, ABB Corporate Research (Switzerland) . . . . . [3674-31]

4:00 pm: **Injection molded piezoelectric actuators,** C. D. Near, G. Schmidt, K. McNeal, R. L. Gentilman, Materials Systems Inc. . . . . [3674-32]

4:20 pm: **High-voltage switching piezo drive amplifier,** D. J. Clingman, M. Gamble, Boeing Information, Space & Defense Systems [3674-17]

4:40 pm: **Embedding piezoelectric actuators for high-strain applications,** R. C. Hardy, W. K. Belvin, NASA Langley Research Ctr.; D. J. Inman, Virginia Polytechnic Institute and State Univ. . . . . [3674-33]

5:00 pm: **Adaptive input shaping for precision stage systems,** D. Hamilton, G. Sullivan, D. R. Huston, Univ. of Vermont . . . . . [3674-34]

5:20 pm: **Experimental investigation on the effect of environmental stress on active fiber composite actuators,** D. G. Morris, Boeing Information, Space & Defense Systems; A. Pizzochero, N. W. Hagood, Massachusetts Institute of Technology . . . . . [3674-57]

Conference 3675

3:40 pm: **Electrostatic self-assembled metal nanocluster thin films with bulk material conductivity,** Y. Liu, R. O. Claus, Virginia Polytechnic Institute and State Univ. . [3675-13]

4:00 pm: **Ultracapacitors formed by molecular self-assembly,** A. Rosidian, Y. Liu, W. Zhao, R. O. Claus, Virginia Polytechnic Institute and State Univ. . . . . [3675-14]

SESSION 4
Room: Pacific Ballroom E
Wed. 4:20 pm

Polymeric and Other Materials I

Chair: **Manfred Wuttig,** Univ. of Maryland/College Park

4:20 pm: **Use of embedded self-repair adhesives in certain areas of concrete bridge members to prevent failure from severe dynamic loading,** C. M. Dry, J. Unzicker, Univ. of Illinois/Urbana-Champaign [3675-15]

4:40 pm: **Magnetorheological elastomers: properties and applications,** J. M. Ginder, M. E. Nichols, L. D. Elie, J. L. Tardiff, Ford Motor Co. . . . . [3675-16]

5:00 pm: **Conducting polymer composite materials for smart microwave windows,** A. Barnes, K. Lees, P. V. Wright, B. Chambers, Univ. of Sheffield (UK) . . [3675-17]

5:20 pm: **New multicomponent oxide materials for thin film gas sensors,** T. Miyata, T. Minami, Kanazawa Institute of Technology (Japan) . . . . . [3675-40]

SPIE's 6th Annual International Symposium on

Conference 3667 | Conference 3668 | Conference 3670

Thursday 4 March 1999

Plenary Presentation

Pacific Ballroom C/D . . . . . **8:00 to 8:45 am**

Micro-Air Vehicles

Speaker: **Dr. James McMichael,** DARPA

Coffee Break . . . . . 8:45 to 9:20 am

Session 13A and Session 13B are concurrent

SESSION 13
Room: Newport Ballroom North
Thurs. 9:20 am

Shape Memory Alloys II

Chair: **Victor Birman,** Univ. of Missouri/Rolla

9:20 am: **Damping of rod vibrations caused by impact,** E. R. Oberaigner, Univ. for Mining and Metallurgy (Austria); K. Tanaka, Tokyo Metropolitan Institute of Technology (Japan); F. D. Fischer, Univ. for Mining and Metallurgy (Austria) . [3667-54]

9:40 am: **Stiffness of smart composites with shape memory alloy fibers in the presence of matrix cracks,** V. Birman, Univ. of Missouri/Rolla . . . . . [3667-55]

10:00 am: **Simulation and control of SMA actuators,** N. Papenfuss, S. Seelecke, Technische Univ. Berlin (Germany) . . . . . [3667-56]

10:20 am: **Mesomechanical modeling of shape memory effect,** D. Vokoun, V. Kafka, Institute of Theoretical and Applied Mechanics (Czech Republic) . . . . . [3667-57]

SESSION 13A
Room: Pacific Ballroom D
Thurs. 9:20 am

Shape Memory Alloys

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

9:20 am: **Experimental characterization of Ni-Ti shape memory alloy wires under complex loading conditions,** H. Prahlad, I. Chopra, Univ. of Maryland/College Park . . . . . [3668-55]

9:40 am: **Thin film NiTi shape memory alloy,** J. E. Favelukis, K. K. Ho, G. P. Carman, Univ. of California/Los Angeles . . . . . [3668-56]

10:00 am: **Passive-adaptive vibration absorbers using shape memory alloys,** K. A. Williams, G. T. Chiu, R. Bernhard, Purdue Univ. . [3668-57]

10:20 am: **Development of a spined underwater biomimetic vehicle with SMA muscles,** O. K. Rediniotis, D. C. Lagoudas, L. Wilson, L. J. Garner, Texas A&M Univ. . . . . [3668-58]

SESSION 13B
Room: Pacific Ballroom F
Thurs. 9:20 am

Manufacturing Issues

Chair: **Andrew R. Johnson,** Univ. of Sheffield (UK)

9:20 am: **Piezoelectrical wire feeding system for micropositioning in bonding machines,** A. Henke, M. A. Kuemmel, J. Wallaschek, Paderborn Univ. (Germany) . . . . . [3668-59]

9:40 am: **Mechanical impedance measurements for improved cost effective process monitoring,** C. R. Clopêt, Defence Evaluation and Research Agency and Brunel Univ. (UK); D. A. Pullen, R. A. Badcock, Defence Evaluation and Research Agency (UK); G. F. Fernando, B. Ralph, Brunel Univ. (UK) [3668-60]

10:00 am: **Influence of bonding on the efficiency of piezoceramic patches as actuators in smart structures,** W. Seemann, Univ. Kaiserslautern (Germany); T. Sattel, Technical Univ. Darmstadt (Germany) . . . . . [3668-61]

10:20 am: **Application of electrically conductive thermoplastic adhesive film for design and manufacturing of smart structures,** A. Javidinejad, S. P. Joshi, P. S. Shiakolas, Univ. of Texas/Arlington . . . . . [3668-62]

SESSION 10
Room: Schooner
Thurs. 9:20 am

Acoustic Health Monitoring Sensors

Chairs: **Jeffrey N. Schoess,** Honeywell Technology Ctr.; **Peter D. Dean,** Lockheed Martin Missiles & Space

9:20 am: **Fault monitoring using acoustic emissions,** D. Zhang, G. Venkatesan, M. Kaveh, A. H. Tewfik, Univ. of Minnesota; K. M. Buckley, Villanova Univ. [3670-54]

9:40 am: **Lamb wave sensing for composite materials evaluation,** S. G. Pierce, B. Culshaw, Univ. of Strathclyde (UK) . . . . . [3670-55]

10:00 am: **Acoustic fault injection tool (AFIT),** J. N. Schoess, Honeywell Technology Ctr. . . . . [3670-56]

10:20 am: **CH-46 rotor head acoustic fault detection analysis,** D. Busch, J. N. Schoess, Honeywell Technology Ctr. . . . . [3670-57]

Session 14A and Session 14B are concurrent

SESSION 14
Room: Newport Ballroom North
Thurs.10:40 am

Vibration Control II

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

10:40 am: **Strategies for smart control of large structures,** R. E. Klein, Univ. of Illinois/Urbana-Champaign . . . . . [3667-58]

11:00 am: **Structural vibration suppression using PZT patches and higher-order saturation phenomena,** P. F. Pai, B. Rommel, Univ. of Missouri/Columbia; M. J. Schulz, North Carolina A&T State Univ. . . . . [3667-59]

11:20 am: **Nonlinear oscillations of a plate with piezoceramic patches,** B. Balachandran, M. X. Zhao, Univ. of Maryland/College Park . . [3667-60]

11:40 am: **Active vibration control using piezoelectric smart discs,** G. Van Schothorst, Philips Research Labs. (Netherlands) . . . . [3667-61]

Noon: **Piezoelectric displacement feedback control with time delay,** J. M. Sloss, Univ. of California/Santa Barbara; S. Adali, Univ. of Natal (South Africa); I. S. Sadek, Univ. of North Carolina; J. C. Bruch, Jr., Univ. of California/Santa Barbara [3667-62]

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

SESSION 14A
Room: Pacific Ballroom D
Thurs.10:40 am

Piezo-motors

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

10:40 am: **Rotary ultrasonic motors actuated by flexural traveling wave operable at planetary and terrestrial conditions,** Y. Bar-Cohen, X. Bao, Jet Propulsion Lab.; W. Grandia, Quality Material Inspection . . . . [3668-63]

11:00 am: **Development of a linear piezoelectric motor based on the inchworm principle,** D. Roberts, Defence Evaluation and Research Agency (UK) . . . . . [3668-64]

11:20 am: **Design and performance of a high-force high-displacement piezoelectric inchworm actuator,** J. E. Frank, G. A. Lesieutre, G. H. Koopmann, W. Chen, The Pennsylvania State Univ. [3668-65]

11:40 am: **Elastodynamic analysis and design of an inchworm robotic insect,** N. O. Lobontiu, M. Goldfarb, E. Garcia, Vanderbilt Univ. [3668-66]

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

SESSION 14B
Room: Pacific Ballroom F
Thurs.10:40 am

Vibration Control of Panels

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

10:40 am: **Vibration control of a plate structure with piezoelectric stack actuators,** M. Maertens, H. Waller, Ruhr-Univ. Bochum (Germany) . . . . . [3668-67]

11:00 am: **Vibration analysis of composite panels using embedded fiber optic sensors and pulsed-DSPI,** M. P. Whelan, R. P. Kenny, A. C. Lucia, European Commission Joint Research Ctr. (Italy) . . . . [3668-68]

11:20 am: **Active vibration confinement by using eigenstructure placement and piezoelectric actuators,** L. R. Corr, W. W. Clark, Univ. of Pittsburgh . . . . . [3668-69]

11:40 am: **Embedded distributed piezoelectric actuators for adaptive structures,** H. A. Moini, California State Univ./Fullerton . . . . [3668-70]

Noon: **Electromechanical fatigue behavior of graphite/epoxy laminates embedded with piezoelectric actuators,** S. Mall, T. L. Hsu, Air Force Research Lab. . . . . [3668-71]

Lunch Break . . . . . 12:20 to 1:50 pm

10:40 am: **Intelligent data processing of an ultrasonic sensor system for pattern recognition improvements,** S. Y. Na, M. S. Park, Chonnam National Univ. (Korea) . . [3670-58]

11:00 am: **Application of wavelet in detection of AE signals in piezoelectric smart structures,** L. Shi, B. Chen, B. Zhou, Nanjing Engineering Institute (China) . . . . . [3670-59]

11:20 am: **Detection and characterization of damage in composite plates using shearography and wave-based acoustic emission techniques,** A. C. Okafor, A. W. Otieno, V. S. Rao, R. Parvataneni, Univ. of Missouri/Rolla . . [3670-61]

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

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Conference 3674 | Conference 3675

Thursday 4 March 1999

Plenary Presentation

Pacific Ballroom C/D . . . . . **8:00 to 8:45 am**

Micro-Air Vehicles

Speaker: **Dr. James McMichael,** DARPA

Coffee Break . . . . . 8:45 to 9:20 am

SESSION 7
Room: Pacific Ballroom C
Thurs. 9:20 am

Spacevehicle Applications

Chairs: **Jack H. Jacobs,** Honeywell Space Systems; **Richard Cobb,** Air Force Research Lab.

9:20 am: **Smart interface structures for spacecraft applications,** F. Doengi, Daimler-Benz Aerospace Dornier (Germany) . . . . . [3674-35]

9:40 am: **Satellite ultraquiet isolation technology experiment (SUITE),** E. H. Anderson, M. E. Evert, R. M. Glaese, J. C. Goodding, S. C. Pendleton, CSA Engineering, Inc.; D. Camp, J. Fumo, M. Jessen, Trisys Inc.; R. Cobb, R. S. Erwin, J. Jensen, Air Force Research Lab. . . . . [3674-36]

10:00 am: **Design and fabrication of a full-scale actively controlled satellite appendage simulator unit,** J. H. Jacobs, D. Quenon, R. Self, S. Hadden, Honeywell Space Systems . . . . . [3674-37]

10:20 am: **Viscoelastic strain-energy hinge for solar array deployment,** M. K. Kwak, W. Rah, Dongguk Univ. (Korea) . . . . . [3674-39]

10:40 am: **Hybrid launch isolation system,** D. Sciulli, Air Force Research Lab. . . . . [3674-40]

11:00 am: **Preliminary analysis of hybrid launch isolation for spacecraft,** G. Karahalis, G. S. Agnes, Air Force Institute of Technology . . . . . [3674-41]

11:20 am: **Single-axis piezoceramic gimbal,** G. C. Horner, B. K. Taleghani, NASA Langley Research Ctr.[3674-42]

11:40 am: **Bragg grating impact sensing on an inert Delta II solid rocket motor,** C. M. Klimcak, Y. Chan, B. Jaduszliwer, The Aerospace Corp. . . . . [3674-58]

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

SESSION 5
Room: Pacific Ballroom E
Thurs. 9:20 am

Polymeric and Other Materials II

Chair: **Manfred Wuttig,** Univ. of Maryland/College Park

9:20 am: **Strain monitoring by evanascent wave spectroscopy,** L. Kjerengtroen, V. Kapila, W. M. Cross, J. J. Kellar, South Dakota School of Mines and Technology . . . . . [3675-18]

9:40 am: **Squeezing light out of crystals: triboluminescent sensors,** G. Bourhill, I. Sage, Defence Evaluation and Research Agency Malvern (UK); R. A. Badcock, L. Humberstone, Defence Evaluation and Research Agency Farnborough (UK); N. Geddes, Defence Evaluation and Research Agency Malvern (UK); M. Kemp, S. Bishop, Defence Evaluation and Research Agency Farnborough (UK) . . . . . [3675-19]

10:00 am: **Micro-electrohydrodynamic-based actuators with application to active vibration control,** R. Kashani, K. P. Hallinan, S. Kang, Univ. of Dayton [3675-20]

