

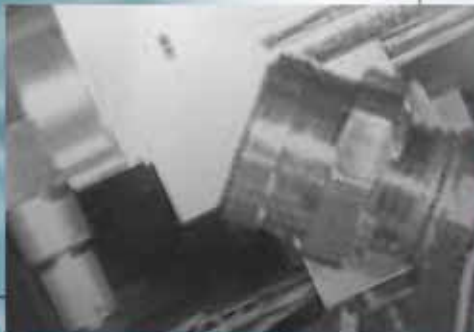
*SPIE's 9<sup>th</sup> Annual International Symposium on*  
**Smart Structures  
and Materials**

*SPIE's 7<sup>th</sup> Annual International Symposium on*  
**NDE for Health  
Monitoring  
and Diagnostics**

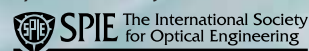
**17–21 March 2002**

*New Location!*

Town and Country Resort & Convention Center  
San Diego, California USA



*Sponsored by*



# Smart Structures and Materials

17-21 March 2002

Town & Country Resort and Convention Center  
San Diego, California USA

## Welcome!

We, the organizers and executive committees of the 2002 International Symposia on Smart Structures and Materials and on NDE for Health Monitoring and Diagnostics, and SPIE, welcome you. We think you will find significant opportunities for mutually beneficial interactions between our two symposia. While our primary objectives are to foster communications 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, we also hope to excite and inspire you through the plenary presentations and special conference talks addressing our theme of "The 'Smarts' of Smart Structures, Materials and Systems."

Please join us along with hundreds of engineers and scientists from the military, commercial, and academic sectors around the world 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.

**Marc E. Regelbrugge,**  
Rhombus Consultants Group

**Vasundara V. Varadan,**  
The Pennsylvania State University  
*Smart Structures Symposium Chairs*

**George Y. Baaklini,**  
NASA Lewis Research Ctr.

**Glenn Washer,**  
Federal Highway Administration  
*NDE Symposium Chairs*

**Welcome Reception**  
Monday 6:00 to 7:00 pm

*See page 2 for information.*

# NDE for Health Monitoring and Diagnostics

## Contents

Special Events .....	2-3
Daily Schedule .....	4
General Information .....	5
Technical Exhibition .....	6
<i>Technical Conferences</i>	
<b>Smart Structures and Materials</b> .....	7-30
Participants .....	31-35
<i>Technical Conferences</i>	
<b>NDE for Health Monitoring and Diagnostics</b> .....	36-43
Participants .....	44-45
Final Summary Digest .....	47-205
<i>Proceedings of SPIE</i> .....	206
Publications Order Form .....	207
SPIE Membership .....	208



## The Town and Country Resort

**& Convention Center** features 1,000 guest rooms spread over 40 lushly landscaped acres in San Diego's Mission Valley. The hotel has five restaurants providing diverse dining experiences, and several lounges offer a relaxing retreat from the day's activities. For casual dining, try the **Terrace Café** or for a quick bite visit the **Sunshine Deli**. You'll enjoy **Charlie's** for fun eats, a game of pool or the latest sports events on their big screen TV. **Trellises Garden Grille** features creative appetizers, healthy light entrees, a variety of pastas and pizzas, fish, vegetable entrees and lavish desserts. **Kelly's Steakhouse & Irish Pub** continues a tradition of serving some of the best slow-roasted prime rib you'll ever taste as well as hosting nightly sing-alongs in Kelly's famous piano bar. Four swimming pools, spa, and health club, barber and beauty services, in-room movies, valet and room services, and a complimentary morning newspaper are available to each guest! Located in the heart of Mission Valley, the Town and Country Resort is ideally situated for attendees and their guests to enjoy the many adjacent and nearby attractions. *Attendees wishing to arrange for tours/sightseeing for themselves, or traveling guests, should contact the hotel concierge prior to the meeting to make arrangements.*



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

This program is based on commitments received up to the time of publication and is subject to change without notice. Please check schedule board outside of the conference rooms for the most current changes.



# Special Events

## Sunday 17 March

### Smart Structures and Materials Technology Overviews

Room: Gold West

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

- 1:00 pm  
**Introduction**  
**Marc E. Regelbrugge,**  
Rhombus Consultants Group
- 1:20 pm  
**Smart Structures**
- 1:40 pm  
**Sensors**
- 2:00 pm  
**Actuators**
- 2:20 pm  
**MEMS**
- 2:40 pm  
**Controls**
- Coffee Break  
3:00 to 3:30 pm
- 3:30 pm  
**Damping and Isolation**
- 3:50 pm  
**Power Systems**
- 4:10 pm  
**Signal Processing**
- 4:30 pm  
**Conclusion**  
**Marc E. Regelbrugge**

## Monday 18 March

8:00 to 8:45 am • Town & Country

### SPIE Smart Structures and Materials Achievement Award

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

Plenary Presentation

#### Active Chatter Control Achieves Order-of-Magnitude Increase in Metal Removal Rate

Speaker: **Dr. Leonard S. Haynes**, President Intelligent Automation, Inc., Rockville, MD



**Biography:** Dr. Haynes is Founder and President of Intelligent Automation, Inc. and provides both the technical and business direction for all technology-related projects. In IAI's first 15 years of business IAI successfully won over 270 contracts. Of these, Dr. Haynes was the sole author of about 150 winning proposals, many of which relate directly to smart structures and materials. Dr. Haynes was Chairman of both the IEEE Robotics and Automation Society's

Standards Committee, and the Robotic Industries Association Standards Committee R15.04, and is active in other ongoing standards activities. Prior to founding IAI Dr. Haynes was the Leader of the Real-time Control Systems Group at NIST.

8:00 to 8:45 am • Pacific Salon 1

### NDE Best Student Paper Award

### NDE Best Paper Awards

### NDE Achievement Awards

Presenter: **George Y. Baaklini**, NASA Glenn Research Ctr.

Special Presentation

### NDE Reliability: the Past, Present, and Future

Dr. **Steven R. Doctor**, Pacific Northwest National Lab.

### NDE Achievement Award Winner

See page 37 for further information.

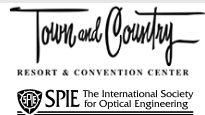
## Welcome Reception

Poolside by Terrace Pavilion

Monday 18 March . . . . . 6:00 to 7:00 pm

Sponsored by:  
San Diego Town and Country Resort  
& Convention Center

and SPIE



All attendees are invited to relax, socialize, and enjoy refreshments at the Town & Country resort poolside. Please remember to wear your conference registration badges. Dress is casual.

## Technical Group Meeting

Room: Royal Palm I

### Smart Structures and Materials

Monday 18 March . . . . . 7:30 to 9:00 pm

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

The Smart Structures and Materials Technical Group will meet to hear presentations from the six finalists in the Best Student Paper Contest, sponsored by Boeing Co., Rhombus Consultants Group, and CSA Engineering, Inc. Following the presentations, technical working group members will vote to determine the 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> place winning papers. The winners will be announced before the Plenary Presentation on Wednesday morning.

All conference attendees are cordially invited to attend.

## Tuesday 19 March

8:00 to 8:45 am • Town & Country

### ASME Adaptive Structures and Materials Systems Best Paper Awards

Presenter: **ASME Adaptive Structures and Materials Systems Technical Committee**

Plenary Presentation

### Multifunctional Materials

Speaker: **Dr. Leo Christodoulou**, DARPA, Arlington, VA

Photo not available.

**Dr. Leo Christodoulou**, DARPA Defense Sciences Office, is a Program Manager in the Structural Materials R&D area. His expertise encompasses the synthesis, processing, and performance of metallic, intermetallic, and composite materials. Dr. Christodoulou obtained his bachelor's degree and doctorate in metallurgy from Imperial College of Science, Technology, and Medicine, London, England.

## Poster/Exhibition Reception

Golden Ballroom

Tuesday 19 March . . . . . 6:00 to 7:30 pm

A poster session will be held on Tuesday evening for all attendees of the Smart Structures and Materials and NDE for Health Monitoring and Diagnostics symposia. 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 hearty hors d'oeuvres will be served. Attendees are requested to wear their conference registration badge.

Poster authors will be able to set up their poster papers between 10:00 am and 3:00 pm Tuesday. Poster papers can be previewed after 3 pm before the formal poster session begins at 6 pm.

Authors must remove their papers at the conclusion of the poster reception. It is the author's responsibility to remove their posters. Papers not removed will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of the poster reception.

**SPIE Thanks**

**BOEING**

**Rhombus  
Consultant Group**

**CSA Engineering, Inc.**

for sponsoring the  
**Smart Structures  
Best Student Paper Awards.**

## Wednesday 20 March

8:00 to 8:45 am • Town & Country

### Smart Structures and Materials Best Student Paper Awards

**Presenter:** Dr. Alison Flatau, National Science Foundation

*Plenary Presentation*

### Structural Damage Detection and Health Monitoring: A Myth or Reality

**Speaker:** Dr. Anne S. Kiremidjian, Professor and Director, Stanford Univ./ The John A. Blume Earthquake Engineering Ctr., Stanford, CA



**Biography:** Anne S. Kiremidjian is Professor of Civil and Environmental Engineering and Director of The John A. Blume Earthquake Engineering Ctr. at Stanford Univ. She received her B.S. degree from Columbia Univ. in Civil Engineering and her M.S. and Ph.D. degrees from Stanford Univ. in Structural Engineering. Professor Kiremidjian has

been on the faculty at Stanford since 1978 where she teaches courses in structural analysis, earthquake engineering, probabilistic methods, and structural reliability analysis. Her research has focused in the area of stochastic modeling of earthquake events, site hazard characterization, ground motion modeling, earthquake damage and loss estimation, structural damage modeling, risk analysis of transportation systems, and reliability analysis of industrial systems. Currently she is working on the development of distributed remote sensing systems for structural damage monitoring using imbedded sensors and wireless communication. Another major research topic is the development of methods for seismic risk analysis of transportation systems including port facilities. She has more than 100 papers and reports published on these topics.

During her career, Professor Kiremidjian has been active as a member of the Probabilistic Methods Committee of the Engineering Mechanics Div. of ASCE;

the Seismic Risk Committee and the Research Committee of EERI, the Committee on Building Instrumentation, CSMIP of the California Seismic Safety Commission; the Committee on Stochastic Methods in Structural Engineering, IASSAR; the Advisory Committee to the Biological and Critical Systems Div. of NSF; the Executive Committee of Technical Council on Lifeline Earthquake Engineering of ASCE for which she served as a chair in 1995-1996; Board of Directors, CUREe, for which she served as a Treasurer and Secretary; the Scientific Advisory Committee of NCEER, the Research Board of the Pacific Earthquake Engineering Ctr., and on the National Research Council Committee in Loss Estimation, National Academy of Engineering. She has received the School of Engineering Distinguished Advisor Award, Stanford Univ., June 1989, the National Science Foundation Faculty Award for Women, 1991-1995, the Society of Women Engineers Distinguished Educator Award, 1992, the American Society of Civil Engineer, the Technical Council on Lifeline Earthquake Engineering Distinguished Service Award, August 11, 1995 and the Extraordinary Achievement Award from Applied Technology Council in 1998. She was one of the founders of K2 Technologies, Inc., a leading natural catastrophe risk assessment and software development company, and served as its Chairman of the Board until 1998. She is also an advisor and consultant to other private companies and corporations.

Dr. Kiremidjian has 140 publications that include journals papers, technical reports, and conference proceeding papers. She has been an invited and keynote speaker at major national and international conferences and makes frequent presentations at seminars and other professional meetings.

## Thursday 21 March

8:00 to 8:45 am • Town & Country

### Smart Structures Product Implementation Award

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

*Plenary Presentation*

### Smart Materials 2002: Is There a Solid Business Opportunity Yet?

**Speaker:** Dr. Arthur V. Cooke, President Active Signal Technologies, Baltimore, MD

*Photo not available.*

**Biography:** Arthur Cooke is President of Active Signal Technologies, a six-year-old "start-up" company in Baltimore, Maryland, specializing in the development of devices that exploit the potential of smart materials for next-generation military and medical applications. These devices run the gamut from brain condition assessment in head-injured patients to small, power dense drivers for control surface actuation in unmanned aircraft.

Prior to founding Active Signal Technologies in 1996, Arthur was with Lockheed Martin for 14 years at the central research laboratory where he was program manager on a number of different technical initiatives and concurrently oversaw the Labs' patents and licensing portfolio.

He received his bachelors, masters, and Ph.D. degrees from Cambridge Univ. in England between 1978 and 1985.

[spieworks.com/careerexpos/ss](http://spieworks.com/careerexpos/ss)

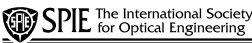





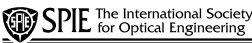





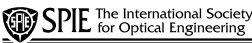





### Online Career Expo

**Job Seekers:** Find exciting new opportunities at the Smart Structures & NDE Career Expo. Live dates 17-21 March 2002.

**Employers:** Post jobs for free. That's right, there's no charge to post jobs to the Smart Structures & NDE Career Expo. Go to [spieworks.com/employers/CreateAccount](http://spieworks.com/employers/CreateAccount), create a "Web Account" and then sign in using your new Employer username and password. Once signed in, select the "Post a Job" button and then select the free Career Expo posting option. Your free job will be live 17-21 March 2002.

The Career Expo is sponsored by SPIEWorks.com, a career website designed by SPIE to serve the optics, photonics and imaging professional. You'll find jobs, company overviews and resource materials in one convenient location. Visit [SPIEWorks.com](http://SPIEWorks.com) today!

# Daily Schedule

Sunday 17	Monday 18	Tuesday 19	Wednesday 20	Thursday 21			
<b>Smart Structures and Materials</b>							
<b>Smart Structures and Materials Technical Overviews, p. 2</b> <i>(Free to registered attendees.)</i>	Conf. 4693 Modeling, Signal Processing, and Control, p. 8-28						
	Conf. 4694 Smart Sensor Technology and Measurement Systems, p. 8-20						
	Conf. 4695 Electroactive Polymer Actuators and Devices (EAPAD), p. 8-30						
	Conf. 4696 Smart Systems for Bridges, Structures, and Highways, p. 8-22						
	Conf. 4697 Damping and Isolation, p. 8-23						
	Conf. 4698 Industrial and Commercial Applications of Smart Structures Technologies, p. 8-29						
	Conf. 4699 Active Materials: Behavior and Mechanics, p. 8-30						
	Conf. 4700 Smart Electronics, MEMS, and Nanotechnology, p. 8-25						
	Conf. 4701 Smart Structures and Integrated Systems, p. 8-29						
<b>NDE for Health Monitoring and Diagnostics</b>							
	Conf. 4702 Smart NDE and Health Monitoring of Structural and Biological Systems, p. 37-43						
	Conf. 4703 Nondestructive Evaluation and Reliability of Micro- and Nanomaterial Systems, p. 37-42			Key Conf. = Conference			
	Conf. 4704 NDE and Health Monitoring of Aerospace Materials and Civil Infrastructures, p. 37-42						
<b>Special Events</b>							
<b>Smart Structures and Materials Technical Overviews, p. 2</b> <i>(Free to registered attendees.)</i>	<b>Smart Structures and Materials Achievement Award, p. 2</b> <i>Plenary Presentation: Active Chatter Control Achieves Order-of-Magnitude Increase in Metal Removal Rate, (Haynes), p. 2</i>	<b>ASME Adaptive Structures and Materials Systems Best Paper Awards, p. 2</b> <i>Plenary Presentation: Multifunctional Materials (Christodolou), p. 2</i>	<b>Smart Structures and Materials Best Student Paper Awards, p. 3</b> <i>Plenary Presentation: Structural Damage Detection and Health Monitoring: A Myth or Reality (Kiremidjian), p. 3</i>	<b>Smart Structures Product Implementation Award, p. 3</b> <i>Plenary Presentation: Smart Materials 2002: Is There a Solid Business Opportunity Yet? (Cooke), p. 3</i>			
	Smart Structures and Materials <b>Technical Group Meeting, p. 2</b>	<b>Poster/Exhibition Reception, 6:00 to 7:30 pm, p. 2</b> <b>Technical Exhibition, 10:00 am to 4:00 pm, p. 6</b>					
	<b>Ndestructive Evaluation Best Student Paper Award, p. 2</b>						
	<b>Ndestructive Evaluation Best Paper Awards, p. 2</b>						
	<b>Ndestructive Evaluation Achievement Awards, p. 2</b>						
	<b>Welcome Reception, p. 32</b>						
<table border="0"> <tr> <td style="vertical-align: top;"> <b>Sponsored by</b>             The International Society for Optical Engineering         </td> <td style="vertical-align: top;"> <b>Cosponsored by</b>   American Society of Mechanical Engineers   Society for Experimental Mechanics   Boeing Co.   Rhombus Consultants Group            CSA Engineering, Inc.   ISIS Canada         </td> <td style="vertical-align: top;"> <b>Cooperating Organizations</b>            Air Force Office of Scientific Research            DARPA—Defense Advanced Research Projects Agency            Intelligent Materials Forum (Japan)            U.S. Army Research Office            Jet Propulsion Lab.            National Science Foundation            The Ceramic Society of Japan            Office of Naval Research            Naval Research Lab.         </td> </tr> </table>					<b>Sponsored by</b>  The International Society for Optical Engineering	<b>Cosponsored by</b>  American Society of Mechanical Engineers  Society for Experimental Mechanics  Boeing Co.  Rhombus Consultants Group CSA Engineering, Inc.  ISIS Canada	<b>Cooperating Organizations</b> Air Force Office of Scientific Research DARPA—Defense Advanced Research Projects Agency Intelligent Materials Forum (Japan) U.S. Army Research Office Jet Propulsion Lab. National Science Foundation The Ceramic Society of Japan Office of Naval Research Naval Research Lab.
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# General Information

SPIE's 9<sup>th</sup> Annual International Symposium on  
**Smart Structures and Materials**

and

SPIE's 7<sup>th</sup> Annual International Symposium on  
**NDE for Health Monitoring  
and Diagnostics**

## Registration Hours

San Diego Town and Country Resort &  
Convention Center  
San Diego, California

Atlas Foyer

Sunday 17 March . . . . . 11:00 am to 4:00 pm

Grand Foyer

Monday 18 March . . . . . 7:00 am to 4:00 pm

Tuesday 19 March . . . . . 7:15 am to 4:00 pm

Wednesday 20 March . . . . . 7:30 am to 4:00 pm

Thursday 21 March . . . . . 7:30 to 11:00 am

## Technical Exhibition Hours

Golden Ballroom

Tuesday 19 March . . . . . 10:00 am to 4:00 pm  
6:00 to 7:30 pm

Wednesday 20 March . . . . . 10:00 am to 4:00 pm

- Meet managers and technicians to discuss your technology needs
- Compare the latest products and services
- Network with colleagues and exhibitors

## Speakers Audiovisual Desk Hours

Terrace Salon I/II

Sunday . . . . . 11:00 am to 5:00 pm

Monday through Thursday . . . . . 7:30 am to 5:00 pm

Speakers who have requested equipment beyond an overhead projector prior to the request deadline are asked to report to the Audiovisual Desk upon arrival at the meeting to confirm equipment requests. Speakers will be responsible for delivering visual materials to the conference room and may obtain their materials from the room monitor in the conference room immediately following the session.

## All Conference Welcome Reception

Poolside by Terrace Pavilion

Monday 18 March . . . . . 6:00 to 7:00 pm

Sponsored by: San Diego Town and Country Resort & Convention Center and SPIE

All attendees are invited to relax, socialize, and enjoy refreshments at the Town & Country resort poolside. Please remember to wear your conference registration badges. Dress is casual.

## Poster/Exhibition Reception

Golden Ballroom

Tuesday 19 March . . . . . 6:00 to 7:30 pm

The exhibition hall will be open Tuesday evening, in conjunction with the poster session, to allow attendees specific exhibition and poster viewing time during the symposia. Take this opportunity to see the exhibits and talk with company representatives as well as review posters. Refreshments will be served. Please remember to wear your conference registration badge.

## Coffee Breaks

10:00 to 10:30 am

Coffee and bakery items will be served at the following locations:

Monday and Thursday, Atlas Foyer

Tuesday-Wednesday, Exhibition Hall (Golden Ballroom)

3:10 to 3:40 pm

Coffee will be served at the following locations:

Sunday (3:00 to 3:30 pm), Monday and Thursday,

Atlas Foyer

Tuesday-Wednesday, Exhibition Hall (Golden Ballroom)

## Desserts

Dessert snacks will be served in the Exhibition Hall (Golden Ballroom) Tuesday and Wednesday from 1:00 to 1:30 pm. Complimentary tickets for 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 to twelve weeks after the symposium. If you are unable to attend, you may order Proceedings now at reduced prepublication prices. See page 206 for details and order information.

## Message Center

San Diego Town and Country Resort & Convention Center, San Diego, California

Phone: 619-908-5072

The SPIE Message Board will be located near the Registration Desk. Messages will be taken during registration hours Sunday through Thursday.

## Video/Digital Recording Policy

For copyright reasons, video or digital recording of any conference session is strictly prohibited without written prior consent from each specific presenter to be recorded. Individuals not complying with this policy will be asked to leave a given session and to surrender their film or disc. It is the responsibility of the presenter to notify SPIE if consent is given.

## Child Care

A child sitting service available in San Diego is:

**Marion's Child Care**

www.hotelchildcare.com

Note: SPIE does not imply an endorsement nor recommendation of these services. They are provided on an "information only" basis for your further analysis and decision. Other services may be available.

## Travel Arrangements



SPIE thanks United Airlines for providing discounted rates for the symposia.



SPIE thanks Southwest Airlines for providing discounted rates for the symposia.



Hertz Car Rental has been selected as the official car rental agency for this Symposia. To reserve a car, identify yourself as a **Smart Structures & Non Destructive Evaluation Meeting attendee** using the **Hertz Meeting Code CV# 029B0002**. In the United States call 800-654-2240.

## San Diego Town & Country Resort and Convention Center

500 Hotel Circle North, San Diego, CA 92108 USA

Hotel Telephone: 619 291 7131 or 800 772 8527

Fax: 619 291 3584

## Parking

Guest self-parking has been arranged at the hotel for Smart Structure/NDE attendees for \$5.00 per night. Be sure to identify yourself as a Smart Structures/NDE 2002 attendee at check-in to receive the parking discount.

## San Diego Trolley (Metropolitan Transit System)

The San Diego Trolley, referred to as the "moving landmark" is a fun way to get around, serving a wide area from the International Border, to Centre City's shopping harbor, Mission Valley, Fashion Valley, Old Town, Downtown including the Gas Lamp Quarter, etc. Fares are based on the trip distance.

Trolley Fares are based on trip distance. Cash fares are listed below. Tickets can be purchased from ticket machines at each station. Some machines require exact change, some accept \$1.00 or \$5.00 bills, and Susan B. Anthony coins are also accepted.

**One-way Trolley Fare**, if you travel within downtown San Diego \*, or 1 station-\$1.25\*; 2 Stations-\$1.50; 3 Stations-\$1.75; 4-10 Stations-\$2.00; 11-19 Stations-\$2.25; 20+ Stations-\$2.50; Senior/Disabled (any distance)-\$1.00

\*Downtown San Diego cash fare allows unlimited rides (including round trips) within the Center City area only for two-hours from the time of ticket purchase. For further information check their website at [www.sdcommute.com](http://www.sdcommute.com)

## Local Attractions

**Fashion Valley Mall:** Located directly behind the hotel. Two level outdoor garden center featuring over 300 speciality shops and restaurants and an 18 screen movie complex. It is the largest shopping area in San Diego!

**Old Town:** Take the Trolley or Hotel Shuttle to the founding site of San Diego with excellent Mexican dining and shopping at Bazaar Del Mundo.

**San Diego Zoo:** Located 5 miles south of the hotel.

**Sea World:** West of the hotel on Mission Bay.

**Horton Plaza/Gas Lamp Quarter:** Take the Trolley to downtown San Diego and enjoy shopping at Horton Plaza and/or the exciting nightlife of excellent restaurants and clubs of the Gas Lamp District.

**Seaport Village:** Situated on 22 acres of parkland at the water's edge, over 60 shops, galleries, and boutiques along with restaurants are found in this unique village.



# Dont miss the Exhibition!

## Exhibition Hours

Golden Ballroom

Tuesday 19 March ..... 10:00 am to 4:00 pm;  
6:00 pm to 7:30 pm

Wednesday 20 March ..... 10:00 am to 4:00 pm

- Meet managers and technicians to discuss your technology needs
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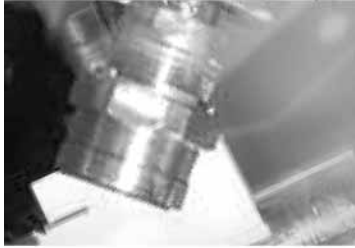
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*SPIE's 9th Annual International Symposium on*

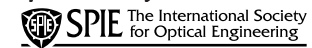
# Smart Structures and Materials

17–21 March 2002 • San Diego, CA

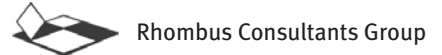
## *Symposium Executive Committee*

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**Gary L. Anderson**, U.S. Army Research Office  
*Army Representative*  
**Pratul K. Ajmera**, Louisiana State Univ.  
**A. Emin Aktan**, Drexel Univ.  
**Eric H. Anderson**, CSA Engineering, Inc.  
**Yoseph Bar-Cohen**, Jet Propulsion Lab.  
**Amr M. Baz**, Univ. of Maryland/College Park  
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**Dryver R. Huston**, Univ. of Vermont  
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**Vittal S. Rao**, Univ. of Missouri/Rolla  
**Marc Regelbrugge**, Rhombus Consultants Group  
**Anna-Maria Rivas McGowan**, NASA Langley Research Ctr.  
**Jeffrey N. Schoess**, Honeywell Technology Ctr.  
**Ralph C. Smith**, North Carolina State Univ.  
**Yoshiro Suzuki**, The Ceramic Society of Japan  
**Luc Thevenaz**, Swiss Federal Institute of Technology (Switzerland)  
**Eric Udd**, Blue Road Research  
**Vasundara V. Varadan**, The Pennsylvania State Univ.  
**Vijay K. Varadan**, The Pennsylvania State Univ.  
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Jet Propulsion Lab.  
Office of Naval Research  
National Science Foundation  
Naval Research Lab.

# Smart Structures and Materials

Sunday

17 March 2002

## Smart Structures and Materials Technology Overviews

Room: Golden West

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

1:00 pm

### Introduction

**Marc E. Regelbrugge**, Rhombus Consultants Group

1:20 pm

### Smart Structures

1:40 pm

### Sensors

2:00 pm

### Actuators

2:20 pm

### MEMS

2:40 pm

### Controls

Coffee Break

3:00 to 3:30 pm

3:30 pm

### Damping and Isolation

3:50 pm

### Power Systems

4:10 pm

### Signal Processing

4:30 pm

### Conclusion

**Marc E. Regelbrugge**

## Proceedings of SPIE

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## Conference 4693

Room: Pacific Salon III

Mon.–Thurs. 18–21 March 2002  
Proceedings of SPIE Vol. 4693

## Modeling, Signal Processing, and Control

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

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

*Program Committee:* **Balakumar Balachandran**, Univ. of Maryland/College Park; **H. Thomas Banks**, North Carolina State Univ.; **Christian Boller**, European Aeronautic Defence and Space Co. (Germany); **Fredéric Bourquin**, Lab. Central des Ponts et Chaussées (France); **Fu-Kuo Chang**, Stanford Univ.; **Marcelo J. Dapino**, The Ohio State Univ.; **Ulrich Gabbert**, Univ. Magdeburg (Germany); **Stephen C. Galea**, Defence Science and Technology Organisation (Australia); **Karolos M. Grigoriadis**, Univ. of Houston; **Hans Irschik**, Johannes Kepler Univ. Linz (Austria); **Qing Jiang**, Univ. of California/Riverside; **Katharine J. Jones**, Rice Univ.; **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; **Reinhard Lerch**, Friedrich-Alexander Univ. Erlangen-Nürnberg (Germany); **Liviu I. Librescu**, Virginia Polytechnic Institute and State Univ.; **Thomas J. Royston**, Univ. of Illinois/Chicago; **Stefan Seelecke**, North Carolina State Univ.; **Robert T. Skelton**, Univ. of California/San Diego; **Vasundara V. Varadan**, The Pennsylvania State Univ.; **Wieslaw J. Staszewski**, Univ. of Sheffield (UK)

## Conference 4694

Room: Pacific Salon I

Mon.–Tues. 18–19 March 2002  
Proceedings of SPIE Vol. 4694

## Smart Sensor Technology and Measurement Systems

*Conference Chairs:* **Daniele Inaudi**, Smartec SA (Switzerland); **Eric Udd**, Blue Road Research

*Cochairs:* **Dryver R. Huston**, Univ. of Vermont; **Kim D. Bennett**, Lafayette College; **Jeffrey N. Schoess**, Honeywell Technology Ctr.; **Brian Culshaw**, Univ. of Strathclyde (UK); **Luc Thevenaz**, Swiss Federal Institute of Technology (Switzerland)

*Program Committee:* **Xiaoyi Bao**, Univ. of Ottawa (Canada); **Richard O. Claus**, Virginia Polytechnic Institute and State Univ.; **John P. Dakin**, Univ. of Southampton (UK); **Peter D. Dean**, Lockheed Martin Advanced Technology Ctr.; **Carolyn M. Dry**, Univ. of Illinois/Urbana-Champaign; **Wolfgang Ecke**, Institute for Physical High Technology (Germany); **Riccardo Falciali**, Consiglio Nazionale Ricerche (Italy); **Peter L. Fuhr**, San Jose State Univ.; **E. J. Friebele**, Naval Research Lab.; **Stephan Grosswig**, GESO (Germany); **Alfredo Knecht**, Univ. of Applied Sciences of Southern Switzerland (Switzerland); **Mark S. Miller**, BFGoodrich Aerospace; **Marc Niklès**, Omnisens SA (Switzerland); **Whitten L. Schulz**, Blue Road Research; **Pieter L. Swart**, Rand Afrikaans Univ. (South Africa); **Maurice P. Whelan**, European Commission Joint Research Ctr. (Italy)

## Conference 4695

Room: Town & Country

Mon.–Thurs. 18–21 March 2002  
Proceedings of SPIE Vol. 4695

## Electroactive Polymer Actuators and Devices (EAPAD)

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

*Cochair:* **Yoshihito Osada**, Hokkaido Univ. (Japan)

*Program Committee:* **Ray H. Baughman**, Honeywell Technology Ctr.; **Paul D. Calvert**, Univ. of Arizona; **Richard O. Claus**, Virginia Polytechnic Institute and State Univ.; **Pierre-Gilles de Gennes**, ESPCI (France); **Daniilo De Rossi**, Univ. degli Studi di Pisa (Italy); **Rainer W. Gülich**, Eberhard-Karls-Univ. Tübingen (Germany); **Olle Inganäs**, Univ. Linköping (Sweden); **Wen-Liang Liu**, Industrial Technology Research Institute (Taiwan); **Jaehwan Kim**, Inha Univ. (Korea); **Roy D. Kornbluh**, SRI International; **Ajit K. Mal**, Univ. of California/Los Angeles; **Benjamin R. Mattes**, Santa Fe Science and Technology, Inc.; **Chris Melhuish**, Univ. of the West of England (UK); **Siavouche Nemat-Nasser**, Univ. of California/San Diego; **Toribio F. Otero**, Univ. del País Vasco and Univ. Politécnica de Cartagena (Spain); **Randall R. Sands**, Consultant; **Mohsen Shahinpoor**, Univ. of New Mexico and Environmental Robots, Inc.; **Valery P. Shibaev**, Moscow State Univ. (Russia); **Elisabeth Smela**, Univ. of Maryland/College Park; **Peter Sommer-Larsen**, Risø National Lab. (Denmark); **Ji Su**, NASA Langley Research Ctr.; **Satoshi Tadokoro**, Kobe Univ. (Japan); **Minoru Taya**, Univ. of Washington; **Gordon G. Wallace**, Univ. of Wollongong (Australia); **Steven G. Wax**, DARPA; **Qi Ming Zhang**, The Pennsylvania State Univ.; **Miklos Zrinyi**, Budapest Univ. of Technology and Economics (Hungary)

## Conference 4696

Room: Royal Palm II

Mon.–Wed. 18–20 March 2002  
Proceedings of SPIE Vol. 4696

## Smart Systems for Bridges, Structures, and Highways

*Conference Chairs:* **S. C. Liu**, National Science Foundation; **Darryll J. Pines**, Univ. of Maryland/College Park

*Cochairs:* **Jan Ming Ko**, Hong Kong Polytechnic Univ. (Hong Kong); **A. Emin Aktan**, Drexel Univ.; **Steven B. Chase**, Federal Highway Administration

*Program Committee:* **Makola M. Abdullah**, Florida A&M Univ. and Florida State Univ.; **Thomas Baca**, Applied Technology Associates; **Fabio Casciati**, Univ. Degli Studi di Pavia (Italy); **Reginald DesRoches**, Georgia Institute of Technology; **Shirley J. Dyke**, Washington Univ.; **Charles R. Farrar**, Los Alamos National Lab.; **Maria Q. Feng**, Univ. of California/Irvine; **Alison B. Flatau**, National Science Foundation; **Dan M. Frangopol**, Univ. of Colorado/Boulder; **Toshiaki Fujimori**, Shimizu Corp. (Japan); **Yozo Fujino**, Univ. of Tokyo (Japan); **Gabriel V. Garcia**, New Mexico State Univ.; **Henri P. Gavin**, Duke Univ.; **Faramarz Gordaninejad**, Univ. of Nevada/Reno; **Dryver R. Huston**, Univ. of Vermont; **Sami F. Masri**, Univ. of Southern California; **Isao Nishimura**, Musashi Institute of Technology (Japan); **Shunsuke Otani**, Univ. of Tokyo (Japan); **James Roberts**, CalTrans; **Peter Schwesinger**, Bauhaus-Univ. Weimar (Germany); **Charles S. Sikorsky**, CalTrans; **Metz A. Sozen**, Purdue Univ.; **Billie F. Spencer, Jr.**, Univ. of Notre Dame; **Nobuo Takeda**, Univ. of Tokyo (Japan); **Kenzo Takeo**, Kyoto Univ. (Japan); **Ming L. Wang**, Univ. of Illinois/Chicago; **Glenn A. Washer**, Federal Highway Administration; **Norman M. Wereley**, Univ. of Maryland/College Park; **Sharon Wood**, Univ. of Texas/Austin; **Bojidar S. Yanev**, New York City DOT; **Kazuo Yoshida**, Keio Univ. (Japan)

# Smart Structures and Materials

## Conference 4697 Room: Pacific Salon II

Mon.–Wed. 18–20 March 2002  
*Proceedings of SPIE* Vol. 4697

## Damping and Isolation

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

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

*Program Committee:* **Mehdi Ahmadian**, Virginia Polytechnic Institute and State Univ.; **Eric M. Austin**, Clemson Univ.; **H. Thomas Banks**, North Carolina State Univ.; **Amr M. Baz**, Univ. of Maryland/College Park; **William W. Clark**, Univ. of Pittsburgh; **L. Porter Davis**, Honeywell Space Systems; **Michael L. Drake**, Univ. of Dayton Research Institute; **Eugene R. Fosness**, Air Force Research Lab.; **Faramarz Gordaninejad**, Univ. of Nevada/Reno; **T. Tupper Hyde**, Honeywell Space Systems; **Roy Ikegami**, Boeing Phantom Works; **Daniel J. Inman**, Virginia Polytechnic Institute and State Univ.; **Conor D. Johnson**, CSA Engineering, Inc.; **George A. Lesieutre**, The Pennsylvania State Univ.; **Donald J. Leo**, Virginia Polytechnic Institute and State Univ.; **Joseph R. Maly**, CSA Engineering, Inc.; **Zahidul H. Rahman**, Jet Propulsion Lab.; **Steve I. Shen**, Univ. of Washington; **Roger Stanway**, Univ. of Sheffield (UK); **Jian Q. Sun**, Univ. of Delaware; **Geoffrey R. Tomlinson**, Univ. of Sheffield (UK); **Norman M. Wereley**, Univ. of Maryland/College Park

## Conference 4698 Room: San Diego

Mon.–Thurs. 18–21 March 2002  
*Proceedings of SPIE* Vol. 4698

## Industrial and Commercial Applications of Smart Structures Technologies

*Conference Chair:* **Anna-Maria R. McGowan**, NASA Langley Research Ctr.

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

*Program Committee:* **Grigory Adamovsky**, NASA Glenn Research Ctr.; **Emanuele Bianchini**, Active Control eXperts, Inc.-ACX; **Christian Boller**, European Aeronautic Defence and Space Co. (Germany); **Bernie F. Carpenter**, Lockheed Martin Astronautics; **Peter C. Chen**, Systems Planning and Analysis, Inc.; **William W. Clark**, Univ. of Pittsburgh; **Johannes K. Dürr**, DaimlerChrysler AG (Germany); **B. Kyle Henderson**, Air Force Research Lab.; **Ursula Herold-Schmidt**, DaimlerChrysler AG (Germany); **Jack H. Jacobs**, Honeywell Space Systems; **Mark R. Jolly**, Lord Corp.; **Jayanth N. Kudva**, Northrop Grumman Corp.; **Douglas K. Lindner**, Virginia Polytechnic Institute and State Univ.; **Craig D. Near**, Materials Systems Inc.; **Wade J. Pulliam**, Fortis Technologies, Inc.; **Brian P. Sanders**, Air Force Research Lab.; **Janet M. Sater**, Institute for Defense Analyses; **Richard A. Singer**, Rockwell Science Ctr.; **Edward V. White**, Boeing Co.

## Conference 4699 Room: California

Mon.–Thurs. 18–21 March 2002  
*Proceedings of SPIE* Vol. 4699

## Active Materials: Behavior and Mechanics

*Conference Chair:* **Christopher S. Lynch**, Georgia Institute of Technology

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

*Program Committee:* **Gary L. Anderson**, Army Research Office; **William D. Armstrong**, Univ. of Wyoming; **Abhijit Bhattacharyya**, Univ. of Alberta (Canada); **Roshdy G. Barsoum**, Office of Naval Research; **Gregory P. Carman**, Univ. of California/Los Angeles; **Tord Cedell**, Lunds Tekniska Högskola (Sweden); **Martin L. Dunn**, Univ. of Colorado/Boulder; **Craig L. Hom**, Lockheed Martin Advanced Technology Ctr.; **Robert C. O'Handley**, Massachusetts Institute of Technology; **Qing Jiang**, Univ. of California/Riverside; **Marc Kamlah**, Forschungszentrum Karlsruhe (Germany); **Robert M. McMeeking**, Univ. of California/Santa Barbara; **Thomas R. Shrouf**, The Pennsylvania State Univ.; **Quanshui Zheng**, Tsinghua Univ. (China)

## Conference 4700 Room: Royal Palm I

Mon.–Wed. 18–20 March 2002  
*Proceedings of SPIE* Vol. 4700

## Smart Electronics, MEMS, and Nanotechnology

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

*Cochair:* **Pratul K. Ajmera**, Louisiana State Univ.

*Program Committee:* **Vasu K. Aatre**, Defence Research & Development Organisation (India); **Derek Abbott**, Univ. of Adelaide (Australia); **Steven W. Arms**, MicroStrain, Inc.; **Henry Baltes**, ETH Zurich (Switzerland); **John H. Belk**, Boeing Co.; **Thomas G. Bifano**, Boston Univ.; **Stephen M. Bobbio**, Univ. of North Carolina/Charlotte; **Jung-Chih Chiao**, Chorum Technologies Inc. and Univ. of Hawaii/Manoa; **Sang H. Choi**, NASA Langley Research Ctr.; **Julian W. Gardner**, Univ. of Warwick (UK); **Jan G. Korvink**, Albert-Ludwigs-Univ. Freiburg (Germany); **Jeong-Bong Lee**, Louisiana State Univ.; **Y. Eugene Pak**, Samsung Advanced Institute of Technology & CRI (Korea); **M. K. Ramasubramanian**, North Carolina State Univ.; **Jeffrey N. Schoess**, Honeywell Technology Ctr.; **Andrei M. Shkel**, Univ. of California/Irvine; **Norio Shinya**, National Research Institute for Metals (Japan); **Gregory Washington**, The Ohio State Univ.

## Conference 4701 Room: Golden West

Mon.–Thurs. 18–21 March 2002  
*Proceedings of SPIE* Vol. 4701

## Smart Structures and Integrated Systems

*Conference Chair:* **L. Porter Davis**, Honeywell Space Systems

*Cochairs:* **Yuji Matsuzaki**, Nagoya Univ. (Japan); **Amr M. Baz**, Univ. of Maryland/College Park

*Program Committee:* **Gregory S. Agnes**, Air Force Institute of Technology; **Hiroshi Asanuma**, Chiba Univ. (Japan); **Eric H. Anderson**, CSA Engineering, Inc.; **Gary L. Anderson**, Army Research Office; **Balakumar Balachandran**, Univ. of Maryland/College Park; **Roshdy G. Barsoum**, Office of Naval Research; **Diann E. Brei**, Univ. of Michigan; **Allen J. Bronowicki**, TRW Space & Electronics Group; **Gregory P. Carman**, Univ. of California/Los Angeles; **Fu-Kuo Chang**, Stanford Univ.; **Aditi Chattopadhyay**, Arizona State Univ.; **Peter C. Chen**, Systems Planning and Analysis, Inc.; **Seung-Bok Choi**, Inha Univ. (Korea); **Alison B. Flatau**, National Science Foundation; **Ephraim Garcia**, DARPA; **John M. Ginder**, Ford Motor Co.; **Victor Giurgiutiu**, Univ. of South Carolina; **Nesbitt W. Hagood**, Continuum Control Corp.; **T. Tupper Hyde**, Honeywell Space Systems; **Daniel J. Inman**, Virginia Polytechnic Institute and State Univ.; **George A. Lesieutre**, The Pennsylvania State Univ.; **John A. Main**, Univ. of Kentucky; **David R. Martinez**, Sandia National Labs.; **Michihiro C. Natori**, Institute of Space and Astronautical Science (Japan); **Darryll J. Pines**, Univ. of Maryland/College Park; **Dale Ruebsamen**, Honeywell, Satellite Systems Operations; **Roger Stanway**, Univ. of Sheffield (UK); **Friedrich K. Straub**, Boeing Co.; **Kon-Well Wang**, The Pennsylvania State Univ.; **Norman M. Wereley**, Univ. of Maryland/College Park; **Shoko Yoshikawa**, Active Control eXperts, Inc.-ACX; **Yung H. Yu**, NASA Ames Research Ctr.



# Smart Structures and Materials

Conference 4693  
Room: Pacific Salon III

Conference 4694  
Room: Pacific Salon I

Conference 4695  
Room: Town & Country

Conference 4696  
Room: Royal Palm II

Monday 18 March

8:00 to 8:45 am • Room: Town & Country

**SPIE Smart Structures and Materials Achievement Award**

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

Plenary Presentation

**Active Chatter Control Achieves Order-of-Magnitude Increase in Metal Removal Rate**

Speaker: **Dr. Leonard S. Haynes**, President, Intelligent Automation, Inc., Rockville, MD

## SESSION 1

Room: Pacific Salon III  
Mon. 9:00 am

### Control of Smart Structures I

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

9:00 am: **Active control of smart structures with optimal sensor and actuator locations**, P. Liu, V. S. Rao, Univ. of Missouri/Rolla; M. M. Derriso, Air Force Research Lab. . . . . [4693-01]

9:20 am: **Hybrid adaptive control of smart structures with simultaneous precision positioning and vibration suppression**, K. Ma, M. N. Ghasemi-Nejhad, S. Pourjalali, Univ. of Hawaii/Manoa . . . . . [4693-02]

9:40 am: **Control techniques for high-performance nonlinear smart systems**, J. M. Nealis, R. C. Smith, North Carolina State Univ. [4693-03]

Coffee Break . . . 10:00 to 10:30 am

## SESSION 2

Room: Pacific Salon III  
Mon. 10:30 am

### Active Structural Acoustic Control

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

10:30 am: **Hybrid Rayleigh-Ritz/ boundary element method for active noise control studies**, S. V. Gopinathan, V. V. Varadan, V. K. Varadan, The Pennsylvania State Univ. . . . . [4693-04]

10:50 am: **Active structural acoustic control: numerical modeling, robust controller design, and experimental validation**, F. Deuble, C. Hofmann, K. Well, Univ. Stuttgart (Germany) . . . . . [4693-05]

11:10 am: **Finite element models applied in active structural acoustic control**, M. H. Oude Nijhuis, A. de Boer, Univ. of Twente (Netherlands) . . . . . [4693-06]

11:30 am: **Active control of radiated noise of a thick-walled cylindrical shell**, K. Song, Massachusetts Institute of Technology; M. J. Atalla, United Technologies Research Ctr.; S. R. Hall, Massachusetts Institute of Technology . . . . . [4693-07]

11:50 am: **Optimal passive and hybrid control of vibration and sound radiation from linear and nonlinear PZT-based smart structures**, M. B. Ozer, T. J. Royston, Univ. of Illinois/Chicago. [4693-08]

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

## SESSION 1

Room: Pacific Salon I  
Mon. 9:00 am

### Fiber Optic Sensors

Chairs: **Daniele Inaudi**, SMART EC SA (Switzerland); **Eric Udd**, Blue Road Research

9:00 am: **Challenging the notion of equal modal power distribution in multimode optical fibers** (Invited Paper), K. D. Bennett, L. Alexander, M. Marbell, Lafayette College . . . . . [4694-01]

9:30 am: **Determining the relationship between the amplitude parameter and the modal power in dual-mode fibers** (Invited Paper), K. D. Bennett, M. Marbell, Lafayette College . . . . . [4694-02]

Coffee Break . . . 10:00 to 10:30 am

10:30 am: **Brillouin optical fiber sensor for cryogenic thermometry**, L. Thevenaz, A. Fellay, M. Facchini, Swiss Federal Institute of Technology (Switzerland); W. Scandale, CERN (Switzerland); M. Niklès, Omnisens SA (Switzerland); P. Robert, Swiss Federal Institute of Technology (Switzerland) . . . . . [4694-03]

10:50 am: **Fiber optic acoustic emission sensor based on a fused tapered coupler**, C. T. Doyle, G. F. Fernando, Cranfield Univ. (UK) . . . . . [4694-04]

11:10 am: **Development of a fiber optic interferometric inclinometer**, D. Inaudi, B. Glisic, SMART EC SA (Switzerland) . . . . . [4694-05]

11:30 am: **New techniques for the manufacturing of EFPI sensors**, C. J. Tuck, G. F. Fernando, Cranfield Univ. (UK) . . . . . [4694-06]

11:50 am: **Fiber optic sensors for process monitoring of composite aerospace structures**, J. M. Menendez, P. Muñoz Esquer, AIRBUS (Spain); J. Guemes, Univ. Politecnica de Madrid (Spain) . . . . . [4694-07]

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

## SESSION 1

Room: Town & Country  
Mon. 9:00 am

### EAP as Emerging Actuators

Chairs: **Yoseph Bar-Cohen**, Jet Propulsion Lab.; **Yoshihito Osada**, Hokkaido Univ. (Japan)



9:00 am: **Biologically inspired intelligent robots** (Keynote Address), C. Breazeal, MIT Media Lab. [4695-01]

9:40 am: **Electroactive polymers: current capabilities and challenges**, Y. Bar-Cohen, Jet Propulsion Lab. . . . . [4695-02]

Coffee Break . . . 10:00 to 10:30 am

10:30 am: **Recent advances in electromechanical actuators based on conducting polymers or carbon nanotubes**, G. G. Wallace, G. M. Spinks, L. Liu, D. Zhou, Univ. of Wollongong (Australia); M. Gao, L. Dai, CSIRO (Australia) . . [4695-03]

10:50 am: **Amphiphilic intelligent gels**, Y. Osada, J. Gong, Hokkaido Univ. (Japan) . . . . . [4695-04]

11:10 am: **Carbon nanotube actuators based on double-layer charge injection: from materials processing to device physics and performance**, R. Baughman, A. A. Zakhidov, E. Munoz, Univ. of Texas/Dallas; J. N. Barisci, G. M. Spinks, L. S. Fiffeld, G. G. Wallace, Univ. of Wollongong (Australia); M. E. Kozlov, H. Hui, New Jersey Institute of Technology; M. Kertesz, G. Sun, Georgetown University; Y. N. Gartstein, Xerox Corp. . . [4695-05]

11:30 am: **Biomedical applications of electroactive polymers and shape-memory alloys** (Invited Paper), S.K. Lee, Dankook Univ. (Korea); H.-J. An, Korea Univ. (Korea); S.-J. Lee, Dankook Univ. (Korea); S.-E. Cha, J. J. Pak, Korea Univ. (Korea); J. K. Chang, Seoul National Univ. (Korea) . . . . . [4695-06]

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

## SESSION 1

Room: Royal Palm II  
Mon. 9:00 am

### Information Technology

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

9:00 am: **Scalable wireless Web-enabled sensor networks**, C. P. Townsend, M. J. Hamel, P. A. Sonntag, S. W. Arms, MicroStrain, Inc. . . . . [4696-01]

9:20 am: **Development of reusable software components for monitoring data management, visualization, and analysis**, D. Inaudi, SMART EC SA (Switzerland) . . . . . [4696-02]

9:40 am: **Development of the software for strain monitoring of the Humen Bridge**, F. Qiu, W. Du, P. Pan, J. Qian, Tsinghua Univ. (China) . . . . . [4696-03]

10:00 am: **Health monitoring for effective management of infrastructure**, A. E. Aktan, M. Pervizpour, Drexel Univ. . [4696-53]

Coffee Break . . . 10:00 to 10:30 am

## SESSION 2

Room: Royal Palm II  
Mon. 10:30 am

### Smart Bridges

Chair: **A. Emin Aktan**, Drexel Univ.

10:30 am: **Field vibration tests of bridge stay cables incorporated with magnetorheological (MR) dampers**, J. M. Ko, G. Zheng, Hong Kong Polytechnic Univ. (Hong Kong); Z. Q. Chen, Central South Univ. (China); Y. Q. Ni, Hong Kong Polytechnic Univ. (Hong Kong) . . . . . [4696-04]

10:50 am: **Damping identification of MR-damped bridge cables from in-situ monitoring under wind-rain-excited conditions**, Y. Q. Ni, Y. F. Duan, Hong Kong Polytechnic Univ. (Hong Kong); Z. Q. Chen, Central South Univ. (China); J. M. Ko, Hong Kong Polytechnic Univ. (Hong Kong) . . . . . [4696-05]

11:10 am: **Smart suspension systems for bridge-friendly vehicles**, C. Tan, Y. Chen, Wayne State Univ.; L. A. Bergman, Univ. of Illinois/ Urbana-Champaign; T. C. Tsao, Univ. of California/Los Angeles [4696-06]

11:30 am: **Monitoring steel stay-cables via ultrasonic measurements**, F. Lanza di Scalea, P. Rizzo, Univ. of California/ San Diego . . . . . [4696-07]

11:50 am: **One year's experiences in bridge testing using the loading truck BELFA**, P. Schwesinger, B. Thor, Bauhaus-Universität Weimar (Germany) . . . . . [4696-08]

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



# Smart Structures and Materials

Conference 4697  
Room: Pacific Salon II

Conference 4698  
Room: San Diego

Conference 4699  
Room: California

Conference 4700  
Room: Royal Palm I

Conference 4701  
Room: Golden West

Monday 18 March

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Plenary Presentation

**Active Chatter Control Achieves Order-of-Magnitude Increase in Metal Removal Rate**

Speaker: **Dr. Leonard S. Haynes**, President, Intelligent Automation, Inc., Rockville, MD

**SESSION 1**  
Room: Pacific Salon II  
Mon. 9:00 am

**Aerospace Applications**  
Chairs: **Gregory S. Agnes**, Air Force Institute of Technology; **Kon-Well Wang**, The Pennsylvania State Univ.

9:00 am: **Whole-spacecraft shock isolation system**, P. S. Wilke, C. D. Johnson, CSA Engineering, Inc. . . . . . [4697-01]

9:20 am: **Vibration damping of inflatable/rigidizable tubes**, G. S. Agnes, Air Force Institute of Technology . . . . . [4697-02]

9:40 am: **Development of an integral damping treatment for NASA's next generation hollow fan blades**, J. B. Kosmatka, Univ. of California/San Diego; O. Mehmed, NASA Lewis Research Ctr. . . . . [4697-03]

Coffee Break . . . . . 10:00 to 10:30 am

**SESSION 2**  
Room: Pacific Salon II  
Mon. 10:30 am

**Constrained Layer Damping**  
Chairs: **Eric M. Austin**, Clemson Univ.; **Steve I. Shen**, Univ. of Washington

10:30 am: **Improving the MSE method for viscoelastic damped structures**, F. Scarpa, F. P. Landi, J. A. Rongong, G. R. Tomlinson, Univ. of Sheffield (UK) . . . . . [4697-04]

10:50 am: **Revised modal strain energy method for finite element analysis of viscoelastic damping treated structures**, Y. Xu, Y. Liu, B. S. Wang, Maxtor Corp. . . . . [4697-05]

11:10 am: **Passive damping of laminated composite materials with engineered defects**, T. Fronk, V. M. Akula, Utah State Univ. . . . . [4697-06]

11:30 am: **Dynamics optimization of HDD cover with constrained layer damping treatment**, Y. Liu, Y. Xu, Maxtor Corp. . . . . [4697-07]

11:50 am: **Wave beaming effects in bi-dimensional cellular structures**, M. Ruzzene, Catholic Univ. of America; F. Scarpa, Univ. of Sheffield (UK) . . . . . [4697-08]

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

**SESSION 1**  
Room: San Diego  
Mon. 9:00 am

**Aircraft Applications I**  
Chairs: **Anna-Maria R. McGowan**, NASA Langley Research Ctr.; **Edward V. White**, The Boeing Co.

9:00 am: **Smart structures and actuators: past, present, and future**, E. Garcia, DARPA . . . . . [4698-01]

9:20 am: **SAMPSON smart inlet design overview and wind tunnel test, Part I: design overview**, D. M. Pitt, J. P. Dunne, E. V. White, Boeing Co. . . . . [4698-02]

9:40 am: **SAMPSON smart inlet design overview and wind tunnel test, Part II: wind tunnel test**, D. M. Pitt, J. P. Dunne, E. V. White, Boeing Co. . . . . [4698-03]

Coffee Break . . . . . 10:00 to 10:30 am

10:30 am: **Overview of the DARPA/AFRL/NASA smart materials and structures and Smart Wing program**, J. N. Kudva, Northrop Grumman Corp. . . . . [4698-04]

10:50 am: **Design, fabrication, and testing of scaled wind tunnel model for the Smart Wing Phase 2 program**, C. A. Martin, Northrop Grumman Corp. . . . . [4698-05]

11:10 am: **Development, control, and test results of high-rate hingeless trailing edge control surface for the Smart Wing Phase 2 wind tunnel model**, D. P. Wang, Northrop Grumman Corp. . . . . [4698-06]

11:30 am: **DARPA/AFRL Smart Wing Phase 2 wind tunnel test results**, L. B. Scherer, Northrop Grumman Corp. . . . . [4698-07]

11:50 am: **Development of a smart material active flap rotator**, F. K. Straub, Boeing Co. . . . . [4698-08]

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

**SESSION 1**  
Room: California  
Mon. 9:00 am

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

9:00 am: **Enhancing strain capability and energy density in current and potential future actuator materials (Invited Paper)**, L. E. Cross, The Pennsylvania State Univ. [4699-01]

9:40 am: **Behavior of relaxor single crystals**, C. S. Lynch, Georgia Institute of Technology . . . . . [4699-02]

Coffee Break . . . . . 10:00 to 10:30 am

10:30 am: **Displaying process zones in ferroelectric ceramics using a liquid crystal display**, D. C. Lupascu, A. B. Kounga, J. Rödel, Technische Univ. Darmstadt (Germany) [4699-03]

10:50 am: **Thermodynamically and microscopically motivated constitutive model for piezoceramics in uniaxial formulation**, M. Kamlah, Forschungszentrum Karlsruhe (Germany); Q. Jiang, Univ. of California/Riverside . . . . . [4699-04]

11:10 am: **Phenomenological switching model for ferroelectric ceramics**, A. Haug, R. M. McMeeking, Univ. of California/Santa Barbara . . . . . [4699-05]

11:30 am: **Constitutive and finite element modeling of ferroelectric repolarization**, H. Kessler, Technische Univ. Dresden (Germany); M. Kamlah, Forschungszentrum Karlsruhe (Germany); H. Balke, Technische Univ. Dresden (Germany) [4699-06]

11:50 am: **New finite element formulation for electromechanics**, C. M. Landis, Rice Univ. . . . . [4699-07]

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

**SESSION 1**  
Room: Royal Palm I  
Mon. 9:00 am

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

**Keynote Presentation**  
9:00 am: **Carbon nanotube-based nanotechnology: opportunities and challenges in nanoelectronics, sensors, and NEMS**, Meyya Meyyappan, NASA Ames Research Ctr. . . . . [4700-01]

9:40 am: **Three-dimensional MEMS with functionalized carbon nanotubes**, V. K. Varadan, J. Xie, T. Ji, The Pennsylvania State Univ. . . . . [4700-02]

Coffee Break . . . . . 10:00 to 10:30 am

**SESSION 2**  
Room: Royal Palm I  
Mon. 10:30 am

**Nanotechnology II**  
Chair: **K. A. Jose**, The Pennsylvania State Univ.

**Keynote Presentation**  
10:30 am: **MEMS and nanotechnologies for biomedical applications**, Y. Eugene Pak, Samsung Advanced Institute of Technology (Korea) . . . . . [4700-03]

**Keynote Presentation**  
11:10 am: **Noise and randomness at nanoscales in bioMEMS**, Laszlo B. Kish, Texas A&M Univ. [4700-04]

11:50 am: **Fabrication and characterization of nano-array of PbZrxTi1-xO3 sensors and actuators**, D. Kumar, M. J. Sundaresan, North Carolina A&T State Univ.; J. Narayan, North Carolina State Univ.; J. Sankar, North Carolina A&T State Univ. . . . . [4700-05]

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

**SESSION 1**  
Room: Golden West  
Mon. 9:00 am

**ER/MR Fluids and Devices I**  
Chair: **Seung-Bok Choi**, Inha Univ. (Korea)

9:00 am: **Vibration control of a passenger car using MR engine mounts**, S. B. Choi, H. H. Lee, H. J. Song, Inha Univ. (Korea) . . . . . [4701-01]

9:20 am: **Performance of a MR hydraulic power actuator system**, J. H. Yoo, N. M. Wereley, Univ. of Maryland/College Park . . . . . [4701-02]

9:40 am: **Electrorheological clutch for robotics application: an experimental study of closed-loop control**, R. Stanway, K. P. Tan, N. D. Sims, A. R. Johnson, Univ. of Sheffield (UK) . . . . . [4701-03]

Coffee Break . . . . . 10:00 to 10:30 am

**SESSION 2**  
Room: Golden West  
Mon. 10:30 am

**Active/Smart Materials**  
Chair: **Elisabeth Smela**, Univ. of Maryland/College Park

10:30 am: **Development of PZT thin-film sensors and actuators for smart structures and MEMS applications**, Y. C. Hsu, I. Y. Shen, G. Z. Cao, Univ. of Washington . . . . . [4701-04]

10:50 am: **Experimental characterization of NiMnGa ferromagnetic shape-memory alloy rods under variable loading conditions**, R. Couch, I. Chopra, M. R. Wuttig, Univ. of Maryland/College Park . . . . . [4701-05]

11:10 am: **Development of active and sensitive material systems using metal-based composites**, H. Asanuma, Chiba Univ. (Japan) . . . . . [4701-06]

11:30 am: **Self-healing of creep damage in heat resisting steel**, N. Shinya, J. Kyono, National Research Institute for Materials Science (Japan) . . . . . [4701-07]

11:50 am: **Self-repairing, self-forming, and self-sensing system for ceramic/polymer composites**, C. M. Dry, Univ. of Illinois/Urbana-Champaign . . . . . [4701-08]

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

**Monday Welcome Reception**  
Sponsored by San Diego Town and Country Resort & Convention Center and SPIE.  
See page 2 for details.

# Smart Structures and Materials

Conference 4693  
Room: Pacific Salon III

Conference 4694  
Room: Pacific Salon I

Conference 4695  
Room: Town & Country

Conference 4696  
Room: Royal Palm II

Monday 18 March

## SESSION 3

Room: Pacific Salon III

Mon. 1:30 pm

### Modeling Applications I

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

1:30 pm: **Enhancement of dynamic buckling load and vibration control of a plate by using piezoceramic elements and viscoelastic layers**, R. C. Batra, T. S. Geng, Virginia Polytechnic Institute and State Univ. .... [4693-09]

1:50 pm: **Model reduction and substructuring for computing responses of structures containing frequency-dependent viscoelastic materials**, S. Germès, F. van Herpe, PSA Peugeot Citrön (France) [4693-11]

2:10 pm: **New constitutive model for vibrations of a beam with a piezopatch actuator**, Z. K. Kusculuoglu, Univ. of Illinois/Chicago; B. Fallahi, Northern Illinois Univ.; T. J. Royston, Univ. of Illinois/Chicago . . . [4693-12]

2:30 pm: **Analytic solution of a plate vibration problem controlled by piezoelectric patches**, J. C. Bruch, Jr., Univ. of California/Santa Barbara; I. S. Sadek, American Univ. of Sharjah (United Arab Emirates); J. M. Sloss, Univ. of California/Santa Barbara; S. Adali, Univ. of Natal (South Africa) . . . . . [4693-13]

Coffee Break . . . . . 2:50 to 3:40 pm

## SESSION 4

Room: Pacific Salon III

Mon. 3:40 pm

### Optimization of Active Structures

*Chair: Mary I. Frecker, The Pennsylvania State Univ.*

3:40 pm: **Review of current research activities in optimization of smart structures and actuators** (*Invited Paper*), M. I. Frecker, The Pennsylvania State Univ. . . [4693-14]

4:20 pm: **Topology optimization and detailed finite element modeling of piezoelectric actuators: effect of external loads and detail geometry on actuator output**, S. Bharti, M. I. Frecker, The Pennsylvania State Univ. . . . . [4693-15]

4:40 pm: **Topology optimization of structures for vibration control**, J. Qiu, Y. Zhu, J. Tani, Tohoku Univ. (Japan); H. Du, Nanyang Technological Univ. (Singapore) . . . . . [4693-30]

5:00 pm: **Combined optimization of active structural systems and drive circuits**, M. M. Abdalla, Z. Gurdal, D. K. Lindner, Virginia Polytechnic Institute and State Univ. . . [4693-59]

5:20 pm: **Topological optimization of smart structures using an homogenization approach**, M. Bühler, B. Bettig, G. G. Parker, Michigan Technological Univ. . . . . [4693-63]

5:40 am: **Compliant mechanism synthesis for shape-change applications using Fourier descriptors**, K. Lu, S. Kota, Univ. of Michigan . . . . . [4693-26]

## SESSION 2

Room: Pacific Salon I

Mon. 1:30 pm

### Piezoelectric Sensors and Acoustic Sensing

*Chairs: Jeffrey N. Schoess,*

Honeywell Technology Ctr.; **Brian Culshaw**, Univ. of Strathclyde (UK)

1:30 pm: **Single crystal strain sensor development**, M. Giovanardi, M. P. Kogan, S. Yoshikawa, ACX - A Division of Cymer, Inc. . . . [4694-08]

1:50 pm: **Field responsive polyimides: an analysis of their piezoelectricity**, Z. Ounaies, NASA Langley Research Ctr.; R. C. Smith, North Carolina State Univ.; C. Park, J. S. Harrison, D. J. Klein, NASA Langley Research Ctr. . . . . [4694-09]

2:10 pm: **Detection and suppression for mechanical resonance in hard-disk drives with built-in piezoelectric sensors**, P. Gao, Y. Lou, K. Okada, Sony Electronics Singapore Pte. Ltd. (Singapore) . . . . . [4694-10]

2:30 pm: **Method and system for air-driven pump monitoring based on frequency analysis of the acoustic signal**, N. Ida, R. Ciocan, Univ. of Akron . . . . . [4694-11]

2:50 pm: **Defectoscopy analysis of laser-generated ultrasound in aluminum waveguide using acoustic emission sensors**, S. R. Ravishankar, Brunel Univ. (UK) . . . . . [4694-12]

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

## SESSION 3

Room: Pacific Salon I

Mon. 3:40 pm

### Composite Materials Monitoring

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

3:40 pm: **Embedded optical fiber Bragg grating sensors for the measurement of crack bridging forces in composites**, M. Studer, Swiss Federal Institute of Technology (Switzerland); K. J. Peters, North Carolina State Univ.; J. Botsis, Swiss Federal Institute of Technology (Switzerland) . . . . . [4694-13]

4:00 pm: **Application of chirped fiber Bragg grating sensors for damage identification in composites**, N. Takeda, Y. Okabe, R. Tsuji, S.-I. Takeda, Univ. of Tokyo (Japan) . . . . . [4694-14]

4:20 pm: **Embedded fiber Bragg gratings as local damage sensors for composite materials**, J. Guemes, Univ. Politecnica de Madrid (Spain); F. Rodriguez-Lence, J. M. Menendez, AIRBUS (Spain) . . . . . [4694-15]

4:40 pm: **Condition monitoring of vibrating composite structures based on optical fiber strain sensing and finite element model updating**, G. Nosenzo, Univ. of Limerick (Ireland); M. P. Whelan, European Commission Joint Research Ctr. (Italy); T. Dalton, Univ. of Limerick (Ireland) . . . . . [4694-16]

5:00 pm: **Detection of delamination in composite laminates using small-diameter FBG sensors**, S.-I. Takeda, Y. Okabe, N. Takeda, Univ. of Tokyo (Japan) . . . . . [4694-17]

## SESSION 2

Room: Town & Country

Mon. 1:30 pm

### Ionic EAP: Conductive Polymers, IPMC, and Nanotubes I

*Chairs: Ji Su, NASA Langley Research Ctr.; Peter Sommer-Larsen, Risø National Lab. (Denmark)*

1:30 pm: **Progress of experimental characterization and micromechanistic modeling of actuation of ionic polymer metal composites** (*Invited Paper*), S. Nemat-Nasser, Univ. of California/San Diego . . . . . [4695-07]

2:10 pm: **Nanometer scale ionic reservoir based on ion-responsive hydrogels**, K. Levon, S. S. Kazakov, M. Kaholek, I. Teraoka, Polytechnic Univ. . . . . [4695-08]

2:30 pm: **Fabrication, morphology, and actuation from novel single-wall carbon nanotube/naflon composites**, D. Chattopadhyay, I. E. Galeska, Univ. of Connecticut; R. Baughman, E. Munoz, Univ. of Texas/Dallas; F. Papadimitrakopoulos, Univ. of Connecticut . . . . [4695-09]

2:50 pm: **Design of naflon-based actuators with enhanced displacement**, M. Taya, M. Uchida, C. Xu, M. Leguilly, Univ. of Washington . . . . . [4695-10]

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

3:40 pm: **Electrically induced permanent strain in ionic polymer-metal composite actuators**, K. M. Newbury, D. J. Leo, Virginia Polytechnic Institute and State Univ. . . . . [4695-11]

4:00 pm: **Naflon-based smart membrane as a multiarrayed actuator**, M. L. Guilly, M. Uchida, M. Taya, Univ. of Washington . . . . [4695-12]

4:20 pm: **Electric shape-memory effects in ionic polymers**, M. Shahinpoor, K. J. Kim, Univ. of New Mexico . . . . . [4695-13]

4:40 pm: **Interpenetrating network (IPNs)-based actuator**, F. Vidal, H. Randriamahazaka, J.-F. Popp, C. Chevrot, D. Teyssie, Univ. of Cergy-Pontoise (France) . . . . . [4695-14]

EAP-in-Action Demonstration  
5:00 to 5:40 pm

*Moderator: Yoseph Bar-Cohen, Jet Propulsion Lab.*

## SESSION 3

Room: Royal Palm II

Mon. 1:30 pm

### Health Monitoring I

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

1:30 pm: **Structural health monitoring system using FBG-based sensors for a damage tolerant building**, H. Iwaki, Shimizu Corp. (Japan); N. Takeda, Univ. of Tokyo (Japan) . . . . . [4696-09]

1:50 pm: **Structural monitoring of composite marine piles using multiplexed fiber Bragg grating sensors: in-field applications**, C. S. Baldwin, T. Poloso, J. B. Niemczuk, P. C. Chen, J. S. Kiddy, Systems Planning and Analysis, Inc. [4696-10]

2:10 pm: **Health monitoring of smart structures using damage index sensors**, A. Mita, S. Takahira, Keio Univ. (Japan) . . . . . [4696-11]

2:30 pm: **Consideration of environmental and operational variability for damage diagnosis**, H. Sohn, C. R. Farrar, Los Alamos National Lab.; K. Worden, Univ. of Sheffield (UK) . . . . . [4696-12]

2:50 pm: **Health monitoring of vibratory soil compaction**, M. A. Mooney, Univ. of Oklahoma [4696-13]

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

## SESSION 4

Room: Royal Palm II

Mon. 3:40 pm

### Health Monitoring II

*Chair: Charles S. Sikorsky, Caltrans*

3:40 pm: **Damage detection of a bridge structure using ambient test data**, G. V. Garcia, R. McMurry, J. Garde, New Mexico State Univ. . . . . [4696-14]

4:00 pm: **Validation of a wireless modular monitoring system for structures**, J. Lynch, K. H. Law, A. S. Kiremidjian, J. E. Carryer, T. W. Kenny, A. Partridge, Stanford Univ. [4696-15]

4:20 pm: **Research about damage identification of the structural building using the quasi-Newton method**, S. Ono, Ariake National College of Technology and Osaka Univ. (Japan); E. Tachibana, Osaka Univ. (Japan) . . . . . [4696-16]

4:40 pm: **Monitoring of a concrete arch bridge during construction**, D. Inaudi, SMARTEC SA (Switzerland); A. Rüfenacht, Preisig AG (Switzerland); B. von Arx, Kanton Aargau (Switzerland); H. P. Noher, Geotechnisches Institut AG (Switzerland); S. Vurpillot, B. Glisic, SMARTEC SA (Switzerland) [4696-17]

5:00 pm: **Detecting multiple damages in a civil building structure model**, J. Ma, D. J. Pines, Univ. of Maryland/College Park . . [4696-18]

5:20 pm: **Digital image processing for a wireless crack documentation system**, Y. Mo, C. Liu, T. T. Hsu, Univ. of Houston . . . . . [4696-51]

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# Smart Structures and Materials

Conference 4697  
Room: Pacific Salon II

Conference 4698  
Room: San Diego

Conference 4699  
Room: California

Conference 4700  
Room: Royal Palm I

Conference 4701  
Room: Golden West

Monday 18 March

## SESSION 3

Room: Pacific Salon II  
Mon. 1:30 pm

### Vibration Absorbers

*Chairs:* William W. Clark, Univ. of Pittsburgh; Jian Q. Sun, Univ. of Delaware

- 1:30 pm: **H<sub>2</sub> optimization of the three-element type dynamic vibration absorbers**, T. Asami, Himeji Institute of Technology (Japan); O. Nishihara, Kyoto Univ. (Japan) . . . . . [4697-09]
- 1:50 pm: **Dynamically tuned shroud for gun barrel vibration attenuation**, A. G. Littlefield, E. Kathe, R. Durocher, Army Research Lab. . . . . [4697-10]
- 2:10 pm: **Design of multi-degree-of-freedom tuned-mass dampers**, S. Nayfeh, Massachusetts Institute of Technology . . . . . [4697-11]
- 2:30 pm: **Power flow analysis methods for amplifier design and energy harvesting**, D. J. Leo, N. Vujic, D. K. Lindner, Virginia Polytechnic Institute and State Univ. . . . . [4697-12]
- 2:50 pm: **Remote dynamic absorber**, H. Ghoneim, T. Nichols, Rochester Institute of Technology . . . . . [4697-13]
- Coffee Break . . . . . 3:10 to 3:40 pm

## SESSION 4

Room: Pacific Salon II  
Mon. 3:40 pm

### Damping Materials I

*Chairs:* Norman M. Wereley, Univ. of Maryland/College Park; H. Thomas Banks, North Carolina State Univ.