10:20 am: **Laser-induced production of conductive structures in the surface of AlN,** B. Stolz, E. W. Kreutz, S. Geisler, Fraunhofer Institute für Lasertechnik (Germany) . [3675-22]

SESSION 6
Room: Pacific Ballroom E
Thurs.10:40 am

Shape Memory I

Chair: **Manfred Wuttig,** Univ. of Maryland/College Park

10:40 am: **Field-induced strain in NiMnGa** *(Invited Paper),* M. Wuttig, Univ. of Maryland/College Park; R. D. James, Univ. of Minnesota/Twin Cities . . . . . [3675-23]

11:10 am: **Magnetic and mechanical properties of FeNiCoTi magnetic shape memory alloys,** S. J. Murray, M. Marioni, R. Hayashi, S. M. Allen, R. C. O'Handley, Massachusetts Institute of Technology . . [3675-24]

11:30 am: **Modeling field-induced strain in magnetic shape memory materials,** R. C. O'Handley, M. Marioni, S. M. Allen, S. J. Murray, Massachusetts Institute of Technology . . . . . [3675-25]

11:50 am: **Magnetic properties and field-induced strain of Ni_2MnGa-based shape memory alloys,** K. Inoue, S. Jeong, W. D. Armstrong, M. Taya, Univ. of Washington; D. Alman, U.S. Dept. of Energy . . . . . [3675-21]

Lunch Break . . . . . 12:10 to 1:30 pm

SPIE's 6th Annual International Symposium on

Conference 3667

Conference 3668

Conference 3670

Thursday 4 March 1999

Session 15A and Session 15B are concurrent

SESSION 15
Room: Newport Ballroom North
Thurs. 1:30 pm

Control Theory and Techniques IV

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

1:30 pm: **Non-interacting control with internal stability and wavelets transform for dynamic model smart composite plate,** V. F. Poterasu, Technical Univ. Iasi (Romania) . . . . . [3667-63]

1:50 pm: **Aircraft maneuver performance analysis using smart actuation systems,** K. Appa, Northrop Grumman Corp.; N. S. Khot, Air Force Research Lab.; J. Ausman, Northrop Grumman Corp. . . . . [3667-64]

2:10 pm: **Wavelet control model of suppressing vibration of beam-plates with piezoelectric sensors and actuators,** Y. Zhou, J. Wang, X. Zheng, Q. Jiang, Lanzhou Univ. (China) . . . . . [3667-65]

2:30 pm: **Wave-based vibration supression in flexible manipulators using piezoelectrics,** R. W. Jones, C. Mei, B. R. Mace, Univ. of Auckland (New Zealand) . . . . . [3667-66]

2:50 pm: **Real-time automatic tuning of vibration controllers for smart structures by genetic algorithm,** M. K. Kwak, T. Shin, Dongguk Univ. (Korea) . . . . . [3667-67]

Standby Presentation **Comparing direct model reference adaptive control with traditional feedback control in the area of damage mitigation,** D. P. Waters, U.S. Air Force Academy . . . . . [3667-77]

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

SESSION 15A
Room: Pacific Ballroom D
Thurs. 1:30 pm

Energy and Power Issues

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

1:30 pm: **Power flow and work efficiency in nonlinear piezoelectric systems,** M. K. Lutz, N. W. Hagood, Massachusetts Institute of Technology . . . . . [3668-72]

1:50 pm: **Power consumption characteristics of a series R-L and parallel R-L shunt circuit,** C. H. Park, C. Niezrecki, D. J. Inman, Virginia Polytechnic Institute and State Univ. . . . . [3668-73]

2:10 pm: **Electronics for random access of large-scale distributed piezoelectric sensors and actuators,** F. Pourboghrat, Southern Illinois Univ.; R. Etienne-Cummings, Johns Hopkins Univ.; H. K. Maruboyina, S. K. Dhali, Southern Illinois Univ. . . . . [3668-74]

2:30 pm: **Power system design issues for smart materials,** D. K. Lindner, S. Chandrasekaran, Virginia Polytechnic Institute and State Univ. . . . . [3668-75]

2:50 pm: **Semi-passive and semi-active vibration control using new amplified piezoelectric actuators,** P. Bouchilloux, Magsoft Corp.; H. Bruneau, R. Le Letty, F. Claeyssen, F. Barillot, N. Lhermet, Cedrat Recherche (France) . . . . [3668-76]

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

SESSION 15B
Room: Pacific Ballroom F
Thurs. 1:50 pm

Novel Applications

Chair: **Ronald L. Spangler, Jr.,** Active Control eXperts, Inc.

1:50 pm: **Use of piezoelectric dampers for improving the feel of ball-impact sporting goods,** E. Bianchini, R. L. Spangler, Jr., T. Pandell, Active Control eXperts, Inc. . . . . [3668-77]

2:10 pm: **Design of piezoelectric inchworm actuator and compliant end-effector for minimally invasive surgery,** S. Canfield, B. Peterson, M. I. Frecker, G. H. Koopmann, The Pennsylvania State Univ. [3668-78]

2:30 pm: **Piezoelectric hydraulic pump,** L. Mauck, C. S. Lynch, Georgia Institute of Technology . . [3668-79]

2:50 pm: **Microwave-driven smart material actuators,** S. H. Choi, S. H. Chu, M. Kwak, A. D. Cutler, NASA Langley Research Ctr. . . . [3668-80]

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

SESSION 11
Room: Schooner
Thurs. 1:30 pm

Sensors for Civil Structural Systems

Chairs: **Daniele Inaudi,** SMARTEC SA (Switzerland); **Dryver R. Huston,** Univ. of Vermont

1:30 pm: **Fiber optical Bragg grating sensors embedded in CFRP wires,** P. M. Nellen, P. Anderegg, R. Brönnimann, U. Meier, U. J. Sennhauser, Swiss Federal Labs. for Materials Testing and Research (Switzerland) . . . . . [3670-62]

1:50 pm: **GIMA antenna design for ground penetrating radar in concrete structures NDE applications,** J. Q. Hu, D. R. Huston, P. L. Fuhr, Univ. of Vermont . . . . . [3670-63]

2:10 pm: **Impedance-based health monitoring technique for massive structures and high-temperature structures,** G. Park, H. H. Cudney, Virginia Polytechnic Institute and State Univ. . . . . [3670-64]

2:30 pm: **Ground strain measuring system using optical fiber sensors,** T. Sato, R. Honda, Kyoto Univ. (Japan); Y. Hatayama, Takenaka Civil Engineering & Construction Co., Ltd. (Japan) . . . . . [3670-65]

2:50 pm: **Development of a novel fiber optic sensor for humidity and pH monitoring,** P. Kronenberg, Swiss Federal Institute of Technology (Switzerland); S. G. Pierce, Univ. of Strathclyde (UK); D. Inaudi, SMARTEC SA (Switzerland) [3670-66]

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

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Conference 3674

Conference 3675

Thursday 4 March 1999

SESSION 8
Room: Pacific Ballroom C
Thurs. 1:30 pm

Airvehcile Applications II

Chairs: **Edward V. White,** Boeing Co.; **Jürgen Becker,** Daimler-Benz Aerospace (Germany)

1:30 pm: **Overview of the SAMPSON smart inlet,** M. A. Hopkins, E. W. Baumann, J. P. Dunne, D. M. Pitt, Boeing Phantom Works . [3674-43]

1:50 pm: **Smart-actuated continuous moldline technology(CMT) mini wind-tunnel test,** D. M. Pitt, J. P. Dunne, R. H. Wille, K. J. Kilian, Boeing Phantom Works . [3674-44]

2:10 pm: **Effect of synthetic jet arrays on boundary layer control,** D. Smith, Univ. of Wyoming; V. Kibens, D. M. Pitt, M. A. Hopkins, Boeing Phantom Works . . . . . [3674-45]

2:30 pm: **Design and development of a conformal load-bearing smart-skin antenna: overview of the AFRL Smart Skin Structures technology demonstration (S3TD) program,** A. J. Lockyer, K. H. Alt, D. P. Coughlin, M. D. Durham, J. N. Kudva, Northrop Grumman Corp.; J. Tuss, Air Force Wright Lab.; A. C. Goetz, TRW, Inc. . . . . [3674-46]

2:50 pm: **Smart spoilers for subsonic missiles,** S. P. Joshi, Univ. of Texas/Arlington; J. A. August, Lockheed Martin Tactical Aircraft Systems . . . . . [3674-47]

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

SESSION 7
Room: Pacific Ballroom E
Thurs. 1:30 pm

Composite Systems

Chair: **William D. Armstrong,** Univ. of Washington

1:30 pm: **Nonlinear deformation of magnetically dilute magnetostrictive particulate composites,** W. D. Armstrong, Univ. of Washington . . . . . [3675-27]

1:50 pm: **Dissipation mechanisms in a composite Terfenol sonar transducer,** J. H. Goldie, J. Oleksy, SatCon Technology Corp.; M. J. Gerver, Consultant; G. P. Carman, T. A. Duenas, Univ. of California/Los Angeles . . . . . [3675-28]

2:10 pm: **Thermal deformation behavior of a NiTi actuated aluminum metal matrix composite,** W. D. Armstrong, Univ. of Washington; T. Lorentzen, Risø National Lab. (Denmark) [3675-31]

2:30 pm: **Shape memory alloy repair technique,** K. A. Tsoi, X. Wang, Y. Mai, Univ. of Sydney (Australia); S. C. Galea, Defence Science and Technology Organisation (Australia) . . . . . [3675-32]

SESSION 8
Room: Pacific Ballroom E
Thurs. 2:50 am

Shape Memory II

Chair: **Dimitris C. Lagoudas,** Texas A&M Univ.

2:50 pm: **Characterization of MSM material properties,** S. Valkealahti, Y. Ezer, ABB Corporate Research Oy (Finland); K. Ullakko, Technical Univ. of Helsinki (Finland) . . . . [3675-26]

3:10 pm: **Fabrication and characterization of thin film NiTi for use as a microbubble for active flow control,** K. K. Ho, J. J. Gill, G. P. Carman, P. Jardine, Univ. of California/Los Angeles . . [3675-34]

Coffee Break . . . . . 3:30 to 3:50 pm

Conference 3667

3:40 pm: **Artificial neural network for piezoelectric control systems,** J. M. Bakashwain, J. Refaee, M. Sunar, M. Mohandes, King Fahad Univ. of Petroleum and Minerals (Saudi Arabia) . . . . . [3667-68]

SESSION 16
Room: Newport Ballroom North
Thurs. 4:00 pm

Materials and Devices Modeling

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

4:00 pm: **Thermodynamic rationale for dynamic boundary value problem and heat conduction equation for piezothermoelastic magnetised materials,** A. K. Belyaev, State Technical Univ. of St. Petersburg (Austria) . . . . . [3667-69]

4:20 pm: **Constitutive model of piezoelectric polymer PVDF,** A. Vinogradov, Montana State Univ./Bozeman . . . . . [3667-70]

4:40 pm: **Steady state piezothermoelastic response of smart composite plates using 2D theory approximations for displacements,** S. Kapuria, Engineers India Limited (India); P. C. Dumir, ITT Delhi (India); S. Sengupta, Engineers India Limited (India) . . . . . [3667-71]

5:00 pm: **Testing and modeling of THUNDER sensors and actuators,** V. Giurgiutiu, G. A. Nall, C. A. Rogers, Univ. of South Carolina/Columbia; N. Rose, B. Cunningham, Face International Corp. . [3667-72]

5:20 pm: **Modeling aspects concerning THUNDER actuators,** R. C. Smith, H. T. Banks, North Carolina State Univ.; K. Mossi, Face International Corp. . . . . [3667-73]

3667 ends ■

Conference 3668

Thursday 4 March 1999

Session 16A and Session 16B are concurrent

SESSION 16A
Room: Pacific Ballroom D
Thurs. 3:40 pm

Vibration Control of Shells

Chair: **Peter C. Chen,** Systems Planning and Analysis, Inc.

3:40 pm: **Composite circular thin shell modeling for the THUNDER actuator and positioning control with classical and fuzzy control algorithm,** G. Washington, J. K. Song, The Ohio State Univ. . . . . [3668-81]

4:00 pm: **Implementation of a distributed control law for thin shell vibrations by a distributed electronic circuit,** S. Bereksi, M. Lenczner, Univ. de Franche-Comte (France) [3668-82]

4:20 pm: **Active control of shallow spherical shells using piezoceramic sheets,** S. K. Ghaedi, A. K. Misra, McGill Univ. (Canada) . . [3668-83]

4:40 pm: **Compensation methodologies for local control using strain actuators and sensors,** J. H. Yung, E. F. Crawley, Massachusetts Institute of Technology . . [3668-84]

SESSION 16B
Room: Pacific Ballroom F
Thurs. 3:40 pm

Design and Simulation

Chair: **Wilfried J. Elspass,** Swiss Federal Institute of Technology (Switzerland)

3:40 pm: **Mobile haptic interface with active functional design,** W. J. Elspass, Swiss Federal Institute of Technology (Switzerland) [3668-85]

4:00 pm: **Interdisciplinary development of smart systems with functional and geometrical modeling techniques,** M. A. Kuemmel, A. Henke, J. Wallaschek, Paderborn Univ. (Germany) . . . . . [3668-86]

4:20 pm: **Design and prototyping of an actuator for vibration control,** D. R. Smith, J. P. D'Angelo, Univ. of Massachusetts/Lowell; S. W. Zewari, K. A. Blumenstock, K. R. Lee, NASA Goddard Space Flight Ctr.; R. Sturmfels, Univ. of Wisconsin/Madison . . . . . [3668-87]

4:40 pm: **Vibration control of flexible structures using self-sensing actuators,** F. Pourboghrat, M. Daneshdoost, H. Pongpairoj, I. Youn, R. Balasubramaniam, R. Radhakrishnan, Southern Illinois Univ./Carbondale . . . . . [3668-88]

3668 ends ■

Conference 3670

3:40 pm: **Reduction of temperature effects in a fiber optic distributed sensor for strain measurement in civil structures,** T. Kurashima, H. Ohno, Y. Uchiyama, NTT Access Network Systems Labs. (Japan) . . . [3670-67]