- 3:40 pm: **Modeling of piezoelectric materials on rubber beams**, E. M. Austin, B. Ananthasayanam, Clemson Univ. . . . . [4697-14]
- 4:00 pm: **Effective moduli of a porous viscoelastic material**, R. C. Batra, B. Jiang, Virginia Polytechnic Institute and State Univ. . . . . [4697-15]
- 4:20 pm: **Electrorheological fluids in dynamic squeeze: an improved modeling technique with experimental validation**, R. Stanway, Univ. of Sheffield (UK); A. K. El-Wahed, J. L. Sproston, Univ. of Liverpool (UK) . . . . . [4697-16]
- 4:40 pm: **Comparative analysis on the Bingham characteristics of magnetorheological fluids with different viscometer tests**, Y. Jeon, Yuhan College (Korea); Y. T. Choi, N. M. Wereley, Univ. of Maryland/College Park . . . . . [4697-17]
- 5:00 pm: **Damping of flexural vibration by coupling to low-density granular materials**, S. Nayfeh, Massachusetts Institute of Technology . . . . . [4697-18]
- 5:20 pm: **Mechanical properties of metallic closed cellular materials containing organic material for passive damping**, S. Kishimoto, N. Shinya, National Institute for Materials Science (Japan) . . . . . [4697-19]

## SESSION 2

Room: San Diego  
Mon. 1:30 pm

### Aircraft Applications II

*Chairs:* Brian P. Sanders, Air Force Research Lab.; Jayanth N. Kudva, Northrop Grumman Corp.

- 1:30 pm: **Boeing active flow control system III**, A. D. Jacot, F. T. Calkins, J. Smith, Boeing Phantom Works . . . . . [4698-09]
- 1:50 pm: **Vibrating surface actuators for active flow control**, F. T. Calkins, D. J. Clingman, Boeing Phantom Works . . . . . [4698-10]
- 2:10 pm: **Recent results from NASA's morphing project**, A. R. McGowan, A. E. Washburn, L. G. Horta, R. G. Bryant, D. E. Cox, E. J. Siochi, S. L. Padula, N. M. Holloway, NASA Langley Research Ctr. . . . . [4698-11]
- 2:30 pm: **Utilizing adaptive wing technology in the control of a micro air vehicle**, W. R. Null, M. G. Wagner, S. V. Shkarayev, W. C. Jouse, Univ. of Arizona . . . . . [4698-12]
- 2:50 pm: **Process for identification of military morphing aircraft missions and technologies**, J. Bowman, B. P. Sanders, Air Force Research Lab.; T. A. Weisshaar, Purdue Univ. [4698-62]
- Coffee Break . . . . . 3:10 to 3:40 pm

## SESSION 3

Room: San Diego  
Mon. 3:40 pm

### Noise Control

*Chairs:* Donald J. Leo, Virginia Polytechnic Institute and State Univ.; Emanuele Bianchini, Active Control eXperts, Inc.

- 3:40 pm: **Active interior noise control: an industrial perspective**, B. Petitjean, European Aeronautic Defence and Space Co. (France) . . . . . [4698-13]
- 4:00 pm: **Noise reduction performance of smart panels incorporating piezoelectric shunt damping**, J. Kim, J. Y. Choi, Inha Univ. (Korea) . . . . . [4698-14]
- 4:20 pm: **High-frequency jet nozzle actuators for noise reduction**, C. L. Davis, F. T. Calkins, Boeing Phantom Works; G. W. Butler, Boeing Commercial Aircraft Group [4698-15]
- 4:40 pm: **Payload noise suppression using distributed active vibration absorbers**, S. O'Regan, B. Burkewitz, Vibro-Acoustic Sciences, Inc.; C. Fuller, Fuller Technologies Inc.; S. A. Lane, Air Force Research Lab.; M. Johnson, Fuller Technologies Inc. . . . . [4698-16]

## SESSION 2

Room: California  
Mon. 1:30 pm

### Reliability of Ferroelectrics

*Chair:* Christopher S. Lynch, Georgia Institute of Technology

- 1:30 pm: **Fatigue mechanisms in PZT (Invited Paper)**, D. C. Lupascu, J. Nuffer, C. Verdier, J. Rödel, Technische Univ. Darmstadt (Germany) . . . . . [4699-08]
- 2:10 pm: **Observations of fatigue crack growth in ferroelectrics under electrical loading**, J. Shieh, N. A. Fleck, J. E. Huber, Univ. of Cambridge (UK) . . . . . [4699-09]
- 2:30 pm: **Electroelastic field at the tip of an embedded electrode in a multilayered ferroelectric actuator**, X. Zeng, R. K. N. D. Rajapakse, Univ. of British Columbia (Canada) . . . . . [4699-10]
- 2:50 pm: **Domain switching near the crack tip in single crystal piezoceramics**, S. Kalyanam, C. T. Sun, Purdue Univ. . . . . [4699-11]
- Coffee Break . . . . . 3:10 to 3:40 pm

## SESSION 3

Room: California  
Mon. 3:40 pm

### Characterization of Ferroelectrics

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

- 3:40 pm: **Determination of plastic strains from compression tests including the effect of change of Young's modulus**, T. Fett, M. Kamlah, D. Munz, G. Thun, Forschungszentrum Karlsruhe (Germany) . . . . . [4699-12]
- 4:00 pm: **Fabrication of high-performance PNN-PZT ceramics using microwave and hot-press hybrid sintering process**, H. Takahashi, Fuji Ceramics Corp. (Japan); J. Qiu, J. Tani, K. Hirose, Tohoku Univ. (Japan) . . . . . [4699-13]
- 4:20 pm: **Modeling of the dynamic effective characteristics of fiber reinforced transversely isotropic piezoelectric materials**, V. M. Levin, Petrozavodsk State Univ. (Russia); T. M. Michelitsch, H. Gao, Max-Planck Institute for Metals Research (Germany) . . . . . [4699-14]
- 4:40 pm: **Integration, electrical, and electromechanical properties of PZT and PMN-PT thin films for MEMS applications**, M. Hoffmann, C. Kügeler, U. Böttger, RWTH-Aachen (Germany); R. Waser, RWTH-Aachen and IFF Research Labs. Juelich (Germany) . . . . . [4699-15]
- 5:00 pm: **Compression of PZT-5H piezoelectric ceramic at constant electric field: Investigation of energy absorption mechanism**, P. M. Chaplya, G. P. Carman, Univ. of California/Los Angeles . . . . . [4699-16]

## SESSION 3

Room: Royal Palm I  
Mon. 1:30 pm

### Smart Electronics and RF MEMS

*Chairs:* Pratul K. Ajmera, Louisiana State Univ.; K. J. Vinoy, The Pennsylvania State Univ.

- 1:30 pm: **Novel scheme for the sensor readout**, A. Srivastava, H. N. Venkata, P. K. Ajmera, Louisiana State Univ. . . . . [4700-06]
- 1:50 pm: **Laterally movable gate FET (LMGFET) as a resonant gate device**, I. H. Song, T. Xin, P. K. Ajmera, Louisiana State Univ. . . . . [4700-07]
- 2:10 pm: **Development of micromachined RF switches with piezofilm actuation**, C. Fox, X. Chen, Univ. of Nottingham (UK); H. W. Jiang, P. Kirby, Cranfield Univ. (UK); S. McWilliam, Univ. of Nottingham (UK) . . . . . [4700-08]
- 2:30 pm: **On-chip dome-shape spiral micro-inductor for high-frequency applications**, N. Chomnawang, Louisiana State Univ.; J. B. Lee, Univ. of Texas at Dallas . . . . . [4700-09]
- 2:50 pm: **RF MEMS phase shifters by microstereo lithography on silicon**, T. Ji, K. J. Vinoy, V. K. Varadan, The Pennsylvania State Univ. . . . . [4700-10]
- Coffee Break . . . . . 3:10 to 3:40 pm

## SESSION 4

Room: Royal Palm I  
Mon. 3:40 pm

### Microsensors and MEMS I

*Chairs:* K. A. Jose, The Pennsylvania State Univ.; Pascal Xavier, DSO National Labs. (Singapore)

- 3:40 pm: **Dial-mass micromachined gyroscopes theory, design, and experiment**, C. Acar, A. M. Shkel, Univ. of California/Irvine . . . . . [4700-11]
- 4:00 pm: **Development of a MEMS angular-rate sensor with PZT actuation and sensing**, C. Fox, C. Royle, Univ. of Nottingham (UK) . . . . . [4700-12]
- 4:20 pm: **Novel design concept and experimental demonstration of MEMS gyroscopes with improved robustness**, C. Acar, A. M. Shkel, Univ. of California/Irvine . . . . . [4700-13]
- 4:40 pm: **Micromachined cochlear-like acoustic sensor**, R. D. White, K. Grosh, Univ. of Michigan [4700-14]
- 5:00 pm: **Integrated MOSFET-based hydrophone device for underwater applications**, B. Zhu, V. K. Varadan, The Pennsylvania State Univ. . . . . [4700-15]
- 5:20 pm: **Carbon nanotube polymer-based accelerometer and gyroscope**, Y. Sha, J. Xie, V. K. Varadan, The Pennsylvania State Univ. . . . . [4700-16]

## SESSION 3

Room: Golden West  
Mon. 1:30 pm

### Health Monitoring I

*Chair:* Fu-Kuo Chang, Stanford Univ.

- 1:30 pm: **Structural health monitoring using thermal approaches**, G. P. Carman, A. Stewart, Univ. of California/Los Angeles . . . . . [4701-09]
- 1:50 pm: **Nondestructive technique based on vibration measurements and piezoelectric patches for monitoring corrosion phenomena**, E. Monaco, L. De Rosa, F. Bellucci, L. Lecce, Univ. degli Studi di Napoli Federico II (Italy) . . . . . [4701-10]
- 2:10 pm: **Design of a piezoelectric-based structural health monitoring system for damage detection in composite materials**, S. S. Kessler, S. Spearing, Massachusetts Institute of Technology . . . . . [4701-11]
- 2:30 pm: **Built-in damage detection system for sandwich structures under cryogenic temperatures**, E. J. Blaise, F. K. Chang, Stanford Univ. . . . . [4701-12]
- 2:50 pm: **Progress in demonstrator program of Japanese Smart Material and Structure System Project**, N. Tajima, R&D Institute of Metals and Composites for Future Industries (Japan); N. Takeda, Univ. of Tokyo (Japan); T. Kishi, National Institute for Material Science (Japan) . . . . . [4701-13]
- Coffee Break . . . . . 3:10 to 3:40 pm

## SESSION 4

Room: Golden West  
Mon. 3:40 pm

### Health Monitoring II

*Chair:* Stuart Hsu, Honeywell Inc.

- 3:40 pm: **Evaluation of mechanical modal characteristics using optical techniques**, J. D. Lekki, NASA Glenn Research Ctr.; P. W. Flanagan, Cleveland State Univ.; G. Adamovsky, K. Weiland, NASA Glenn Research Ctr. . . . . [4701-14]
- 4:00 pm: **Structural health monitoring using empirical mode decomposition and Hilbert-Huang transform on one-dimensional structures**, D. J. Pines, Univ. of Maryland/College Park; L. W. Salvino, Naval Surface Warfare Ctr.; A. S. Ppurekar, Univ. of Maryland/College Park . . . . . [4701-15]
- 4:20 pm: **Damage location identification for an aluminum plate by wavelet analysis**, B. Xie, G. Song, Univ. of Akron . . . . . [4701-16]
- 4:40 pm: **Structural integrity monitoring of composite patch repairs using wavelet analysis and neural networks**, V. K. Amaravadi, V. S. Rao, K. Mitchell, Univ. of Missouri/Rolla; M. M. Derriso, Air Force Research Lab. . . . . [4701-17]
- 5:00 pm: **Embedded systems for the assessment of structural damages**, N. Dang, V. S. Rao, Univ. of Missouri/Rolla . . . . . [4701-18]
- 5:20 pm: **Advances in utilization of structurally integrated sensor networks for health monitoring in commercial applications**, M. Lin, A. Kumar, X. Qing, S. J. Beard, Acellent Technologies, Inc. . . . . [4701-63]

# Smart Structures and Materials

Conference 4693  
Room: Pacific Salon III

Conference 4694  
Room: Pacific Salon I

Conference 4695  
Room: Town & Country

Conference 4696  
Room: Royal Palm II

Tuesday 19 March

8:00 to 8:45 am • Room: Town & Country

**ASME Adaptive Structures and Materials Systems Best Paper Awards**

Presenter: ASME Adaptive Structures and Materials Systems Technical Committee

Plenary Presentation **Multifunctional Materials**

Speaker: Dr. Leo Christodolou, DARPA, Arlington, VA

## SESSION 5

Room: Pacific Salon III  
Tues. 9:00 am

### Nonlinear Modeling

Chair: **Marcelo J. Dapino**, The Ohio State Univ.

9:00 am: **Hysteresis models for piezoceramic materials**, R. C. Smith, North Carolina State Univ.; Z. Ounaies, NASA Langley Research Ctr. .... [4693-19]

9:20 am: **Evolution model for hysteresis in piezoelectric materials**, R. C. Smith, S. Seelecke, North Carolina State Univ. .... [4693-20]

9:40 am: **Nonlinear model of the longitudinal oscillations of a piezoelectric rod**, R. Gausmann, S. König, W. Seemann, Univ. Kaiserslautern (Germany) [4693-21]

Coffee/Exhibition Break . 10:00 to 10:30 am

## SESSION 6

Room: Pacific Salon III  
Tues.10:30 am

### Finite Element Analysis

Chair: **Romesh C. Batra**, Virginia Polytechnic Institute and State Univ.

10:30 am: **Thin-plate electrostrictive finite element: numerical results and experimental validations**, F. Pablo, ONERA and CNAM (France); D. L. Osmont, ONERA (France); R. Ohayon, CNAM (France) .... [4693-23]

10:50 am: **Coupled structural-acoustic-piezoelectric dynamic finite element analysis of high-frequency undersea transducer arrays**, R. M. Koch, Naval Undersea Warfare Ctr. .... [4693-24]

11:10 am: **Finite element analysis on reduction of the crosstalk in ultrasonic transducers**, Y. R. Roh, H. Eun, K. Kang, Kyungpook National Univ. (Korea) .... [4693-25]

Lunch/Exhibition Break 11:30 am to 1:30 pm

## SESSION 4

Room: Pacific Salon I  
Tues. 9:00 am

### Fiber Bragg Grating Sensors I

Chairs: **John P. Dakin**, Univ. of Southampton (UK); **Maurice P. Whelan**, European Commission Joint Research Ctr. (Italy)

9:00 am: **Structural monitoring using a novel high-performance fiber optic measurement system** (Invited Paper), M. D. Todd, M. E. Seaver, S. Trickey, Naval Research Lab. .... [4694-18]

9:40 am: **Using multi-axis fiber grating strain sensors to measure transverse strain and transverse strain gradients in composite materials with weave structures**, C. A. Black, E. Udd, R. W. Lumsden, T. Taylor, W. Kunzler, M. Kunzler, S. T. Kreger, S. Calvert, W. L. Schulz, Blue Road Research; D. Heider, Univ. of Delaware ..... [4694-19]

Coffee/Exhibition Break . 10:00 to 10:30 am

10:30 am: **Fiber Bragg grating first- and second-order diffraction wavelengths based transducer optimized design**, J. Echevarría, J. Madruga, M. Lomer, J. López-Higuera, Univ. de Cantabria (Spain) .... [4694-20]

10:50 am: **Characterization of embedded fiber Bragg grating sensors written in high-birefringent optical fibers subjected to transverse loading**, F. Bosia, P. Giaccari, M. Facchini, J. Botsis, H. G. Limberger, R. Salathé, Swiss Federal Institute of Technology (Switzerland) [4694-21]

11:10 am: **Embedded optical strain rosette for in-plane measurements**, J. Matrat, K. Levin, Swedish Defence Research Agency (Sweden)[4694-22]

11:30 am: **Novel polarization maintaining fiber Bragg grating interrogation system for multi-axis strain sensing**, C.-C. Ye, S. E. Staines, S. W. James, R. P. Tatam, Cranfield Univ. (UK) .... [4694-23]

Lunch/Exhibition Break 11:50 am to 1:30 pm

## SESSION 3

Room: Town & Country  
Tues. 9:00 am

### Electronic EAP: Ferroelectrics Dielectrics

Chairs: **Roy D. Kornbluh**, SRI International; **Kinji Asaka**, National Institute of Advanced Industrial Science and Technology (Japan)

9:00 am: **Performance evaluation of bending actuators using electrostrictive graft elastomers**, J. Su, R. C. Costen, J. S. Harrison, NASA Langley Research Ctr.; K. M. Newbury, D. J. Leo, Virginia Polytechnic Institute and State Univ. .... [4695-15]

9:20 am: **Electrostrictive response of an ideal polar rubber**, G. R. Davies, Univ. of Leeds (UK) .... [4695-16]

9:40 am: **Effects of electrical properties of papers and electrodes for electroactive paper actuators**, J. Kim, Inha Univ. (Korea); Y. B. Seo, Chungnam National Univ. (Korea); S. H. Choi, J. Su, NASA Langley Research Ctr. .... [4695-17]

Coffee/Exhibition Break . 10:00 to 10:30 am

10:30 am: **Dielectric elastomer artificial muscle actuators: toward biomimetic motion**, R. Pelrine, R. D. Kornbluh, Q. Pei, S. Stanford, S. Oh, J. Eckerle, SRI International; R. J. Full, K. Meijer, M. A. Rosenthal, Univ. of California/Berkeley .... [4695-18]

10:50 am: **Biomimetic actuator based on dielectric polymer**, H. Choi, S. M. Ryew, H. T. Kim, J. W. Jeon, H. M. Kim, J. D. Nam, Sung Kyun Kwan Univ. (Korea); A. Takanishi, Waseda Univ. (Japan); K. Hosokawa, R. Maeda, K. Kaneko, K. Tanie, National Institute of Advanced Industrial Science and Technology (Japan)[4695-19]

11:10 am: **Mechanical properties of dielectric elastomer actuators with smart metallic compliant electrodes**, M. Benslimane, P. Gravesen, Danfoss A/S (Denmark); P. Sommer-Larsen, Risø National Lab. (Denmark) .. [4695-20]

11:30 am: **Performance of dielectric elastomer actuators and materials**, P. Sommer-Larsen, G. Kofod, Risø National Lab. (Denmark); M. Benslimane, P. Gravesen, Danfoss A/S (Denmark) .... [4695-21]

11:50 am: **Electromechanical properties and molecular conformation in P(VDF-TrFE) based terpolymer**, Z. Cheng, H. Li, F. Xia, C. Huang, Q. M. Zhang, The Pennsylvania State Univ.; G. A. Abdul-Sedat, K. D. Belfield, R. Y. Ting, CREOL/Univ. of Central Florida; G. J. Kavarnos, Univ. of Rhode Island ..... [4695-22]

Lunch/Exhibition Break 12:10 to 1:30pm

## SESSION 5

Room: Royal Palm II  
Tues. 9:00 am

### Shape-Memory Alloy Applications

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

9:00 am: **Real-time seismic damping and frequency control of steel structures using Nitinol wire**, G. McGavin, G. Guerin, California State Polytechnic Univ. .... [4696-20]

9:20 am: **Damping via Cu-Zn-Al shape-memory alloys (SMA): the action of diffusive effects on the macroscopic description**, V. Torra, A. Isalgue, Univ. Politècnica de Catalunya (Spain); F. C. Lovey, Institute Balseiro-Ctr. Atomico de Bariloche (Argentina) ... [4696-21]

Coffee/Exhibition Break . 9:40 to 10:30 am

## SESSION 6

Room: Royal Palm II  
Tues.10:30 am

### Active Control

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

10:30 am: **Active vibration control of a smart pultruded fiber-reinforced polymer I-beam**, G. Song, P. Qiao, V. Sethi, A. Prasad, Univ. of Akron ..... [4696-23]

10:50 am: **Non-clipping optimal control of randomly excited nonlinear systems using semi-active ER/MR dampers**, Z. G. Ying, Y. Q. Ni, J. M. Ko, Hong Kong Polytechnic Univ. (Hong Kong) ..... [4696-24]

11:10 am: **Sliding mode control of structures with uncertain coupled subsystems**, N. Luo, Univ. of Girona (Spain); V. Manósa, Technical Univ. of Catalonia (Spain); E. Reithmeier, Univ. Hannover (Germany); J. Rodellar, Technical Univ. of Catalonia (Spain) ..... [4696-25]

11:30 am: **Variable structural system-based fuzzy control of a bridge using magnetorheological fluid dampers**, F. Gordaninejad, Y. Liu, C. A. Eversen, G. Hitchcock, Univ. of Nevada/Reno ..... [4696-26]

Lunch/Exhibition Break 11:50 to 1:30 pm

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# Smart Structures and Materials

Conference 4697  
Room: Pacific Salon II

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Conference 4699  
Room: California

Conference 4700  
Room: Royal Palm I

Conference 4701  
Room: Golden West

Tuesday 19 March

8:00 to 8:45 am • Room: Town & Country

ASME Adaptive Structures and Materials Systems Best Paper Awards

Presenter: ASME Adaptive Structures and Materials Systems Technical Committee

Plenary Presentation Multifunctional Materials

Speaker: Dr. Leo Christodolou, DARPA, Arlington, VA

## SESSION 5

Room: Pacific Salon II  
Tues. 9:00 am

### Acoustics

*Chairs:* Donald J. Leo, Virginia Polytechnic Institute and State Univ.; Joseph R. Maly, CSA Engineering, Inc.

9:00 am: **Computational model for sound field absorption by acoustic arrays**, H. T. Banks, North Carolina State Univ.; D. G. Cole, Duke Univ.; K. M. Furati, King Fahd Univ. of Petroleum & Minerals (Saudi Arabia); K. Ito, North Carolina State Univ.; G. A. Pinter, Univ. of Wisconsin/Milwaukee . . . [4697-20]

9:20 am: **Control of vibration and wave propagation in sandwich plates with periodic auxetic**, M. Ruzzene, L. Mazzarella, P. Tsopelas, Catholic Univ. of America; F. Scarpa, Univ. of Sheffield (UK) . . . [4697-21]

9:40 am: **Recursive methods for optical jitter suppression using acoustic actuators**, S. M. Moon, R. L. Clark, Duke Univ. . . . . [4697-22]

Coffee/Exhibition Break . 10:00 to 10:30 am

## SESSION 6

Room: Pacific Salon II  
Tues.10:30 am

### Active Vibration Absorbers

*Chairs:* George A. Lesiutre, The Pennsylvania State Univ.; Roy Ikegami, Boeing Phantom Works

10:30 am: **Suppression of bladed disk forced vibrations with active vibration absorbers**, G. S. Agnes, Air Force Institute of Technology; M. J. Keller, Air Force Research Lab. . . . . [4697-23]

10:50 am: **Current flowing multiple-mode piezoelectric shunt dampener**, S. Behrens, S. Moheimani, Univ. of Newcastle (Australia) . . . [4697-24]

11:10 am: **Analysis of a state-switched absorber design concept**, K. Cunefare, A. M. Albanese, Georgia Institute of Technology . . . [4697-26]

11:30 am: **Modeling and experimental verification using the sensor/actuator circuit for passive vibration damping**, M. V. Kozlowski, D. G. Cole, R. L. Clark, Duke Univ. . . . . [4697-27]

11:50 am: **Simulation of earthquake-induced structural vibrations in systems with SMA damping elements**, O. Heintze, North Carolina State Univ.; A. Masuda, Kyoto Institute of Technology (Japan); S. Seelecke, North Carolina State Univ. . . . . [4697-51]

Lunch/Exhibition Break12:10 to 1:30 pm

## SESSION 4

Room: San Diego  
Tues. 9:00 am

### Multifunctional Systems: Materials Development I

*Chairs:* Eric H. Anderson, CSA Engineering, Inc.; Peter Matic, Naval Research Lab.

9:00 am: **Structure-power multifunctional composites**, J. Thomas, P. Matic, R. Everett, Naval Research Lab.; M. A. Qidwai, GeoCenters, Inc.; A. S. Gozdz, Telcordia Technologies, Inc.; M. Keennon, J. Grasmeyer, AeroVironment Inc. . . . . [4698-17]

9:20 am: **Autophagous spacecraft composite materials for orbital propulsion**, P. Joshi, B. L. Upschulte, A. H. Gelb, B. D. Green, Physical Sciences Inc.; D. M. Lester, I. A. Wallace, W. D. Starrett, Thiokol Propulsion; D. W. Marshall, Textron Systems . . . . . [4698-18]

9:40 am: **Structure-battery multifunctional composite design rules and tools**, M. A. Qidwai, GeoCenters, Inc.; J. Thomas, P. Matic, R. Everett, Naval Research Lab. . . . . [4698-19]

Coffee/Exhibition Break . 10:00 to 10:30 am

10:30 am: **Thermal management of SMA sandwich panel shape actuators**, D. J. Sypeck, H. N. G. Wadley, Univ. of Virginia [4698-20]

10:50 am: **Shape-memory-based structural actuator panels**, D. M. Elzey, A. Y. N. Softa, H. N. G. Wadley, Univ. of Virginia . . . . . [4698-21]

11:10 am: **Electron-beam-directed vapor deposition of multifunctional structures for electrochemical storage**, D. T. Queheillalt, D. D. Hass, H. N. G. Wadley, Univ. of Virginia . . . . . [4698-22]

11:30 am: **Engineered porous structures: a biological model in the echinoid egg**, A. M. Sastry, J. Parmigiani, Univ. of Michigan . . . . . [4698-23]

11:50 am: **Deployable plates made from stable-element class 1 tenacity**, R. T. Skelton, M. Masic, Univ. of California/San Diego . . . . . [4698-24]

Lunch/Exhibition Break12:10 to 1:30 pm

## SESSION 4

Room: California  
Tues. 9:00 am

### Characterization and Modeling of Active Materials, SMAs and MSMAs

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

9:00 am: **Multi-axial response of hard and soft ferroelectrics under stress and electric field**, J. Shieh, N. A. Fleck, J. E. Huber, Univ. of Cambridge (UK) . . . . . [4699-17]

9:20 am: **Modeling of nonlinear piezoelectric behavior**, A. Achuthan, C. T. Sun, Purdue Univ. . . . [4699-18]

9:40 am: **Mechanics of field coupled materials**, C. S. Lynch, Georgia Institute of Technology . . . [4699-73]

Coffee/Exhibition Break . 10:00 to 10:30 am

10:30 am: **Next-generation electroceramic fibers for active control**, P. Bystricky, M. R. Pascucci, H. B. Strock, CeraNova Corp. . . . . [4699-20]

10:50 am: **AC magnetic field-induced strain of single crystal Ni-Mn-Ga**, C. P. Henry, D. C. Bono, J. Feuchtwangner, S. M. Allen, R. C. O'Handley, Massachusetts Institute of Technology . . . . . [4699-21]

11:10 am: **Design of ferromagnetic shape-memory alloy composite based on NiTi for robust and fast actuators**, T. Tagawa, T. Wada, Y. Liang, M. Taya, Univ. of Washington . . . . . [4699-22]

11:30 am: **Thermomechanical characterization and development of SMA embedded CFRP composites with self-damage control**, B. K. Jang, Y. Xu, R. Oishi, H. Nagai, H. Yoshida, Y. Akimune, K. Otsuka, National Institute of Advanced Industrial Science and Technology (Japan); T. Kishi, National Institute for Materials Science (Japan) . . . . . [4699-23]

11:50 am: **Pulsed magnetic field actuation of single crystalline ferromagnetic shape-memory alloy Ni-Mn-Ga**, M. Marioni, D. C. Bono, S. M. Allen, R. C. O'Handley, Massachusetts Institute of Technology . . . . . [4699-24]

Lunch/Exhibit Break12:10 to 1:30 pm

## SESSION 5

Room: Royal Palm I  
Tues. 9:00 am

### Microsensors and MEMS II

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

#### Keynote Presentation

9:00 am: **MEMS arrays for military applications**, Paul B. Ruffin, U.S. Army Aviation and Missile Command . . . . . [4700-17]

9:40 am: **Active skin for turbulent drag reduction**, O. K. Rediniotis, D. C. Lagoudas, R. Mani, Texas A&M Univ. . . . . [4700-18]

Coffee/Exhibition Break . 10:00 to 10:30 am

## SESSION 6

Room: Royal Palm I  
Tues.10:30 am

### Microsensors and MEMS III

*Chairs:* Vijay K. Varadan, The Pennsylvania State Univ.; Pratul K. Ajmera, Louisiana State Univ.

10:30 am: **Simulation of a microflowmeter**, M. Nossair, A. K. Bhattacharya, Solar Turbines Inc. . . . . [4700-19]

10:50 am: **Hierarchical model for MEMS-based sensors and sensor performance simulation**, K. Park, K. Pochiraju, Stevens Institute of Technology . . . . . [4700-20]

11:10 am: **Simulation of multidomain MEMS problems with finite element and boundary element and boundary element methods**, R. Peipp, M. Kaltenbacher, B. Baffoun, H. Landes, R. Lerch, Friedrich-Alexander Univ. Erlangen-Nürnberg (Germany) . . . . . [4700-21]

11:30 am: **Vertical electrostatic actuator with extended digital range via tailored topology**, Y. Zhang, M. L. Dunn, Univ. of Colorado/ Boulder . . . . . [4700-22]

11:50 am: **Identification of anisotropy in rate integrating gyroscopes**, C. Painter, A. M. Shkel, Univ. of California/Irvine [4700-23]

12:10 pm: **Numerical simulation of IDT-based syroscope by HPEESOF**, A. Mehta, K. A. Jose, V. K. Varadan, The Pennsylvania State Univ. [4700-24]

Lunch/Exhibition Break12:30 to 1:30 pm

## SESSION 5

Room: Golden West  
Tues. 9:00 am

### Active Structural Control Systems

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

9:00 am: **State-of-the-art and open problems in stabilizing platforms for pointing and tracking**, J. E. McInroy, F. Jafari, Univ. of Wyoming [4701-19]

9:20 am: **General over-constrained stabilized platforms: differential kinematics and fault tolerance**, Y. Yi, J. E. McInroy, Univ. of Wyoming; Y. Chen, Penn State Univ. . . . [4701-20]

9:40 am: **Feedback control of an active material adaptive tuned vibration absorber using relative phase**, K. A. Williams, Univ. of Alabama; G. T. Chiu, Purdue Univ. . . . . [4701-21]

Coffee/Exhibition Break . 10:00 to 10:30 am

## SESSION 6

Room: Golden West  
Tues.10:30 am

### Aircraft and Helicopter Applications

*Chair:* Dale Ruebsamen, Honeywell Space Systems

10:30 am: **Zero-mass MEMS micro-jets for improved aerodynamic efficiency of micro-air vehicles**, N. A. Koratkar, T. Borca-Tasciuc, Rensselaer Polytechnic Institute . . . . . [4701-22]

10:50 am: **Application of shape-memory alloy (SMA) spars for aircraft maneuver enhancement**, C. Nam, A. Chattopadhyay, Arizona State Univ.; Y. Kim, Seoul National Univ. (Korea) . . . . . [4701-23]

11:10 am: **Development of a SMA-based actuator for compact kinetic energy missile**, D. D. Shin, D. Lee, K. P. Mohanchandra, G. P. Carman, Univ. of California/Los Angeles . . . [4701-24]

11:30 am: **Design of an improved shape-memory alloy actuated in-flight tracking tab deflection mechanism for helicopter rotor blades**, K. Singh, I. Chopra, Univ. of Maryland/College Park . . [4701-25]

11:50 am: **Design, optimization, and development of a shape-memory alloy reconfigurable wing**, D. C. Lagoudas, J. K. Strelec, J. Yen, M. A. Khan, Texas A&M Univ. . . [4701-26]

12:10 pm: **Aeroelastic vibration feedback control of smart aircraft wings in subsonic flight speeds**, Z. Qin, L. I. Librescu, Virginia Polytechnic Institute and State Univ. . . . . [4701-64]

Lunch/Exhibition Break12:30 to 1:30 pm

# Smart Structures and Materials

Conference 4693  
Room: Pacific Salon III

Conference 4694  
Room: Pacific Salon I

Conference 4695  
Room: Town & Country

Conference 4696  
Room: Royal Palm II

Tuesday 19 March

## SESSION 7

Room: Pacific Salon III  
Tues. 1:30 pm

### Control of Smart Structures II

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

1:30 pm: **Design of fast output sampling feedback control for smart structure model**, M. Umopathy, Regional Engineering College (India); B. Bandyopadhyay, Indian Institute of Technology Bombay (India) [4693-27]

1:50 pm: **Optimal feedback control using adaptive coprime factorization**, M. A. McEver, D. G. Cole, R. L. Clark, Duke Univ. [4693-28]

2:10 pm: **Adaptive positive position feedback controller design for the vibration suppression of smart structures**, M. K. Kwak, S. Heo, G. Jin, Dongguk Univ. (Korea) .. [4693-29]

2:30 pm: **Novel modeling methodology for magnetostrictive/piezoelectric hybrid transducers**, M. J. Dapino, The Ohio State Univ.; R. C. Smith, North Carolina State Univ. .... [4693-18]

2:50 pm: **Control of smart structures using reduced order models**, V. S. Rao, P. Liu, Univ. of Missouri/Rolla ..... [4693-31]

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

## SESSION 5

Room: Pacific Salon I  
Tues. 1:30 pm

### Fiber Bragg Grating Sensors II

Chairs: **Luc Thevenaz**, Swiss Federal Institute of Technology (Switzerland); **Michael D. Todd**, Naval Research Lab.

1:30 pm: **Transverse strain effects on fiber Bragg grating measurements**, S. A. Mastro, Naval Surface Warfare Ctr.; M. A. El-Sherif, Drexel Univ. .... [4694-24]

1:50 pm: **Development of multipoint strain measuring systems using small-diameter fiber Bragg gratings**, S. Kojima, K. Satori, K. Fukuchi, A. Hongo, Hitachi Cable, Ltd. (Japan); N. Takeda, Univ. of Tokyo (Japan) ..... [4694-25]

2:10 pm: **Fiber optic grating moisture and humidity sensor field tests**, H. M. Laylor, T. Taylor, R. W. Lumsden, W. L. Schulz, E. Udd, Blue Road Research ..... [4694-26]

2:30 pm: **Adhesively bonded optical sensors: stress transfer and durability**, A.-M. Skontorp, J. Gürin, Swedish Defense Research Agency (Sweden) ..... [4694-27]

Coffee/Exhibition Break . 2:50 to 3:40 / Exhibition pm

## SESSION 4

Room: Town & Country  
Tues. 1:30 pm

### Ionic EAP: Conductive Polymers, IPMC, and Nanotubes II

Chairs: **John D. Madden**, Massachusetts Institute of Technology; **Qi Ming Zhang**, The Pennsylvania State Univ.

1:30 pm: **Conducting polymer actuators: molecular design and device characterization (Invited Paper)**, J. D. Madden, P. A. Anquetil, P. G. Madden, H.-H. Yu, T. M. Swager, I. W. Hunter, Massachusetts Institute of Technology ..... [4695-23]

2:10 pm: **State of water and transport properties of solid polymer electrolyte membranes in relation to polymer actuators**, K. Asaka, N. Fujiwara, K. Oguro, National Institute of Advanced Industrial Science and Technology (Japan); K. Onishi, S. Sewa, Eamex Corp. (Japan) [4695-24]

2:30 pm: **Large deformation model of ion-exchange actuators using electrochemical potentials**, E. T. Enikov, G. S. Seo, Univ. of Arizona ..... [4695-25]

2:50 pm: **Ionic polymer-metal composites in manufacturing techniques**, K. J. Kim, Univ. of Nevada/Reno; M. Shahinpoor, Univ. of New Mexico and Environmental Robots, Inc. . . /Exhibition [4695-26]

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

## SESSION 7

Room: Royal Palm II  
Tues. 1:30 pm

### Sensors

Chair: **Akira Mita**, Keio Univ. (Japan)

1:30 pm: **Real-time damage assessment of civil structures using fiber grating sensors and modal analysis**, W. L. Schulz, M. Kunzler, H. M. Laylor, R. MacMahon, E. Udd, Blue Road Research; J. P. Conte, Univ. of California/San Diego . [4696-28]

1:50 pm: **Fiber grating traffic monitoring systems**, M. Kunzler, W. L. Schulz, H. M. Laylor, T. Taylor, E. Udd, Blue Road Research [4696-29]

2:10 pm: **Sensor/actuators placement on civil structures using a real coded genetic algorithm**, A. Richardson, M. M. Abdullah, Florida A&M Univ./Florida State Univ. .... [4696-30]

2:30 pm: **MEMS ultrasonic transducer for resident monitoring of steel structures**, I. J. Oppenheim, A. Jain, D. W. Greve, Carnegie Mellon Univ. .... [4696-31]

2:50 pm: **Fiber optic protection system for concrete structures**, J. S. Leng, D. Winter, A. Hameed, R. A. Barnes, G. C. Mays, G. F. Fernando, Cranfield Univ. Shrivenham (UK) ..... [4696-32]

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

# Smart Structures and Materials

**Conference 4697**  
Room: Pacific Salon II

**Conference 4698**  
Room: San Diego

**Conference 4699**  
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**Conference 4700**  
Room: Royal Palm I

**Conference 4701**  
Room: Golden West

**Tuesday 19 March**

**SESSION 7**

Room: Pacific Salon II  
Tues. 1:30 pm

**Semi-active Damping**

*Chairs:* **Faramarz Gordaninejad**, Univ. of Nevada/Reno; **Mehdi Ahmadian**, Virginia Polytechnic Institute and State Univ.

1:30 pm: **Optimal placement of semi-active joints in large space truss structures**, J. Wirmitzer, A. Kistner, L. Gaul, Univ. Stuttgart (Germany) . . . . . [4697-28]

1:50 pm: **Analysis of a novel semi-active piezoelectric coulomb actuator**, O. Durmaz, W. W. Clark, Univ. of Pittsburgh . . . . . [4697-29]

2:10 pm: **Comparison between the theoretical model and experimental outcomes of oscillations of para- and dia-magnetic structures subject to passive magnetic elements**, B. A. Piombo, E. Bonisoli, Politecnico di Torino (Italy); M. Ruzzene, Catholic Univ. of America . . . . . [4697-50]

2:30 pm: **Semi-active vibration isolation using magnetorheological isolator**, Y. T. Choi, N. M. Wereley, Univ. of Maryland/College Park; Y. S. Jeon, Yuhan College (Korea)[4697-31]

2:50 pm: **Seismic-active variable damping TLCD applying artificial neural network**, H. Li, S. Yan, Shenyang Architectural and Civil Engg. Univ. (China) . . . . . [4697-32]  
Coffee/Exhibition Break3:10 to 3:40 pm

**SESSION 5**

Room: San Diego  
Tues. 1:30 pm

**Multifunctional Systems: Materials Development II**

*Chairs:* **Eric H. Anderson**, CSA Engineering, Inc.; **Peter Matic**, Naval Research Lab.

1:30 pm: **Machine augmented composites**, G. F. Hawkins, The Aerospace Corp. . . . . [4698-25]

1:50 pm: **Structural composites with integrated electromagnetic functionality**, S. Nemat-Nasser, Univ. of California/San Diego . . . . . [4698-26]

2:10 pm: **Applications of self-assembled multifunctional materials to electro-optic devices**, R. E. Taylor, Lockheed Martin Space Systems Co. . . . . [4698-27]

2:30 pm: **Three-dimensional multifunctional electroelastomer actuators and their application for biomimetic walking robots**, Q. Pei, S. Stanford, SRI International; M. S. Rosenthal, SRI International and Univ. of California/Berkeley; R. Pelrine, R. D. Kornbluh, SRI International; K. Meijer, R. J. Full, Univ. of California/Berkeley . . . . . [4698-28]

2:50 pm: **Electroelastomers: applications of dielectric elastomer transducers for actuation, generation, and smart structures**, R. D. Kornbluh, R. Pelrine, Q. Pei, R. Heydt, S. Stanford, S. Oh, J. Eckerle, SRI International . . . . . [4698-29]  
Coffee/Exhibition Break3:10 to 3:40 pm

**SESSION 5**

Room: California  
Tues. 1:30 pm

**SMA and MSMA Materials I**

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

1:30 pm: **Crystal structure, magnetic anisotropy, and mechanical properties of seven-layered martensite in Ni-Mn-Ga**, A. Sozinov, A. A. Likhachev, N. Lanska, K. Ullakko, V. K. Lindroos, Helsinki Univ. of Technology (Finland) . . . . . [4699-25]

1:50 pm: **Effect of composition on the magnetically activated properties of Ni-Mn-Ga**, M. J. Dapino, The Ohio State Univ.; T. A. Logrosso, Iowa State Univ. . . . . [4699-26]

2:10 pm: **Model calculation of stress-strain relationships of polycrystalline Fe-Pd, FSMA**, Y. Liang, T. Wada, Univ. of Washington; T. Tagawa, Nagoya Univ.; M. Taya, T. Mori, Univ. of Washington [4699-27]

2:30 pm: **Combinatorial investigation of ferromagnetic shape-memory alloys**, I. Takeuchi, O. Famodu, M. Aronova, A. Jaworski, M. R. Wuttig, Univ. of Maryland/College Park. . . . . [4699-28]

2:50 pm: **Influence of target temperature on sputter deposited Ti-Ni-Cu shape-memory alloys**, K. P. Mohanchandra, Univ. of California/Los Angeles and Mangalore Univ. (India); K. K. Ho, G. P. Carman, Univ. of California/Los Angeles [4699-29]  
Coffee/Exhibition Break3:10 to 3:40 pm

**SESSION 7**

Room: Royal Palm I  
Tues. 1:30 pm

**Fabrication**

*Chairs:* **Norio Shinya**, National Institute for Materials Science (Japan); **Jining Xie**, The Pennsylvania State Univ.

1:30 pm: **Application of composite particles to electronic devices**, M. Kobayashi, T. Dan, M. Egashira, K. Saito, N. Shinya, National Institute for Materials Science (Japan) . . . . . [4700-25]

1:50 pm: **Novel technique for fabrication of multilayered microcoils for microelectromechanical systems (MEMS) applications**, H. D. Chang, J. Qian, Q. Xu, M. Bachman, G. P. Li, Univ. of California/Irvine [4700-26]

2:10 pm: **Carbon and ceramic microcoils for MEMS by microwave CVD**, J. Xie, P. K. Sharma, V. K. Varadan, The Pennsylvania State Univ. . . . . [4700-27]

2:30 pm: **Fabrication of microgap in electroplated metallic structures for MEMS**, Q. Xu, M. Bachman, G. P. Li, Univ. of California/Irvine [4700-28]

2:50 pm: **Design issues in SOI-based high-sensitivity piezoresistive cantilever devices**, S. K. Kashegane, M. J. Madou, R. Whitten, J. V. Zoval, B. Maher, K. Sarkar, Nanogen, Inc. . . . . [4700-29]  
Coffee/Exhibition Break3:10 to 3:40 pm

**SESSION 7**

Room: Golden West  
Tues. 1:30 pm

**Smart Composites**

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

1:30 pm: **Modeling of layerwise piezolaminated structures**, C. M. M. Soares, Instituto Superior Tecnico (Portugal); J. E. Semedo-Garcao, Univ. Nova de Lisbon (Portugal); J. N. Reddy, Texas A&M Univ. . . . . [4701-27]

1:50 pm: **Implementation of structures with self-sensing piezoelectric actuators incorporating active mechanisms**, W. Liao, W. W. Law, J. Huang, The Chinese Univ. of Hong Kong . . . . . [4701-28]

2:10 pm: **Dynamic and static assessment of procedures for embedment of piezoelectric components into composite**, P. Masson, F. Cote, Univ. de Sherbrooke (Canada); N. Mrad, National Research Council Canada . . . . . [4701-29]

2:30 pm: **Smart composite material system with sensor, actuator, and processor functions**, R. Oishi, H. Yoshida, B. Jang, H. Nagai, Y. Xu, National Institute of Advanced Industrial Science and Technology (Japan); N. Ami, Chiyoda Maintenance Co., Ltd. (Japan) . . . . . [4701-30]

2:50 pm: **Thermal deformation compensation of a composite beam using piezoelectric actuators**, X. Zhou, G. Song, Univ. of Akron . . . . . [4701-31]  
Coffee/Exhibition Break3:10 to 3:40 pm

**Poster/Exhibition Reception**

*Golden Ballroom*

Tuesday 19 March . . . . . 6:00 to 7:30 pm

A poster session will be held on Tuesday evening for all attendees of the Smart Structures and Materials and NDE for Health Monitoring and Diagnostics symposia. 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 hearty hors d'oeuvres will be served. Attendees are requested to wear their conference registration badge.

Poster authors will be able to set up their poster papers between 10:00 am and 3:00 pm Tuesday. Poster papers can be previewed after 3 pm before the formal poster session begins at 6 pm.

Authors must remove their papers at the conclusion of the poster reception. It is the author's responsibility to remove their posters. Papers not removed will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of the poster reception



# Smart Structures and Materials

Conference 4693  
Room: Pacific Salon III

Conference 4694  
Room: Pacific Salon I

Conference 4695  
Room: Town & Country

Conference 4696  
Room: Royal Palm II

Tuesday 19 March

## SESSION 8

Room: Pacific Salon III  
Tues. 3:40 pm

### Signal Processing for Structural Health Monitoring

Chair: **Wieslaw J. Staszewski**, Univ. of Sheffield (UK)

3:40 pm: **Two-dimensional wavelet mapping techniques for damage detection**, B. Amizic, V. S. Rao, V. Amarvadi, Univ. of Missouri/Rolla; M. M. Derriso, Air Force Research Lab. .... [4693-32]

4:00 pm: **Local interaction modeling for acousto-ultrasonic wave propagation in metallic structures**, B. C. Lee, W. J. Staszewski, Univ. of Sheffield (UK) .... [4693-33]

4:20 pm: **Lamb wave detection based on adaptive wavelet modeling**, L. Shi, J. Ihn, F. Chang, Stanford Univ. .... [4693-34]

4:40 pm: **Damage detection in mechanical structures using extreme value statistics**, K. Worden, Univ. of Sheffield (UK); H. Sohn, C. R. Farrar, Los Alamos National Lab. .... [4693-35]

5:00 pm: **Wave propagation sensing for damage detection in plates**, A. Ghoshal, Arizona State Univ.; W. N. Martin, Naval Undersea Warfare Ctr.; M. J. Schulz, Univ. of Cincinnati; A. Chattopadhyay, Arizona State Univ.; W. H. Prosser, NASA Langley Research Ctr. .... [4693-36]

5:20 pm: **Fiber optic sensor for continuous health monitoring in CFRP composite materials**, L. Rippert, S. Van Huffel, M. Wevers, Katholieke Univ. Leuven (Belgium) .... [4693-37]

## SESSION 6

Room: Pacific Salon I  
Tues. 3:40 pm

### Civil Engineering and Applications

Chairs: **Wolfgang R. Habel**, Federal Institute for Materials Research & Testing (Germany); **Whitten L. Schulz**, Blue Road Research

3:40 pm: **Autonomous remote monitoring system for landslides**, L. Manetti, Univ. of Applied Sciences of Southern Switzerland (Switzerland); A. Terribilini, Swiss Federal Institute of Technology (Switzerland); A. Knecht, Univ. of Applied Sciences of Southern Switzerland (Switzerland) .... [4694-29]

4:00 pm: **Application of the optical sensing technology to the civil engineering field with optical fiber strain measurement device (B-OTDR)**, K. Komatsu, K. Fujihashi, M. Okutsu, Nippon Telegraph and Telephone Corp. (Japan) . [4694-30]

4:20 pm: **Complex measurement system for long-term monitoring of prestressed railways bridges in the new Lehrter Bahnhof in Berlin**, W. R. Habel, D. Hofmann, H. Kohlhoff, J. Knapp, K. Brandes, Bundesanstalt für Materialforschung und -prüfung (BAM) (Germany); G. Wilhelm, H. Hänichen, Deutsche Bahn Projekt Verkehrsbau GmbH (Germany); D. Inaudi, Smartec SA (Switzerland) .... [4694-31]

4:40 pm: **Remote structural monitoring of the Cathedral of Como using an optical fiber Bragg sensor system**, M. P. Whelan, D. Albrecht, European Commission Joint Research Ctr. (Italy); A. Capsoni, Politecnico di Milano (Italy) .... [4694-32]

5:00 pm: **Characterization of bond performance of textiles in cement-matrices by using fiber optic sensors**, M. Molter, RWTH-Aachen (Germany); D. Hofmann, T. Gutmann, F. Basedau, W. R. Habel, Bundesanstalt für Materialforschung und -prüfung (BAM) (Germany) .... [4694-33]

5:20 pm: **Strain monitoring of a newly developed precast concrete track for high-speed railway traffic using embedded fiber optic sensors**, S. Crail, Deutsche Bahn AG (Germany); U. Schreiner, E. Lindner, Max Bögl GmbH (Germany); W. R. Habel, D. Hofmann, F. Basedau, K. Brandes, Bundesanstalt für Materialforschung und -prüfung (BAM) (Germany); W. Ecke, K. Schröder, Institut für Physikalische Hochtechnologie eV (Germany) .... [4694-34]

## SESSION 4 Cont.

3:40 pm: **Measurement and micro-models of ionomeric polymer-metal composites (IPMC)**, X. Bao, Y. Bar-Cohen, S.-S. Lih, Jet Propulsion Lab. .... [4695-27]

4:00 pm: **Extensional transduction properties of ionic polymer materials**, D. J. Leo, O. Parrott, S. Brooks, D. J. Leo, Virginia Polytechnic Institute and State Univ. .... [4695-28]

4:20 pm: **Multiwall carbon nanotube sensors and actuators**, L. Dai, M. Gao, CSIRO (Australia); G. M. Spinks, G. G. Wallace, Univ. of Wollongong (Australia); R. Baughman, Univ. of Texas/Dallas .... [4695-29]

## SESSION 8

Room: Royal Palm II  
Tues. 3:40 pm

### Smart Buildings and Highways

Chair: **Ming L. Wang**, Univ. of Illinois/Chicago

3:40 pm: **Earthquake response reduction of buildings by rocking structural systems**, M. Midorikawa, T. Azuhata, Building Research Institute (Japan); T. Ishihara, National Institute for Land and Infrastructure Management (Japan); Y. Matsuba, Maeda Corp. (Japan); Y. Matsushima, Fudo Construction Co., Ltd. (Japan); A. Wada, Tokyo Institute of Technology (Japan) .... [4696-33]

4:00 pm: **Continuous measurement of temperature distributed on a building construction**, I. B. Kwon, C. Y. Kim, M. Y. Choi, Korea Research Institute of Standards and Science (Korea) .... [4696-34]

4:20 pm: **Highway texture measurement system using a laser device**, Y. Rao, R. Liang, X. Jiang, X. Chen, C. Liu, Univ. of Houston .... [4696-35]

4:40 pm: **Highway crack monitoring system**, M. Wu, X. Chen, C. Liu, Univ. of Houston .... [4696-36]

5:00 pm: **Auto-adaptive response modification in moment resisting frame structures**, G. Fischer, V. C. Li, Univ. of Michigan .... [4696-38]

5:20 pm: **Smart towers for unusual and extreme loads**, A. Rajaraman, Indian Institute of Technology Madras (India) .... [4696-39]

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# Smart Structures and Materials

Conference 4697  
Room: Pacific Salon II

Conference 4698  
Room: San Diego

Conference 4699  
Room: California

Conference 4700  
Room: Royal Palm I

Conference 4701  
Room: Golden West

Tuesday 19 March

## SESSION 8

Room: Pacific Salon II  
Tues. 3:40 pm

### Active Damping I

*Chairs:* Donald J. Leo, Virginia Polytechnic Institute and State Univ.; Amr M. Baz, Univ. of Maryland/College Park

3:40 pm: **Active vibration isolation device using PZT wafers and passive damping material**, M. K. Kwak, M. H. Kwak, S. Heo, Dongguk Univ. (Korea) ..... [4697-33]

4:00 pm: **Optimum design of hybrid piezoelectric damping system for flexible structure**, K. Adachi, Y. Kitamura, T. Iwatsubo, Kobe Univ. (Japan) ..... [4697-34]

4:20 pm: **Robust vibration control based on readily determined variables**, E. Reithmeier, Univ. Hannover (Germany); G. Leitmann, Univ. of California/Berkeley [4697-35]

4:40 pm: **Prediction of ER long-stroke damper response: model updating methods**, N. D. Sims, R. Stanway, C. Wong, Univ. of Sheffield (UK) ..... [4697-36]

5:00 pm: **Electrorheological damper analysis using an Eyring constitutive relationship**, L. Bitman, N. M. Wereley, Univ. of Maryland/College Park ..... [4697-37]

5:20 pm: **Active damping of cantilever beam using piezoelectric fiber reinforced composite layer**, M. C. Ray, N. Mallik, Indian Institute of Technology (India) ..... [4697-38]

## SESSION 5 Cont.

3:40 pm: **Recent advances in magnetostrictive particulate composite technology**, W. J. Pulliam, Fortis Technologies, Inc. [4698-30]

## SESSION 6

Room: San Diego  
Tues. 4:00 pm

### Electronics

*Chairs:* Douglas K. Lindner, Virginia Polytechnic Institute and State Univ.; B. Kyle Henderson, Air Force Research Lab.

4:00 pm: **Low-input voltage switching amplifiers for piezoelectric actuators**, D. K. Lindner, D. Cheng, W. Huang, C. Song, M. Zhu, Virginia Polytechnic Institute and State Univ. .... [4698-31]

4:20 pm: **Fabrication of adhesivesless lightweight flexible circuits using Langley Research Center soluble imide "LaRC-SI" polyimide film**, N. M. Holloway, K. N. Barnes, G. K. Draughon, L. A. Scott, NASA Langley Research Ctr. .... [4698-32]

4:40 pm: **Smaller and lightweight power amplifiers**, Q. A. Shams, R. L. Fox, R. W. Moses, R. G. Bryant, P. C. Robinson, NASA Langley Research Ctr.; M. Shirvani, New River Community College .... [4698-33]

## SESSION 6

Room: California  
Tues. 3:40 pm

### SMA and MSMA Materials II

*Chair:* Robert C. O'Handley, Massachusetts Institute of Technology

3:40 pm: **Ferromagnetic SMA, smart materials, and adaptive structures (Invited Paper, Presentation Only)**, R. G. Barsoum, Office of Naval Research ..... [4699-30]

4:20 pm: **Fabrication of porous shape-memory alloys from pre-alloyed NiTi powders**, D. C. Lagoudas, P. B. Entchev, E. L. Vandyrgriff, Texas A&M Univ. .... [4699-31]

4:40 pm: **Microstructures and transformation behavior of cobalt-base ferromagnetic shape-memory alloys**, M. R. Wuttig, Y. Kishi, Univ. of Maryland/College Park; M. De Graef, Carnegie Mellon Univ.; T. A. Lograsso, Iowa State Univ.; C. Craciunescu, Univ. of Maryland/College Park ..... [4699-32]

5:00 pm: **Microscopic aspects for models of ferromagnetic shape-memory actuation**, R. C. O'Handley, D. I. Paul, M. Marioni, C. P. Henry, M. Richard, P. G. Tello, S. M. Allen, Massachusetts Institute of Technology ..... [4699-33]

5:20 pm: **Magneto-mechanical behavior of a ferromagnetic shape-memory alloy: Fe<sub>3</sub>Pd**, T. W. Shield, J. Cui, Univ. of Minnesota . [4699-34]

5:40 pm: **Multiferroic materials: what interesting behavior is predicted theoretically for a material that is both ferroelectric and ferromagnetic?** R. D. James, Univ. of Minnesota ..... [4699-35]

## SESSION 8

Room: Royal Palm I  
Tues. 3:40 pm

### Smart Skin and Reconfigurable Antenna and Frequency Selective Surface (FSS)

*Chairs:* Yanan Sha, The Pennsylvania State Univ.; Gregory Washington, The Ohio State Univ.

3:40 pm: **Rectennas for smart membrane actuators**, S. H. Choi, W. J. Yi, M. D. Deshpande, R. G. Bryant, NASA Langley Research Ctr.; K. D. Song, Norfolk State Univ.; G. C. King, NASA Langley Research Ctr. [4700-30]

4:00 pm: **Simulation and testing of a smart reconfigurable aperture antenna**, G. Washington, The Ohio State Univ.; M. Angelino, Boeing Satellite Systems ..... [4700-31]

4:20 pm: **Power systems and requirements for integration of smart structures into aircraft**, A. J. Lockyer, Northrop Grumman Corp.; D. K. Lindner, Virginia Polytechnic Institute and State Univ.; W. R. Sheppard, C. A. Martin, Northrop Grumman Corp. .... [4700-32]

4:40 pm: **Reconfigurable digital controllers for smart structural systems**, V. Satagopan, V. S. Rao, H. J. Pottinger, Univ. of Missouri/Rolla ..... [4700-33]

5:00 pm: **Bluetooth technology for wireless sensors**, V. K. Varadan, V. Ravindran, The Pennsylvania State Univ. .... [4700-34]

5:20 pm: **Optimized multilayered graded fractal FSS: micro-genetic algorithm and comparison with experiment**, Y. Sha, K. J. Vinoy, K. A. Jose, C. Neo, V. K. Varadan, The Pennsylvania State Univ. [4700-35]

## SESSION 8

Room: Golden West  
Tues. 3:40 pm

### Piezo Ultrasonic Applications

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

3:40 pm: **Development of a novel standing wave type ultrasonic linear motor**, Y. R. Roh, S. Lee, J. Kown, Kyungpook National Univ. (Korea) ..... [4701-33]

4:00 pm: **Novel horn designs for ultrasonic/sonic cleaning, welding, soldering, cutting, and drilling**, S. Sherrit, S. A. Askins, M. Gradziol, B. P. Dolgin, X. Bao, Z. Chang, Y. Bar-Cohen, Jet Propulsion Lab. [4701-34]

4:20 pm: **Modeling of particle flow due to ultrasonic drilling**, Z. Chang, B. P. Dolgin, X. Bao, S. Sherrit, Y. Bar-Cohen, Jet Propulsion Lab. [4701-35]

4:40 pm: **Analysis and simulation of the ultrasonic/sonic driller/corer (USDC)**, X. Bao, Z. Chang, S. Sherrit, B. P. Dolgin, Y. Bar-Cohen, Jet Propulsion Lab.; D. S. Pal, S. Du, T. Peterson, Cybersonics, Inc. [4701-36]

# Smart Structures and Materials

Tuesday 19 March

## ✓ Posters—Tuesday

The following posters will be displayed in the formal poster session and Exhibit Reception on Tuesday evening from 6:00 to 7:30 pm. Authors will be present at this time for discussion. Poster authors will be able to set up their poster papers between 10:00 am and 3:00 pm Tuesday. Poster papers can be previewed from 3:00 to 4:00 pm before the formal poster session begins at 6:00 pm.

### Conference 4693

- ✓ **Transient non-homogeneous modeling of ferroelectric polymers in smart structures using finite-element boundary-element methods**, M. D. Driga, A. Yu, Univ. of Texas/ Austin ..... [4693-22]
- ✓ **Extremely high-resolution position control system for a tip-tilt-piston mirror**, L. Zago, I. Kjelberg, P. Spanoudakis, R. Gentsch, E. Onillon, L. Mealares, Ctr. Suisse d'Electronique et de Microtechnique (Switzerland) ..... [4693-67]

### Conference 4694

- ✓ **Experimental validation of fiber Bragg grating sensors for steel girder strain characterization**, J. Echevarría, C. Jáuregui, A. Quintela, M. A. Rodríguez, R. García, J. A. Polanco, I. Carrascal, J. López-Higuera, Univ. de Cantabria (Spain) ... [4694-35]
- ✓ **Concrete-beam curing process and flexural test with fiber Bragg grating based transducers**, J. Echevarría, C. Jáuregui, A. Quintela, M. A. Rodríguez, R. García, G. Gutierrez, J. López-Higuera, Univ. de Cantabria (Spain) ..... [4694-36]
- ✓ **Optical fiber transducer for monitoring the cooling profile of iron-steel bars**, J. Madruga, V. Alvarez, D. Gonzalez, J. Echevarría, J. López-Higuera, Univ. de Cantabria (Spain) ..... [4694-37]
- ✓ **Measurement of local bending moment using embedded optical fiber Bragg grating sensors**, M. Prabhugoud, K. J. Peters, North Carolina State Univ. . [4694-38]
- ✓ **Development of the monitoring system for slope deformations with fiber Bragg grating arrays**, Y. Yoshida, Y. Kashiwai, Taisei Kiso Sekkei Co., Ltd. (Japan); E. Murakami, Kanden Kogyo Corp. (Japan); S. Ishida, N. Hashiguchi, Fujita Corp. (Japan) .. [4694-39]
- ✓ **Research on an innovative optical waveguided tactile sensing technology**, Y. Pan, J. Liu, S. Qiao, Chongqing Univ. (China)[4694-40]
- ✓ **Temperature-compensated strain measurement using FBG sensors embedded in composite laminates**, N. Tanaka, Y. Okabe, N. Takeda, Univ. of Tokyo (Japan)..... [4694-41]
- ✓ **Transmission/reflection-type hybrid extrinsic Fabry-Perot interferometric optical fiber sensors**, S.-H. Kim, J.-J. Lee, Korea Advanced Institute of Science and Technology (Korea) .. [4694-43]
- ✓ **Recent technology developments in contactless monitoring of the electromagnetic activities of the human heart and brain**, S. G. Popa, Interactive Electronics, Inc.; M. Shahinpoor, Univ. of New Mexico; L. O. Sillerud, Interactive Electronics, Inc. .... [4694-44]

- ✓ **Acoustic/vibration fiber optic sensor based on a single-mode fiber coupler**, Z.-L. Hu, Y.-M. Hu, Z. Meng, National Univ. of Defense Technology (China); Y.-B. Liao, Tsinghua Univ. (China) ..... [4694-45]
- ✓ **Monitoring of stress concentration at a circular hole caused by cyclic loading**, K. Ichinose, K. Gomi, Tokyo Denki Univ. (Japan); K. Taniuchi, Meiji Univ. (Japan); K. Fukuda, Univ. of Tokyo (Japan); Y. Funamoto, Tokyo Denki Univ. (Japan)..... [4694-46]
- ✓ **Fiber optic sensor system for energy measurements in active acoustics control**, M. Yu, M. Al-Bassyouni, B. Balachandran, Univ. of Maryland/College Park ..... [4694-47]
- ✓ **Waveguide sensor based on coupling of surface plasmon modes**, K. V. Nerkararyan, N. A. Janunts, Yerevan State Univ. (Armenia) ..... [4694-48]
- ✓ **Optical chemical sensor based on Fabry-Perot resonance modes**, Z. Cao, S. Huang, X. Liu, Q. Shen, Shanghai Jiao Tong Univ. (China) ..... [4694-49]
- ✓ **Crack identification in CFRP laminates using small-diameter FBG sensors**, T. Mizutani, Y. Okabe, N. Takeda, Univ. of Tokyo (Japan)..... [4694-50]
- ✓ **Fiber optic sensor for hydrocarbon leak detection and localization based on transmission/reflection analysis**, V. V. Spirin, R. Lopez, M. G. Shlyagin, S. V. Miridonov, I. Marquez, CICESE; E. A. Kuzin, G. Beltran-Perez, INAOE (Mexico); P. L. Swart, Rand Afrikaans Univ. (South Africa) ..... [4694-52]
- ✓ **Distributed excess strain sensor using fiber Bragg gratings**, I. Marquez Borbon, M. G. Shlyagin, S. V. Miridonov, V. V. Spirin, R. Lopez, CICESE (Mexico)[4694-53]
- ✓ **Optical fiber Bragg grating sensor instrument for structural degradation detection**, I. Saxena, D. Files, Intelligent Optical Systems, Inc; L. Kempen, E. Mendoza, Optical Technology Systems; S. G. Pierce, Univ. of Strathclyde, (UK) ... [4694-54]

End of Conference 4694 ■

### Conference 4695

- ✓ **Development of the novel composite based on thermoplastic polymers and low-melting point metal alloys**, E. Bormashenko, S. Semion, P. Roman, College of Judea and Samaria (Israel) .... [4695-59]
- ✓ **Electrostrictive response of P(VDF-TrFE)/P(VDF/HFP) copolymer blends**, J. I. Scheinbeim, Rutgers Univ. .... [4695-60]
- ✓ **Wave transmission and attenuation characteristics of EAP**, J.-H. Kim, J. Kim, Inha Univ. (Korea); V. V. Varadan, V. K. Varadan, The Pennsylvania State Univ. .... [4695-61]
- ✓ **Nanocomposited electrostrictive elastomer actuators by using nanosized ionic silicate layer reinforcement**, J.-D. Nam, S. Hwang, J. Lee, H. Kim, H. R. Choi, H. H. Kim, J. W. Jeon, Sung Kyun Kwan Univ. (Korea); K. J. Kim, Univ. of Nevada/Reno [4695-62]
- ✓ **Bending of partially sulfonated ionic polymer gels: hydrated cation effect and applications**, L. Yao, Virginia Commonwealth Univ.; S. Krause, Rensselaer Polytechnic Institute; G. E. Wnek, Virginia Commonwealth Univ. .... [4695-64]
- ✓ **Electrochemical and mechanical investigation of new fluorinated ionomer composites**, W.-L. Liu, J.-L. Chen, Z.-H. Huang, C.-Y. Yeh, L.-C. Cheng, T.-L. Yang, Industrial Technology Research Institute (Taiwan) ..... [4695-65]
- ✓ **Development of new artificial muscle actuator**, N. Saga, Q. Jianhui, J. Uehara, T. Iwade, Akita Prefectural Univ. (Japan) [4695-66]
- ✓ **Relaxor: ferroelectric characteristics of proton irradiated BST/P(VDF-TrFE) 0-3 composites**, S. U. Adikary, Hong Kong Polytechnic Univ. (Hong Kong); B. Sundarvel, I. H. Wilson, Chinese Univ. of Hong Kong; H. L. Chan, C. Choy, Hong Kong Polytechnic Univ. (Hong Kong) ..... [4695-68]
- ✓ **Progress toward a conducting polymer-based microwave "smart window": the effect of physical and chemical parameters on material performance**, A. Barnes, R. Zhang, P. V. Wright, K. L. Ford, B. Chambers, Univ. of Sheffield (UK) ..... [4695-69]
- ✓ **Characterization of carbon nanotubes in polymeric matrix**, T. C. Fan, International Open Univ.; S. Q. Li, Beijing Central Iron & Steel Research Institute (China) ..... [4695-70]

# Smart Structures and Materials

Tuesday 19 March

## ✓ Posters—Tuesday

The following posters will be displayed in the formal poster session and Exhibit Reception on Tuesday evening from 6:00 to 7:30 pm. Authors will be present at this time for discussion. Poster authors will be able to set up their poster papers between 10:00 am and 3:00 pm Tuesday. Poster papers can be previewed from 3:00 to 4:00 pm before the formal poster session begins at 6:00 pm.