4:00 pm: **Measuring soil's strains using fiber optic sensors,** C. E. Miller, J. S. Sirkis, Univ. of Maryland/College Park . . . . . [3670-68]

3670 ends ■

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Conference 3674

Conference 3675

Thursday 4 March 1999

SESSION 9
Room: Pacific Ballroom C
Thurs. 3:40 pm

Rotating Machinery Applications

Chairs: **Grigory Adamovsky,** NASA Lewis Research Ctr.; **William B. Spillman, Jr.,** BF Goodrich Aerospace

3:40 pm: **Structural integration of shape memory alloys for turbomachinery applications,** M. Ahrens, ABB Corporate Research (Switzerland) . . . . . [3674-48]

4:00 pm: **Active vibration control of smart composite drive shafts,** M. Ahrens, ABB Corporate Research (Switzerland) . . . . . [3674-49]

4:20 pm: **Online diagnosis of the structural behavior of windmills by Bragg gratings and piezoelectrics,** S. Díaz-Carrillo, C. Pardo, J. A. Guemes, Univ. Politecnica de Madrid (Spain) . . . . . [3674-50]

4:40 pm: **Twisting of pretwisted laminated piezoelectric plates,** D. Onipede, Univ. of Pittsburgh . . . . . [3674-51]

5:00 pm: **Smart coatings for in-situ monitoring of engine components,** B. W. McKee, S. Dahl, K. Shkarlet, Innovative Dynamics . . . [3674-52]

3674 ends ■

3:50 pm: **Keeping the shape memory properties of miniaturized components of NiTi-alloys by laser machining,** H. Haferkamp, M. Goede, S. Paschko, S. Nolte, G. Kamlage, C. Momma, Laser Zentrum Hannover eV (Germany); M. Leester-Schaedel, Technical Univ. Braunschweig (Germany) . . . . . [3675-30]

4:10 pm: **Modeling and experiments of thermomechanical fatigue of SMA,** D. C. Lagoudas, D. A. Miller, Texas A&M Univ. . . . . [3675-29]

SESSION 9
Room: Pacific Ballroom E
Thurs. 4:30 am

Shape Memory III

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

4:30 pm: **Two-way behavior of a Nitinol torsion bar,** W. Huang, Nanyang Technological Univ. (Singapore) . . . . . [3675-33]

4:50 pm: **Thermo-mechanical characterization of shape memory alloy torque tubes,** A. O'Keefe, G. P. Carman, Univ. of California/Los Angeles . . . . . [3675-41]

5:10 pm: **Microstructure and shape memory effect of NiTi-Ta alloys,** J. Ma, Z. J. Pu, J. I. Subirana, K. Wu, Florida International Univ. [3675-36]

5:30 pm: **Shape memory alloy actuator fatigue properties,** C. R. Clark, R. R. Hanson, D. Marcelli, ITN Energy Systems Inc. . . . . [3675-37]

5:50 pm: **Dilatometric and electrical resistivity measurements in various phases of Nitinol,** J. Uchil, K. Mohanchandra, K. K. Mahesh, K. G. Kumara, Mangalore Univ. (India) . . . . . [3675-35]

3675 ends ■

SPIE's International Symposium on

Nondestructive Evaluation Techniques for Aging Infrastructure & Manufacturing

3–5 March 1999

Conference 3585

Room: Pacific Ballroom A
Wed.–Friday 3–5 March 1999
Proceedings of SPIE Vol. 3585

Nondestructive Evaluation of Aging Materials and Composites

Conference Chairs: **George Y. Baaklini,** NASA Lewis Research Ctr.; **Carol A. Lebowitz,** Edison Welding Institute; **Eric S. Boltz,** TPL, Inc.

Program Committee: **Lawrence M. Brown,** Naval Surface Warfare Ctr.; **Neil J. Goldfine,** JENTEK Sensors, Inc.; **John H. Hemann,** Cleveland State Univ.; **David K. Hsu,** Iowa State Univ.; **Chiaki Miyasaka,** The Pennsylvania State Univ.; **Michele R. Novack,** Naval Surface Warfare Ctr.; **Larry D. Olson,** Olson Engineering, Inc.; **Robert Osiander,** Johns Hopkins Univ.; **Robert J. Ross,** USDA Forest Service; **Peter K. Soltani,** Liberty Technologies, Inc.; **Michael Rooney,** Johns Hopkins Univ.; **Nasser Qaddoumi,** Colorado State Univ.; **Graham H. Thomas,** Lawrence Livermore National Lab.

Conference 3586

Room: Trimaran
Wed.–Fri.3–5 March 1999
Proceedings of SPIE Vol. 3586

Nondestructive Evaluation of Aging Aircraft, Airports, and Aerospace Hardware III

Conference Chair: **Ajit K. Mal,** Univ. of California/Los Angeles

Cochairs: **Yoseph Bar-Cohen,** Jet Propulsion Lab.; **Roy Ikegami,** Boeing Information, Space & Defense Group

Program Committee: **Deborah H. Bailey,** U.S. Air Force Aeronautical Systems Ctr.; **Marc Choquet,** National Research Council Canada; **Glenn A. Geithman, Gary E. Georgeson,** Boeing Information, Space & Defense Group; **Neil J. Goldfine,** JENTEK Sensors, Inc.; **Roger F. Johnson,** QUEST Integrated, Inc.; **Jiann W. Ju,** Univ. of California/Los Angeles; **Carl A. Lenngren,** National Swedish Road Administration (Sweden); **Clay W. Maranville,** Boeing Information, Space & Defense Group; **Shaker A. Meguid,** Univ. of Toronto (Canada); **Yogesh Mehrotra,** Materials Technologies Corp.; **Roberto A. Osegueda,** Univ. of Texas/El Paso; **Walter N. Podney,** SQM Technology, Inc.; **Christine Scala,** Defence Science and Technology Organization (Australia); **William W. Shurtleff,** Iowa State Univ.; **Michael Slack,** Dept. of National Defense (Canada); **William P. Winfree,** NASA Langley Research Ctr.;

Conference 3587

Room: Pacific Ballroom B
Wed.–Fri. 3–5 March 1999
Proceedings of SPIE Vol. 3587

Nondestructive Evaluation of Bridges and Highways III

Conference Chair: **Steven B. Chase,** Federal Highway Administration

Cochair: **Glenn A. Washer,** Federal Highway Administration

Program Committee: **Keith A. Bartels,** Southwest Research Institute; **Gerardo G. Clemena,** Virginia Transportation Research Council; **Nancy K. Del Grande,** Lawrence Livermore National Lab.; **Philip E. Fish,** Wisconsin Dept. of Transportation; **Paul E. Hartbower,** California Dept. of Transportation; **Theodore Hopwood,** Kentucky Transportation Council; **Michael Lynch,** Texas Dept. of Transportation; **David Meggars,** Kansas Dept. of Transportation

Conference 3588

Room: Yawl
Thurs. 4 March 1999
Proceedings of SPIE Vol. 3588

Nondestructive Evaluation of Utilities and Pipelines III

Conference Chair: **Walter G. Reuter,** LMITCO/INEEL

Cochair: **Gary J. Weil,** EnTech Engineering, Inc.

Program Committee: **Marvin Fields, Lloyd Mager,** Abbott Labs.; **Bruce W. Maxfield,** Industrial Sensors and Actuators; **Peter O. Paulson,** Pure Technologies, Inc. (Canada); **Valery M. Petuchov,** Kazan State Technical Univ. (Russia); **Yichi Lu,** Southwest Research Institute

Conference 3589

Room: Catamaran
Wed.–Thurs. 3–4 March 1999
Proceedings of SPIE Vol. 3589

Process Control and Sensors for Manufacturing

Conference Chair: **David M. Pepper,** HRL Labs.

Program Committee: **Yoseph Bar-Cohen,** Jet Propulsion Lab.; **Sharon Cascadden,** Hughes Space and Communications Co.; **Michael J. Ehrlich,** Johns Hopkins Univ.; **Marvin B. Klein,** Lasson Technologies, Inc.; **Clinton M. Logan,** Lawrence Livermore National Lab.; **Tom Moran,** Air Force Research Lab.; **David D. Nolte,** Purdue Univ.; **John N. Pike,** J.J. Pike & Co., Inc.; **Moshe Rosen,** Johns Hopkins Univ.

Sunset Cruise

Wednesday 3 March • 5:30 pm and 6:00 pm

Symposium attendees are invited to relax and enjoy the beautiful sunset sights departing from the historic Balboa Pavilion.

See p. 48

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Cochair: Nondestructive Evaluation of Bridges and Highways II

Gary J. Weil, EnTech Engineering, Inc.
Cochair: Nondestructive Evaluation of Utilities and Pipelines III

Conference 3585

Conference 3586

Conference 3587

Conference 3588

Conference 3589

Wednesday 3 March 1999

Plenary Presentation

Newport Ballroom North . . . . . 8:00 to 8:45 am

Maintaining Older Aircraft:
The Pivotal Role for Nondestructive Evaluation and Inspection

Speaker: **Dr. Joseph P. Gallagher,** Univ. of Dayton

Coffee Break . . . . . 8:45 to 9:20 am

SESSION 1
Room: Pacific Ballroom A
Wed. 9:20 am

NDE for Fretting and Corrosion Damage Detection

Chairs: **David K. Hsu,** Iowa State Univ.; **Eric S. Boltz,** TPL, Inc.

9:20 am: **Characterization of fretting fatigue damage using nondestructive approaches,** T. E. Matikas, E. Shell, Univ. of Dayton . . . . . [3585-01]

9:40 am: **Analysis of fretting experimental data using wavelets,** G. N. Frantziskonis, Univ. of Arizona; E. Shell, Univ. of Dayton; J. Woo, Univ. of Arizona; T. E. Matikas, Univ. of Dayton . . . . . [3585-02]

10:00 am: **Modeling fretting fatigue: interface contact conditions-temperature profiles** *(Invited Paper),* P. D. Nicolaou, National Ctr. for Scientific Research Demokritos (Greece); T. E. Matikas, Univ. of Dayton . . . . . [3585-03]

10:30 am: **Influence of pitting corrosion on structural integrity of aluminum alloys,** L. B. Simon, M. Khobaib, T. E. Matikas, Univ. of Dayton; C. Jeffcoate, Univ. of Dayton and Systran Corp.; M. Donley, Air Force Research Lab. . . . . [3585-04]

10:50 am: **Characterization of pitting corrosion damage with wavelet and fractal analysis,** G. N. Frantziskonis, Univ. of Arizona; L. B. Simon, Univ. of Dayton; J. Woo, Univ. of Arizona; T. E. Matikas, Univ. of Dayton . . . . . [3585-05]

11:10 am: **Aging evaluation techniques for aging aircraft,** J. E. Pascente, Lixi, Inc. . . . [3585-06]

11:30 am: **Enhanced x-ray images using amorphous silicon arrays,** W. F. Hartman, E. S. Boltz, TPL, Inc. . . . . [3585-07]

Lunch/
Exhibit Break . 11:50 am to 1:30 pm

SESSION 1
Room: Trimaran
Wed. 9:20 am

Health Monitoring I

Chair: **Ajit K. Mal,**
Univ. of California/Los Angeles

9:20 am: **AACE: an innovative partnership to enhance aircraft safety** *(Invited Paper),* W. W. Shurtleff, Iowa State Univ. . . . . [3586-01]

9:50 am: **Corrosion quantification by different nondestructive inspection methods,** P. S. Rutherford, J. Luzar, Boeing Information, Space & Defense Systems . . . . . [3586-02]

10:10 am: **Nondestructive evaluation for crack, corrosion, and stress detection for metal assemblies and structures,** M. J. Dudziak, MODIS Corp.; A. Chervonenkis, Magneto-Optics Lab. . . . . [3586-03]

10:30 am: **Crack growth detection and monitoring using broadband acoustic emission techniques,** E. Haugse, T. J. Leeks, Boeing Information, Space & Defense Systems; S. M. Ziola, Digital Wave Corp.; R. Ikegami, Boeing Information, Space & Defense Systems . . . . . [3586-04]

10:50 am: **Health monitoring of an adhesive joint using a multi-axis fiber grating strain sensor system,** W. L. Schulz, E. Udd, M. Morrell, J. M. Seim, Blue Road Research; I. M. Perez, Naval Air Warfare Ctr.; A. Trego, Boeing Information, Space & Defense Systems . . . . . [3586-05]

11:10 am: **Structural damage localization using optimization method,** W. G. Luber, Daimler-Benz Aerospace (Germany) . . . [3586-06]

11:30 am: **Optical fiber-based corrosion monitoring systems for aging aircraft,** J. L. Elster, J. A. Greene, M. E. Jones, T. A. Bailey, F&S, Inc.; W. H. Velander, Virginia Polytechnic Institute and State Univ.; I. M. Perez, Naval Air Warfare Ctr. . . [3586-07]

Lunch/
Exhibit Break . 11:50 am to 1:30 pm

SESSION 1
Room: Pacific Ballroom B
Wed. 9:20 am

Health Monitoring of Highway Bridges I

9:20 am: **Role of NDE on bridge health-monitoring** *(Invited Paper),* A. E. Aktan, J. Roebling, Drexel Univ. . . . . [3587-01]

9:50 am: **Embeddable sensor for corrosion measurement,** R. G. Kelley, S. H. Jones, Univ. of Virginia . . . . . [3587-02]

10:10 am: **Detection and characterization of corrosion of steel bridge cables by time domain reflectometry,** W. Liu, R. G. Hunsperger, K. Folliard, M. J. Chajes, J. Barot, D. Jhaveri, Univ. of Delaware; E. Kunz, VETEK Systems Corp. . . . . [3587-03]

10:30 am: **Nondestructuve evaluation of crack damage in bridge decks,** C. M. Dry, Univ. of Illinois/Urbana-Champaign . . . . . [3587-04]

10:50 am: **Fiber optic smart bearing load structure,** E. Udd, W. L. Schulz, J. Selm, Blue Road Research; K. Corona-Bittick, Production Products and Sales Inc.; J. Dorr, K. T. Slattery, Duke Engineering Group, Inc.; H. M. Laylor, G. E. McGill, Oregon Dept. of Transportation; S. B. Chase, Federal Highway Administration . [3587-05]

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

SESSION 1
Room: Catamaran
Wed. 9:40 am

Sensors

Chairs: **Clinton M. Logan,** Lawrence Livermore National Lab.;
Tom Moran, Air Force Research Lab.