### Conference 4697

✓ **Vibration control in an MR fluid damper suspension system**, L. Xie, L. Ma, Y. Luo, Jiangsu Univ. of Science and Technology (China) . . . . . [4697-47]

### Conference 4698

✓ **Smart material screening machines using smart materials and controls**, D. Allaei, Smart Screen Systems, Inc.; A. Waigand, USX Engineers and Consultants, Inc. . . . . [4698-61]

### Conference 4699

✓ **Behaviors of LIPCA actuators**, N. Goo, Y. Kwon, S. W. Choo, Kyungpook National Univ. (Korea); K. Yoon, Konkuk Univ. (Korea) . . . . . [4699-72]

### Conference 4700

✓ **Characterization of nanocrystalline silicon films**, H. Lin, Beijing Institute of Technology (China); J. Zhu, Nanjing Electronic Devices Institute (China) . . . . [4700-48]

✓ **New smart systems based on fundamentally new phenomena of laser-induced high-temperature superconductivity with new superspralling theory with best effectivity**, E. G. Popov, Crimean Astrophysical Observatory (Ukraine) [4700-49]

### Conference 4701

✓ **Double bridge technique for temperature compensation of piezoresistive pressure sensor**, P. Hsieh, C. Uang, I-Shou Univ. (Taiwan); Y. M. Chang, Taiwan Silicon Microelectronics Corp. (Taiwan); J. M. Xu, I-Shou Univ. (Taiwan) . . . . . [4701-65]

## Poster/Exhibition Reception

*Golden Ballroom*

Tuesday 19 March . . . . . 6:00 to 7:30 pm

See page 2 for details.

# Smart Structures and Materials

Conference 4693  
Room: Pacific Salon III

Conference 4695  
Room: Town & Country

Conference 4696  
Room: Royal Palm II

Wednesday 20 March

8:00 to 8:45 am • Town & Country

Smart Structures and Materials Best Student Paper Awards

Presenter: Dr. Alison Flatau, National Science Foundation

Plenary Presentation: Structural Damage Detection and Health Monitoring: A Myth or Reality

Speaker: Dr. Anne S. Kiremidjian, Professor and Director, Stanford Univ./The John A. Blume Earthquake Engineering Ctr., Stanford, CA

## SESSION 9

Room: Pacific Salon III  
Wed. 9:00 am

### Shape-Memory Alloys

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

9:00 am: **Macroscopic models for SMA characterization and design**, J. E. Massad, R. C. Smith, S. Seelecke, North Carolina State Univ. [4693-38]

9:20 am: **Modeling of shape-memory alloy springs using Preisach model for passive vibration isolation**, D. C. Lagoudas, M. M. Khan, Texas A&M Univ. [4693-39]

9:40 am: **Control shape-memory alloy actuators using pulse width (PW) modulation**, N. Ma, G. Song, Univ. of Akron [4693-40]

Coffee/Exhibition Break 10:00 to 10:30 am

## SESSION 10

Room: Pacific Salon III  
Wed. 10:30 am

### Control Applications

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

10:30 am: **Active vibration control of a gear pair using direct adaptive control method**, Y. Guan, T. C. Lim, W. S. Shepard, Univ. of Alabama [4693-41]

10:50 am: **Comparisons of actuator designs for active vibration control of a gear pair system**, Y. Guan, M. Li, T. C. Lim, W. S. Shepard, Univ. of Alabama [4693-42]

11:10 am: **Closed-loop control of a shape-memory alloy actuation system for variable area fan nozzle**, P. Baroah, N. M. Rey, United Technologies Research Ctr. [4693-43]

11:30 am: **Active acoustics control with fiber optic sensors**, M. Al-Bassiyouni, M. Yu, B. Balachandran, J. E. Oh, Univ. of Maryland/College Park [4693-44]

11:50 am: **Modeling and analyses of smart localized structural elements for nonlinear vibration control of a taut string**, O. Gottlieb, Technion-Israel Institute of Technology (Israel); G. Rega, W. Lacarbonara, Univ. degli Studi di Roma (Italy) [4693-45]

Lunch/Exhibition Break 12:10 to 1:30 pm

## SESSION 5

Room: Town & Country  
Wed. 9:00 am

### EAP Properties Characterization

Chairs: Leonard J. Buckley, Naval Research Lab.; Danilo De Rossi, Univ. degli Studi di Pisa (Italy)

9:00 am: **In-situ measurement of conducting polymers on evaporated and electrochemically deposited Au surfaces**, C. C. Bohn, Univ. of Florida; M. Pyo, Sunchon National Univ. (Korea); S. Sadki, CNRS (France); E. Smela, Univ. of Maryland/College Park; A. B. Brennan, J. R. Reynolds, Univ. of Florida [4695-31]

9:20 am: **Mechanical characterization of artificial muscles by image treatment**, L. Weruaga-Prieto, A. J. Fernandez-Romero, J. Gonzalez-Sanchez, J. Morales-Sanchez, J. L. Pedreno-Molina, T. F. Otero, Univ. Politecnica de Cartagena (Spain) [4695-32]

9:40 am: **Characterization of the electromechanical properties of ionic polymer-metal composite (IPMC)**, Y. Bar-Cohen, X. Bao, S-S. Lih, Jet Propulsion Lab./Caltech [4695-33]

10:30 am: **Characterizing the dynamic properties of electroviscoelastic materials**, J. B. Kosmatka, S. C. Mak, Univ. of California/San Diego [4695-34]

10:50 am: **Piezoelectric resonators for the characterization of mechanical properties of polymers**, S. Sherrit, V. Olazabal, J. M. Sansinena, Y. Bar-Cohen, Jet Propulsion Lab. [4695-35]

## Open Discussion

Room: Town & Country

Wed. 11:10 am to 12:10 pm

Participants: Yoseph Bar-Cohen, Jet Propulsion Lab.; Rainer W. Güelch, Eberhard-Karls-Universität Tübingen (Germany); Seung-Ki Lee, Dankook Univ. (Korea); John D. Madden, Massachusetts Institute of Technology; Slavouche Nemat-Nasser, Univ. of California/San Diego; Mohsen Shahinpoor, Environmental Robotics, Inc.; Danilo De Rossi, Univ. degli Studi di Pisa (Italy); Gordon G. Wallace, Univ. of Wollongong (Australia)

Topics to include:

- Areas of EAP weakness shortcoming of the EAP technology infrastructure.
- What is the gap between the needed and available EAP and how to bridge it?
- Do we see in the horizon a commercial EAP actuator or device?
- Future science and engineering directions.

Lunch/Exhibition Break 12:10 to 1:30 pm

## SESSION 9

Room: Royal Palm II  
Wed. 9:00 am

### Smart Concrete Technologies

Chair: Fu-Kuo Chang, Stanford Univ.

9:00 am: **Developments in chlorine detection in concrete using NMR**, J. H. Garrett, Jr., G. K. Fedder, K. M. Frederick, J. J. Hsu, I. J. Lowe, I. J. Oppenheim, M. E. Patton, P. J. Sides, A. H. Yun, Carnegie Mellon Univ. [4696-40]

9:20 am: **Design of smart rebar for identifying debond in reinforced concrete structures**, H. L. Chan, F. K. Chang, Stanford Univ. [4696-41]

9:40 am: **Microwave subsurface imaging of damage in concrete structures**, Y. J. Kim, Univ. of California/Irvine; L. Jofre, Univ. Politecnica de Catalunya (Spain); F. De Flaviis, M. Q. Feng, Univ. of California/Irvine [4696-42]

10:00 am: **Health monitoring for effective management of infrastructure**, A. E. Aktan, M. Pervizpour, Drexel Univ. [4696-53]

Coffee/Exhibition Break 10:20 to 10:30 am

## SESSION 10

Room: Royal Palm II  
Wed. 10:30 am

### Semi-active Devices

Chair: Shirley J. Dyke, Washington Univ.

10:30 am: **Experimental investigation on seismic response control of adjacent buildings using semi-active MR dampers**, Y. Q. Ni, H. J. Liu, J. M. Ko, Hong Kong Polytechnic Univ. (Hong Kong) [4696-43]

10:50 am: **Magnetorheological fluid damper for seismic mitigation of large structures**, F. Gordaninejad, G. Hitchcock, X. Wang, Univ. of Nevada/Reno [4696-44]

11:10 am: **Application of MR damper to base-isolated structures**, N. Iwata, Kinki Univ. (Japan); H. Fujitani, Building Research Institute (Japan); S. Soda, Waseda Univ. (Japan); Y. Shiozaki, T. Hiwatashi, Building Research Institute (Japan); H. Sodeyama, Sanwa Tekki Corp. (Japan); K. Hata, Bando Chemical Industries, Ltd. (Japan); M. Iiba, Building Research Institute (Japan) [4696-45]

11:30 am: **Extending precast/prestressed bridge spans using post-tensioning and splicing**, B. Collett, J. Saliba, Univ. of Dayton [4696-50]

End of Conference 4696 ■

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# Smart Structures and Materials

Conference 4697  
Room: Pacific Salon II

Conference 4698  
Room: San Diego

Conference 4699  
Room: California

Conference 4700  
Room: Royal Palm I

Conference 4701  
Room: Golden West

Wednesday 20 March

8:00 to 8:45 am • Town & Country

Smart Structures and Materials Best Student Paper Awards

Presenter: Dr. Alison Flatau, National Science Foundation

Plenary Presentation: Structural Damage Detection and Health Monitoring: A Myth or Reality

Speaker: Dr. Anne S. Kiremidjian, Professor and Director, Stanford Univ./The John A. Blume Earthquake Engineering Ctr., Stanford, CA

## SESSION 9

Room: Pacific Salon II  
Wed. 9:00 am

### Damping Materials II

Chairs: T. Tupper Hyde, Honeywell Space Systems; Zahidul H. Rahman, Jet Propulsion Lab.

9:00 am: **Experimental analysis of lead behavior**, A. Beghini, M. Abe, Y. Fujino, J. Yoshida, Univ. of Tokyo (Japan) ..... [4697-39]

9:20 am: **Performance of SMA-based damping devices with optimized hysteretic characteristics**, A. Masuda, A. Sone, Kyoto Institute of Technology (Japan); M. N. Noori, North Carolina State Univ. .... [4697-40]

9:40 am: **Characteristics of rubber used in seismic isolation by digital and thermal image analysis**, C. S. Lewangamage, M. Abe, Y. Fujino, J. Yoshida, Univ. of Tokyo (Japan) ..... [4697-41]

Coffee/Exhibition Break10:00 to 10:30 am

## SESSION 10

Room: Pacific Salon II  
Wed.10:30 am

### Active Damping II

Chairs: Wolfgang G. Luber, DaimlerChrysler AG (Germany); Geoffrey R. Tomlinson, Univ. of Sheffield (UK)

10:30 am: **Harmonic analysis of semi-active control with MR dampers**, W. H. Liao, Chinese Univ. of Hong Kong; C. Y. Lai, ATAL Engineering Ltd. (Hong Kong) ..... [4697-42]

10:50 am: **Experimental considerations on fabrication of smart actuator for vibration control using shape-memory alloy (SMA)**, K. Yuse, D. Nam, Y. Kikushima, National Institute of Advanced Industrial Science and Technology (Japan) ..... [4697-43]

11:10 am: **High-torque magnetorheological fluid clutch**, F. Gordaninejad, B. M. Kavlicoglu, C. A. Evrensel, N. Cobanoglu, M. Xin, C. Heine, A. Fuchs, G. Korol, Univ. of Nevada/Reno ..... [4697-45]

11:30 am: **Active modal control of a truss structure considering displacement constraint**, Y. Kikushima, M. Saigo, T. Segawa, D. H. Nam, K. Yuse, National Institute of Advanced Industrial Science and Technology (Japan); N. Tanaka, Tokyo Metropolitan Institute of Technology (Japan) ..... [4697-46]

End of Conference 4697 ■

## SESSION 7

Room: San Diego  
Wed. 9:00 am

### ADAPTRONIK Project

Chairs: Johannes K. Dürr, DaimlerChrysler AG (Germany); Janet M. Sater, Institute for Defense Analyses

9:00 am: **New results and future plans of the German major project ADAPTRONICS**, H. P. Monner, DLR (Germany) ..... [4698-35]

9:20 am: **Comparison of adaptronic microsystems based on piezoelectric fibers for general use or for the utilization in prepreg FRP**, T. Gesang, H. Knäbel, U. Maurieschat, H. Schäfer, A. Hartwig, T. Riesenbeck, Fraunhofer-Institut für Fertigungstechnik und Angewandte Materialforschung (Germany); A. Battermann, J. Perl, A. Gau, Panacol-Elosol GmbH (Germany) . [4698-36]

9:40 am: **Application specific design of adaptive structures with piezoceramic patch actuators**, P. Wierach, H. P. Monner, DLR (Germany); A. Schönecker, Fraunhofer IKTS Dresden (Germany); J. K. Dürr, DaimlerChrysler AG (Germany) ..... [4698-37]

Coffee/Exhibition Break10:00 to 10:30 am

10:30 am: **Analysis and design of thin-walled smart structures in industrial applications**, F. Seeger, U. Gabbert, H. Koeppel, K. Fuchs, Univ. Magdeburg (Germany) .. [4698-38]

10:50 am: **Analysis and design of an adaptive lightweight satellite mirror**, J. K. Dürr, R. Honke, DaimlerChrysler AG (Germany); M. V. Alberti, R. Sippel, Astrium GmbH (Germany) ..... [4698-39]

11:10 am: **Bimorph mirrors for UHV applications**, T. Moeller, F. S. Hoeller, M. Ross-Messemer, Carl Zeiss (Germany); A. Schönecker, F. Schlenkrich, Fraunhofer Institut für Keramische Technologien u (Germany); H. Hanselka, Technische Univ. Darmstadt (Germany)[4698-40]

11:30 am: **Adaptronic in airliner design: a new structural approach**, C. Anhalt, E. J. Breitbach, H. P. Monner, DLR (Germany) . [4698-41]

Lunch/Exhibition Break11:50 am to 1:30 pm

## SESSION 7

Room: California  
Wed. 9:00 am

### Actuators and Actuator Technology

Chair: Qing Jiang, Univ. of California/Riverside

9:00 am: **Pressurized shape-memory micropumps**, Y. C. Shu, National Taiwan Univ. (Taiwan) ... [4699-36]

9:20 am: **Characterization of active fiber composite actuators for helicopter rotor blade applications**, V. Wickramasinghe, National Research Council Canada; N. W. Hagood, Massachusetts Institute of Technology ..... [4699-37]

9:40 am: **Research on the orthotropic piezoelectric composite materials actuator and its preliminary application**, Y. Luo, G. Zhao, J. Gu, Z. Liu, Jiangsu Univ. of Science and Technology (China) ..... [4699-38]

Coffee/Exhibition Break10:00 to 10:30 am

10:30 am: **Spring-based actuators**, T. Wada, M. Taya, Univ. of Washington ..... [4699-39]

10:50 am: **Active piezoelectric diaphragms**, R. G. Bryant, NASA Langley Research Ctr.; R. T. Effinger, IV, I. Aramda, Jr., Texas A&M Univ.; B. M. Copeland, Jr., NASA Langley Research Ctr. .... [4699-40]

11:10 am: **Experimental performance evaluation of lightweight piezo-composite curved actuators (LIPCA)**, K. J. Yoon, K. H. Park, H. C. Park, Konkuk Univ. (Korea) . . . [4699-41]

11:30 am: **Flutter suppression using V-stack piezoelectric actuator**, E. V. Ardelean, M. J. Patil, R. L. Clark, Duke Univ. .... [4699-42]

11:50 am: **High-performance thin film actuator design using PZT layer with high-breakdown voltage**, M. Lebedev, J. Akedo, National Institute of Advanced Industrial Science and Technology (Japan) ..... [4699-43]

12:10 pm: **Geometrical effects on energy production of a thin unimorph prestressed bender**, K. M. Mossi, Virginia Commonwealth Univ.; Z. Ounaies, NASA Langley Research Ctr.; R. C. Smith, North Carolina State Univ.; S. Oakley, Face International Corp. .... [4699-44]

Lunch/Exhibit Break12:30 to 1:30 pm

## SESSION 9

Room: Royal Palm I  
Wed. 9:00 am

### Packaging

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

**Keynote Presentation**  
9:00 am: **Packaging and integration issues for MEMS and nanotechnology**, Ajay P. Malshe, Univ. of Arkansas ..... [4700-36]

9:40 am: **Vacuum packaging of microresonators by rapid thermal processing**, M. Chiao, L. Lin, Univ. of California/Berkeley .... [4700-37]

Coffee/Exhibition Break10:00 to 10:30 am

## SESSION 10

Room: Royal Palm I  
Wed.10:30 am

### Microsensors and MEMS IV

Chairs: Ajay P. Malshe, Univ. of Arkansas; Vijay K. Varadan, The Pennsylvania State Univ.

10:30 am: **Linear actuator with sequenced step operation**, S. M. Bobbio, Univ. of North Carolina/Charlotte; S. W. Smith, J. M. Zara, Duke Univ.; M. Kerns, A. Stuka, Univ. of North Carolina/Charlotte[4700-38]

10:50 am: **Wafer-level microcap array to enable high-yield microsystem**, Y. Chiang, M. Bachman, G. Li, Univ. of California/Irvine ..... [4700-39]

11:10 am: **Thermal-mechanical optimization of thermally actuated cantilever beam array**, D. Bullen, M. Zhang, C. Liu, Univ. of Illinois/Urbana-Champaign .... [4700-40]

11:30 am: **High-performance micromachined smart flextensional actuators based on electrostrictive PVDF-based polymers**, T. Xu, Z. Y. Cheng, Q. M. Zhang, The Pennsylvania State Univ. . [4700-41]

11:50 am: **Microminiature temperature-compensated magnetoelastic strain gauge**, S. W. Arms, C. P. Townsend, MicroStrain, Inc. .... [4700-42]

Lunch/Exhibition Break12:10 to 1:30 pm

## SESSION 9

Room: Golden West  
Wed. 9:00 am

### Modeling of Smart Structures

Chair: Nesbitt W. Hagood, Continuum Control Corp.

**Research of north-finder using fiber optic gyroscope**, X. Guo, K. Wu, Changchun Institute of Optics, Fine Mechanics, and Physics (China) ..... [4701-37]

9:20 am: **Adaptive estimation of angular velocity and acceleration of a single-axis MEMS corollis sensor**, J. Karmarkar, Innovative Configuration, Inc.; S. Singh, Univ. of Nevada Las Vegas ..... [4701-38]

9:40 am: **Computationally efficient piezoelectric modeling for system optimization**, R. E. Richard, R. L. Clark, Duke Univ. .... [4701-39]

Coffee/Exhibition Break10:00 to 10:30 am

## SESSION 10

Room: Golden West  
Wed.10:30 am

### Control of Smart Structures

Chair: Tristan T. Hyde, Honeywell Space Systems

10:30 am: **Experimental study of model-based feedforward control of longitudinal wave transmission through hollow cylinders**, I. Pelinescu, B. Balachandran, Univ. of Maryland/College Park .. [4701-41]

10:50 am: **Active noise control with a hybrid-control algorithm using an active/passive smart foam actuator**, Y. S. Kim, G. Kim, C. H. Roh, Kumoh National Univ. of Technology (Korea) ..... [4701-42]

11:10 am: **Response of active periodic shells to moving internal pressure and projectile**, M. Ruzzene, Catholic Univ. of America; A. M. Baz, Univ. of Maryland/College Park .. [4701-43]

11:30 am: **Analysis of wave propagation rods and shells with non-uniform thickness**, M. Toso, A. M. Baz, Univ. of Maryland/College Park; M. Ruzzene, Catholic Univ. of America ..... [4701-44]

Lunch/Exhibition Break11:50 am to 1:30 pm

# Smart Structures and Materials

Conference 4693  
Room: Pacific Salon III

Conference 4695  
Room: Town & Country

Wednesday 20 March

## SESSION 11

Room: Pacific Salon III  
Wed. 1:30 pm

### Vibration Control Systems

*Chair:* **Robert L. Clark**, Duke Univ.

1:30 pm: **Vibration suppression schemes for active composite strut and panel**, R. Russ, S. Pourjalali, M. N. Ghasemi-Nejhad, Univ. of Hawaii/Manoa ..... [4693-46]

1:50 pm: **Controller design for engineering smart structures based on finite element models**, U. Gabbert, H. Koeppel, T. Nestorovic Trajkov, Univ. Magdeburg (Germany) ..... [4693-47]

2:10 pm: **Optimal hybrid active/passive vibration control design**, J. D. Kemp, R. L. Clark, Duke Univ. .... [4693-48]

2:30 pm: **Optimal vibration control of a rotating shearable blade using distributed piezoelectric sensing and actuation**, C. D. Shete, N. K. Chandiramani, Indian Institute of Technology (India); L. I. Librescu, Virginia Polytechnic Institute and State Univ. .... [4693-49]

2:50 pm: **Optimal placement of piezoelectric sensor/actuator pairs for vibration control of composite plate**, S. Quek, S. Wang, K. K. Ang, National Univ. of Singapore [4693-66]

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

## SESSION 7

Room: Town & Country  
Wed. 1:30 pm

### Modeling EAP

*Chairs:* **Siavouche Nemat-Nasser**, Univ. of California/San Diego; **S. C. Sanday**, Naval Research Lab.

1:30 pm: **Ionic polymer-metal composites: fundamentals and phenomenological modeling**, K. J. Kim, Univ. of Nevada/Reno; M. Shahinpoor, Univ. of New Mexico and Environmental Robots Inc. .... [4695-36]

1:50 pm: **Numerical simulation of a coupled chemo-electric-formulation for ionic polymer gels in electric fields**, T. Wallmersperger, B. Kröplin, Univ. Stuttgart (Germany); R. W. Gülich, Eberhard-Karls-Univ. Tübingen (Germany) ..... [4695-37]

2:10 pm: **Biologically inspired control for artificial muscles**, R. Richardson, J. A. Hawkes, P. G. Walker, Univ. of Leeds (UK); K. Watterson, Leeds General Infirmary (UK); M. D. Brown, M. C. Levesley, Univ. of Leeds (UK) ..... [4695-38]

2:30 pm: **Control system design for a dielectric elastomer actuator**, L. A. Toth, A. A. Goldenberg, Univ. of Toronto (Canada) ..... [4695-39]

2:50 pm: **Simulation and control of ionic-elastic beam dynamic deflection model**, M. Shahinpoor, R. J. Alvarez, Univ. of New Mexico ..... [4695-40]

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

# Smart Structures and Materials

**Conference 4698**  
Room: San Diego

**Conference 4699**  
Room: California

**Conference 4700**  
Room: Royal Palm I

**Conference 4701**  
Room: Golden West

**Wednesday 20 March**

## SESSION 8

Room: San Diego  
Wed. 1:30 pm

### Shape-Memory Alloy Applications

*Chairs:* **Christian Boller**, European Aeronautic Defence and Space Co. (Germany); **Anna-Maria R. McGowan**, NASA Langley Research Ctr.

1:30 pm: **Application studies of CFRP laminates with embedded SMA foils for aircraft structures**, T. Ogisu, M. Nomura, N. Ando, J. Takaki, Fuji Heavy Industries Ltd. (Japan); N. Takeda, Univ. of Tokyo (Japan) ..... [4698-42]

1:50 pm: **Shape-memory actuator systems and the use of thermoelectric modules**, R. T. Ruggeri, A. D. Jacot, D. J. Clingman, Boeing Phantom Works . [4698-43]

2:10 pm: **Shape-memory alloy wires turn composites into smart structures, part I: material requirements**, J. Schrooten, Katholieke Univ. Leuven (Belgium); V. Michaud, Ecole Polytechnique Federale de Lausanne (Switzerland); Y. Zheng, Katholieke Univ. Leuven (Belgium); J. Balta-Neumann, J. E. Manson, Ecole Polytechnique Federale de Lausanne (Switzerland) ..... [4698-59]

2:30 pm: **Shape-memory alloy wires turn composites into smart structures, part II: manufacturing and properties**, V. Michaud, Ecole Polytechnique Federale de Lausanne (Switzerland); J. Schrooten, Katholieke Univ. Leuven (Belgium); M. Parlinska, R. Gotthardt, Ecole Polytechnique Federale de Lausanne (Switzerland); J. Bidaux, Ecole d'Ingenieurs du Valais (Switzerland) ..... [4698-60]

2:50 pm: **Performance of SMA-reinforced composites in an aerodynamic profile**, J. Simpson, C. Boller, European Aeronautic Defence and Space Co. (Germany) [4698-45]

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

## SESSION 8

Room: California  
Wed. 1:30 pm

### Modeling of SMA

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

1:30 pm: **Effects of thermomechanical history on the tensile behavior of nitinol ribbon**, C. L. Lach, T. L. Turner, K. Tamingir, NASA Langley Research Ctr.; R. N. Shenoy, Lockheed Martin Co. .... [4699-45]

1:50 pm: **One-dimensional constitutive model of stress-induced transitions between Ms and Mf in shape-memory alloys**, Y. Luo, T. Takagi, Tohoku Univ. (Japan) ..... [4699-46]

2:10 pm: **Thermomechanical representation of the multiaxial behavior of shape-memory alloys**, D. Helm, P. Haupt, Univ. Gesamthochschule Kassel (Germany) ..... [4699-47]

2:30 pm: **Thermodynamic constitutive model for stress-induced phase transformation in shape-memory alloys**, Q. Liu, J. Zhu, W. Huang, K. M. Liew, Nanyang Technological Univ. (Singapore) ..... [4699-48]

2:50 pm: **Inner loops of pseudoelastic hysteresis of shape-memory alloys**, Y. Matsuzaki, H. Naito, K. Funami, Nagoya Univ. (Japan) ..... [4699-49]

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

## SESSION 11

Room: Royal Palm I  
Wed. 1:30 pm

### Applications

*Chair:* **K. J. Vinoy**, The Pennsylvania State Univ.

1:30 pm: **High-yield microfabrication process for biomimetic artificial haircell sensors**, J. Li, Z. Fan, J. Chen, J. Zou, C. Liu, F. Delcomyn, Univ. of Illinois/Urbana-Champaign ..... [4700-43]

1:50 pm: **Performance of NiTi thin-film microgripper actuated by electrical current**, Q. Y. Liu, W. M. Huang, J. P. Tan, X. Y. Gao, L. M. He, Nanyang Technological Univ. (Singapore) ..... [4700-44]

2:10 pm: **Microelectrooptical DNA array sensor**, S. K. Kassegne, H. Reese, P. Swanson, J. M. Yang, D. D. Smolko, D. Hodko, D. Raymond, B. Wallace, M. J. Madou, Nanogen, Inc. .... [4700-45]

2:30 pm: **Lessons learned about distributed wireless sensor technologies for structural health monitoring**, K. Mitchell, V. S. Rao, H. J. Pottinger, Univ. of Missouri/Rolla ..... [4700-46]

2:50 pm: **Wireless health monitoring of cracks in structures with MEMS-IDT sensors**, J. S. Kim, K. J. Vinoy, V. K. Varadan, The Pennsylvania State Univ. .... [4700-47]

3:10 pm: **Design, simulation, fabrication, and packaging of microwave rf switch**, A. Ziaei, P. Bondavalli, D. Thierry, Thales Lab. Central de Recherches (France) ..... [4700-50]

*End of Conference 4700 ■*

## SESSION 11

Room: Golden West  
Wed. 1:30 pm

### Actuators

*Chair:* **Ephraim Garcia**, DARPA

1:30 pm: **Comparison of amplified piezoelectric actuators based on topological optimization**, P. W. Loveday, Ctr. for Integrated Sensing Systems (South Africa) ... [4701-45]

1:50 pm: **Simple thermal actuator using R-phase transformation of Nitinol**, J. Uchil, K. K. Ganesha, K. K. Mahesh, Mangalore Univ. (India) ..... [4701-46]

2:10 pm: **Comprehensive piezoceramic actuator review**, G. Washington, C. Taylor, The Ohio State Univ. .... [4701-47]

2:30 pm: **New dual-stack piezoelectric actuation device with improved performance**, D. E. Heverly II, K.W. Wang, E. C. Smith, The Pennsylvania State Univ. [4701-48]

2:50 pm: **Fabrication and modeling of porous bimorph piezoelectric actuators**, A. Almajid, M. Taya, Univ. of Washington; J. F. Li, K. Takagi, R. Watanabe, Tohoku Univ. (Japan) ..... [4701-49]

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



# Smart Structures and Materials

Conference 4693  
Room: Pacific Salon III

Conference 4695  
Room: Town & Country

Wednesday 20 March

## SESSION 12

Room: Pacific Salon III  
Wed. 3:40 pm

### Modeling Applications II

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

3:40 pm: **Finite element calculation of the dispersion relations of infinitely extended SAW structures including bulk wave radiation**, M. Hofer, Friedrich-Alexander Univ. Erlangen-Nürnberg (Germany); S. Zaglmayr, J. Schüberl, Univ. of Linz (Austria); G. Kovacs, EPCOS AG (Germany); U. Langer, Univ. of Linz (Austria); R. Lerch, Friedrich-Alexander Univ. Erlangen-Nürnberg (Germany) . . . . . [4693-50]

4:00 pm: **Intrinsic sensor element for composite piezoelectric plates**, Y. F. Chou, R. B. Cheng, National Taiwan Univ. (Taiwan) . . . . . [4693-51]

4:20 pm: **Model development and control design for atomic force microscopy**, R. C. Smith, North Carolina State Univ.; M. V. Salapaka, Iowa State Univ. . . . . [4693-52]

4:40 pm: **Free vibration of piezoelectric coupled thick circular plates**, S. T. Quek, Q. Wang, X. Liu, National Univ. of Singapore [4693-53]

5:00 pm: **Model development for piezoelectric polymer unimorphs**, R. C. Smith, North Carolina State Univ.; Z. Ounaies, NASA Langley Research Ctr. . . . . [4693-54]

5:20 pm: **Micromechanical modeling of smart composite materials with a periodic structure**, A. L. Kalamkarov, A. V. Georgiades, Dalhousie Univ. (Canada) . . . . . [4693-55]

## SESSION 8

Room: Town & Country  
Wed. 3:40 pm

### Applications I

*Chairs: Yoshihito Osada, Hokkaido Univ. (Japan); Gordon G. Wallace, Univ. of Wollongong (Australia)*

3:40 pm: **MEMS-based fabrication of a multidirectional IPMC actuator**, J. Sheppard, S. Witherspoon, S. Tung, Univ. of Arkansas . . . . . [4695-41]

4:00 pm: **Electroactive polyacrylonitrile nanofibers as artificial nano muscles**, M. Shahinpoor, Univ. of New Mexico; K. J. Kim, Univ. of Nevada/Reno; L. O. Sillerud, Environmental Robots Inc.; I. D. Norris, B. R. Mattes, Santa Fe Science and Technology, Inc. . . . . [4695-42]

4:20 pm: **Industrial and medical applications of ionic polymer-metal composites as biomimetic sensors, actuators, and artificial muscles**, M. Shahinpoor, Univ. of New Mexico; A. Ahghar, Environmental Robots Inc.; K. J. Kim, Univ. of Nevada/Reno; L. O. Sillerud, Environmental Robots Inc. . . . . [4695-43]

4:40 pm: **Electroviscoelastic materials as active dampers**, J. B. Kosmatka, J. M. Biggerstaff, Univ. of California/San Diego . . . [4695-44]

5:00 pm: **Control system for conducting polymer actuators**, B. Qi, W. Lu, B. R. Mattes, Santa Fe Science and Technology, Inc. . . . [4695-45]

5:20 pm: **Microfabricated conjugated polymer actuators**, E. Smela, Univ. of Maryland/College Park . [4695-67]

# Smart Structures and Materials

Conference 4698  
Room: San Diego

Conference 4699  
Room: California

Conference 4701  
Room: Golden West

Wednesday 20 March

## SESSION 8 Cont.

3:40 pm: **Application of SMA technology to auxiliary functions in appliances**, D. E. Brei, B. Johnson, Univ. of Michigan; J. Patera, Whirlpool Corp. . . . . [4698-46]

4:00 pm: **Fuel-powered compact SMA actuator**, O. K. Rediniotis, D. C. Lagoudas, R. D. Allen, H. Y. Jun, Texas A&M Univ. . . . . [4698-44]

## SESSION 9

Room: San Diego  
Wed. 4:20 pm

### Health Monitoring and Sensing

*Chairs:* **Wade J. Pulliam**, Fortis Technologies, Inc.; **Johannes K. Dürr**, DaimlerChrysler AG (Germany)

4:20 pm: **Structural health monitoring with smart sensors: approach to a new NDI technology**, H. Speckmann, Airbus Deutschland GmbH (Germany) . . . . . [4698-47]

4:40 pm: **Impact damage detection of curved stiffened composite panels using wavy embedded small-diameter optical fibers**, H. Tsutsui, A. Kawamata, J. Kimoto, T. Sanda, Kawasaki Heavy Industries, Ltd. (Japan); N. Takeda, Univ. of Tokyo (Japan) . . . . . [4698-48]

5:00 pm: **Fiber optic sensors for cure/health monitoring of composite materials**, K. H. Wood, M.-C. Wu, NASA Langley Research Ctr.; C. B. Gause, Luna Innovations, Inc. . . . . [4698-49]

5:20 pm: **Structural load monitoring of the R/V Triton using fiber optic sensors**, J. S. Kiddy, P. C. Chen, C. S. Baldwin, T. Poloso, Systems Planning and Analysis, Inc. . . . . [4698-50]

## SESSION 9

Room: California  
Wed. 3:40 pm

### Coupled Construction Behavior: SMA

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

3:40 pm: **Empirical property map of Ni-Mn-Ga over valence electron concentration**, X. J. Jin, M. Marioni, S. M. Allen, R. C. O'Handley, Massachusetts Institute of Technology . . . . . [4699-50]

4:00 pm: **Evaluation of phase transformation in ferromagnetic shape-memory Fe-Pd alloy by magnetic Barkhausen noise**, Y. Furuya, Hirotsaki Univ. (Japan); S. M. Spearing, N. W. Hagood, Massachusetts Institute of Technology; S. Tamoto, T. Kubota, T. Okazaki, Hirotsaki Univ. (Japan) . . . . . [4699-51]

4:20 pm: **Deformation behavior of TiNi shape memory alloy under strain- or stress-controlled conditions**, H. Tobushi, K. Okumura, M. Endo, Aichi Institute of Technology (Japan); K. Tanaka, Tokyo Metropolitan Institute of Technology (Japan) . . . . . [4699-52]

4:40 pm: **Constitutive model for shape-memory alloys and its use in design and finite-element analysis**, S. Santhanam, Villanova Univ. . . . . [4699-53]

5:00 pm: **Shape-memory alloy reinforced multifunctional composites for improved fracture toughness and crash safety**, N. A. Koratkar, K. G. Jaanimagi, Rensselaer Polytechnic Institute . . . [4699-54]

5:20 pm: **Image-based dynamic modeling of phase transformation in hybrid porous SMA**, M. A. Qidwai, Geo-Centers, Inc.; V. G. DeGiorgi, Naval Research Lab. . . . . [4699-69]

## SESSION 12

Room: Golden West  
Wed. 3:40 pm

### Actuators and Applications

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

3:40 pm: **Position control of a cylinder system using piezoactuator-driven pumps**, S. B. Choi, J. K. Yoo, M. S. Cho, Inha Univ. (Korea) . . . . . [4701-50]

4:00 pm: **High-speed, adjustable, compact, rugged, and simple fuel injectors**, C. B. Bright, PEI, Bright Engineering Inc.; S. E. Garman, Molecotrol, Inc. . . . . [4701-51]

4:20 pm: **Smart missile fins with active spoiler using a piezoelectric actuator**, S. J. Kim, C. Y. Yun, S. H. Moon, Seoul National Univ. (Korea); S. Jung, Chonbuk National Univ. (Korea) . . . . . [4701-52]

4:40 pm: **Design of single-crystal vibration absorbers**, R. Rusovici, STI Technologies Inc.; J. Dosch, PCB Piezotronics Inc.; G. A. Lesieutre, The Pennsylvania State Univ. . [4701-53]

5:00 pm: **Design and development of a biomimetic device for MAVs**, F. Bohorquez, D. J. Pines, Univ. of Maryland/College Park . . [4701-54]

5:20 pm: **Active control of cylindrical shell vibration using smart materials**, M. B. Xu, G. Song, Univ. of Akron . . . . . [4701-66]

# Smart Structures and Materials

Conference 4693  
Room: Pacific Salon III

Conference 4695  
Room: Town & Country

Thursday 21 March

8:00 to 8:45 am • Town & Country

## Smart Structures Product Implementation Award

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

Plenary Presentation: **Smart Materials 2002: Is There a Solid Business Opportunity Yet?**

Speaker: **Dr. Arthur V. Cooke**, President, Active Signal Technologies, Baltimore, MD

### SESSION 13

Room: Pacific Salon III  
Thurs. 9:00 am

#### PZT/Ultrasonic Motors

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

9:00 am: **Nonlinear oscillator model for a bar-type piezoelectric motor**, S. Gutschmidt, G. Chakraborty, P. Hagedorn, Technische Univ. Darmstadt (Germany) . . . [4693-56]

9:20 am: **Modeling of ultrasonic traveling wave motors: the influence of normal prestress on the torque-speed characteristics**, T. Sattel, Univ. Paderborn (Germany); P. Hagedorn, Technische Univ. Darmstadt (Germany) . . . . . [4693-57]

9:40 am: **Application of the genetic optimization method to the design of ultrasonic motors**, P. Bouchilloux, Rensselaer Polytechnic Institute; K. Uchino, The Pennsylvania State Univ.; K. C. Craig, Rensselaer Polytechnic Institute . . . . . [4693-58]

Coffee Break . . . 10:00 to 10:30 am

### SESSION 14

Room: Pacific Salon III  
Thurs. 10:30 am

#### Piezoelectric Actuators

Chair: **Douglas K. Lindner**, Virginia Polytechnic Institute and State Univ.