9:40 am: **Integrated waveguide/thermocouple sensor for liquid properties,** R. D. Costley, G. Boudreaux, J. Simpson, C. Menezes, Mississippi State Univ. . . [3589-02]

10:00 am: **Drastically simplified holographic methods well suited for in-situ monitoring and process control in practical industrial environment,** V. Petrov, Fachhochschule Ulm (Germany) . . . . . [3589-03]

10:20 am: **Homodyne detection of ultrasonic surface displacements using two-wave mixing in photorefractive polymers,** M. B. Klein, G. D. Bacher, Lasson Technologies, Inc.; A. Grunnet-Jepsen, D. Wright, W. E. Moerner, Univ. of California/San Diego . . . [3589-04]

Coffee Break . . . 10:40 to 11:00 am

11:00 am: **Non-contact characterization of static paper materials using a photorefractive interferometer,** E. Lafond, J. P. Gerhardstein, P. Brodeur, Institute of Paper Science and Technology[3589-05]

11:20 am: **Improved sensitivity in photo induced-emf sensors for laser-based ultrasound detection applications,** D. M. Pepper, G. J. Dunning, HRL Labs.; D. D. Nolte, I. Lahiri, J. Coy, Purdue Univ.; M. B. Klein, G. D. Bacher, M. Chiao, Lasson Technologies, Inc. . . . . [3589-06]

11:40 am: **Architectures and processing for improving the performance of laser-based ultrasonic phased array detectors,** D. M. Pepper, G. J. Dunning, T. R. O'Meara, HRL Labs. . . . . [3589-07]

Lunch/
Exhibit Break . . . . Noon to 1:50 pm

Conference 3585

Conference 3586

Conference 3587

Conference 3588

Conference 3589

Wednesday 3 March 1999

SESSION 2
Room: Pacific Ballroom A
Wed. 1:30 pm

Thermal Methods

Chairs: **Michael Rooney,** Johns Hopkins Univ.; **Nasser Qaddoumi,** Colorado State Univ.

1:30 pm: **Multimodal NDE for accelerated aging studies of carbon fiber composites,** D. J. Chinn, P. F. Durbin, Z. Wu, S. Groves, Lawrence Livermore National Lab. . [3585-08]

1:50 pm: **Thermoelastic stress analysis of a pin-loaded composite joint,** J. H. Hemann, R. E. Martin, D. G. Mandic, Cleveland State Univ. . . . . [3585-09]

2:10 pm: **Infrared nondestructive techniques to control porosity in fiberglass components,** C. G. Guida, ABB Ricerca SpA (Italy); A. Catenacci, ABB Sae (Italy); E. G. Grinzato, CNR-ITEF (Italy) . . . . . [3585-10]

2:30 pm: **Thermographic evaluation of window structures for Antarctic environment,** P. K. Dutta, U.S. Army Cold Regions Research & Engineering Lab. . . . . [3585-11]

2:50 pm: **Evaluation of the limit of acceptable damage for leather products using infrared thermography,** M. P. Luong, CNRS-LMS (France) . . . . . [3585-12]

Coffee/Exhibit Break 3:10 to 3:40 pm

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

NDE for Quantification of Fatigue Damage

Chairs: **Neil J. Goldfine,** JENTEK Sensors, Inc.; **Chiaki Miyasaka,** The Pennsylvania State Univ.

3:40 pm: **Low-cycle fatigue/high-cycle fatigue (LCF/HCF) interaction studies using a 20 kHz HCF loading device** *(Invited Paper),* T. E. Matikas, Univ. of Dayton . . . . . [3585-13]

4:10 pm: **In-situ monitoring of acoustic linear and nonlinear behavior of titanium alloys during cycling loading,** J. Frouin, T. E. Matikas, J. K. Na, S. Sathish, Univ. of Dayton . . . . . [3585-14]

4:30 pm: **Development of methods to observe material fatigue damage through surface characteristics,** J. Schroeder, T. E. Matikas, D. Eylon, Univ. of Dayton . . . . . [3585-15]

4:50 pm: **Full-field detection of surface defects using real-time holography and optical correlation techniques,** J. L. Blackshire, B. D. Duncan, Univ. of Dayton [3585-16]

5:10 pm: **Advanced electronic phase stepped interferometry (EPSI) for detection and characterization of early stage damage in aerospace materials,** J. L. Blackshire, R. C. Hardie, M. I. Younus, Univ. of Dayton . . . . . [3585-17]

5:30 pm: **Theromelastic stress analysis: the mean stress effect in metallic alloys,** A. L. Gyekenyesi, NASA Lewis Research Ctr. [3585-18]

SESSION 2
Room: Trimaran
Wed. 1:30 pm

Health Monitoring II

1:30 pm: **Nondestructive characterization of corrosion damage and fatigue life** *(Invited Paper),* S. I. Rokhlin, The Ohio State Univ. . . . . [3586-08]

2:00 pm: **Developments in real-time 2D ultrasound inspection for aging aircraft,** M. E. Lasser, J. Kula, G. Rohrer, Imperium, Inc.; G. H. Harrison, Univ. of Maryland/ Baltimore . . . . . [3586-09]

2:20 pm: **Aircraft engine blade cooling holes detection and classification from infrared images,** W. G. Wee, R. D. Rosemau, S. Nawaz, A. Niu, Univ. of Cincinnati . . . . . [3586-10]

2:40 pm: **Life extension for new and aging aircraft using permanently mounted and surface scanning eddy current sensor arrays,** N. J. Goldfine, V. Weiss, D. E. Schlicker, A. P. Washabaugh, D. Clark, JENTEK Sensors, Inc. . . . . [3586-11]

3:00 pm: **Quantitative characterization of cracks with the vibro-acoustic modulation technique,** D. M. Donskoy, Stevens Institute of Technology . . . . . [3586-12]

Coffee/Exhibit Break 3:20 to 3:50 pm

3:50 pm: **Automatic object segmentation and characterization of workpieces from CT data,** W. Wang, W. G. Wee, Univ. of Cincinnati . . . . . [3586-13]

4:10 pm: **Ultrasonic characterization of radial fatigue cracks in aging airplane structures,** I. N. Komsky, J. D. Achenbach, Northwestern Univ. . . . . [3586-14]

4:30 pm: **State-of-the-art of thermal wave imaging for NDE of aging aircraft,** L. D. Favro, R. L. Thomas, X. Han, Wayne State Univ. [3586-15]

4:50 pm: **Three dimensional CT data processing for surface detection and inspection,** X. Wu, W. Wang, L. Han, W. G. Wee, Univ. of Cincinnati . . . . . [3586-16]

5:10 pm: **Precise Æ source location technology for aerospace industry,** M. Ge, GE Acoustics Technology (Canada) . . . . . [3586-47]

SESSION 2
Room: Pacific Ballroom B
Wed. 1:30 pm

Health Monitoring of Highway Bridges II

1:30 pm: **Fabrication and health monitoring of a composite bridge,** D. Heider, D. A. Eckel II, L. Ribeiro, K. Krieger, J. W. Gillespie, Jr., Univ. of Delaware . . . . . [3587-06]

1:50 pm: **Long-term monitoring of a concrete bridge with 100+ fiber optic long-gage sensors,** D. Inaudi, SMARTEC SA (Switzerland); S. Vurpillot, B. Glisic, P. Kronenberg, S. Lloret, Swiss Federal Institute of Technology (Switzerland) [3587-07]

2:10 pm: **Nondestructive damage detection and evaluation technique for seismically damaged structures by intelligent sensors,** Y. Adachi, S. Unjoh, Ministry of Construction/ Public Works Research Institute (Japan) . . . . . [3587-08]

2:30 pm: **Comparison between four identification techniques of a road bridge dynamic test,** L. Garibaldi, A. Fasana, E. Giorcelli, S. Marchesiello, M. Ruzzene, Politecnico di Torino (Italy) . . . . . [3587-09]

Coffee/Exhibit Break 2:50 to 3:20 pm

SESSION 3
Room: Pacific Ballroom B
Wed. 3:20 pm

Thermal Methods for Damage Detection and Health Monitoring

3:20 pm: **Theory and application of coating tolerant thermography,** J. R. Lesniak, D. J. Bazile, M. J. Zickel, Stress Photonics, Inc. . . . [3587-10]

3:40 pm: **Coatings for combined thermoelastic and photoelastic stress measurement,** M. K. Hinders, D. Woolard, C. S. Welch, College of William and Mary . . . . . [3587-11]

4:00 pm: **Detecting manufacturing flaws in FRP retrofit applications,** G. F. Hawkins, E. Johnson, The Aerospace Corp.; J. P. Nokes, Michigan State Univ. . . . [3587-12]

4:20 pm: **Thermal nondestructive testing (TNDT) of adhesively bonded composite reinforcements applied to concrete civil structures,** D. D. Burleigh, BF Goodrich Aerospace; R. Bohner, Bohner Engg. . [3587-13]

SESSION 2
Room: Catamaran
Wed. 1:50 pm

Process Monitoring I

Chairs: **Marvin B. Klein,** Lasson Technologies, Inc.; **John N. Pike,** J.J. Pike & Co., Inc.

1:50 pm: **Novel laser-EMAT system for weld inspection,** S. B. Palmer, S. Dixon, C. Edwards, Univ. of Warwick (UK) . . . . . [3589-08]

2:10 pm: **Non-contact ultrasound for monitoring the fill level of drink cans,** S. B. Palmer, S. Dixon, C. Edwards, Univ. of Warwick (UK) . . [3589-09]

2:30 pm: **In-situ microwave characterization of planar/nonplanar specimens,** V. V. Varadan, K. A. Jose, V. K. Varadan, The Pennsylvania State Univ. . . . . [3589-10]

2:50 pm: **In-situ non-contact, nondestructive, point-to-point microwave inspection system,** V. V. Varadan, R. Hollinger, A. R. Tellakula, V. K. Varadan, HVS Technologies, Inc. . . . . [3589-11]

Coffee/Exhibit Break 3:10 to 3:40 pm

SESSION 3
Room: Catamaran
Wed. 3:40 pm

Process Monitoring II

Chairs: **Yoseph Bar-Cohen,** Jet Propulsion Lab.; **David D. Nolte,** Purdue Univ.

3:40 pm: **Non-contact real-time measurement of surface roughness inside cylinders,** J. N. Pike, J.J. Pike & Co., Inc.; Y. Mehrotra, Materials Technologies Corp. . . . . [3589-12]

4:00 pm: **Reduced wire count SMARTweave,** J. H. Belk, Boeing Phantom Works; D. G. Krantz, MTS Systems Corp.; S. M. Walsh, U.S. Army Research Lab. . . . . [3589-13]

4:20 pm: **In-line industrial monitoring and controlling system integrating single-chip computer with linear CCD image sensor,** J. Wang, A. Mei, Wuhan Technical Univ. of Surveying and Mapping (China) . . . [3589-14]

4:40 pm: **Open architecture framework for distributed real-time fault diagnosing,** H. Wang, G. Dai, Institute of Software (China) [3589-15]

5:00 pm: **Effects of drilling conditions, frill material, and point angle on acoustic emission and exit hole delaminating in drilling advanced composite,** A. C. Okafor, S. R. Birdsong Univ. of Missouri/ Rolla . . . . . [3589-25]

5:20 pm: **Monitoring drilling of advanced composites, drill wear, and exit hole delamination using wave-based acoustic emission,** A. C. Okafor, S. R. Birdsong, Univ. of Missouri/Rolla . . . . . [3589-26]

Nondestructive Evaluation Techniques for Aging Infrastructure & Manufacturing

Conference 3585 | Conference 3586 | Conference 3587 | Conference 3588 | Conference 3589

Thursday 4 March 1999

Plenary Presentation

Newport Ballroom North . . . . . 8:00 to 8:45 am

Predictive Engineering for Aging Infrastructure

Speaker: **Dr. Leonard J. Bond,** Pacific Northwest National Lab.

Coffee Break . . . . . 8:45 to 9:20 am

SESSION 4
Room: Pacific Ballroom A
Thurs. 9:20 am

Ultrasonic Methods

Chairs: **Graham H. Thomas,** Lawrence Livermore National Lab.; **Jaswinder S. Sandhu,** Santec Systems, Inc.

9:20 am: **Overview of the knowledge-based inspection system (KBIS),** C. A. Lebowitz, R. Spencer, Edison Welding Institute; L. M. Brown, Naval Surface Warfare Ctr.; R. Kok, Kok & Associates, Inc.; L. Udpa, Iowa State Univ. [3585-19]

9:40 am: **Acoustography: a side-by-side comparison with conventional ultrasonic scanning,** J. S. Sandhu, H. Wang, W. J. Popek, Santec Systems, Inc.; P. Sincebaugh, U.S. Army Research Lab. . . . . [3585-20]

10:00 am: **Computational methods for NDT,** J. J. Kaufman, CyberLogic, Inc. and Mount Sinai School of Medicine; G. Luo, New York Univ. Medical Ctr.; B. Bianco, A. Chiabrera, Univ. of Genova (Italy); R. S. Siffert, Mount Sinai School of Medicine . . . . . [3585-21]

10:20 am: **Curing behavior of polyvinyl acetate and urea formaldehyde resins by means of ultrasound monitoring,** A. Ballerini, E. Baradit, C. Fuentealba, Univ. del Bio-Bio (Chile) . . . . . [3585-22]

10:40 am: **Ultrasound application for MOE determination of some Chilean species of wood,** E. Baradit, C. Rozas, I. Bravo, Univ. del Bio-Bio (Chile) . . . . . [3585-23]

11:00 am: **Enhancing quality control in transportation construction through nondestructive testing,** U. B. Halabe, D. R. Martinelli, S. H. Petro, West Virginia Univ. . . . . [3585-24]

11:20 am: **Quality evaluation of aged concrete by ultrasound,** H. Tavossi, B. R. Tittmann, The Pennsylvania State Univ. . . . . [3585-25]

11:40 am: **Rebound shear modulus interpretation from a class of nondestructive impact tests,** U. Karim, Univ. of Twente (Netherlands) . . . . . [3585-26]

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

SESSION 3
Room: Trimaran
Thurs. 9:20 am

NDE of Airport and Aerospace Hardware

Chair: **Surendra P. Shah,** Northwestern Univ.