10:30 am: **Adaptive piezoelectric shunt damping**, A. J. Fleming, S. Moheimani, Univ. of Newcastle (Australia) . . . . . [4693-60]

10:50 am: **Artificial intelligence for identifying impact to smart composite**, Q. Shan, G. King, R. Loscombe, Design and Advance Technology Research Ctr. (UK); J. Savage, Hamble Structures Division of Dowty Industries (UK) . . . [4693-61]

11:10 am: **Using linear parameter varying methods for the design of switching piezoceramic actuators in flexible structures**, M. A. Demetriou, Worcester Polytechnic Institute . . . . . [4693-62]

11:30 am: **Design issues in SOI-based high-sensitivity piezoresistive cantilever devices**, S. Kessegne, M. J. Madou, R. Whitten, J. V. Zoval, B. Mather, K. Sarkar, Nanogen, Inc. . . . . [4693-65]

11:50 am: **System dynamic modeling of a piezoelectric hydraulic pump**, W. S. Oates, L. D. Mauck, C. S. Lynch, Georgia Institute of Technology . . . [4693-16]

12:10 pm: **Radiation and scattering analysis of piezoelectric transducers using finite and infinite wave envelope elements**, J. Kim, E. Jung, Inha Univ. (Korea) . . . . . [4693-17]

End of Conference 4693 ■

### SESSION 9

Room: Town & Country  
Thurs. 9:00 am

#### Applications II

Chairs: **Ron Pelrine**, SRI International; **Torbio F. Otero**, Univ. del Pais Vasco and Univ. Polit cnica de Cartagena (Spain)

9:00 am: **Characterization of electroactive behavior and of progress in developments and applications of ionic polymer gels (Invited Paper)**, R. W. G lch, A. Weible, Eberhard-Karls-Univ. T bingen (Germany); T. Wallmersperger, Univ. Stuttgart (Germany) . . . . . [4695-46]

9:40 am: **Characterizing electroactive polymers for use in robotic surgical instruments**, A. J. Snyder, A. L. Cohen, Q. Zhang, Z. Cheng, J. P. Runt, The Pennsylvania State Univ. . . . . [4695-47]

Coffee Break . . . 10:00 to 10:30 am

10:30 am: **Macroscopic devices and complex movements developed with artificial muscles**, T. F. Otero, Univ. Polit cnica de Cartagena (Spain); M. Cortes Monta es, I. Boyano-Sarasola, Univ. del Pais Vasco (Spain) . . . . . [4695-48]

10:50 am: **Electrostrictive polymers for development of a micro-air vehicle wing**, K. J. Pawlowski, J. Su, D. L. Raney, E. J. Siochi, J. S. Harrison, NASA Langley Research Ctr.; G. L. Bowlin, Virginia Commonwealth Univ. . . . [4695-49]

11:10 am: **Development of electroactive silicate nanocomposites prepared for use as ionic polymer-metal composites (IPMCs) artificial muscles and sensors**, J.-D. Nam, J.-H. Lee, H. R. Choi, H. M. Kim, J. W. Jeon, Sung Kyun Kwan Univ. (Korea); J. Paquette, K. J. Kim, Univ. of Nevada/Reno; Y. Tak, Inha Univ. (Korea); H. Xu, Univ. of New Mexico . . . . . [4695-50]

11:30 am: **Importance of nonverbal expression to the emergence of emotive artificial intelligence systems**, D. De Rossi, F. Di Francesco, S. Dinelli, C. Domenici, D. Hanson, G. Pioggia, Univ. degli Studi di Pisa (Italy) . . . . . [4695-51]

11:50 am: **Plastic hyper redundant robot manipulators actuated by optimized binary electrostrictive polymers**, A. Wingert, M. Hafez, S. Dubowsky, Massachusetts Institute of Technology . . . . . [4695-52]

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

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# Smart Structures and Materials

Conference 4698  
Room: San Diego

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Room: Golden West

Thursday 21 March

8:00 to 8:45 am • Town & Country

## Smart Structures Product Implementation Award

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

Plenary Presentation: **Smart Materials 2002: Is There a Solid Business Opportunity Yet?**

Speaker: **Dr. Arthur V. Cooke**, President, Active Signal Technologies, Baltimore, MD

**SESSION 10**  
Room: San Diego  
Thurs. 9:00 am

### Enabling Actuator Technologies

*Chairs:* **Jack H. Jacobs**, Honeywell Space Systems; **Eric H. Anderson**, CSA Engineering, Inc.

9:00 am: **Smart roof bolts for underground mines/storage facilities**, J. S. Dunning, U.S. Dept. of Energy . . . . . [4698-51]

9:20 am: **Controlled motion: an enabling technology for photonics automation**, G. D. Powers, J. C. Fasick, Q. Xu, Burleigh Instruments, Inc. . . . . [4698-52]

9:40 am: **Piezoelectric direct drive servovalve**, J. E. Lindler, E. H. Anderson, CSA Engineering, Inc. . . . . [4698-53]

Coffee Break . . . 10:00 to 10:30 am

10:30 am: **Aerospace applications of mass market MEMS developments**, K. Bauer, G. Kroetz, J. Schalk, U. Prechtel, G. Müller, European Aeronautic Defence and Space Co. (Germany) . . . . . [4698-54]

10:50 am: **Adaptive electrorheological glue-based fixation of machined blades**, E. V. Korobko, V. L. Kolik, A.V. Luikov Heat and Mass Transfer Institute (Belarus); Y. O. Korobko, Intel Corp. . . . . [4698-55]

11:10 am: **Force feedback system using magnetorheological fluids for telerobotic surgery**, G. Washington, V. A. Neelakantan, The Ohio State Univ. . . . . [4698-57]

11:30 am: **Use of active structural control to enhance the cutting performance of a milling machine**, J. L. Dohner, J. P. Lauffer, T. D. Hinnerichs, Sandia National Labs.; N. Shankar, Lockheed Martin Space Systems Co.; M. E. Regelbrugge, Rhombus Consultants Group, Inc.; C. Kwan, R. Xu, Intelligent Automation, Inc.; W. Winterbauer, Ingersoll Milling Machine Co.; K. Bridger, Active Signal Technology, Inc. . . . . [4698-58]

End of Conference 4698 ■

**SESSION 10**  
Room: California  
Thurs. 9:00 am

### Magnetostrictive and Ferromagnetic Materials

*Chair:* **William D. Armstrong**, Univ. of Wyoming

9:00 am: **Magnetostrictive materials and concepts: classical and nonclassical alloys** (*Invited Paper*), A. E. Clark, Clark Associates, Inc.; M. Wun-Fogle, Naval Surface Warfare Ctr. . . . . [4699-55]

9:40 am: **Effect of electrical point shorts on performance of Terfenol-D transducers**, J. C. Slaughter, Etrema Products, Inc. . . . . [4699-56]

Coffee Break . . . 10:00 to 10:30 am

10:30 am: **Effect of demagnetizing field and elastic modulus of epoxy matrix on magnetostrictive Terfenol-D composites**, N. Nersessian, S. W. Or, G. P. Carman, Univ. of California/Los Angeles . . . . . [4699-57]

10:50 am: **Dynamic magnetomechanical characterization of 1-3 Terfenol-D/epoxy magnetostrictive composites**, S. W. Or, N. Nersessian, G. P. Carman, Univ. of California/Los Angeles . . . . . [4699-58]

11:10 am: **Equation of state for ferromagnetic transducers**, C. S. Schneider, U.S. Naval Academy . . . . . [4699-59]

11:30 am: **Magnetorheological fluids exploiting nanometer-sized powders**, S. John, Univ. of Maryland/College Park; R. Radhakrishnan, Materials Modification Inc.; N. M. Wereley, Univ. of Maryland/College Park; T. S. Sudarshan, Materials Modification Inc. . . . . [4699-61]

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

**SESSION 13**  
Room: Golden West  
Thurs. 9:00 am

### Piezohydraulic Systems

*Chair:* **Razvan Rusovici**, STI Technologies Inc.

9:00 am: **Piezoelectric pump with innovative volume displacing mechanism**, D. Lee, S. W. Or, G. P. Carman, Univ. of California/Los Angeles; Q. Chan, Univ. of Central Florida; C. H. O'Neill, Kinetic Ceramics Inc. . . . . [4701-55]

9:20 am: **Performance of a piezohydraulic system with active valves**, D. J. Leo, H. Tan, W. Hurst, Virginia Polytechnic Institute and State Univ. . . . . [4701-56]

9:40 am: **Design and testing of a high-pumping frequency piezoelectric-hydraulic hybrid actuator**, J. Sirohi, I. Chopra, Univ. of Maryland/College Park . . [4701-57]

Coffee Break . . 10:00 to 10:30 am

**SESSION 14**  
Room: Golden West  
Thurs. 10:30 am

### Control of Plates and Shells

*Chair:* **Torey Davis**, Honeywell Space Systems

10:30 am: **Piezoelectric actuator and sensor models for an inflated toroidal shell**, A. K. Jha, D. J. Inman, Virginia Polytechnic Institute and State Univ. . . . . [4701-58]

10:50 am: **Simultaneous optimization of the electromagnetic and structural properties of honeycomb materials**, F. C. Smith, Univ. of Hull (UK); F. Scarpa, Univ. of Sheffield (UK) . . . . . [4701-59]

11:10 am: **Structural acoustic response of a shape-memory alloy hybrid composite panel**, T. L. Turner, NASA Langley Research Ctr. [4701-60]

11:30 am: **Active stiffeners for shape and vibration control of circular plate structure**, M. K. Philen, K.-W. Wang, The Pennsylvania State Univ. . . . . [4701-61]

11:50 am: **Optimal placement of piezoelectric actuators and sensors on an inflated toroidal shell**, A. K. Jha, D. J. Inman, Virginia Polytechnic Institute and State Univ. . [4701-62]

End of Conference 4701 ■



# Smart Structures and Materials

Conference 4695  
Room: Town & Country

Conference 4699  
Room: California

Thursday 21 March

## SESSION 10

Room: Town & Country  
Thurs. 1:30 pm

### New Active Polymers and Applications

*Chairs:* **Wen-Liang Liu**, Industrial Technology Research Institute (Taiwan); **Seung-Ki Lee**, Dankook Univ. (Korea)

1:30 pm: **Electrically controllable liquid crystal elastomer-graphite composite artificial muscles** (*Invited Paper*), M. Shahinpoor, Univ. of New Mexico; H. Finkelmann, Albert-Ludwigs-Univ. Freiburg (Germany) . . . . . [4695-53]

2:10 pm: **Thermally actuated polymeric benders**, D. Thomsen III, R. G. Bryant, NASA Langley Research Ctr. . . . . [4695-54]

2:30 pm: **Enhanced contrast ratios and rapid switching color changeable device based on poly(3,4-propylenedioxythiophene) derivative and counter-electrode**, C. Xu, Univ. of Washington; H. Tamagawa, Gifu Univ. (Japan); M. L. Guilly, M. Taya, Univ. of Washington . . . . . [4695-55]

2:50 pm: **Reduced voltage artificial eyelid for protection of optical sensors**, S. H. Goodwin-Johansson, MCNC; M. R. Davidson, Univ. of Florida; D. E. Dausch, MCNC; G. J. Exarhos, Pacific Northwest National Lab.; R. W. Schwartz, Clemson Univ.; R. F. Cozzens, Naval Research Lab.; G. McGuire, MCNC; P. H. Holloway, Univ. of Florida . . . . . [4695-56]

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

3:40 pm: **Thiophene-based conducting polymer molecular actuators**, P. A. Anquetil, J. D. Madden, P. G. Madden, H. Yu, T. M. Swager, I. W. Hunter, Massachusetts Institute of Technology . . . [4695-57]

4:00 pm: **Tuning of thermoelastic properties of liquid crystal elastomer muscles**, H. Jeon, J. W. Naciri, Naval Research Lab.; P. Keller, CNRS (France); J. Selinger, B. R. Ratna, Naval Research Lab. . . . [4695-58]

*End of Conference 4695* ■

## SESSION 11

Room: California  
Thurs. 1:30 pm

### Navy Transducer Materials and Design

*Chair:* **William D. Armstrong**, Univ. of Wyoming

1:30 pm: **Material challenges for transducer designers in the 21st century** (*Invited Paper*), J. Lindberg, Office of Naval Research [4699-62]

2:10 pm: **Recent advances in broadband Terfenol-D driven underwater transducers** (*Invited Paper*), R. Porzio, J. H. Goodemote, M. L. Marietta, Jr., Lockheed Martin Corp. . . . . [4699-63]

2:30 pm: **Time-dependent behavior in a Terfenol-D actuated visco-elastic polymer matrix composite**, W. D. Armstrong, Univ. of Wyoming; C. Hoguea, SUNY/Binghamton [4699-64]

2:50 pm: **2.5 kHz magnetostrictive Tonpitz sonar transducer design**, S. C. Butler, Naval Undersea Warfare Ctr. . . . . [4699-65]

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

## SESSION 12

Room: California  
Thurs. 3:40 pm

### Transducer Materials

*Chair:* **William D. Armstrong**, Univ. of Wyoming

3:40 pm: **Stress dependent behavior of  $d_{33}$  and  $Y_{33}$  in Navy Type III and VI PZT ceramics**, R. S. Levinson Fisher, H. C. Robinson, E. A. McLaughlin, Naval Undersea Warfare Ctr. . . . . [4699-66]

4:00 pm: **Frequency dependence of PMN-PT and PZT ceramics under electrical bias and prestress**, H. C. Robinson, E. A. McLaughlin, Naval Undersea Warfare Ctr. . . [4699-67]

4:20 pm: **Magnetoelastic thin films and multilayers for high-frequency applications**, A. Ludwig, M. Frommberger, S. Glasmachers, E. Quandt, Ctr. of Advanced European Studies and Research (Germany) . . . . . [4699-68]

4:40 pm: **Optimizing work output in Ni-Mn-Ga and other ferromagnetic shape-memory alloys**, A. A. Likhachev, A. Sozinov, K. Ullakko, Helsinki Univ. of Technology (Finland) . . . . . [4699-70]

5:00 pm: **Fabrication of TiNi/CFRP smart composite using cold drawn TiNi wires**, Y. Xu, K. Otsuka, N. Toyama, B. Jang, H. Yoshida, H. Nagai, R. Oishi, National Institute of Advanced Industrial Science and Technology (Japan); T. Kishi, National Institute for Materials Science (Japan) . . . . . [4699-71]

*End of Conference 4699* ■

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## Participants List

Names appearing in boldface are members of SPIE.

### A

Aatre, Vasu K. 4700 ProgComm  
**Abbott, Derek** 4700 ProgComm  
Abdalla, Mostafa M. (4693-59)S4  
Abdul-Sedat, G. A. (4695-22)S3  
Abdullah, Makola M. 4696  
ProgComm, (4696-30)S7  
Abe, Masato (4697-39)S9, (4697-41)S9  
Acar, Cenk (4700-11)S4, (4700-13)S4  
Achuthan, Ajit (4699-18)S4  
Adachi, Kazuhiko (4697-34)S8  
Adali, Sarp (4693-13)S3  
Adamovsky, Grigory 4698  
ProgComm, (4701-14)S4  
Adikary, Sudarman Upali (4695-68)S11  
Agnes, Gregory S. 4697 Chr, 4697 S1 Chr, (4697-02)S1, (4697-23)S6, 4701 ProgComm  
Ahghar, Assoud (4695-43)S8  
Ahmadian, Mehdi 4697  
ProgComm, 4697 S7 Chr  
**Ajmera, Pratul K.** 4700 Cochr, 4700 S3 Chr, (4700-06)S3, (4700-07)S3, 4700 S6 Chr  
Akedo, Jun (4699-43)S7  
Akimune, Yoshio (4699-23)S4  
Aktan, A. Emin 4696 Cochr, (4696-53)S1, 4696 S2 Chr  
Akula, Venkata M. K. (4697-06)S2  
Al-Bassiyouni, Moustafa (4693-44)S10, (4694-47)S7  
Albanese, Anne-Marie (4697-26)S6  
Alberti, Mathias V. (4698-39)S7  
Albrecht, Daniel (4694-32)S6  
Alexander, L. (4694-01)S1  
**Allaei, Daryoush** (4698-61)S11  
Allen, Richard D. (4698-44)S8  
Allen, Samuel M. (4699-21)S4, (4699-24)S4, (4699-33)S6, (4699-50)S9  
Almajid, Abdulhakim (4701-49)S11  
Alvarez, Robert J. (4695-40)S7  
Alvarez, Victor (4694-37)S7  
Amaravadi, Venkata Kasi (4701-17)S4  
Amaravadi, Venkat (4693-32)S8  
Ami, Norio (4701-30)S7  
Amizic, Bruno (4693-32)S8  
An, Ho-Jeong (4695-06)S1  
Ananthasayanam, Balajee (4697-14)S4  
Anderson, Eric H. 4698 Cochr, 4698 S10 Chr, (4698-53)S10, 4698 S4 Chr, 4698 S5 Chr, 4701 ProgComm  
Anderson, Gary L. 4699  
ProgComm, 4701 ProgComm  
Ando, Norio (4698-42)S8  
Ang, Kok Keng (4693-66)S11  
Angelino, Marc (4700-31)S8  
Anhalt, Christian (4698-41)S7  
Anquetil, Patrick A. (4695-23)S4, (4695-57)S10  
Aramda, Isaiiah, Jr. (4699-40)S7  
Ardelean, Emil Valentin (4699-42)S7  
**Arms, Steven W.** (4696-01)S1, 4700 ProgComm, (4700-42)S10  
Armstrong, William D. 4699  
ProgComm, 4699 S10 Chr, 4699 S11 Chr, (4699-64)S11, 4699 S12 Chr  
Aronova, Maria (4699-28)S5  
Asaka, Kinji 4695 S3 Chr, (4695-24)S4

**Asami, Toshihiko** (4697-09)S3  
Asanuma, Hiroshi 4701  
ProgComm, (4701-06)S2  
Askins, Steven A. (4701-34)S8  
**Atalla, Mauro J.** (4693-07)S2  
Austin, Eric M. 4697 ProgComm, 4697 S2 Chr, (4697-14)S4  
Azuhata, Tatsuya (4696-33)S8

### B

Baca, Thomas 4696 ProgComm  
Bachman, Mark (4700-39)S10, (4700-26)S7, (4700-28)S7  
Baffoun, Bassem (4700-21)S6  
Balachandran, Balakumar 4693  
ProgComm, 4693 S2 Chr, (4693-44)S10, (4694-47)S7, 4701 ProgComm, (4701-41)S10  
Baldwin, Christopher S. (4696-10)S3, (4698-50)S9  
Balke, Herbert (4699-06)S1  
Balta-Neumann, J. Antonio (4698-59)S8  
Baltes, Henry 4700 ProgComm  
Bandyopadhyay, Bijnan (4693-27)S7  
Banks, H. Thomas 4693  
ProgComm, 4697 ProgComm, 4697 S4 Chr, (4697-20)S5  
Bao, Xiaoqi (4695-27)S4, (4695-33)S5, (4701-34)S8, (4701-35)S8, (4701-36)S8  
**Bao, Xiaoyi** 4694 ProgComm  
**Bar-Cohen, Yoseph** 4695 Chr, 4695 S1 Chr, (4695-02)S1, (4695-27)S4, (4695-33)S5, (4695-35)S5, 4695 S6 Chr, 4695 Panel, (4701-34)S8, (4701-35)S8, (4701-36)S8  
Barisci, Joseph Norman (4695-05)S1  
Barnes, Alan (4695-69)S11  
Barnes, Kevin N. (4698-32)S6  
Barnes, R. A. (4696-32)S7  
Baroah, Prabir (4693-43)S10  
Barsoum, Roshdy George S. 4699  
ProgComm, (4699-30)S6, 4701 ProgComm  
Basedau, Frank (4694-33)S6, (4694-34)S6  
Batra, Romesh C. (4693-09)S3, 4693 S6 Chr, (4697-15)S4  
Battermann, A. (4698-36)S7  
Bauer, Karin (4698-54)S10  
Baughman, Ray H. 4695  
ProgComm  
Baughman, Ray (4695-05)S1, (4695-09)S2, (4695-29)S4  
Baz, Amr M. 4697 ProgComm, 4697 S8 Chr, 4701 Cochr, (4701-43)S10, (4701-44)S10, 4701 S7 Chr  
Beard, Shawn J. (4701-63)S4  
Beghini, Alessandro (4697-39)S9  
Behrens, Sam (4697-24)S6  
**Belfield, Kevin D.** (4695-22)S3  
Belk, John H. 4700 ProgComm  
Bellucci, F. (4701-10)S3  
Beltran-Perez, Georgina (4694-52)S7  
**Bennett, Kim D.** 4694 Cochr, (4694-01)S1, (4694-02)S1, 4694 S3 Chr  
Benslimane, Mohammed (4695-20)S3, (4695-21)S3  
Bergman, Larry A. (4696-06)S2  
Bettig, Bernhard (4693-63)S4  
Bharti, Smita (4693-15)S4  
Bhattacharya, A. K. (4700-19)S6  
Bhattacharya, Abhijit 4699  
ProgComm  
Bianchini, Emanuele 4698  
ProgComm, 4698 S3 Chr

Bidaux, Jacques-Eric (4698-60)S8  
**Bifano, Thomas G.** 4700  
ProgComm  
Biggerstaff, Janet M. (4695-44)S8  
Bitman, Lionel (4697-37)S8  
**Black, Catherine A.** (4694-19)S4  
**Blaise, Eric J.** (4701-12)S3  
Bobbio, Stephen M. 4700  
ProgComm, (4700-38)S10  
Boettger, Ulrich (4699-15)S3  
Bohn, Clayton C. (4695-31)S5  
Bohroque, Felipe (4701-54)S12  
**Boller, Christian** 4693 ProgComm, 4698 ProgComm, 4698 S8 Chr, (4698-45)S8  
Bondavalli, Paolo (4700-50)S11  
Bonisoli, Elvio (4697-50)S11  
Bono, David (4699-21)S4, (4699-24)S4  
Borca-Tasciuc, Theodorian (4701-22)S6  
**Bormashenko, Edward** (4695-59)S10  
Bosia, Federico (4694-21)S4  
Botsis, John (4694-13)S3, (4694-21)S4  
**Bouchilloux, Philippe** (4693-58)S13  
Bourquin, Frederic 4693  
ProgComm  
Bowling, Gary L. (4695-49)S9  
Bowman, Jason (4698-62)S2  
Boyano-Sarasola, Iker (4695-48)S9  
Brandes, K. (4694-31)S6, (4694-34)S6  
Brazier, Cynthia (4695-01)S1  
**Brei, Diann E.** (4698-46)S8, 4701  
ProgComm  
Breitbach, Elmar J. (4698-41)S7  
Brennan, Anthony B. (4695-31)S5  
Bridger, Keith (4698-58)S10  
Bright, Charles B., PE (4701-51)S12  
Bronowicki, Allen J. 4701  
ProgComm  
Brooks, Sean (4695-28)S4  
Brown, Mike D. (4695-38)S7  
Bruch, John C., Jr. (4693-13)S3  
Bryant, Robert G. (4695-54)S10, (4698-11)S2, (4698-33)S6, (4698-34)S6, (4699-40)S7, (4700-30)S8  
Buckley, Leonard J. 4695 S5 Chr, 4695 S6 Chr, 4695 Panel  
Buehler, Markus (4693-63)S4  
Bullen, David (4700-40)S10  
Burkewitz, Bart (4698-16)S3  
Butler, George W. (4698-15)S3  
Butler, Stephen C. (4699-65)S11  
Bystricky, Pavel (4699-20)S4

### C

**Calkins, Frederick T.** (4698-09)S2, (4698-10)S2, (4698-15)S3  
Calvert, Paul D. 4695 ProgComm  
Calvert, Sean (4694-19)S4  
Cao, G. Z. (4701-04)S2  
**Cao, Zhuangqi** (4694-09)S7  
Capsoni, Antonio (4694-32)S6  
Carman, Gregory Paul 4699  
ProgComm, (4699-57)S10, (4699-58)S10, 4699 S3 Chr, (4699-16)S3, 4699 S5 Chr, (4699-29)S5, 4701 ProgComm, (4701-55)S13, (4701-09)S3, (4701-24)S6  
Carpenter, Bernie F. 4698  
ProgComm  
Carrasco, Isidro (4694-35)S7  
Carryer, John Edward (4696-15)S4  
Casciati, Fabio 4696 ProgComm  
Cedell, Tord 4699 ProgComm  
Cha, Seung-Eun (4695-06)S1

Chakraborty, Goutam (4693-56)S13  
Chambers, Barry (4695-69)S11  
Chan, Helen L.W. (4695-68)S11  
**Chan, Hian-Leng** (4696-41)S9  
Chan, Quanfang (4701-55)S13  
Chandiramani, N. K. (4693-49)S11  
**Chang, Fu-Kuo** 4693 ProgComm, (4693-34)S8, 4696 S9 Chr, (4696-41)S9, 4701 ProgComm, 4701 S3 Chr, (4701-12)S3  
**Chang, Hung-Pin** (4700-26)S7  
Chang, Jun Keun (4695-06)S1  
Chang, Y. M. (4701-65)S14  
Chang, Zensheu (4701-34)S8, (4701-35)S8, (4701-36)S8  
Chaplya, Pavel M. (4699-16)S3  
Chase, Steven B. 4696 Cochr  
Chattopadhyay, Aditi (4693-36)S8, 4701 ProgComm, (4701-23)S6  
Chattopadhyay, Debjit (4695-09)S2  
Chen, Jack (4700-43)S11  
Chen, Jen-Luan (4695-65)S11  
Chen, Peter C. (4696-10)S3, 4698  
ProgComm, (4698-50)S9, 4701  
ProgComm  
Chen, Xuemin (4696-35)S8, (4696-36)S8  
Chen, Xuesheng (4700-08)S3  
Chen, Yixin (4701-20)S5  
Chen, Yonghong (4696-06)S2  
Chen, Z.Q. (4696-04)S2, (4696-05)S2  
Cheng, Danling (4698-31)S6  
Cheng, Lon-Cheng (4695-65)S11  
Cheng, Ron-Bin (4693-51)S12  
Cheng, Zhong-Yang (4695-22)S3, (4695-47)S9, (4700-41)S10  
Chevrot, Claude (4695-14)S2  
**Chiang, Yuh-Min** (4700-39)S10  
**Chiao, Jung-Chih** 4700 ProgComm  
Chiao, Mu (4700-37)S9  
Chiu, George T.C. (4701-21)S5  
Cho, Meang-Hyo S. (4701-50)S12  
Choi, Hyoukryeol (4695-19)S3  
Choi, Hyuk Ryul (4695-50)S9, (4695-62)S11  
Choi, Jin-Young (4698-14)S3  
Choi, Man-Yong (4696-34)S8  
Choi, Sang H. (4695-17)S3, 4700  
ProgComm, (4700-30)S8  
Choi, Seung-Bok 4701 ProgComm, 4701 S1 Chr, (4701-01)S1, (4701-50)S12  
**Choi, Young-Tai** (4697-17)S4, (4697-31)S7  
Chomnawang, Nimit (4700-09)S3  
Choo, Sang Woo (4699-72)S13  
**Chopra, Inderjit** (4701-57)S13, (4701-05)S2, (4701-25)S6  
Chou, Yuan-Fang (4693-51)S12  
Choy, Chung-Loong (4695-68)S11  
Christodolou, Leo Plenary  
Ciocan, Razvan (4694-11)S2  
Clark, Arthur E. (4699-55)S10  
Clark, Robert L. (4693-28)S7, 4693  
S11 Chr, (4693-48)S11, (4697-22)S5, (4697-27)S6, (4699-42)S7, (4701-39)S9  
Clark, William W. 4697 ProgComm, 4697 S3 Chr, (4697-29)S7, 4698  
ProgComm  
**Claus, Richard O.** 4694  
ProgComm, 4695 ProgComm  
Clingman, Dan J. (4698-10)S2, (4698-43)S8  
Cobanoglu, Nigar (4697-45)S10  
Cohen, Adam L. (4695-47)S9  
Cole, Daniel G. (4693-28)S7, (4697-20)S5, (4697-27)S6  
Collett, Brandon (4696-50)S11  
Conte, Joel Pascal (4696-28)S7

Cooke, Arthur V. Plenary  
Copeland, Ben M., Jr. (4699-40)S7  
Cortes Montanes, M. Teresa (4695-48)S9  
Costen, Robert C. (4695-15)S3  
Cote, Francois (4701-29)S7  
Couch, Ronald (4701-05)S2  
Cox, David E. (4698-11)S2  
Cozzens, Robert F. (4695-56)S10  
Craciunescu, Corneliu (4699-32)S6  
Craig, Kevin C. (4693-58)S13  
Crail, Stephanie (4694-34)S6  
**Cross, Leslie Eric** (4699-01)S1  
**Cui, Jun** (4699-34)S6  
**Culshaw, Brian** 4694 Cochr, 4694  
S2 Chr  
Cunefare, Kenneth (4697-26)S6

### D

Dai, Liming (4695-03)S1, (4695-29)S4  
Dakin, John P. 4694 ProgComm, 4694 S4 Chr  
Dalton, T. (4694-16)S3  
Dan, Takehiro (4700-25)S7  
Dang, Nghia (4701-18)S4  
Dapino, Marcelo J. 4693  
ProgComm, 4693 S5 Chr, (4693-18)S7, (4699-26)S5  
**Dausch, David Edward** (4695-56)S10  
Davidson, Mark R. (4695-56)S10  
Davies, Geoff R. (4695-16)S3  
Davis, Christopher L. (4698-15)S3  
**Davis, L. Porter** 4697 ProgComm, 4701 Chr  
Davis, Torey 4701 S14 Chr  
de Boer, Andre (4693-06)S2  
de Gennes, Pierre-Gilles 4695  
ProgComm  
De Flaviis, Franco (4696-42)S9  
De Graef, Marc (4699-32)S6  
De Rosa, L. (4701-10)S3  
De Rossi, Danilo 4695 ProgComm, 4695 S5 Chr, 4695 S6 Chr, (4695-51)S9, 4695 Panel  
Dean, Peter D. 4694 ProgComm  
DeGiorgi, Virginia G. (4699-69)S9  
Delcomyn, Fred (4700-43)S11  
**Demetriou, Michael A.** (4693-62)S14  
Derriso, Mark M. (4693-01)S1, (4693-32)S8, (4701-17)S4  
Deshpande, Manohar D. (4700-30)S8  
DesRoches, Reginald 4696  
ProgComm, 4696 S5 Chr, (4696-22)S5  
Deuble, Frank (4693-05)S2  
Di Francesco, Fabio (4695-51)S9  
Dinelli, Serena (4695-51)S9  
**Dohner, Jeffrey L.** (4698-58)S10  
Dolgin, Benjamin P. (4701-34)S8, (4701-35)S8, (4701-36)S8  
Domenici, Claudio (4695-51)S9  
Dosch, Jeffrey (4701-53)S12  
Doyle, Crispin T. M. (4694-04)S1  
Drake, Michael L. 4697 ProgComm  
Draughon, Gregory K. (4698-32)S6  
Driga, Mircea D. (4693-22)S15  
**Dry, Carolyn M.** 4694 ProgComm, (4701-08)S2  
Du, Hejun (4693-30)S4  
Du, Shu (4701-36)S8  
Du, Wenbo (4696-03)S1  
Duan, Y.F. (4696-05)S2  
Dubowsky, Steven (4695-52)S9  
Duerr, Johannes K. 4698  
ProgComm, 4698 S7 Chr, (4698-37)S7, (4698-39)S7, 4698  
S9 Chr  
Dunn, Martin L. 4699 ProgComm, (4700-22)S6