9:20 am: **Using non-contact sensors for paving operations on airport pavements** *(Invited Paper),* C. A. Lenngren, National Swedish Road Administration (Sweden) [3586-17]

9:50 am: **Monitoring crack length in concrete beams using resonance measurements,** K. V. Subramaniam, Northwest Univ.; G. Goldstein, Goergia Institute of Technology; J. S. Popovics, S. P. Shah, Northwestern Univ. . . . . [3586-18]

10:10 am: **High-speed rolling deflectometer data evaluation,** P. Andrén, Royal Institute of Technology (Sweden) . . . [3586-19]

10:30 am: **Elastic degradation, damage, and service life prediction of concrete subject to environmental attack using ultrasonic NDE and tensile testing,** J. W. Ju, L. S. Weng, Univ. of California/Los Angeles . . . . . [3586-20]

10:50 am: **Nondestructive critical pressure determination of defect zones in vessel-like constructions,** I. Onichtchenko, G. J. Salamo, Univ. of Arkansas . . . . . [3586-21]

11:10 am: **Low-frequency electromagnetic sensing of cracks and inclusions in ferromagnetic materials using magnetoresistive sensors,** A. R. Perry, P. V. Czipott, Quantum Magnetics, Inc.; P. Meilland, IRSID (France); A. Singsaas, Concept Technology Inc.; W. F. Avrin, Quantum Magnetics, Inc. [3586-22]

11:30 am: **Improved near-field characteristics of phased arrays for assessing concrete and cementitious materials,** S. Wooh, L. Azar, Massachusetts Institute of Technology . . . . . [3586-23]

11:50 am: **Rapid determination of airport pavement condition using seismic methods,** D. R. Alexander, USAE Waterways Experimental Station . . . . . [3586-24]

Lunch Break . . . . . 12:10 to 1:30 pm

SESSION 4
Room: Pacific Ballroom B
Thurs. 9:20 am

Condition Assessment of Highway Bridges

9:20 am: **Validation of NDE methods** *(Invited Paper),* G. A. Washer, Federal Highway Administration; B. M. Phares, M. Moore, Wiss, Janney, Elstner Associates, Inc. . . [3587-14]

9:50 am: **Comparison of bridge load rating based on analytical and field testing methods,** C. S. Cai, M. A. Shahawy, A. El-Saad, Florida Dept. of Transportation . . . . . [3587-15]

10:10 am: **Computer stereo vision method for strand slippage measurement in prestressed concrete piles,** S. L. Gassman, M. F. Petrou, Univ. of South Carolina . [3587-16]

10:30 am: **Ultrasonic inspection of components in steel bridges using dual-line scanning technique,** I. N. Komsky, J. D. Achenbach, Northwestern Univ. . . . . [3587-17]

10:50 am: **Low-cost optical technology for remote bridge status measurements,** G. J. Wyntjes, A. D. Ducharme, T. F. Zehnpfennig, Visidyne, Inc. . . . . [3587-18]

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

SESSION 1
Room: Yawl
Thurs. 9:20 am

Chair: **Walter G. Reuter,** LMITCO/INEEL

9:20 am: **Portable holographic interferometer for residual stress measurement and nondestructive testing (NDT) of the pipelines,** I. Onichtchenko, A. Kniazkov, G. J. Salamo, Univ. of Arkansas [3588-01]

9:40 am: **Explosion-proof fiber optic system for continuous methane-concentration measurements,** S. Mirumyants, A. S. Makarov, State Institute of Applied Optics (Russia); V. M. Petukhov, JSK Transneftepprodukt (Russia) . . . . . [3588-02]

10:00 am: **Thermographic detection and quantification of material loss in steel by application of scanning line source,** K. Cramer, W. P. Winfree, NASA Langley Research Ctr.; J. Johnson, D. Reid, College of William and Mary; T. L. Reilly, ThermTech Services, Inc. . . . . [3588-03]

10:20 am: **Wide-range microspectrophotometer for monitoring the environmental hydrocarbon pollution,** I. G. Denisov, A. I. Bakhtin, Kazan State Univ. (Russia); A. S. Makarov, S. Kozlov, State Institute of Applied Optics (Russia) . . . . . [3588-04]

10:40 am: **Clean, inspect, and repair: total solution piping maintenance with one tool,** R. K. Lewis, R. Brooks Associates, Inc. . . . . [3588-05]

11:00 am: **Portable optoelectronic device for detecting the corona discharges in high-voltage power lines,** Y. A. Vandyukov, A. S. Makarov, V. Ivanov, S. Kozlov, Y. Dedyukhin, V. K. Kozlov, A. Sobolev, A. Safin, State Institute of Applied Optics (Russia) . . . . . [3588-06]

11:20 am: **Novel temperature indicator for identifying hot spots in power plant boilers,** J. Lai, City Univ. of Hong Kong . . . . . [3588-07]

11:40 am: **Video information-decoding automation in the problem of pipeline leakage location with helicopter equipment,** R. Aleev, V. Fofanov, A. Busarev, Research & Production Co. Optooil (Russia) . . . . . [3588-08]

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

SESSION 4
Room: Catamaran
Thurs. 9:20 am

Process Monitoring III

Chairs: **Sharon Cascadden,** Hughes Space and Communications Co.; **Moshe Rosen,** Johns Hopkins Univ.; **David M. Pepper,** HRL Labs.

9:20 am: **Fiber optic sensor for composite cure monitoring,** J. L. Lenhart, National Institute of Standards and Technology; J. H. van Zanten, Johns Hopkins Univ.; J. Dunkers, C. G. Zimba, National Institute of Standards and Technology; S. K. Pollack, C. James, Howard Univ.; R. Parnas, National Institute of Standards and Technology [3589-16]

9:40 am: **Feedback control of the vacuum assisted resin transfer molding (VARTM) process,** D. Heider, Univ. of Delaware; B. K. Fink, U.S. Army Research Lab.; J. W. Gillespie, Jr., Univ. of Delaware . . . [3589-17]

10:00 am: **Intelligent control of an induction welding process for carbon fiber composites,** R. M. Foulk, IV, R. Berger, S. Yarlagadda, D. Heider, Univ. of Delaware; B. K. Fink, U.S. Army Research Lab.; J. W. Gillespie, Jr., Univ. of Delaware . . . [3589-18]

10:20 am: **Fiber optic Raman backscatter temperature monitoring in composites,** J. H. Belk, E. W. Baumann, M. L. Vandernoot, Boeing Phantom Works . . . . . [3589-19]

Coffee Break . . . 10:40 to 11:00 am

11:00 am: **Marceling detection and location in composites,** J. H. Belk, Boeing Phantom Works; S. Ng, S. J. Claus, Naval Air Warfare Ctr.; P. Jouin, Boeing Phantom Works . [3589-20]

11:20 am: **Pitch catch untrasonic bond sensor for the in-situ tow placement consolidation of thermoplastic laminates,** B. Zurn, S. C. Mantell, Univ. of Minnesota/ Twin Cities . . . . . [3589-21]

11:40 am: **Intrinsic fiber optic Sagnac ultrasound sensor for process monitoring in composite structures,** P. Fomitchov, S. Krishnaswamy, J. D. Achenbach, Northwestern Univ. . . . . [3589-22]

Noon: **On-machine characterization of moving paper using a photo-emf laser untrasonic method,** B. F. Pouet, Lasson Technologies, Inc.; E. Lafond, B. Pufahl, P. Brodeur, Institute of Paper Science and Technology; G. D. Bacher, M. B. Klein, Lasson Technologies, Inc. . . . . [3589-23]

12:20 pm: **Acoustic emission monitoring of fiber breakage during TMC consolidation,** R. Rowland, MATSYS, Inc.; G. Munger, Stereoaxis, Inc. . . . . [3589-24]

3589 ends ■

Conference 3585

Conference 3586

Conference 3587

Conference 3588

Conference 3589

Thursday 4 March 1999

SESSION 5
Room: Pacific Ballroom A
Thurs. 1:30 pm

NDE for Composites I

Chairs: **Lawrence M. Brown,** Naval Surface Warfare Ctr.; **John H. Hemann,** Cleveland State Univ.

1:30 pm: **Characterization of composite microstructure and damage using optical coherence tomography,** J. Dunkers, C. G. Zimba, D. Hunston, K. Flynn, R. Parnas, National Institute of Standards and Technology; R. Prasankumar, J. G. Fujimoto, Massachusetts Institute of Technology . . . . . [3585-27]

1:50 pm: **Non-contact laser-based computation method of NDE of composites and other structures,** T. M. Thevar, J. M. Webster, Holographics Inc.; J. M. Mew, Univ. of Portsmouth (UK) . . . . . [3585-28]

2:10 pm: **Application of NDE technologies to support in-service health monitoring of flexible composite components,** L. M. Brown, M. R. Novack, Naval Surface Warfare Ctr.; N. Qaddoumi, Colorado State Univ. . . . . [3585-29]

2:30 pm: **Spectral analysis of plate waves for characterization of composites,** E. Rodriguez, S. Nazarian, J. H. Pierluissi, Univ. of Texas/El Paso . . . . . [3585-30]

2:50 pm: **Imaging of flaws in composite honeycomb aircraft structures using instrumented tap test,** D. K. Hsu, J. J. Peters, D. Fei, D. J. Barnard, Iowa State Univ. . . . . [3585-31]

SESSION 4
Room: Trimaran
Thurs. 1:30 pm

Emerging NDE Technologies

Chair: **Jiann W. Ju,** Univ. of California/Los Angeles

1:30 pm: **Log-periodic time-to-failure analysis of failure** *(Invited Paper),* D. Sornette, Univ. of California/Los Angeles and Univ. de Nice-Sophia Antipolis . . . . . [3586-2 5]

2:00 pm: **Processing of uncertain NDE data,** C. M. Ferregut, A. Revilla, Univ. of Texas/El Paso . . . [3586-26]

2:20 pm: **Pattern recognition techniques applied to data derived from large area rapid scan laser Doppler interferometry of aircraft samples,** J. M. Mew, Univ. of Portsmouth (UK); J. M. Webster, Holographics Inc. . . . . [3586-27]

2:40 pm: **Localization of damage on a vertical stabilizer assembly using strain energies and damage index,** G. C. Andre, C. J. Carrasco, R. A. Osegueda, Univ. of Texas/El Paso; G. H. James III, Univ. of Houston; M. Gryger, NASA Johnson Space Ctr . . . . . [3586-28]

SESSION 5
Room: Pacific Ballroom B
Thurs. 1:30 pm

Condition Assessment of Highway Pavements

1:30 pm: **Framework for incorporating nondestructive evaluation (NDE) into pavement and bridge management systems,** J. Sobanjo, K. Tawfiq, Florida State Univ. . . . . [3587-19]

1:50 pm: **Performance evaluation of FWD backcalculation algorithms through finite element modeling,** S. N. Shoukry, G. W. William, West Virginia Univ. . . . . [3587-20]

2:10 pm: **Rebound shear modulus interpretation from a class of nondestructive impact tests for pavements,** U. Karim, Univ. of Twente (Netherlands) . . . . . [3587-21]

2:30 pm: **Effect of induced deformation on pavement evaluation,** K. Tawfiq, J. Sobanjo, Florida State Univ. . . . . [3587-22]

SESSION 2
Room: Yawl
Thurs. 1:30 pm

Chair: **Walter G. Reuter,** LMITCO/INEEL

1:30 pm: **Real-time data analysis for gas pipeline girth weld inspections,** N. Dube, M. D. Moles, R/D Tech (Canada) . . . . . [3588-09]

1:50 pm: **IR equipment for technical-state monitoring of aging infrastructure and manufacturing,** A. Bugayenko, V. Kurt, V. Lening, State Institute of Applied Optics (Russia) . . . . . [3588-10]

2:10 pm: **Magnetostrictive characterization of notches in steel pipes,** Y. Lu, Southwest Research Institute . . . . . [3588-11]

2:30 pm: **Nondestructive study of plastic pipe characteristics with double-pulse holographic interferometry,** V. B. Markov, J. D. Trolinger, MetroLaser, Inc.; A. I. Khizhnyak, Institute of Applied Optics (Ukraine); P. M. Boone, N. N. Thanh, P. Vanspeybroeck, Univ. of Ghent (Belgium) . . . . . [3588-12]

2:50 pm: **Thermal and mechanical protection of CCD sensor used for monitoring the 3000 meter pipes deep underground,** A. Mei, Z. Lin, Wuhan Technical Univ. of Surveying and Mapping (China) . . . [3588-13]

3588 ends ■

Nondestructive Evaluation Techniques for Aging Infrastructure & Manufacturing

Conference 3585

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Conference 3589

Thursday 4 March 1999

✔Poster Session/Coffee Break

California Ballroom 1&2 . . . . . 3:10 to 4:10 pm

Posters will be displayed 3:10 to 4:10 pm in the California Ballroom 1&2.
Authors will be available for discussion.