# Smart Structures and Materials

## Participants List

- Dunne, James P. (4698-02)S1, (4698-03)S1  
Dunning, John S. (4698-51)S10  
Durmaz, Ozlem (4697-29)S7  
Durocher, Robert (4697-10)S3  
Dyke, Shirley J. 4696 ProgComm, 4696 S10 Chr
- E**  
Echevarria, Juan (4694-20)S4, (4694-35)S7, (4694-36)S7, (4694-37)S7  
Ecke, Wolfgang 4694 ProgComm, (4694-34)S6  
Eckerle, Joseph (4695-18)S3, (4698-29)S5  
Effinger, Robert T., IV (4699-40)S7  
Egashira, Mitsuru (4700-25)S7  
**El-Sherif, Mahmoud A.** (4694-24)S5  
El-Wahed, Ali K. (4697-16)S4  
Elzey, Dana M. (4698-21)S4  
Endo, Masato (4699-52)S9  
**Enikov, Eniko T.** (4695-25)S4  
Entchev, Pavlin B. (4699-31)S6  
Eun, Hong (4693-25)S6  
Everett, Richard (4698-17)S4, (4698-19)S4  
Evrensel, Cahit A. (4696-26)S6, (4697-45)S10  
**Exarhos, Gregory J.** (4695-56)S10
- F**  
Facchini, Massimo (4694-03)S1  
Facchini, Mauro (4694-21)S4  
Falciai, Riccardo 4694 ProgComm  
Fallahi, Behrooz (4693-12)S3  
Famodu, Olugbenga (4699-28)S5  
Fan, Tau C. (4695-70)S11  
Fan, Zhifang (4700-43)S11  
Farrar, Charles R. (4693-35)S8, 4696 ProgComm, (4696-12)S3  
Fasick, John C. (4698-52)S10  
Fedder, Gary K. (4696-40)S9  
Fellay, Alexandre (4694-03)S1  
Feng, Maria Qing 4696 ProgComm, (4696-42)S9  
Fernandez-Romero, Antonio Jesus (4695-32)S5  
Fernando, Gerard Franklyn (4694-04)S1, (4694-06)S1, (4696-32)S7  
Fett, Theo (4699-12)S3  
Feuchtwanger, Jorge (4699-21)S4  
**Fifield, Leonard S.** (4695-05)S1  
Finkelmann, Heino (4695-53)S10  
Fischer, Gregor (4696-38)S8  
Flanagan, Patrick W. (4701-14)S4  
**Flatau, Alison B.** 4696 ProgComm, 4701 ProgComm  
Fleck, Norman A. (4699-09)S2, (4699-17)S4  
Fleming, Andrew J. (4693-60)S14  
Ford, Kenneth Lee (4695-69)S11  
Fosness, Eugene R. 4697 ProgComm  
Fox, Colin (4700-08)S3, (4700-12)S4  
Fox, Robert Lee (4698-33)S6, (4698-34)S6  
Frangopol, Dan M. 4696 ProgComm  
**Frecker, Mary I.** 4693 S4 Chr, (4693-14)S4, (4693-15)S4  
**Frederick, Kevin M.** (4696-40)S9  
Friebele, E. Joseph 4694 ProgComm  
Frommberger, Michael (4699-68)S12  
Fronk, Thomas (4697-06)S2  
Fuchs, Alan (4697-45)S10, (4697-30)S7  
Fuchs, Karl (4698-38)S7
- Fuhr, Peter L.** 4694 ProgComm  
Fujihashi, Kazuhiko (4694-30)S6  
Fujimori, Toshiaki 4696 ProgComm  
Fujino, Yozo 4696 ProgComm, (4697-39)S9, (4697-41)S9  
Fujitani, Hideo (4696-45)S10  
Fujiwara, Naoko (4695-24)S4  
Fukuchi, Keisuke (4694-25)S5  
Fukuda, Katsumi (4694-46)S7  
Full, Robert J. (4695-18)S3, (4698-28)S5  
Fuller, Christopher (4698-16)S3  
Funami, Ken (4699-49)S8  
Funamoto, Yuji (4694-46)S7  
Furati, K. M. (4697-20)S5  
Furuya, Yasubumi (4699-51)S9
- G**  
Gabbert, Ulrich 4693 ProgComm, (4693-47)S11, 4693 S12 Chr, (4698-38)S7  
Galea, Stephen C. 4693 ProgComm  
Galeska, Izabela E. (4695-09)S2  
Ganesha, Kumara K. (4701-46)S11  
Gao, Huajian (4699-14)S3  
Gao, Mei (4695-03)S1, (4695-29)S4  
Gao, Peng (4694-10)S2  
Gao, Xiang Yang (4700-44)S11  
Garcia, Ephraim (4698-01)S1, 4701 ProgComm, 4701 S11 Chr  
Garcia, Gabe V. (4696-14)S4  
**Garcia, Gabriel V.** 4696 ProgComm, 4696 S3 Chr  
Garcia, Roberto (4694-35)S7, (4694-36)S7  
Garde, Joe (4696-14)S4  
Gardner, Julian W. 4700 ProgComm  
Garman, Steven E. (4701-51)S12  
Garrett, James H., Jr. (4696-40)S9  
Gartstein, Yuri N. (4695-05)S1  
Gau, A. (4698-36)S7  
Gaul, Lothar (4697-28)S7  
Gause, Charles B. (4698-49)S9  
Gausmann, Rainer (4693-21)S5  
Gavin, Henri P. 4696 ProgComm, 4696 S6 Chr  
Gelb, Alan (4698-18)S4  
Geng, T. S. (4693-09)S3  
Gentsch, Roland (4693-67)S15  
Georgiades, Anastasis V. (4693-55)S12  
Germes, Sylvain (4693-11)S3  
Gesang, Thomas (4698-36)S7  
Ghasemi, Hamid (4696-48)S11, (4696-49)S11  
Ghasemi-Nejhad, Mehrdad N. (4693-02)S1, (4693-46)S11  
Ghoneim, Hany (4697-13)S3  
**Ghoshal, Anindya** (4693-36)S8  
Giaccari, Philippe (4694-21)S4  
Ginder, John M. 4701 ProgComm  
**Giovanardi, Marco** (4694-08)S2  
Giurgiutiu, Victor 4701 ProgComm  
Glasachers, Stefan (4699-68)S12  
Glisic, Branko (4694-05)S1, (4696-17)S4  
Goldenberg, Andrew A. (4695-39)S7  
Gomi, Kenji (4694-46)S7  
Gong, Jianping (4695-04)S1  
Gonzalez, Daniel (4694-37)S7  
Gonzalez-Sanchez, Jopaquin (4695-32)S5  
**Go, Nam Seo** (4699-72)S13  
Goodemote, John H. (4699-63)S11  
Goodwin-Johansson, Scott H. (4695-56)S10  
Gopinathan, Senthil V. (4693-04)S2
- Gordaninejad, Faramarz** 4696 ProgComm, (4696-44)S10, (4696-26)S6, 4697 ProgComm, (4697-45)S10, 4697 S7 Chr, (4697-30)S7  
Gotthardt, Rolf (4698-60)S8  
Gottlieb, Oded (4693-45)S10  
Gozdz, Antoni S. (4698-17)S4  
Gradziol, Mike (4701-34)S8  
Grasmeyer, Joel (4698-17)S4  
Gravesen, Peter (4695-20)S3, (4695-21)S3  
Green, B. David (4698-18)S4  
Greve, David W. (4696-31)S7  
Grigoriadis, Karolos M. 4693 ProgComm  
Grosh, Karl (4700-14)S4  
Grosswig, Stephan 4694 ProgComm  
Gu, Jianzu (4699-38)S7  
Guan, Yuanhong (4693-41)S10, (4693-42)S10  
Guelch, Rainer W. 4695 ProgComm, 4695 S6 Chr, (4695-37)S7, (4695-46)S9, 4695 Panel  
Guemes, J. Alfredo (4694-07)S1, (4694-15)S3  
Guerin, Greg (4696-20)S5  
Guerin, Jean-Marie (4694-27)S5  
Guilly, Marie Le (4695-12)S2, (4695-55)S10  
Guo, Xiqing (4701-37)S9  
Gurdal, Zafer (4693-59)S4  
Gutierrez, German (4694-36)S7  
Gutmann, Toivo (4694-33)S6  
Gutschmidt, Stefanie (4693-56)S13
- H**  
Habel, Wolfgang R. 4694 S6 Chr, (4694-31)S6, (4694-33)S6, (4694-34)S6  
Haenichen, H. (4694-31)S6  
Hafez, Moustapha (4695-52)S9  
Hagedorn, Peter (4693-56)S13, (4693-57)S13  
**Hagood, Nesbitt W.** (4699-37)S7, (4699-51)S9, 4701 ProgComm, 4701 S9 Chr  
Hall, Steven R. (4693-07)S2  
Hameed, A. (4696-32)S7  
Hamel, Michael J. (4696-01)S1  
Hanselka, Holger (4698-40)S7  
Hanson, David (4695-51)S9  
Harrison, Joycelyn S. (4694-09)S2, (4695-15)S3, (4695-49)S9  
Hartwig, A. (4698-36)S7  
Hashiguchi, Nobuyuki (4694-39)S7  
Hass, Derek D. (4698-22)S4  
Hata, Katsuhiko (4696-45)S10  
Haug, Anja (4699-05)S1  
Haupt, Peter (4699-47)S8  
Hawkes, Jamie A. (4695-38)S7  
Hawkins, Gary F. (4698-25)S5  
Haynes, Leonard S. Plenary  
He, L. M. (4700-44)S11  
Heider, Dirk (4694-19)S4  
Heine, C. (4697-45)S10  
Heintze, O. (4697-51)S6  
Helm, Dirk (4699-47)S8  
Henderson, B. Kyle 4698 ProgComm, 4698 S6 Chr  
**Henry, Christopher P.** (4699-21)S4, (4699-33)S6  
Heo, Seok (4693-29)S7, (4697-33)S8  
Herold-Schmidt, Ursula 4698 ProgComm  
Heverly, David E., II (4701-48)S11  
Heydt, Richard (4698-29)S5  
Hinnerichs, Terry D. (4698-58)S10  
Hirose, Koji (4699-13)S3
- Hitchcock, Gregory (4696-44)S10, (4696-26)S6, (4697-30)S7  
Hiwatashi, Takeshi (4696-45)S10  
Ho, Ken K. (4699-29)S5  
Hodko, D. (4700-45)S11  
Hoeller, Frank Stefan (4698-40)S7  
Hofer, Manfred (4693-50)S12  
Hoffmann, Marcus (4699-15)S3  
Hofmann, Christian (4693-05)S2  
Hofmann, Detlef (4694-31)S6, (4694-33)S6, (4694-34)S6  
Hogea, Cosmina (4699-64)S11  
Holloway, Nancy M. (4698-11)S2, (4698-32)S6  
Holloway, Paul H. (4695-56)S10  
**Hom, Craig L.** 4699 ProgComm  
Hongo, Akihito (4694-25)S5  
Honke, Robert (4698-39)S7  
Horta, Lucas G. (4698-11)S2  
Hosokawa, K. (4695-19)S3  
Hsieh, Po-Tzong (4701-65)S14  
Hsu, J. J. (4696-40)S9  
**Hsu, Stuart** 4701 S4 Chr  
Hsu, Thonas T. C. (4696-51)S4  
Hsu, Yi-Chu (4701-04)S2  
Hu, Yongming (4694-45)S7  
Hu, Zheng-Liang (4694-45)S7  
Huang, Cheng (4695-22)S3  
Huang, Jie (4701-28)S7  
Huang, Shu (4694-49)S7  
Huang, Weiming (4699-48)S8, (4700-44)S10  
Huang, Weixing (4698-31)S6  
Huang, Zhi-Hsien (4695-65)S11  
Huber, John E. (4699-09)S2, (4699-17)S4  
Hui, Han (4695-05)S1  
Hunter, Ian Warwick (4695-23)S4, (4695-57)S10  
Huo, Linsheng (4696-27)S6  
Hurst, William (4701-56)S13  
**Huston, Dryver R.** 4694 Cochr, 4696 ProgComm  
Hwang, Sungduk (4695-62)S11  
**Hyde, T. Tupper** 4697 ProgComm, 4697 S9 Chr, 4701 ProgComm, 4701 S10 Chr
- I**  
**Ichinose, Kensuke** (4694-46)S7  
Ida, Nathan (4694-11)S2  
Ihn, Jeong-Beom (4693-34)S8  
Iiba, Masanori (4696-45)S10  
Ikegami, Roy 4697 ProgComm, 4697 S6 Chr  
**Inaudi, Daniele** 4694 Chr, 4694 S1 Chr, (4694-05)S1, (4694-31)S6, (4696-02)S1, (4696-17)S4  
Ingnas, Olle 4695 ProgComm  
Inman, Daniel J. 4697 ProgComm, 4701 ProgComm, (4701-58)S14, (4701-62)S14  
**Irschik, Hans** 4693 ProgComm  
Isalgue, Antoni (4696-21)S5  
Ishida, Syoji (4694-39)S7  
Ishihara, Tadashi (4696-33)S8  
Ito, Kazufumi (4697-20)S5  
Iwade, Takashi (4695-66)S11  
Iwaki, Hideaki (4696-09)S3  
Iwata, Norio (4696-45)S10  
Iwatsubo, Takuzo (4697-34)S8
- J**  
Jaanimagi, Karl Gustav (4699-54)S9  
Jacobs, Jack H. 4698 ProgComm, 4698 S10 Chr, 4701 S5 Chr  
**Jacot, A. Dean** (4698-09)S2, (4698-43)S8  
Jafari, Farhad (4701-19)S5  
Jain, Akash (4696-31)S7  
James, Richard D. (4699-35)S6
- James, Stephen W. (4694-23)S4  
Jang, Byung-Koog (4699-71)S12, (4699-23)S4, (4701-30)S7  
Janunts, Norik Ararat (4694-48)S7  
Jauregui, Cesar (4694-35)S7, (4694-36)S7  
Jaworski, Allan (4699-28)S5  
Jeon, Hong (4695-58)S10  
Jeon, Jae Wook (4695-19)S3, (4695-50)S9, (4695-62)S11  
Jeon, Young-Sik (4697-17)S4, (4697-31)S7  
Jha, Akhilesh K. (4701-58)S14, (4701-62)S14  
Ji, Taeksoo (4700-02)S1, (4700-10)S3  
Jiang, B. (4697-15)S4  
Jiang, Hong Wen (4700-08)S3  
Jiang, Qing 4693 ProgComm, 4699 ProgComm, 4699 S1 Chr, (4699-04)S1, 4699 S7 Chr  
Jiang, Xuhan (4696-35)S8  
Jianhui, Qui (4695-66)S11  
Jin, Gil-Joo (4693-29)S7  
Jin, Xue-jun (4699-50)S9  
Jofre, Luis (4696-42)S9  
John, Shaju (4699-61)S10  
Johnson, Andrew R. (4701-03)S1  
Johnson, Bart (4698-46)S8  
Johnson, Conor D. 4697 ProgComm, (4697-01)S1  
Johnson, Marty (4698-16)S3  
Jolly, Mark R. 4698 ProgComm  
**Jones, Katharine J.** 4693 ProgComm  
Jose, K. A. 4700 S2 Chr, 4700 S4 Chr, (4700-24)S6, (4700-35)S8  
Joshi, Prakash (4698-18)S4  
Jouse, Wayne C. (4698-12)S2  
Jun, Hyoung Y. (4698-44)S8  
Jung, Eunmi (4693-17)S14  
Jung, Sung-Nam (4701-52)S12
- K**  
Kaholek, Marian (4695-08)S2  
Kalamkarov, Alexander L. (4693-55)S12  
Kaltenbacher, Manfred (4700-21)S6  
Kalyanam, S. (4699-11)S2  
Kamlah, Marc 4699 ProgComm, (4699-04)S1, (4699-06)S1, (4699-12)S3  
Kaneko, K. (4695-19)S3  
Kang, Kookjin (4693-25)S6  
Karmakar, Jay (4701-38)S9  
Kashiwai, Yoshio (4694-39)S7  
Kassegne, Samuel K. (4700-45)S11, (4700-29)S7  
Kathe, Eric (4697-10)S3  
Katz, Andrew Nathan (4697-30)S7  
Kavarnos, G. J. (4695-22)S3  
Kavlicoglu, Barkan M. (4697-45)S10  
Kawamoto, Akio (4698-48)S9  
Kazakov, Sergey S. (4695-08)S2  
Keennon, Matt (4698-17)S4  
Keller, Mark J. (4697-23)S6  
Keller, Patrick (4695-58)S10  
Kemp, Jonathan D. (4693-48)S11  
Kenny, Thomas W. (4696-15)S4  
Kerns, Matthew (4700-38)S10  
Kertesz, Miklos (4695-05)S1  
Kessegne, Samuel (4693-65)S14  
Kessler, Hannes (4699-06)S1  
**Kessler, Seth S.** (4701-11)S3  
Khan, Mohammad A. (4701-26)S6  
Khan, Mughees M. (4693-39)S9  
Khot, Narendra S. 4693 ProgComm, 4693 S10 Chr  
**Kiddy, Jason S.** (4696-10)S3, (4698-50)S9



# Smart Structures and Materials

## Participants List

- Kikuchi, Noboru 4693 ProgComm  
Kikushima, Yoshihiro (4697-43)S10, (4697-46)S10  
Kim, Chi-Yeop (4696-34)S8  
Kim, Gimán (4701-42)S10  
Kim, H.T. (4695-19)S3  
Kim, Hong Kyeong (4695-62)S11  
Kim, Hoon Mo (4695-19)S3, (4695-50)S9, (4695-62)S11  
Kim, Jae-Sung (4700-47)S11  
Kim, Jaehwan 4693 ProgComm, (4693-17)S14, 4695 ProgComm, (4695-17)S3, (4695-61)S11, (4698-14)S3  
Kim, Jun-Hyung (4695-61)S11  
Kim, Kwang J. (4695-13)S2, (4695-43)S8, (4695-62)S11  
Kim, Kwang J. (4695-26)S4, (4695-36)S7, (4695-42)S8, (4695-50)S9  
Kim, Sang-Hoon (4694-43)S7  
Kim, Seung Jo (4701-52)S12  
Kim, Yeungshik (4701-42)S10  
Kim, Yoo Jin (4696-42)S9  
Kim, Youdan (4701-23)S6  
Kimoto, Junichi (4698-48)S9  
King, Glen C. (4700-30)S8  
King, Graham (4693-61)S14  
Kirby, Paul (4700-08)S3  
Kiremidjian, Anne S. (4696-15)S4, Plenary  
Kish, Laszlo B. (4700-04)S2  
Kishi, Teruo (4699-71)S12, (4699-23)S4, (4701-13)S3  
Kishi, Yoichi (4699-32)S6  
**Kishimoto, Satoshi** (4697-19)S4  
Kitner, A. (4697-28)S7  
Kitamura, Yoshitsugu (4697-34)S8  
Kjelberg, Ivar (4693-67)S15  
Klein, Dan J. (4694-09)S2  
Knaebel, H. (4698-36)S7  
Knapp, J. (4694-31)S6  
Knecht, Alfredo 4694 ProgComm, (4694-29)S6  
Ko, Jan Ming 4696 Cochr, (4696-43)S10, (4696-04)S2, (4696-05)S2, (4696-24)S6  
Kobayashi, Mikihiko (4700-25)S7  
Koch, Robert M. (4693-24)S6  
Koeng, Sven (4693-21)S5  
Koeppel, Heinz (4693-47)S11, (4698-38)S7  
Kofod, Guggi (4695-21)S3  
Kogan, Michael P. (4694-08)S2  
Kohlhoff, H. (4694-31)S6  
Kojima, Seiji (4694-25)S5  
Kolik, Valentin L. (4698-55)S10  
Komatsu, Koji (4694-30)S6  
Koratkar, Nikhil A. (4699-54)S9, (4701-22)S6  
Kornbluh, Roy D. 4695 ProgComm, 4695 S3 Chr, (4695-18)S3, (4698-28)S5, (4698-29)S5  
Korobko, Evguenia V. (4698-55)S10  
Korobko, Yulia O. (4698-55)S10  
Korol, G. (4697-45)S10  
Korvink, Jan G. 4700 ProgComm  
**Kosmatka, John B.** (4695-34)S5, (4695-44)S8, (4697-03)S1  
**Kota, Sridhar** 4693 ProgComm, (4693-26)S4  
Kouna, A. B. (4699-03)S1  
Kovacs, Guenter (4693-50)S12  
Kown, Jaewha (4701-33)S8  
Kozlov, Mikhail E. (4695-05)S1  
Kozlowski, Matthew Van Santen (4697-27)S6  
Krause, Sonja (4695-64)S11  
**Kreger, Stephen T.** (4694-19)S4  
Kroepelin, Bernd (4695-37)S7  
Kroetz, Gerhard (4698-54)S10  
Kubota, Takesi (4699-51)S9  
**Kudva, Jayanth N.** 4698 ProgComm, (4698-04)S1, 4698 S2 Chr  
Kuegeler, Carsten (4699-15)S3  
Kumar, Amrita (4701-63)S4  
Kumar, Dhananjay (4700-05)S2  
Kunzler, Marley (4694-19)S4, (4696-28)S7, (4696-29)S7  
**Kunzler, Wesley** (4694-19)S4  
Kurdila, Andrew J. 4693 ProgComm  
Kusculuoglu, Ziya Koray (4693-12)S3  
Kuzin, Evgueni Anatolevich (4694-52)S7  
Kwak, Moon K. (4693-29)S7, (4697-33)S8  
Kwak, Myoung-Hoon (4697-33)S8  
Kwan, Chiman (4698-58)S10  
**Kwon, Il-Bum** (4696-34)S8  
Kwon, Young-Doo (4699-72)S13  
Kyono, Junro (4701-07)S2  
**L**  
Lacarbonara, Walter (4693-45)S10  
Lach, Cynthia L. (4699-45)S8  
**Lagoudas, Dimitris C.** 4693 S9 Chr, (4693-39)S9, (4698-44)S8, 4699 Cochr, 4699 S4 Chr, (4699-31)S6, 4699 S8 Chr, 4699 S9 Chr, (4700-18)S5, (4701-26)S6  
Lai, Chun Yu (4697-42)S10  
Landes, Hermann (4700-21)S6  
Landi, Francesco P. (4697-04)S2  
Landis, Chad M. (4699-07)S1  
Lane, Steven A. (4698-16)S3  
Langer, Ulrich (4693-50)S12  
Lanska, Nataliya (4699-25)S5  
Lanza di Scalea, Francesco (4696-07)S2  
Lauffer, James P. (4698-58)S10  
Law, Kincho H. (4696-15)S4  
Law, Wai Wing (4701-28)S7  
Laylor, Harold Martin (4694-26)S5, (4696-28)S7, (4696-29)S7  
Lebedev, Maxim (4699-43)S7  
**Lecce, Leonardo** (4701-10)S3  
Lee, B. C. (4693-33)S8  
Lee, Donggung (4701-55)S13, (4701-24)S6  
Lee, Hyun-Hee (4701-01)S1  
Lee, Jeong-Bong 4700 ProgComm, (4700-09)S3  
Lee, Jun-Ho (4695-50)S9, (4695-62)S11  
**Lee, Jung-Ju** (4694-43)S7  
Lee, Sang-Jo (4695-06)S1  
Lee, Seung-Ki (4695-06)S1, 4695 S6 Chr, 4695 S10 Chr, 4695 Panel  
Lee, Soosun (4701-33)S8  
Leguily, M. (4695-10)S2  
Leitmann, George (4697-35)S8  
**Lekki, John D.** (4701-14)S4  
Leng, Jinsong (4696-32)S7  
Leo, Donald J. (4695-11)S2, (4695-15)S3, (4695-28)S4, (4695-28)S4, 4697 ProgComm, (4697-12)S3, 4697 S5 Chr, 4697 S8 Chr, 4698 S3 Chr, (4701-56)S13  
Leon, Roberto T (4696-22)S5  
Lerch, Reinhard 4693 ProgComm, (4693-50)S12, (4700-21)S6  
Lesieutre, George Andre 4697 ProgComm, 4697 S6 Chr, 4701 ProgComm, (4701-53)S12  
Lester, Dean M. (4698-18)S4  
Levesley, Martin C. (4695-38)S7  
Levin, Klas (4694-22)S4  
Levin, Valery M. (4699-14)S3  
Levinson Fisher, Rachel S. (4699-66)S12  
Levon, Kalle (4695-08)S2  
Lewangamage, Chamindalal  
Sujeewa (4697-41)S9  
Li, Guann-pyng (4700-39)S10, (4700-26)S7, (4700-28)S7  
Li, Hengfeng (4695-22)S3  
Li, Hong-Nan (4697-32)S7  
Li, Jing-Fing (4701-49)S11  
Li, Junjun (4700-43)S11  
Li, Mingfeng (4693-42)S10  
Li, Ping (4696-19)S4  
Li, Shi Qiong (4695-70)S11  
Li, Victor C. (4696-38)S8  
Li, Xin (4693-64)S15  
Liang, Renyue (4696-35)S8  
Liang, Yuanchang (4699-22)S4, (4699-27)S5  
Liao, Wei-Hsin (4697-42)S10, (4701-28)S7  
Liao, Yanbiao (4694-45)S7  
Librescu, Liviu I. 4693 ProgComm, (4693-49)S11, 4693 S13 Chr, (4701-64)S6  
Liew, Kim Miao (4699-48)S8  
Lih, Shyh-Shiuh (4695-27)S4, (4695-33)S5  
Likhachev, Alexander Anatolyevich (4699-70)S12, (4699-25)S5  
Lim, Teik C. (4693-41)S10, (4693-42)S10  
Limberger, Hans G. (4694-21)S4  
Lin, Hongyi (4700-48)S12  
Lin, Liwei (4700-37)S9  
Lin, Mark (4701-63)S4  
Lindberg, Jan (4699-62)S11  
Lindler, Jason E. (4698-53)S10  
Lindner, Douglas K. (4693-59)S4, 4693 S14 Chr, (4697-12)S3, 4698 ProgComm, 4698 S6 Chr, (4698-31)S6, (4700-32)S8  
Lindner, E. (4694-34)S6  
Lindroos, V. K. (4699-25)S5  
Littlefield, Andrew G. (4697-10)S3  
Liu, C. Richard (4696-51)S4, (4696-35)S8, (4696-36)S8  
Liu, Chang (4700-40)S10, (4700-43)S11  
Liu, H.J. (4696-43)S10  
Liu, Jiamin (4694-40)S7  
Liu, Lu (4695-03)S1  
Liu, Pengxiang (4693-01)S1, (4693-31)S7  
Liu, Qiuyun (4699-48)S8, (4700-04)S11  
Liu, S.-C. 4696 Chr, 4696 S1 Chr  
Liu, Wen-Liang 4695 ProgComm, 4695 S10 Chr, (4695-65)S11  
Liu, Xiang (4693-53)S12  
Liu, Xuanbin (4694-49)S7  
Liu, Yanming (4696-26)S6  
Liu, Yanning (4697-05)S2, (4697-07)S2  
Liu, Zutong (4699-38)S7  
Lockyer, Allen J. (4700-32)S8  
Lograsso, Thomas A. (4699-26)S5, (4699-32)S6  
Lomer, Mauro (4694-20)S4  
Lopez-Higuera, Jose Miguel (4694-20)S4, (4694-35)S7, (4694-36)S7, (4694-37)S7  
Lopez, Rosa (4694-52)S7, (4694-53)S7  
Loscombe, Robin (4693-61)S14  
Lou, Yaolong (4694-10)S2  
Loveday, Philip W. (4701-45)S11  
Lovey, Francisco C. (4696-21)S5  
Lowe, Irving J. (4696-40)S9  
Lu, Kerr-Jia (4693-26)S4  
Lu, Wen (4695-45)S8  
Luber, Wolfgang G. 4697 S10 Chr  
Ludwig, Alfred (4699-68)S12  
Lumsden, Ross W. (4694-19)S4, (4694-26)S5  
Luo, Ningsu (4696-25)S6  
Luo, Ying (4697-47)S11, (4699-38)S7  
Luo, Yun (4699-46)S8  
Lupascu, Doru Constantin (4699-03)S1, (4699-08)S2  
**Lynch, Christopher S.** (4693-16)S14, 4699 Chr, (4699-02)S1, 4699 S2 Chr, (4699-73)S4  
Lynch, Jerome (4696-15)S4  
**M**  
Ma, Jun (4696-18)S4  
Ma, Kougen (4693-02)S1  
Ma, Lvzhong (4697-47)S11  
Ma, Ning (4693-40)S9  
MacMahon, Robert (4696-28)S7  
**Madden, John David** 4695 S4 Chr, (4695-23)S4, 4695 S6 Chr, (4695-57)S10, 4695 Panel  
Madden, Peter Geoffrey (4695-23)S4, (4695-57)S10  
Madou, Marc J. (4693-65)S14, (4700-45)S11, (4700-29)S7  
Madurga, Javier (4694-20)S4, (4694-37)S7  
Maeda, R. (4695-19)S3  
Maher, B. (4700-29)S7  
Mahesh, K.K. (4701-46)S11  
Main, John A. 4701 ProgComm  
Mak, Stanley C. (4695-34)S5  
**Mal, Ajit K.** 4695 ProgComm  
Mallik, Nilanjan (4697-38)S8  
Malshe, Ajay P. 4700 S10 Chr, (4700-36)S9  
Maly, Joseph R. 4697 ProgComm, 4697 S5 Chr  
Manetti, Luca (4694-29)S6  
Mani, Raghavendran (4700-18)S5  
Manosa, Victor (4696-25)S6  
Manson, Jan-Anders E. (4698-59)S8  
Marbell, M. (4694-01)S1, (4694-02)S1  
Marietta, Martin (4699-63)S11  
Marioni, Miguel (4699-24)S4, (4699-33)S6, (4699-50)S9  
Marquez Borbon, Ileana (4694-53)S7  
Marquez, I. (4694-52)S7  
Marshall, David W. (4698-18)S4  
Martin, Christopher A. (4698-05)S1, (4700-32)S8  
**Martin, William N.** (4693-36)S8  
Martinez, David R. 4701 ProgComm  
Masic, Milenko (4698-24)S4  
Masri, Sami F. 4696 ProgComm  
Massad, Jordan E. (4693-38)S9  
**Masson, Patrice** (4701-29)S7  
Mastro, Stephen A. (4694-24)S5  
Masuda, Arata (4697-51)S6, (4697-40)S9  
Mather, Beth (4693-65)S14  
Matic, Peter 4698 S4 Chr, (4698-17)S4, (4698-19)S4, 4698 S5 Chr  
Matrat, Jerome (4694-22)S4  
Matsuba, Yutaka (4696-33)S8  
Matsushima, Yoshiyuki (4696-33)S8  
Matsuzaki, Yuji (4699-49)S8, 4701 Cochr  
Mattes, Benjamin R. 4695 ProgComm, (4695-42)S8, (4695-45)S8  
Mauck, Lisa D. (4693-16)S14  
Maurieschat, U. (4698-36)S7  
Mays, G. C. (4696-32)S7  
Mazzarella, Luca (4697-21)S5  
McEver, Mark A. (4693-28)S7  
McGavin, Gary (4696-20)S5  
McGowan, Anna-Maria Rivas 4698 Chr, 4698 S1 Chr, (4698-11)S2, 4698 S8 Chr  
McGuire, Gary (4695-56)S10  
McInroy, John E. (4701-19)S5, (4701-20)S5  
McLaughlin, Elizabeth A. (4699-66)S12, (4699-67)S12  
McMeeking, Robert M. 4699 ProgComm, (4699-05)S1  
McMurry, Robert (4696-14)S4  
McWilliam, Stewart (4700-08)S3  
Mealares, Laurent (4693-67)S15  
Mehmed, Oral (4697-03)S1  
Mehta, Anshu (4700-24)S6  
Meijer, Kenneth (4695-18)S3, (4698-28)S5  
Melhuish, Chris 4695 ProgComm  
Menendez, Jose Manuel (4694-07)S1, (4694-15)S3  
Meng, Zhou (4694-45)S7  
Meyyappan, Meyya (4700-01)S1  
Michaud, Veronique (4698-59)S8, (4698-60)S8  
**Michelitsch, Thomas M.** (4699-14)S3  
Midorikawa, Mitsumasa (4696-33)S8  
**Miller, Mark S.** 4694 ProgComm, 4694 S3 Chr  
Miridonov, Serguei V. (4694-52)S7, (4694-53)S7  
**Mita, Akira** (4696-11)S3, 4696 S7 Chr  
Mitchell, Kyle (4700-46)S11, (4701-17)S4  
Mizutani, Tadahito (4694-50)S7  
**Mo, Yi-Lung** (4696-51)S4  
Moeller, Timo (4698-40)S7  
Mohanchandra, Kotekar P. (4699-29)S5, (4701-24)S6  
Moheimani, S.O. Reza (4693-60)S14, (4697-24)S6  
Molter, Matthias (4694-33)S6  
Monaco, Ernesto (4701-10)S3  
Monner, Hans Peter (4698-35)S7, (4698-37)S7, (4698-24)S7  
Moon, Seong Hwan (4701-52)S12  
Moon, Suk-Min (4697-22)S5  
Mooney, Michael A. (4696-13)S3  
Morales-Sanchez, Juan (4695-32)S5  
Mori, T. (4699-27)S5  
Moses, Robert W. (4698-33)S6, (4698-34)S6  
**Mossi, Karla M.** (4699-44)S7  
Mrad, Nezhir (4701-29)S7  
Mueller, Gerhard (4698-54)S10  
Munoz, Edgar (4695-05)S1, (4695-09)S2  
Munoz Esquer, Pedro (4694-07)S1  
Munz, Dietrich (4699-12)S3  
Murakami, Eiji (4694-39)S7  
**N**  
Naciri, Jawad W. (4695-58)S10  
Nagai, Hideki (4699-71)S12, (4699-23)S4, (4701-30)S7  
Naito, Hisashi (4699-49)S8  
Nam, Changho (4701-23)S6  
Nam, Dong-Ho (4697-43)S10, (4697-46)S10  
**Nam, Jae-Do** (4695-19)S3, (4695-50)S9, (4695-62)S11  
Narayan, Jagdish (4700-05)S2  
Natori, Michihiro C. 4701 ProgComm  
Nayfeh, Samir (4697-11)S3, (4697-18)S4