✔ **Evaluation of residual stress gradients by diffraction methods with wavelets: a neural network approach,** H. Wern, M. Ringeisen, HTW des Saarlandes I (Germany) . . . . . [3585-43]

✔ **Detection of fatigue damage zone by visualization,** K. Ichinose, Tokyo Denki Univ. (Japan); K. Taniuchi, Meiji Univ. (Japan); K. Fukuda, Univ. of Tokyo (Japan) . [3585-44]

✔ **Evaluation of deformation-induced transformation and reversion processes of stainless steel by acoustic microscope,** Y. Kasuga, Tamagawa Univ. (Japan); T. Endo, Olympus Optical Co. Ltd. (Japan); C. Miyasaka, The Pennsylvania State Univ.; H. Kasano, Takushoku Univ. (Japan) . . . . . [3585-45]

✔ **Ultrasonic non-specular reflection for an immerged multilayered anisotropic structure,** A. Rehman, Nanyang Technological Univ. (Singapore); C. Potel, Univ. de Technologie de Compiegne (France); N. Guo, Nanyang Technological Univ. (Singapore); J. F. de Belleval, Univ. de Technologie de Compiegne (France) . . . . . [3585-46]

✔ **Aberration-free ultrasonic C-mode imaging system with an ultrasonic phase conjugator,** M. Ohno, K. Yamamoto, A. Kokubo, K. Takagi, Univ. of Tokyo (Japan) . . . . . [3585-47]

✔ **Nondestructive measurement for multilayer inhomogeneous material by means of multiresolution analysis,** J. Zhu, Zhejiang Univ. (China) . [3585-48]

✔ **Nondestructive techniques for detection of delamination in ceramic tile: a laboratory comparison between IR thermal cameras and laser doppler vibrometers,** R. M. De Andrade, E. Esposito, G. M. Revel, N. Paone, Univ. degli Studi di Ancona (Italy) . . . . . [3585-49]

✔ **SLDV for the analysis of defects in the teeth cavity resin filling,** L. Scalise, E. Esposito, A. Putignano, G. Rapelli, Univ. degli Studi di Ancona (Italy) . . . . . [3585-50]

✔ **Imaging corrosion in aircraft structures with reverse geometry x-ray Æ,** N. A. Cmar-Mascis, U.S. Army Research Lab.; W. P. Winfree, F. R. Parker, NASA Langley Research Ctr. . . . . [3586-44]

✔ **Emerging holographic techniques for advanced space research,** V. Petrov, Fachhochschule Ulm (Germany) . . . . . [3586-45]

✔ **NDE of hidden flaws in aging aircraft structures using obliquely backscattered ultrasonic signals (OBUS),** Y. Bar-Cohen, Jet Propulsion Lab.; A. K. Mal, Univ. of California/Los Angeles; M. E. Lasser, Imperium, Inc. . [3586-46]

Special Events

Poster Session

Nondestructive Evaluation Techniques for Aging Infrastructure and Manufacturing.

Thursday 4 March
3:00 pm
California Ballroom

This poster session will be in conjunction with the coffee break. Attendees will have an opportunity to view the poster papers and meet informally with the authors, who will be available to answer questions.

NOTE: Poster authors will be able to set up their poster papers between 8:30 am and 2:30 pm Tuesday.

Conference 3585

Conference 3586

Conference 3587

Thursday 4 March 1999

SESSION 6
Room: Pacific Ballroom A
Thurs. 4:10 pm

NDE for Composites II

Chairs: **Michele R. Novack,** Naval Surface Warfare Ctr.; **Carol A. Lebowitz,** Edison Welding Institute

4:10 pm: **NDE characterization of advanced composite materials with high-temperature optical fiber sensors,** T. A. Wavering, J. A. Greene, S. A. Meller, C. L. Kozikowski, T. A. Bailey, K. A. Murphy, F&S, Inc. . . . . [3585-32]

4:30 pm: **Generation mechanisms for laser ultrasonics,** M. K. Hinders, A. Friedman, College of William and Mary; E. Madaras, NASA Langley Research Ctr.; R. F. Anastasi, U.S. Army Research Lab. . . . . [3585-33]

4:50 pm: **Dielectric sensor arrays for monitoring of aging in composites and other low-conductivity media,** A. P. Washabaugh, D. E. Schlicker, A. V. Mamishev, M. Zahn, N. J. Goldfine, JENTEK Sensors, Inc. . . . . [3585-34]

5:10 pm: **FOPSESPI for nondestructive evaluation (NDE) of composites,** M. V. Murukeshan, A. K. Asundi, Nanyang Technological Univ. (Singapore); S. K. Malhotra, Indian Institute of Technology Madras (India) . . . . . [3585-35]

5:30 pm: **Effect of the shear distance on shearographic fringe pattern in NDE of composites,** G. Guo, Z. Wang, Y. Liu, F. Su, X. Wu, Beijing Institute of Aeronautical Material (China) . . . . . [3585-36]

SESSION 4 (continued)
Room: Trimaran
Thurs. 4:30 pm

4:10 pm: **Damage detection of a stiffened-plate using modal strain energy and data fusion,** L. R. Pereyra, R. A. Osegueda, C. J. Carrasco, C. M. Ferregut, Univ. of Texas/ El Paso . . . . . [3586-29]

4:30 pm: **NUVU: hand-held instruments for video inspection of aircraft wiring,** J. N. Pike, J.J. Pike & Co., Inc.; Y. Mehrotra, H. Kaplan, Materials Technologies Corp. . . . . [3586-30]

4:50 pm: **Electromagnetic microscope sizing cracks deep in multilayer structure of airframes,** W. N. Podney, SQM Technology, Inc. . . . . [3586-31]

5:10 pm: **Pulse phase thermography for defect detection and visualization,** S. Marinetti, National Research Council ITEF (Italy); Y. A. Plotnikov, W. P. Winfree, NASA Langley Research Ctr.; A. Braggiotti, National Research Council LADSEB (Italy) . . . . . [3586-32]

5:30 pm: **Artificial intelligence in computer-aided nondestructive inspection and disposition,** M. Collingwood, Boeing Co. . . . . [3586-33]

5:50 pm: **Real-time speckle shearography system for defect detection in aircraft materials,** H. H. van Brug, Delft Univ. of Technology (Netherlands) . . . . . [3586-34]

SESSION 6
Room: Pacific Ballroom B
Thurs. 4:10 pm

Condition Assessment of Reinforced Concrete

4:10 pm: **Ground penetrating radar for concrete bridge health monitoring application,** D. R. Huston, J. Q. Hu, P. L. Fuhr, Univ. of Vermont; K. R. Maser, Infrasense, Inc.; W. H. Weedon, Applied Radar Analysis; C. Adam, Altran Material Engineering . . . . . [3587-23]

4:30 pm: **Initial testing of advanced ground-penetrating radar technology for the inspection of bridge decks: the HEREMS and PERES bridge inspectors,** N. C. Davidson, Federal Highway Adminstration; S. B. Chase, Federal Highway Administration . . . . . [3587-24]

4:50 pm: **Signal processing schema for the HEREMS (high-speed electromagnetic roadway measurement and evaluation system) radar array based bridge deck inspector,** H. E. Jones, Lawrence Livermore National Lab. . [3587-25]

5:10 pm: **Delamination detection in reinforced concrete using thermal inertia mapping,** N. K. Del Grande, Lawrence Livermore National Lab. . . . . [3587-26]

Nondestructive Evaluation Techniques for Aging Infrastructure & Manufacturing

Conference 3585

Conference 3586

Conference 3587

Friday 5 March 1999

Plenary Presentation

Newport Ballroom North . . . . . 8:00 to 8:45 am

The Role of Nondestructive Evaluation in Our Infrastructure

Speaker: **Mr. Charles J. Hellier,** Rockwood Service Corp.

SESSION 7
Room: Pacific Ballroom A
Fri. 9:00 am

Optical Methods

Chairs: **Chiaki Miyasaka,** The Pennsylvania State Univ.; **Robert Osiander,** Johns Hopkins Univ.

9:00 am: **Analysis of organic binder distribution in spray dried granules by AFM hardness analysis,** L. Jia, M. Mandanas, C. Miyasaka, B. R. Tittmann, G. Messing, The Pennsylvania State Univ. [3585-37]

9:20 am: **Microscopic evaluation of ceramic/metal jointed interface,** C. Miyasaka, B. R. Tittmann, The Pennsylvania State Univ. [3585-38]

9:40 am: **Optical nondestructive testing technique capable of predicting failure,** S. J. Yoshida, M. H. Pardede, B. Siahaan, M. Pardede, I. Muhamad, N. Sijabat, H. Simangunsong, T. Simbolon, A. Adlin, J. Jubir, Indonesian Institute of Sciences (Indonesia) . . [3585-39]

Coffee Break . . . 10:00 to 10:30 am

10:30 am: **Non-invasive measurements of damage of frescoes and icons by laser scanning vibrometer: an experimental comparison among different exciters,** E. P. Tomasini, P. Castellini, E. Esposito, N. Paone, Univ. degli Studi di Ancona (Italy) . . [3585-40]

10:50 am: **Coherent light beating scattering (CLBS) for vibration and roughness control of surfaces,** A. T. Sukhodolsky, General Physics Institute (Russia) . . . . . [3585-41]

11:10 am: **Improvement of the video optical diffractometer for strain measurement,** G. Guo, Beijing Institute of Aeronautical Material (China); Y. Qin, L. Shao, Tianjin Univ. (China) . . . . . [3585-42]

3585 ends ■

SESSION 5
Room: Trimaran
Fri. 9:00 am

Lamb Wave NDE

9:00 am: **Composite materials stiffness determination and defects characterization using enhanced leaky Lamb wave dispersion data acquisition method** *(Invited Paper),* Y. Bar-Cohen, S. Lih, Jet Propulsion Lab.; Z. Chang, A. K. Mal, Univ. of California/Los Angeles . . [3586-35]

9:30 am: **Residual stresses in aircraft components, Part I: finite element modeling** *(Invited Paper),* S. A. Meguid, G. Sagals, J. C. Stranart, Univ. of Toronto (Canada) [3586-36]

9:50 am: **Residual stresses in aircraft components, Part II: nondestructive characterization using LLW** *(Invited Paper),* S. A. Meguid, J. C. Stranart, Univ. of Toronto (Canada) [3586-37]

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

10:40 am: **Impact of damage on propagation of Lamb waves on plates,** C. Tirado, S. Nazarian, Univ. of Texas/El Paso . . . . . [3586-38]

11:00 am: **Ultrasonic Lamb wave tomographic scanning,** M. K. Hinders, J. C. P. McKeon, E. V. Malyarenko, College of William and Mary . . . . . [3586-39]

11:20 am: **Lamb wave tomographic imaging system for aircraft structural health assessment,** W. Schwarz, M. E. Read, M. Kremer, Physical Sciences, Inc.; M. K. Hinders, J. C. P. McKeon, B. Smith, College of William and Mary . . . . . [3586-40]

11:40 am: **Evaluation of a wave interrogated near-field scattering measurement approach for NDE of material surfaces,** R. E. Diaz, L. Suresh, E. Hirleman, Arizona State Univ. . . . . [3586-41]

Noon: **Wide-area imaging of ultrasonic Lamb wave fields by electronic speckle pattern interferometry,** G. A. Gordon, B. A. Bard, T. D. Mast, The Pennsylvania State Univ. . . . . [3586-42]

12:20 pm: **Micromachined air transducers for ultrasonic NDE of aircraft,** S. T. Hansen, F. L. Degertekin, B. T. Khuri-Yakub, Stanford Univ. . . . . [3586-43]

3586 ends ■

SESSION 7
Room: Pacific Ballroom B
Fri. 9:00 am

Advanced Condition Assessment Technologies I

9:00 am: **Innovative GPR for pavement inspection,** R. M. Morey, Lawrence Livermore National Lab. . . . . [3587-27]

9:20 am: **Evaluation of reinforced with magnetostrictive sensors,** K. A. Bartels, Y. Lu, C. P. Dynes, Southwest Research Institute . . . . . [3587-28]

9:40 am: **Acoustic inspection of concrete bridge decks,** M. Henderson, G. Dion, R. D. Costley, Mississippi State Univ. . . [3587-29]

10:00 am: **Magnetic field measurements on bridges and development of a mobile SQUID-system,** J. Krieger, Federal Highway Research Institute (Germany); H. J. Krause, Forschungszentrum Juelich (Germany); G. Sawade, Otto-Graf-Institut (Germany); U. Gampe, Siempelkamp Pruef-und Gatachtergesellschaft (Germany) . . . . . [3587-30]

Coffee Break . . . 10:20 to 10:50 am

SESSION 8
Room: Pacific Ballroom B
Fri.10:50 am

Advanced Condition Assessment Technologies II

10:50 am: **Evaluation of holding-down bars in cable-stayed bridges by using frequency response method,** Y. Baek, H. Choi, Daelim Industrial Co., Ltd. (Korea); H. Lee, Korea Univ. (Korea) . . . . . [3587-31]

11:10 am: **Use of seismic pavement analyzer in forensic studies,** D. Yuan, S. Nazarian, Univ. of Texas/El Paso; M. R. Baker, Geomedia Research and Development . . . . . [3587-32]

11:30 am: **Essentially continuous rutting and roll-by deflection measured using scanning ladar designed for rolling wheel deflection systems,** W. J. Herr, Phoenix Scientific, Inc.; M. Symons, U.S. Dept of Transportation; A. Harrison, U.S. Army Corps. of Engineers [3587-33]

11:50 am: **Acoustic emission application for estimation of deterioration of reinforced concrete beams,** D. Yoon, W. Weiss, S. P. Shah, Northwestern Univ. . . . . [3587-34]

3587 ends ■

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Electroactive Polymers (EAP) as Emerging Actuators and Sensors for Devices and Robotic Applications

This course will provide an overview of the fundamentals of EAP and their application to actuators, sensors, devices and robotic mechanisms and systems. The EAP materials that will be covered include ionic polymer metal composites (IPMC), polymer gel muscles, electro-statically actuated, etc. The basic mechanisms that are responsible for the electroactive behavior of EAP materials will be described. In addition, the mechanical properties of normal human muscle will be presented as the "gold standard" which is to be achieved by EAPs. The process of fabricating leading materials and methods of enhancing their performance will be reviewed. The fundamentals of EAP chemical and electrical stimulation will be covered and compared with natural muscle. The course will also cover micro fabricated sensors and actuators as related to the field of MEMS, which is a rapidly growing area. The course begins with describing the currently available EAP materials and principles of operating them as biomimetic sensors, actuators and artificial muscles. The course follows with description of the basic elements of EAP systems including electronic driving circuits. The course ends with a review of the future prospect of EAP as actuation and sensing elements in space, industrial and medical devices/systems, as well as the possibility of incorporating these EAPs during surgical reconstruction of the upper extremities.

BENEFITS

After completing this course, you will be able to:

- identify the available and emerging actuators and sensors using EAP materials
- understand the fundamentals of electroactive behavior in leading EAP materials that can serve as sensors and actuators
- understand the basic structure and mechanical properties of human skeletal muscle
- describe the capability, limitations and benefits of electroactive polymers
- assess the applicability of current EAP actuators and sensors while accounting for their limitations
- define basic principles of electrically driving EAP actuators
- familiarize with mechanical analysis and design principles associated with EAP
- describe the future prospect of EAP materials as sensors and actuators and their applications
- identify major EAP fabrication technologies and trends in applying them to MEMS
- classify major principles for micro EAP sensing and actuation
- recognize future possibilities of applying EAP materials in surgical reconstruction.

INTENDED AUDIENCE

Engineers, scientists and managers who need to understand basic concepts of EAP or interested in learning, applying or engineering actuators, devices or robotic mechanisms using EAP materials and the requirements for their medical application as artificial muscles. Also, it is intended for participants who need to understand the basic concepts of MEMS and evaluate.

INSTRUCTORS

Yoseph Bar-Cohen is resident NDE expert and Group Leader for the NDE and Advanced Actuators Technologies of Jet Propulsion Lab., as well as an Adjunct Professor at UCLA. Also, he is a Fellow of ASNT and a leading expert in advanced actuators using electroactive polymer and ceramic and he has numerous publications and patents.

Paul Calvert is Professor in the Dept. of Materials Science and Engineering, Univ. of Arizona. His particular areas are freeform fabrication, conducting polymers, polymer gels and composites.

Richard L. Lieber is Professor of Orthopaedics and Bioengineering at the Univ. of California/San Diego, School of Medicine. Dr. Lieber studies the design and adaptive ability of skeletal muscle, especially with regard to upper extremity surgery. Dr. Lieber and colleagues recently received the Kappa Delta award from the American Academy of Orthopedic Surgeons for their work in this field.

Chang Liu is Professor at the Urbana-Champaign campus of the Univ. of Illinois. Dr. Liu has conducted research in the MEMS area since 1990, and has published many papers in this field, on subjects including micro-machined sensors and actuators.

Mohsen Shahinpoor is a Regents Professor and Director of Artificial Muscle Research Institute (AMRI), School of Engineering and School of Medicine, Univ. of New Mexico. His particular areas are smart/intelligent materials, structures and systems, ionic polymer metal composite (IPMC) biomimetic sensors and actuators and intelligent robotic systems.

SC01: $300/$360 CEU .65 Sun: 8:30 am to 5:30 pm

Active Structures for Vibration and Shape Control

Smart structures are being used in a wide range of products. The Hubble telescope contains smart materials for correcting optical deficiencies, chip fabrication equipment includes PZT actuators to cancel undesirable vibrations, and brassieres even use memory metals to retain their shape in the laundry. This course presents both fundamental concepts and practical instruction in the use of smart structures for these and other structural applications. Principles are reinforced through the use of the Smart Strut Demo, a self-contained, portable active damping learning aid.

BENEFITS

After completing this course, you will be able to:

- identify the optimum location for sensors and actuators based on critical mode shapes and their strain energy distribution
- quantify actuation performance of various piezoelectric, electrostrictive, magnetostrictive and shape memory materials
- quantify performance of sensors such as piezo ceramics and films, strain gages, LVDTs, inductive sensors and fiber optic Bragg gratings
- model the complete dynamics of a piezoelectric smart structure using standard finite element codes such as Nastran
- understand electronic circuit principles allowing you to design a complete analog vibration control system, including sensor charge amp, actuator driver and feedback compensator
- understand techniques for designing vibration control compensators using Bode, Nichols and root locus plots. Positive position, rate and integral feedback controllers are described.
- implement feedback controllers in discrete time digital systems
- understand and implement adaptive system identification and feedforward vibration control techniques
- apply these principles in applications such as the design of robotic arms and active vibration isolation and positioning systems.

INTENDED AUDIENCE

Engineers, students and instructors who want an in-depth and practical introduction to control systems for precision applications. Some prior finite element and control system knowledge is useful.

INSTRUCTOR

Allen J. Bronowicki is a senior staff engineer at TRW Space & Technology Division. He is currently developing precision structures technology for the Next Generation Space Telescope and the Space Interferometry Mission. Over the

past 13 years he has been principal investigator on several active structures R&D programs. Among these are: the Advanced Composites with Embedded Sensors and Actuators program, which developed an actively stabilized beam expander structure with sixteen foot long active members; and ACTEX-I, the first active member flight experiment, currently operating in space. Dr. Bronowicki is a member of the editorial board of Smart Materials and Structures, and holds eight patents on active and passive damped composite structures. He has received the TRW Chairman's Award for Innovation.

SC02: $300/$360 CEU .65 Sun: 8:30 am to 5:30 pm

Microsensors, MEMS, and Their Applications Including 'Smart Tongue' and 'Electronic Nose'

This course will overview the MEMS and Interdigital transducer (IDT) sensors, introduce the basis of silicon, polymer and composite material technology and characterize the selected aspects of the signal conditioning for sensors with the applications to health monitoring and condition-based maintenance of aerospace and civil structures. Topics to be covered include:

- silicon, UV curable conducting polymer, composite material sensors
- health monitoring and condition-based maintenance of structures using MEMS sensors
- transient MEMS design and biomedical devices
- MEMS sensors for automobile and aircraft
- microfabricated 'smart tongue' and 'electronic nose' sensors for food, liquor and beverages.

This will be followed by an overview of the currently available MEMS sensors and processing technologies including wafer processing, lithographies, film growth and deposition, ion implantation, and etching. Finally, the integration of the sensors, MEMS, and smart electronics into structures will be discussed. Wireless communication between sensors and display will be outlined.

BENEFITS

This course will enable you to:

- identify the sensor market in the auto, aerospace, biomedical and food industries
- understand the microsensor technology
- model and characterize the sensor performance
- appreciate the need of microfabricated sensors for structures
- design and process MEMS for specific and dual-use applications
- learn novel sensors for everyday use at home.

INTENDED AUDIENCE

People who work directly or peripherally with structures; those directly involved in program management, marketing, or other support activities; those who are curious how these miniaturized sensors will help in improving human health and in identifying the "spoiled" items.

INSTRUCTORS

Vijay K. Varadan and Vasundara V. Varadan are Alumni Distinguished Professors of Engineering Science and Electrical Engineering and Co-Directors of the Center for the Engineering of Electronic and Acoustic Materials.

SC03: $300/$360 CEU .65 Sun: 8:30 am to 5:30 pm

Preregister by Short Courses (SC Number)

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Smart Structures: Theory and Applications

A smart structure incorporates distributed actuators and sensors and self-contains the data processing and power conditioning capability. It has the capability to respond to a changing external environment (such as loads and shape changes) as well as to a changing internal environment (such as damage or failure). The course will cover basic fundamentals of smart structures, describe the state-of-the-art in various topical areas and show applications to various systems. Course content includes:

- introduction to smart actuators and sensors
- modeling of beams with induced strain actuation with piezoceramics and validation with test data
- modeling of laminated plates with induced strain actuation with piezoceramics and validation with test data
- Shape Memory Alloys (SMA): characteristics, modeling and fabrication techniques
- Electro-Rheological (ER) and Magneto-Rheological (MR) fluids: damping and stiffness characterization, fabrication and testing of dampers
- active/passive constrained layer damping
- application to various systems: vibration and noise suppression with controllable-twist and trailing-edge flaps.

BENEFITS

The course will enable you to:

- understand basic fundamentals of smart structures
- model and characterize different smart actuators
- comparatively evaluate different smart actuators and sensors
- formulate analysis of systems integrated with smart actuators
- analyze smart structures and systems using various methods
- design and develop smart structures systems
- fabricate and test smart structures systems
- augment damping using semi-active ER/MR fluid devices
- damping control using contrained layer damping
- use smart actuators to actively minimize vibration
- show potential applications.

INTENDED AUDIENCE

Students, practicing engineers, scientists and managers from industry, research laboratories and academia who want to learn basic elements and analytical methods of smart structures and want to apply these to various applications.

INSTRUCTORS

Inderjit Chopra is Minta-Martin Research Professor of Aerospace Engineering and Director of Alfred Gessow Rotorcraft Ctr. at the Univ. of Maryland. He is also the Program Head of ARO-sponsored Multidisciplinary Univ. Research Initiative (MURI), entitled "Innovative Smart Technologies for and Actively Controlled Jet-Smooth Quiet Rotorcraft."

Norman M. Wereley is Assistant Professor of Aerospace Engineering at the Univ. of Maryland and has published extensively in the area of smart structures.

SC04: $300/$360 CEU .65 Sun: 8:30 am to 5:30 pm

Fiber Optic Sensors for Smart Structures: Basics and Applications

Fiber optic sensors have developed to the level where they are having real impact in commercial/full-scale applications in smart structures. This course provides understandable explanations of the basics of Bragg Grating, Extrinsic Fabry-Perot and in-line fiber etalon sensors, describes basic signal processing and multiplexing schemes for these sensors. Applications involving each sensor type will be provided. Important issues like thermal compensation bonding, embedding, etc. will be covered.

BENEFITS

This course will enable you to:

- summarize the basic optics behind fiber optic sensors
- list and compare the basic benefits of different fiber optic sensor technologies
- clarify specific functional differences between Extrinsic Fabry-Perot, Bragg Grating, and In-line Fiber Etalon sensors
- list and compare basic serial multiplexing schemes
- understand and classify basic sensor demodulation schemes for Extrinsic Fabry-Perot, Bragg Grating, and In-line Fiber Etalon sensors
- embed or bond fiber optic sensors in or on structural components
- make basic measurements and interpret fiber optic sensor data
- experience hands-opn demonstrations of fiber optic sensor products.

INTENDED AUDIENCE

Engineers of all disciplines who need to use fiber optic sensors in smart structures and other applications. The course terminology and information disseminating is especially well suited for mechanical, civil and aerospace engineers.

INSTRUCTOR

Jim Sirkis is an Associate Professor of Mechanical Engineering in the Smart Materials and Structures Research Ctr. at the Univ. of Maryland/College Park

SC05: $300/$360 CEU .65 Sun: 8:30 am to 5:30 pm

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

This short course will provide a general overview of the Nondestructive Evaluation (NDE) techniques for civil engineering applications. In-depth coverage will be provided on two of the popular NDE techniques: Ground Penetrating Radar (GPR) and Ultrasonics. The course will include discussions on the basic theory and instrumentation, data interpretation methodology and field applications of GPR and ultrasonic techniques for condition assessment of bridges, pavements, and building components.

BENEFITS

This course will enable you to:

- understand the basic theory and instrumentation
- apply data collection and interpretation methodology for testing of bridges, pavements and building components made up of concrete, steel, wood, and composites.

INTENDED AUDIENCE

The course is intended for practicing field engineers, bridge inspectors, highway personnel, research engineers, and anyone who wants to understand the basic concepts of GPR and ultrasonics for Civil Engineering applications.

INSTRUCTOR

Udaya B. Halabe is an Associate Professor of Civil and Environmental Engineering at West Virginia Univ. Dr. Halabe has several years of research and field testing experience in the area of nondestructive testing and evaluation of structural components. He also offers a graduate level course in nondestructive evaluation at West Virginia Univ., and is the lead author of a manual entitled, "Nondestructive Evaluation Methods for Highway Bridge Superstructures."

SC06: $175/$215 CEU .35 Tue: 8:30 am to 12:30 pm

Participants–

Participants of Smart Structures and Materials listed in black
Participants of NDE listed in green
Participants in boldface are members of SPIE

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Sunday 28 Feb	7:30 am to 4 pm
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Tuesday 2 March	7:30 am to 4 pm
Wednesday 3 March	7:15 am to 4 pm
Thursday 4 March	7:30 am to 4 pm
Friday 5 March	7:30 am to 11 am

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

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Breakfast breads and coffee will be served from 8:45 to 9:20 am Monday through Thursday, and at 7:30 to 8:00 am on Friday for symposium attendees near SPIE Registration. (Tuesday and Wednesday the breakfast breads and coffee will be served in the Exhibit Area.)

Coffee Breaks

Coffee will be served at the following times and locations (Tuesday and Wednesday the breaks will be in the Exhibit Area):

Sunday	10:00 to 10:30 am;
Pacific Ballroom Foyer	3:00 to 3:30 pm
Monday through Thursday	8:45 to 9:20 am;
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Lunches

Noon to 1:30pm
Daily lunch specials at the hotel will be available for attendees for $9.95 (includes entree, beverage, and dessert) on Monday through Thursday of the symposium. You may also order off the regular menu.

Desserts

Dessert snacks will be served in the Exhibit area (California Ballroom) Tuesday and Wednesday from 1:00 to 1:30 pm. Complimentary tickets for the dessert snacks will be included in attendee registration packets.

Proceedings of SPIE

A full-manuscript, editor-reviewed *Proceedings of SPIE* volume will be published for each conference and will be available within eight weeks after the symposium. If you are unable to attend, you may order Proceedings now at reduced prepublication prices. See page **xx** for details and order information.

Smart Structures & Materials Technical Group

Monday 1 March • 7 to 9 pm • Pacific Ballroom E

See p. 6 for more information

Poster Sessions

Smart Structures and Materials

Tuesday 2 March • 6 to 7:30 pm
California Ballroom

A poster session will be held on Tuesday evening for all attendees of the Smart Structures and Materials symposium. Attendees will have an opportunity to view the poster papers and meet informally with the authors, who will be available to answer questions. Refreshments and light hors d'oeuvres 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 8:30 am and 3:00 pm Tuesday. Poster papers can be previewed after 3 pm before the formal poster session begins at 6 pm.

Nondestructive Evaluation Techniques for Aging Infrastructure and Manufacturing.

Thursday 4 March • 3:00 pm
California Ballroom

This poster session will be in conjunction with the coffee break. Attendees will have an opportunity to view the poster papers and meet informally with the authors, who will be available to answer questions.

NOTE: Poster authors will be able to set up their poster papers between 8:30 am and 2:30 pm Thursday.

Sunset Cruise

Symposium attendees are invited to relax and enjoy the beautiful sunset sights departing from historic Balboa Pavilion. You will enjoy a wonderful theme buffet while cruising one of the largest, most beautiful small boat harbors in the world. Newport Harbor is lined with magnificent homes and exotic yachts some belonging to the rich and famous.

Attendees paying full conference registration are entitled to the cruise. If you wish to attend the cruise, you must check in at the Cruise Desk near SPIE registration. There you will receive your boarding ticket and boat assignment. You will need your boarding ticket to be allowed on the bus taking you to the boat dock. Buses begin loading at 6pm in front of the hotel. Vessel sailing times are firm, therefore all passengers must board the shuttles at their designated time. If you miss your bus loading time, you will miss the cruise. Attendees will be bused back to the hotel following the cruise.

Student attendees and guests may purchase tickets at the meeting for $40 each at the SPIE Cruise Desk on a space available basis.

Technical Exhibition

Exhibit Information

Two-Day Technical Exhibit
California Ballroom, Salons 1-4

Tuesday 2 March	8:45 am to 4:00 pm
Wednesday 3 March	8:45 am to 4:00 pm

Please bring a supply of business or personal cards to the exhibition to give to exhibit representatives wishing to contact you after the meeting.

For information about exhibiting at this symposium please contact Michele Johnson, Exhibit Coordinator, (1)360/676-3290 x354 or email **exhibits@spie.org**.

1998 Exhibitor List from Smart Structures and NonDestructive Evaluation Techniques:
Exhibiting Companies confirmed for 1999 are highlighted in **boldface**.(List as of November 12, 1998)

3M Co.; Specialty Optical Fibers
Active Control eXperts, Inc.-ACX
Ando Corp.; Measuring Instruments Div
Blue Road Research
Business Communications, Co
CSA Engineering, Inc.
Centurion NDT, Inc.
Coherent Inc.; Laser Group
Digisonix, Inc.; Division of Nelson Industries
dpiX; A Xerox New Enterprise Co.
Dr. Ettenmeyer GmbH & Co.
ETREMA Products, Inc.
Endevco Corp.
Expert System Applications, Inc.; Smart Structures Div.
Face International Corp
Fuji Medical Systems USA Inc.; Fuji NDT Systems
Hitec Products, Inc.
Honeywell, Inc.; Satellite Systems Operations
Infrasense, Inc.
Karta Technology Inc.; Engineering Services
KrautKramer; Emerson Electric
Laser Technology, Inc.
Lorad Industrial Imaging
Magsoft Corporation
Materials Systems, Inc.
Measurements Group, Inc.
Mesa Technical Services, Inc.
MicroStrain, Inc.
Micron Optics, Inc.
Ometron, Inc.
Panametrics, Inc.; NDT Div.
Photonetics, Inc.; MetriCor Div.
Photonics Spectra; Laurin Publishing Co., Inc.
Polytec PI, Inc.
Proto Manufacturing Ltd.
Pure Technologies, Inc.
R/D Tech
ROCTEST Ltd.
Reinhart & Associates, Inc.
Richter Enterprises Inc.
SAE-Garman Systems, Inc.
SONATEST Inc.
Sensor Technology, Ltd.
Smartec SA
SonicForce Corp.
Stanford Univ.; Structures & Composites Lab.
Test Equipment Distributors

Awards

Wednesday 3 March • 8:00 to 8:10 am • Pacific Ballroom C/D

Smart Structures & Materials Achievement Award

This award will be presented yearly to an individual whose vision and leadership in the research, development, and application of smart structures and materials concepts has led to significant advances in the state-of-the-art of these interdisciplinary technologies. Selection is made by the SPIE Smart Structures and Materials Conference Planning Committee members.

Smart Structures Product Implementation Award

This award is intended to recognize those individuals or companies who have taken the critical step of transitioning smart structures technologies into viable industrial and commercial products. The best product will be selected on the basis of its importance, uniqueness, and usefulness to the defense or commercial industry by a panel of independent technical experts. We are looking for the most innovative—but realistic—products using smart structures and materials technologies. System integration aspects will be an important criterion as well.
A plaque with the names of the company and the product will be presented during the 1999 SPIE Smart Structures and Materials Conference. SPIE will publish information about the winner and the product in OE Reports; and news items will be sent to appropriate trade journals. In addition, the winning company will be able to use the recognition associated with this award in any of its subsequent marketing and promotional endeavors.

Applications, due Friday, 8 January 1999, are still being accepted. Please contact Dr. Janet Sater at the Institute for Defense Analyses, 1801 N. Beauregard St., Alexandria, VA 22311 (phone at 703-578-2978 or e-mail at jsater@ida.org).

Smart Structures & Materials Best Student Paper Award

The award for the best student paper at the Symposium will be presented on Wednesday morning prior to the plenary talk. The paper will be selected by the Smart Structures Technical Group as the one best demonstrating the use of the enabling technologies of smart structures in a system having some degree of adaptability to changing conditions. The author(s) of the winning paper will receive a plaque and a check for $500.

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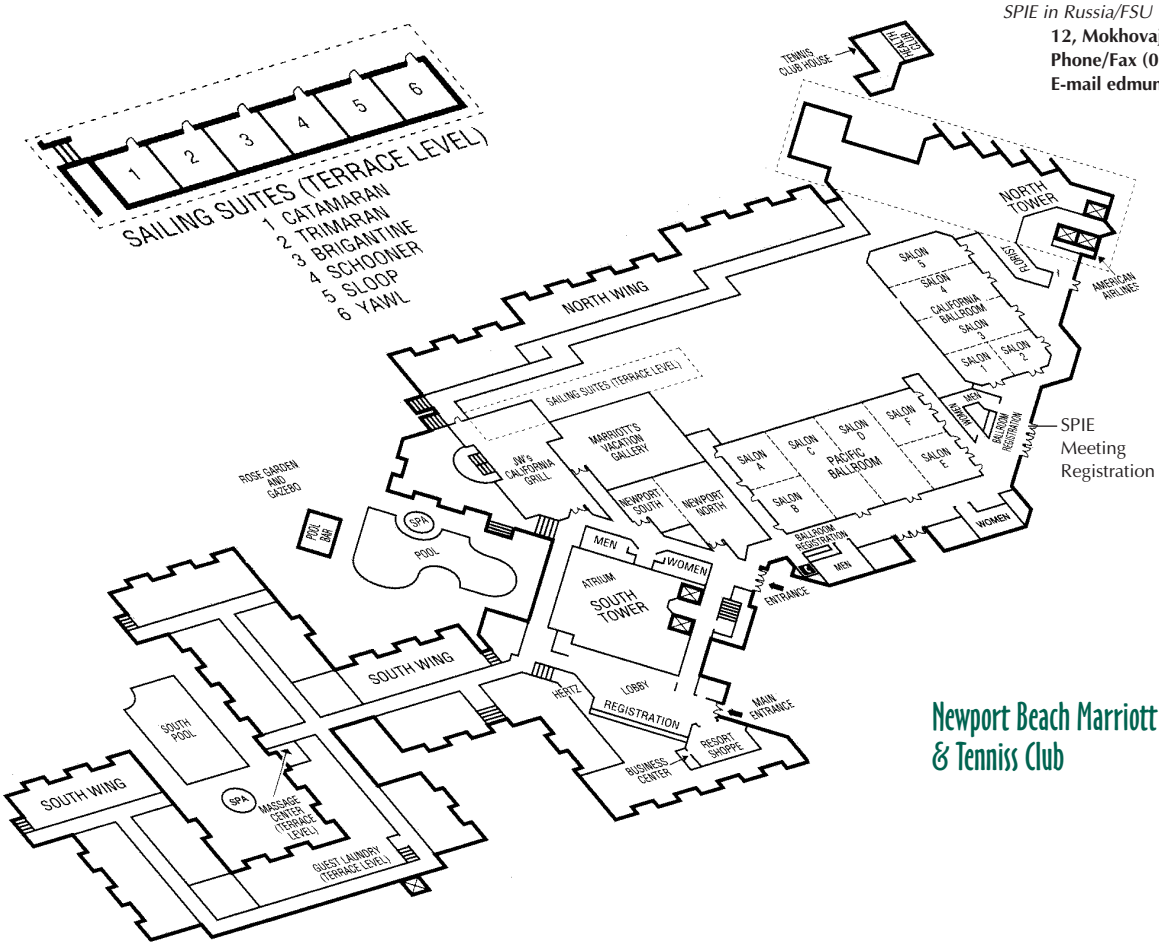

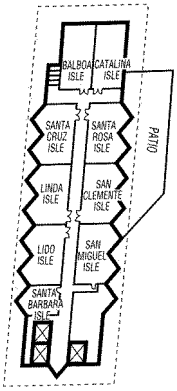

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Reserve housing before 8 Feburary 1999!

Hotel Reservation Form

SPIE's 6th Annual International Symposium on
Smart Structures and Materials

SPIE's International Symposium on
Nondestructive Evaluation Techniques for Aging Infrastructure and Manufacturing.

I will attend SPIE's 6th Annual International Symposium on Smart Structures Materials and/or SPIE's International Symposium on Nondestructive Evaluation Techniques for Aging Infrastructure and Manufacturing, 1-5 March 1999. Please reserve a room for me at the special reduced daily rates for this symposium:

$129 single or double room plus 10% tax.
(An additional fee of $10.00 will be charged for an extra person)

PLEASE MAKE YOUR RESERVATIONS EARLY!
When the SPIE block of rooms is full, you will be charged the hotels' regular rates.

I will require a ☐ single; ☐ double (2 people, 1 bed); or ☐ double-double (2 beds) at the convention rate.

Please Print Number of people in party: _____

Name (Please print) _____

Business Address _____ Arrival Date_____

_____ Arrival Time++_____

City, State, Zip Code
(or Country) _____ Departure Date_____

Telephone _____ Departure Time_____

++ All rooms reserved must be guaranteed by either a first night's cash deposit or a credit card processed as a deposit. If a guaranteed room is not canceled 24-hours prior to arrival, payment for the full rate on that room will be charged.
• Check-in time is 4 pm. Guests arriving before 4 pm will be accommodated as rooms become available. Check-out time is noon.

DEPOSIT AMOUNT $_____(including tax)
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Signature _____

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Make your hotel reservations today. Return the hotel reservation form before 8 February 1999 to:

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IMPORTANT! The Newport Beach Marriott Hotel has reserved a limited block of rooms at a reduced daily rate for attendees of the SPIE's 6th Annual International Symposium on Smart Structures and Materials and SPIE's International Symposium on Nondestructive Evaluation Techniques for Aging Infrastructure and Manufacturing. Accommodations at the reduced rates cannot be guaranteed after the block has been filled. Reservations received by the hotel after Monday, 8 February 1999 will be accepted on a first-come, first-served basis, according to availability and may be charged at the hotels' regular rates. You are urged to fill out and return this reservation form as soon as possible. If reservations are made by phone or other means, be sure to identify your reservation with the SPIE meeting to obtain the reduced rates.

Hotel

The headquarters hotel for this meeting will be the beautiful Newport Beach Marriott Hotel and Tennis Club. Newport Center, the heart of business and fashion, is the site of the hotel which overlooks the Newport Beach Country Club, Newport Harbor and the Pacific Ocean. The hotel offers convenient meeting space, a friendly and courteous staff, restaurants, lounges, a tennis club with eight lighted courts, two swimming pools, whirlpool, sauna, health club facilities, gift shop, and safe-deposit boxes.

Location/Transportation

The Newport Beach Marriott and Tennis Club is centrally located between Los Angeles and San Diego. Newport Beach is easily accessible from the John Wayne/Orange County Airport. The airport is located 10 minutes from the hotel and complimentary shuttle service is provided. The Los Angeles International Airport is approximately 55 minutes on Interstate 405 (San Diego Freeway).

Driving Directions

John Wayne Airport/Orange County: Go south on MacArthur Boulevard to Jamboree Road. Go west (right) on Jamboree three miles. Go south (left) on Santa Barbara Drive to Newport Center Drive. The hotel will be on the right at the top of the hill.

Los Angeles International Airport: Take Interstate 405 (San Diego Freeway) south to San Joaquin Hills Toll Road (73). Exit on Jamboree, turning right towards Corona del Mar. Continue down Jamboree Road to Santa Barbara Drive. Turn left on Santa Barbara Drive. The hotel will be on the right at the top of the hill.

Parking

There is complimentary outdoor parking at the hotel as well as valet parking.

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United Airlines is offering a 10% discount off the unrestricted mid-week coach fare or 5% discount off any published airfare from First Class to the lowest applicable discount for all attendees of this symposium. United Airlines is also pleased to offer an additional 5% discount towards the purchase of tickets purchased at least 60 days in advance of travel. This special offer applies to travel on domestic segments of all United Airlines, United Express and Shuttle by United flights. United's convenient schedule and discounted fares are available when you or your travel agent:

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If you purchase your ticket from your local travel agent, be sure you or the agent calls the United or Alaska Airlines Meeting Desks to make your reservation and that the convention numbers listed above are used. Seats are limited, so call early for best availability. International Travelers, please call your local travel agent or airline representative for best available fares.

AVIS Car Rental has been selected as the official car rental agency for the SPIE Symposium. Call **1-800-331-1600** and identify yourself as an SPIE attendee using the AWD Number **T080998** to receive the following rates: International attendees may fax Avis at: 918-664-2130 or reserve a car on the Avis World Wide **Web site (www.avis.com)**

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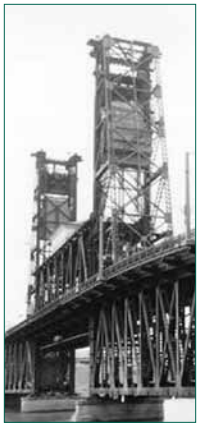

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Registration and Payment must be received by 17 February 1999

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See the Short Course descriptions on pp. 40–41 to determine which courses you wish to attend and for price information. Fill in the course number (e.g., SC1, SC2, etc.) and the price for each course you are registering for. **SPIE members receive substantial discounts** on all Short Courses.

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Did you reserve accommodations? See p. 50

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1–5 March 1999

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3–5 March 1999

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