# Smart Structures and Materials

## Participants List

- Nealis, James M. (4693-03)S1  
Near, Craig D. 4698 ProgComm  
Neelakantan, Vijay Anand (4698-57)S10  
Nemat-Nasser, Siavouche 4695 ProgComm, (4695-07)S2, 4695 S6 Chr, 4695 S7 Chr, 4695 Panel, (4698-26)S5  
Neo, C. (4700-35)S8  
Nerkararyan, Khachatur V. (4694-48)S7  
Nersessian, Nersesse (4699-57)S10, (4699-58)S10  
Nestorovic Trajkov, Tamara (4693-47)S11  
**Newbury, Kenneth M.** (4695-11)S2, (4695-15)S3  
Ni, Yi Qing (4696-43)S10, (4696-04)S2, (4696-05)S2, (4696-24)S6  
Nichols, Todd (4697-13)S3  
Niemczuk, John B. (4696-10)S3  
Nikles, Marc 4694 ProgComm, (4694-03)S1  
Nishihara, Osamu (4697-09)S3  
Nishimura, Isao 4696 ProgComm  
Noher, H. P. (4696-17)S4  
Nomura, Masato (4698-42)S8  
Noori, Mohammad N. (4697-40)S9  
Norris, Ian D. (4695-42)S8  
Nosenzo, Giorgio (4694-16)S3  
Nosseir, M. (4700-19)S6  
Nuffer, Juergen (4699-08)S2  
Null, William R. (4698-12)S2
- O**  
O'Handley, Robert C. 4699 ProgComm, (4699-21)S4, (4699-24)S4, 4699 S6 Chr, (4699-33)S6, (4699-50)S9  
**O'Neill, Conal H.** (4701-55)S13  
O'Regan, Stephen (4698-16)S3  
Oakley, Shelley (4699-44)S7  
Oates, William S. (4693-16)S14  
Ocel, Justin (4696-22)S5  
Ogisu, Toshimichi (4698-42)S8  
Oguro, Keisuke (4695-24)S4  
Oh, Jae-Eung (4693-44)S10  
Oh, Seajin (4695-18)S3, (4698-29)S5  
Ohayon, Roger (4693-23)S6  
Oishi, Ryutarou (4699-71)S12, (4699-23)S4, (4701-30)S7  
Okabe, Yoji (4694-14)S3, (4694-17)S3, (4694-41)S7, (4694-50)S7  
Okada, Kanzo (4694-10)S2  
Okazaki, Teiko (4699-51)S9  
Okumura, Kayo (4699-52)S9  
Okutsu, Masaru (4694-30)S6  
Olazabal, Virginia (4695-35)S5  
Onillon, Emmanuel (4693-67)S15  
Onishi, Kazuo (4695-24)S4  
Ono, Satoko (4696-16)S4  
Oppenheim, Irving J. (4696-31)S7, (4696-40)S9  
Or, Siu Wing (4699-57)S10, (4699-58)S10, (4701-55)S13  
Osada, Yoshihito 4695 Cochr, 4695 S1 Chr, (4695-04)S1, 4695 S6 Chr, 4695 S8 Chr 4695 Panel  
Osmont, Daniel L. (4693-23)S6  
Otani, Shunsuke 4696 ProgComm  
Otero, Toribio Fernandez 4695 ProgComm, (4695-32)S5, 4695 S9 Chr, (4695-48)S9  
Otsuka, Kazuhiro (4699-71)S12, (4699-23)S4  
Ou, Jinping (4696-27)S6
- Oude Nijhuis, Marco H. H. (4693-06)S2  
Ounaies, Zoubeida (4693-19)S5, (4693-54)S12, (4694-09)S2, (4699-44)S7  
Ozer, Mehmet Bulent (4693-08)S2
- P**  
Pablo, Frederic (4693-23)S6  
Padula, Sharon L. (4698-11)S2  
Painter, Chris (4700-23)S6  
Pak, James Jungho (4695-06)S1  
Pak, Y. Eugene 4700 ProgComm, (4700-03)S2  
Pal, Dharmendra Sign (4701-36)S8  
Pan, Peng (4696-03)S1  
**Pan, Yingjun** (4694-40)S7  
Papadimitrakopoulos, Fotios (4695-09)S2  
Paquette, Jason (4695-50)S9  
Park, Cheol (4694-09)S2  
Park, Hoon-chul (4699-41)S7  
Park, Kee (4700-20)S6  
Park, Ki-hoon (4699-41)S7  
Park, Sunwoo (4696-48)S11, (4696-49)S11  
**Parker, Gordon G.** (4693-63)S4  
Parlinska, Magdalena (4698-60)S8  
Parmigiani, John (4698-23)S4  
Parrott, Orion (4695-28)S4  
Partridge, Aaron (4696-15)S4  
Pascucci, Marina R. (4699-20)S4  
Patera, John (4698-46)S8  
Patil, Mayuresh J. (4699-42)S7  
Patton, M. E. (4696-40)S9  
Paul, David I. (4699-33)S6  
Pawlowski, Kristin J. (4695-49)S9  
Pedreno-Molina, Juan Luis (4695-32)S5  
Pei, Qibing (4695-18)S3, (4698-28)S5, (4698-29)S5  
Peipp, Rainer (4700-21)S6  
Pelinescu, Ion (4701-41)S10  
Pelrine, Ron (4695-18)S3, 4695 S9 Chr, (4698-28)S5, (4698-29)S5  
Perl, J. (4698-36)S7  
Pervizpour, Mesut (4696-53)S1  
**Peters, Kara J.** (4694-13)S3, (4694-38)S7  
Peterson, Thomas (4701-36)S8  
Petitjean, Benoit (4698-13)S3  
Philen, Michael Keith (4701-61)S14  
Pines, Darryll J. 4696 Chr, 4696 S11 Chr, (4696-18)S4, 4701 ProgComm, (4701-15)S4  
Pinter, Gabriella A. (4697-20)S5  
Pioggia, Giovanni (4695-51)S9  
**Piombo, Bruno A.** (4697-50)S11  
Piitt, Dale M. (4698-02)S1, (4698-03)S1  
Pochiraju, Kishore (4700-20)S6  
Polanco, Juan A. (4694-35)S7  
Poloso, Toni (4696-10)S3, (4698-50)S9  
Popa, Sorin G. (4694-44)S7  
Popov, Evgeniy Gennadiyovich (4700-49)S12  
Popp, Jean-Francois (4695-14)S2  
Porzio, Ray (4699-63)S11  
Pottinger, Hardy Joseph (4700-46)S11, (4700-33)S8  
Pourjalali, Saied (4693-02)S1, (4693-46)S11  
**Powers, Galen D.** (4698-52)S10  
Prabhugoud, Mohanraj (4694-38)S7  
Prasad, A. (4696-23)S6  
Prechtel, U. (4698-54)S10  
Prosser, William H. (4693-36)S8
- Pulliam, Wade J. 4698 ProgComm, (4698-30)S5, 4698 S9 Chr  
Purekar, Ashish S. (4701-15)S4  
Pyo, MyoungHo (4695-31)S5
- Q**  
Qi, Baohua (4695-45)S8  
Qian, Jiangyuan (4700-26)S7  
Qian, Jiaru (4696-03)S1  
Qiao, P. (4696-23)S6  
Qiao, Shengren (4694-40)S7  
Qidwai, Muhammad A. (4698-17)S4, (4698-19)S4, (4699-69)S9  
Qin, Zhanming (4701-64)S6  
Qing, Xinlin (4701-63)S4  
Qiu, FaWei (4696-03)S1  
Qiu, Jinhao (4693-30)S4, (4699-13)S3  
Quandt, Eckhard (4699-68)S12  
Queheillalt, Douglas T. (4698-22)S4  
Quek, Ser-Tong (4693-66)S11, (4693-53)S12  
Quintela, Antonio (4694-35)S7, (4694-36)S7
- R**  
Radhakrishnan, Radhakumar (4699-61)S10  
Rahman, Zahidul H. 4697 ProgComm, 4697 S9 Chr  
Rajapakse, R. K. Nimal D. (4699-10)S2  
Rajaraman, Arun (4696-39)S8  
Ramasubramanian, M. K. 4700 ProgComm  
Randriamahazaka, Hyacinthe (4695-14)S2  
Raney, David L. (4695-49)S9  
**Rao, Vittal S.** 4693 Chr, (4693-01)S1, 4693 S7 Chr, (4693-31)S7, (4693-32)S8, (4700-46)S11, (4700-33)S8, (4701-17)S4, (4701-18)S4  
Rao, Yong (4696-35)S8  
Ratna, Banahalli R. (4695-58)S10  
Ravindran, Vibha (4700-34)S8  
Ravishankar, Seriampalayam Ramaswamy (4694-12)S2  
Ray, Manas Chandra (4697-38)S8  
Raymond, D. (4700-45)S11  
Reddy, J. N. (4701-27)S7  
Rediniotis, Othon K. (4698-44)S8, (4700-18)S5  
Reese, H. (4700-45)S11  
Rega, Giuseppe (4693-45)S10  
Regelbrugge, Marc E. SympChr, (4698-58)S10  
**Reithmeier, Eduard** (4696-25)S6, (4697-35)S8  
Rey, Nancy M. (4693-43)S10  
Reynolds, John R. (4695-31)S5  
Richard, Marc (4699-33)S6  
Richard, Robert E. (4701-39)S9  
Richardson, Andy (4696-30)S7  
Richardson, Robert (4695-38)S7  
Riesenbeck, T. (4698-36)S7  
Rippert, Laurent (4693-37)S8  
Rizzo, Piervincenzo (4696-07)S2  
**Robert, Philippe-Alain** (4694-03)S1  
Roberts, James 4696 ProgComm  
Robinson, Harold C. (4699-66)S12, (4699-67)S12  
Robinson, Paul C. (4698-33)S6  
Rodellar, Jose (4696-25)S6  
Rodriguez-Lence, Fernando (4694-15)S3  
Rodriguez, Miguel A. (4694-35)S7, (4694-36)S7  
Roedel, Juergen (4699-03)S1, (4699-08)S2
- Roh, Chul-Ha (4701-42)S10  
Roh, Yongrae R. (4693-25)S6, (4701-33)S8  
Roman, Pogreb (4695-59)S11  
Rongong, Jem A. (4697-04)S2  
Rosenthal, Marc S. (4698-28)S5  
Rosenthal, Marcus A. (4695-18)S3  
Ross-Messemer, Martin (4698-40)S7  
Royle, Christopher (4700-12)S4  
Royston, Thomas J. 4693 ProgComm, (4693-08)S2, (4693-12)S3  
Ruebsamen, Dale 4701 ProgComm, 4701 S6 Chr  
Ruefenacht, A. (4696-17)S4  
**Ruffin, Paul B.** (4700-17)S5  
Ruggeri, Robert T. (4698-43)S8  
Runt, James P. (4695-47)S9  
Russovici, Razvan (4701-53)S12, 4701 S13 Chr  
Russ, Richard (4693-46)S11  
Ruzzene, Massimo (4697-50)S11, (4697-08)S2, (4697-21)S5, (4701-43)S10, (4701-44)S10  
Ryew, Sungmoo (4695-19)S3
- S**  
Sadek, Ibrahim S. (4693-13)S3  
Sadki, Said (4695-31)S5  
Saga, Norihiko (4695-66)S11  
Saigo, Muneharu (4697-46)S10  
Saito, Kyoko (4700-25)S7  
Sakurai, Tateo (4701-13)S3  
Salapaka, Murli V. (4693-52)S12  
Salathe, Rene-Paul (4694-21)S4  
Saliba, Joseph (4696-50)S15  
**Salvino, Liming W.** (4701-15)S4  
Sanda, Tomio (4698-48)S9  
Sanday, S. Carlos 4695 S7 Chr  
Sanders, Brian P. 4698 ProgComm, 4698 S2 Chr, (4698-62)S2  
**Sands, Randall R.** 4695 ProgComm  
Sankar, Jagannathan (4700-05)S2  
Sansinena, Jose Maria (4695-35)S5  
Santhanam, Srihar (4699-53)S9  
Sarkar, Kamal (4693-65)S14, (4700-29)S7  
Sastry, Ann Marie (4698-23)S4  
Satagopan, Venkat (4700-33)S8  
Raymond, D. (4700-45)S11  
**Sater, Janet M.** 4698 ProgComm, 4698 S7 Chr  
Satori, Kouji (4694-25)S5  
Sattel, Thomas (4693-57)S13  
Savage, John (4693-61)S14  
Scandale, Walter (4694-03)S1  
Scarpa, Fabrizio (4697-04)S2, (4697-08)S2, (4697-21)S5, (4701-59)S14  
Schaefer, H. (4698-36)S7  
Schalk, Josef (4698-54)S10  
Scheinbeim, Jerry I. (4695-60)S11  
Scherer, Lewis B. (4698-07)S1  
Schlenkrich, Falko (4698-40)S7  
Schneider, Carl S. (4699-59)S10  
Schoenecker, Andreas (4698-37)S7, (4698-40)S7  
**Schoess, Jeffrey N.** 4694 Cochr, 4694 S2 Chr, 4700 ProgComm  
Schreiner, U. (4694-34)S6  
Schroeder, Kerstin (4694-34)S6  
Schrooten, Jan (4698-59)S8, (4698-60)S8  
Schueberl, Joachim (4693-50)S12  
Schulz, Mark J. (4693-36)S8  
**Schulz, Whitten L.** 4694 ProgComm, (4694-19)S4, (4694-26)S5, 4694 S6 Chr, (4696-28)S7, (4696-29)S7  
**Schwartz, Robert W.** (4695-56)S10
- Schwesinger, Peter 4696 ProgComm, (4696-08)S2  
Scott, Lisa A. (4698-32)S6  
Seaver, Mark E. (4694-18)S4  
Seeger, Falko (4698-38)S7  
Seelecke, Stefan 4693 ProgComm, (4693-20)S5, (4693-38)S9, (4697-51)S6  
Seemann, Wolfgang (4693-21)S5  
Segawa, Takehiko (4697-46)S10  
Selinger, Jonathan (4695-58)S10  
Semedo-Garcia, Jose Eugenio (4701-27)S7  
Semion, Sutovski (4695-59)S11  
Seo, Geon Seok (4695-25)S4  
Seo, Young B. (4695-17)S3  
Sethi, V. (4696-23)S6  
Sewa, Shingo (4695-24)S4  
Sha, Yanan (4700-16)S4, 4700 S8 Chr, (4700-35)S8  
**Shahinpoor, Mohsen** (4694-44)S7, 4695 ProgComm, (4695-13)S2, (4695-26)S4, 4695 S6 Chr, (4695-36)S7, (4695-40)S7, (4695-42)S8, (4695-43)S8, (4695-53)S10, 4695 Panel  
Shams, Qamar A. (4698-33)S6, (4698-34)S6  
**Shan, Qingshan** (4693-61)S14  
Shankar, Natarajan (4698-58)S10  
Sharma, Pramod K (4700-27)S7  
Shen, I. Y. (4701-04)S2  
Shen, Qishun (4694-49)S7  
Shen, Steve I. Y. 4697 ProgComm, 4697 S2 Chr  
Shenoy, Ravi N. (4699-45)S8  
Shepard, W. Steve (4693-41)S10, (4693-42)S10  
Sheppard, Jason (4695-41)S8  
Sheppard, William R. (4700-32)S8  
Sherrif, Stewart (4695-35)S5, (4701-34)S8, (4701-35)S8, (4701-36)S8  
Shete, C. D. (4693-49)S11  
Shi, Lihua (4693-34)S8  
Shibaev, Valery P. 4695 ProgComm  
Shibah, Jay (4699-09)S2, (4699-17)S4  
Shield, Thomas W. (4699-34)S6  
Shin, Daniel (4701-24)S6  
Shinya, Norio (4697-19)S4, 4700 ProgComm, 4700 S7 Chr, (4700-25)S7, (4701-07)S2  
Shiozaki, Yoichi (4696-45)S10  
Shirvani, Mir (4698-33)S6, (4698-34)S6  
Shkarayev, Sergey V. (4698-12)S2  
**Shkel, Andrei M.** 4700 ProgComm, (4700-11)S4, (4700-13)S4, (4700-23)S6  
Shlyagin, Mikhail G. (4694-52)S7, (4694-53)S7  
Shrout, Thomas R. 4699 ProgComm  
Shu, Yi-Chung (4699-36)S7  
Sides, Paul J. (4696-40)S9  
Sikorsky, Charles S. 4696 ProgComm, 4696 S4 Chr  
Sillerud, Laurel O. (4694-44)S7, (4695-42)S8, (4695-43)S8  
Simpson, John (4698-45)S8  
Sims, Neil D. (4697-36)S8, (4701-03)S1  
Singer, Richard A. 4698 ProgComm  
Singh, Kiran (4701-25)S6  
Singh, Sahjendra (4701-38)S9  
Siocchi, Emilie J. (4695-49)S9, (4698-11)S2  
Sippel, Rudolf (4698-39)S7  
**Sirohi, Jayant** (4701-57)S13

# Smart Structures and Materials

Skelton, Robert T. 4693  
ProgComm, (4698-24)S4  
**Skontorp, Arne** (4694-27)S5  
Slaughter, Julie C. (4699-56)S10  
Sloss, James M. (4693-13)S3  
Smela, Elisabeth 4695 ProgComm,  
(4695-31)S5, (4695-67)S8, 4701  
S2 Chr  
Smith, Edward C. (4701-48)S11  
Smith, Frank C. (4701-59)S14  
Smith, Josef (4698-09)S2  
Smith, Ralph C. 4693 Cochr, 4693  
S1 Chr, (4693-03)S1, (4693-  
19)S5, (4693-20)S5, (4693-  
18)S7, (4693-38)S9, (4693-  
52)S12, (4693-54)S12, (4694-  
09)S2, (4699-44)S7  
Smith, Stephen W. (4700-38)S10  
Smolko, Daniel D. (4700-45)S11  
Snyder, Alan J. (4695-47)S9  
Soares, Cristovao M. Mota (4701-  
27)S7  
**Soda, Satsuya** (4696-45)S10  
Sodeyama, Hiroshi (4696-45)S10  
Sofla, Aarash Yusefzadeh Nagh  
(4698-21)S4  
Sohn, Hoon (4693-35)S8, (4696-  
12)S3  
Sommer-Larsen, Peter 4695  
ProgComm, 4695 S2 Chr,  
(4695-20)S3, (4695-21)S3  
Sone, Akira (4697-40)S9  
Song, Chunging (4698-31)S6  
Song, Gangbing (4693-40)S9,  
(4696-23)S6, (4701-16)S4,  
(4701-31)S7  
Song, Hyun-Jeong (4701-01)S1  
Song, In-Hyouk (4700-07)S3  
**Song, Kyo D.** (4700-30)S8  
Song, Kyungyeol (4693-07)S2  
Sonntag, Peter A. (4696-01)S1  
Sozen, Mete A 4696 ProgComm  
Sozinov, Alexei (4699-70)S12,  
(4699-25)S5  
Spanoudakis, Peter (4693-67)S15  
Spearing, S. Mark (4699-51)S9,  
(4701-11)S3  
Speckmann, Holger (4698-47)S9  
Spencer, Billie F., Jr. 4696  
ProgComm  
Spinks, Geoffrey M. (4695-03)S1,  
(4695-05)S1, (4695-29)S4  
Spirin, Vasili V. (4694-52)S7,  
(4694-53)S7  
Sproston, John L. (4697-16)S4  
Srivastava, Ashok (4700-06)S3  
Staines, Steven E. (4694-23)S4  
Stanford, Scott (4695-18)S3,  
(4698-28)S5, (4698-29)S5  
Stanway, Roger 4697 ProgComm,  
(4697-16)S4, (4697-36)S8, 4701  
ProgComm, (4701-03)S1  
Starrett, W. David (4698-18)S4  
Staszewski, Wieslaw J. 4693  
ProgComm, 4693 S8 Chr,  
(4693-33)S8  
Stewart, Anna (4701-09)S3  
**Straub, Friedrich K.** (4698-08)S1,  
4701 ProgComm  
Strelec, Justin K. (4701-26)S6  
Strock, Harold B. (4699-20)S4  
Studer, Michel (4694-13)S3  
Stuka, Amanda (4700-38)S10  
Su, Ji 4695 ProgComm, 4695 S2  
Chr, (4695-15)S3, (4695-17)S3,  
(4695-49)S9  
Sudarshan, T. S. (4699-61)S10  
Sun, Chin-Teh (4699-11)S2, (4699-  
18)S4  
Sun, Guangyu (4695-05)S1  
Sun, Jian Q. 4697 ProgComm, 4697  
S3 Chr

**Sundaresan, Mannur J.** (4700-  
05)S2  
Sundarvel, Balakrishnan (4695-  
68)S11  
Swager, Timothy M. (4695-23)S4,  
(4695-57)S10  
Swanson, P. (4700-45)S11  
Swart, Pieter L. 4694 ProgComm,  
(4694-52)S7  
Sypeck, David J. (4698-20)S4  
**T**  
Tachibana, Eizaburo (4696-16)S4  
Tadokoro, Satoshi 4695  
ProgComm  
Taftal, Berk (4696-22)S5  
Tagawa, Tetsuya (4699-22)S4,  
(4699-27)S5  
Tak, Yong Suk (4695-50)S9  
Takagi, Kenta (4701-49)S11  
Takagi, Toshiyuki (4699-46)S8  
Takahashi, Hirofumi (4699-13)S3  
Takahira, Shinpei (4696-11)S3  
Takaki, Junji (4698-42)S8  
Takanishi, A. (4695-19)S3  
Takeda, Nobuo (4694-14)S3,  
(4694-17)S3, (4694-25)S5,  
(4694-41)S7, (4694-50)S7, 4696  
ProgComm, (4696-09)S3,  
(4698-42)S8, (4698-48)S9,  
(4701-13)S3  
Takeda, Shin-ichi (4694-14)S3,  
(4694-17)S3  
Takeuchi, Ichiro (4699-28)S5  
Tamagawa, Hirohisa (4695-55)S10  
Tamingier, Karen (4699-45)S8  
Tamoto, Sizuka (4699-51)S9  
Tan, Chin An (4696-06)S2  
Tan, Honghui (4701-56)S13  
Tan, Jun Ping (4700-44)S11  
Tan, Kim Piew (4701-03)S1  
Tanaka, Kikuaki (4699-52)S9  
Tanaka, Nobuhira (4694-41)S7  
Tanaka, Nobuo (4697-46)S10  
Tani, Junji (4693-30)S4, (4699-  
13)S3  
Tanie, K. (4695-19)S3  
**Taniuchi, Kiyoshi** (4694-46)S7  
**Tatam, Ralph P.** (4694-23)S4  
Taya, Minoru 4695 ProgComm,  
(4695-10)S2, (4695-12)S2,  
(4695-55)S10, (4699-22)S4,  
(4699-27)S5, (4699-39)S7,  
(4701-49)S11  
Taylor, Chris (4701-47)S11  
**Taylor, Rebecca E.** (4698-27)S5  
Taylor, Tad (4694-19)S4, (4694-  
26)S5, (4696-29)S7  
Tello, Pablo G. (4699-39)S6  
Teraoka, Iwao (4695-08)S2  
Terrillini, Andrea (4694-29)S6  
Teysie, Dominique (4695-14)S2  
Thevenaz, Luc 4694 Cochr, (4694-  
03)S1, 4694 S5 Chr  
Thierry, Dean (4700-50)S11  
Thomas, James (4698-17)S4,  
(4698-19)S4  
Thomsen, D. Laurence, III (4695-  
54)S10  
Thor, Bianca (4696-08)S2  
Thun, Gerhard (4699-12)S3  
Ting, Robert Y. (4695-22)S3  
Tobushi, Hisaaki (4699-52)S9  
Todd, Michael D. (4694-18)S4,  
4694 S5 Chr  
Tokeo, Kenzo 4696 ProgComm  
Tomlinson, Geoffrey R. 4697  
ProgComm, 4697 S10 Chr,  
(4697-04)S2  
Torra, Vicenc (4696-21)S5  
Toso, Mario (4701-44)S10  
**Toth, Landy A.** (4695-39)S7

Townsend, Christopher P. (4696-  
01)S1, (4700-42)S10  
Toyama, Nobuyuki (4699-71)S12  
Trickey, Stephen (4694-18)S4  
Tsao, T. C. (4696-06)S2  
Tsopeles, Panagiotis (4697-21)S5  
Tsujii, Ryohei (4694-14)S3  
Tsutsui, Hiroaki (4698-48)S9  
Tuck, Christopher J. (4694-06)S1  
Tung, Steve (4695-41)S8  
Turner, Travis L. (4699-45)S8,  
(4701-60)S14  
**U**  
**Uang, Chii-Maw** (4701-65)S14  
Uchida, Mikio (4695-10)S2, (4695-  
12)S2  
Uchil, Jayagopal (4701-46)S11  
Uchino, Kenji (4693-58)S16  
**Udd, Eric** 4694 Chr, 4694 S1 Chr,  
(4694-19)S4, (4694-26)S5,  
(4696-28)S7, (4698-29)S7  
Uehara, Junichi (4695-66)S11  
Ullakko, Kari (4699-70)S12, (4699-  
25)S5  
Umapathy, Mangalanathan (4693-  
27)S7  
Upschulte, Bernard L. (4698-18)S4  
**V**  
**Van Huffel, Sabine** (4693-37)S8  
van Herpe, Francois (4693-11)S3  
Vandygriff, Eric L. (4699-31)S6  
**Varadan, Vasundara V.** SympChr,  
4693 ProgComm, (4693-04)S2,  
4693 S3 Chr, (4695-61)S11  
**Varadan, Vijay K.** (4693-04)S2,  
(4695-61)S11, 4700 Chr, 4700  
S1 Chr, (4700-02)S1, 4700 S10  
Chr, (4700-47)S11, (4700-10)S3,  
(4700-15)S4, (4700-16)S4, 4700  
S5 Chr, 4700 S6 Chr, (4700-  
24)S6, (4700-27)S7, (4700-  
34)S8, (4700-35)S8, 4700 S9  
Chr  
Venkata, Harish N. (4700-06)S3  
Verdier, Cyril (4699-08)S2  
Vidal, Frederic (4695-14)S2  
Vinoy, K. J. 4700 S11 Chr, (4700-  
47)S11, 4700 S3 Chr, (4700-  
10)S3, (4700-35)S8  
von Arx, B. (4696-17)S4  
Vujic, Nikola (4697-12)S3  
Vurpillot, Samuel (4696-17)S4  
**W**  
Wada, Akira (4696-33)S8  
Wada, Taishi (4699-22)S4, (4699-  
27)S5, (4699-39)S7  
Wadley, Haydn N. G. (4698-20)S4,  
(4698-21)S4, (4698-22)S4  
Wagner, Matthew G. (4698-12)S2  
Waigand, Al (4698-61)S11  
Walker, Peter G. (4695-38)S7  
Wallace, B. (4700-45)S11  
Wallace, Gordon G. 4695  
ProgComm, (4695-03)S1,  
(4695-05)S1, (4695-29)S4, 4695  
S6 Chr, 4695 S8 Chr, 4695  
Panel  
Wallace, Ingvar (4698-18)S4  
Wallmersperger, Thomas (4695-  
37)S7, (4695-46)S9  
Wang, Bill S. (4697-05)S2  
Wang, Donny P. (4698-06)S1  
Wang, Kon-Well 4697 Cochr, 4697  
S1 Chr, 4701 ProgComm, (4701-  
48)S11, 4701 S12 Chr, (4701-  
61)S14  
**Wang, Ming L.** 4696 ProgComm,  
4696 S8 Chr  
Wang, Quan (4693-53)S12

Wang, Shengyin (4693-66)S11  
**Wang, Xiaojie** (4696-44)S10,  
(4697-30)S7  
Wang, Yutian (4693-64)S15  
Waser, Rainer (4699-15)S3  
Washburn, Anthony E. (4698-11)S2  
Washer, Glenn A. 4696 ProgComm  
Washington, Gregory (4698-  
57)S10, 4700 ProgComm, 4700  
S8 Chr, (4700-31)S8, (4701-  
47)S11  
Watanabe, Ryuzo (4701-49)S11  
Watterson, Kevin (4695-38)S7  
Wax, Steven G. 4695 ProgComm  
Weible, Andrea (4695-46)S9  
Weiland, Kenneth (4701-14)S4  
Weisshaar, Terrence A. (4698-  
62)S2  
Well, Klaus (4693-05)S2  
**Wen, Yumei** (4696-19)S4  
Wereley, Norman M. 4696  
ProgComm, 4697 ProgComm,  
4697 S4 Chr, (4697-17)S4,  
(4697-31)S7, (4697-37)S8,  
(4699-61)S10, 4701 ProgComm,  
(4701-02)S1  
Weruaga-Prieto, Luis (4695-32)S5  
Wevers, Martine (4693-37)S8  
Whelan, Maurice Patrick 4694  
ProgComm, (4694-16)S3, 4694  
S4 Chr, (4694-32)S6  
White, Edward V. 4698 ProgComm,  
4698 S1 Chr, (4698-02)S1,  
(4698-03)S1  
White, Robert D. (4700-14)S4  
Whitten, Ralph (4693-65)S14,  
(4700-29)S7  
Wickramasinghe, Viresh (4699-  
37)S7  
Wierach, Peter (4698-37)S7  
Wilhelm, G. (4694-31)S6  
Wilke, Paul S. (4697-01)S1  
**Williams, Keith A.** (4701-21)S5  
Wilson, Ian Howard (4695-68)S11  
Wingert, Andreas (4695-52)S9  
Winter, D. (4696-32)S7  
Winterbauer, William (4698-  
58)S10  
Wirmitzer, Jan (4697-28)S7  
Witherspoon, Scott (4695-41)S8  
Wnek, Gary E. (4695-64)S11  
Wong, C. X. (4697-36)S8  
**Wood, Karen H.** (4698-49)S9  
Wood, Sharon 4696 ProgComm  
Worden, Keith (4693-35)S8, (4696-  
12)S3  
Wright, Peter Victor (4695-69)S11  
**Wu, Keyong** (4701-37)S9  
Wu, Meng-Chou (4698-49)S9  
Wu, Min (4696-36)S8  
Wun-Fogle, Marilyn (4699-55)S10  
Wuttig, Manfred R. (4699-28)S5,  
(4699-32)S6, (4701-05)S2  
**X**  
Xavier, Pascal 4700 S4 Chr  
Xia, Feng (4695-22)S3  
Xie, Bo (4701-16)S4  
Xie, Jining (4700-02)S1, (4700-  
16)S4, 4700 S7 Chr, (4700-  
27)S7  
Xie, Lijun (4697-47)S11  
Xin, Mei (4697-45)S10, (4697-  
30)S7  
Xin, Tinghui (4700-07)S3  
Xu, Chunye (4695-10)S2, (4695-  
55)S10  
Xu, Huifang (4695-50)S9  
Xu, J. M. (4701-65)S14  
**Xu, Qin** (4698-52)S10  
Xu, Qingzhou (4700-26)S7, (4700-  
28)S7

## Participants List

Xu, Roger (4698-58)S10  
**Xu, Tian-Bing** (4700-41)S10  
Xu, Ya (4699-71)S12, (4699-23)S4,  
(4701-30)S7  
Xu, Yanchu (4697-05)S2, (4697-  
07)S2  
**Y**  
Yan, Shi (4696-27)S6, (4697-32)S7  
Yanev, Bojidar S 4696 ProgComm  
Yang, J. M. (4700-45)S11  
Yang, Tsung-Lung (4695-65)S11  
Yao, Li (4695-64)S11  
Ye, Chen-Chun (4694-23)S4  
Yeh, Chih-Yang (4695-65)S11  
Yeh, John (4701-26)S6  
Yi, Won J. (4700-30)S8  
Yi, Yong (4701-20)S5  
Ying, Z.G. (4696-24)S6  
Yoo, J. K. (4701-50)S12  
**Yoo, Jinhyeong** (4701-02)S1  
Yoon, Kwang-joon (4699-72)S13,  
(4699-41)S7  
Yoshida, Hitoshi (4699-71)S12,  
(4699-23)S4, (4701-30)S7  
Yoshida, Junji (4697-39)S9, (4697-  
41)S9  
Yoshida, Kazuo 4696 ProgComm  
Yoshida, Yukimi (4694-39)S7  
**Yoshikawa, Shoko** (4694-08)S2,  
4701 ProgComm, 4701 S8 Chr  
Yu, Albert (4693-22)S15  
Yu, Hsiao-hua (4695-23)S4, (4695-  
57)S10  
Yu, Miao (4693-44)S10, (4694-  
47)S7  
Yu, Yung H. 4701 ProgComm  
Yun, Andrew Haebum (4696-40)S9  
Yun, Chul Yong (4701-52)S12  
Yuse, Kaori (4697-43)S10, (4697-  
46)S10  
**Z**  
Zaglmayr, Sabine (4693-50)S12  
Zago, Lorenzo (4693-67)S15  
Zakhidov, Anvar A. (4695-05)S1  
**Zara, Jason M.** (4700-38)S10  
Zeng, Xianwei (4699-10)S10  
Zhang, Ming (4700-40)S10  
Zhang, Qi Ming 4695 ProgComm,  
(4695-22)S3, 4695 S4 Chr,  
(4695-47)S9, (4700-41)S10  
Zhang, Rong (4695-69)S11  
Zhang, Shuqing (4693-64)S15  
Zhang, Yanhang (4700-22)S6  
Zhao, Guoqi (4699-38)S7  
Zheng, Gang (4696-04)S2  
Zheng, Quanshui 4699 ProgComm  
Zheng, Yanjun (4698-59)S8  
Zhou, Dezhi (4695-03)S1  
Zhou, Wenwei (4696-19)S4  
Zhou, Xiaogin (4701-31)S7  
Zhu, Bei (4700-15)S4  
Zhu, Jian (4700-48)S12  
Zhu, Jiujiang (4699-48)S8  
Zhu, Molly (4698-31)S6  
Zhu, Ye (4693-30)S4  
Ziaei, Afshin (4700-50)S11  
Zou, Jun (4700-43)S11  
Zoval, Jim V. (4693-65)S14, (4700-  
29)S7  
Zrinyi, Miklos 4695 ProgComm

SPIE's 7th Annual International Symposium on

# NDE for Health Monitoring and Diagnostics

17–21 March 2002 • San Diego, CA

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**SPIE and the NDE Organizing Committee  
are pleased to present the**

**2002 NDE Lifetime Achievement Award**

to

**Dr. Steven R. Doctor**

*for his commitment and outstanding leadership in the  
research and development in the field of Nondestructive  
Evaluation.*



Biography: Senior Staff Engineer - National Security Division Pacific Northwest National Laboratory, Richland, WA 99352 Steven Doctor's research has focused on nondestructive examination (NDE) technology and reliability for the past 25 years. Specific research includes methodology for quantifying NDE inspection performance and studies on determining means for improving NDE inspection performance. His efforts were a major contribution to the development of performance demonstration in Appendix VIII of the ASME Section XI Boiler and Pressure Vessel Code. As part of an effort to re-evaluate rules for determining the remaining lifetime of nuclear reactor pressure vessels, he is leading a major research effort to develop density and distribution functions for fabrication flaws created during their manufacture for use in fracture mechanics structural integrity assessments. He also developed an acoustical holography technique that has been patented. He is an Editor of the international journal Nuclear Engineering and Design, and was the NDE for Health Monitoring and Diagnostics symposium chair for 1999-2001 of the International Society for Optical Engineering (SPIE). He has been active in the coordination of conferences and organizing sessions at conferences such as ASME PVP, SMiRT-15, and SMiRT-16. He has over 150 published papers, reports and presentations.



# NDE for Health Monitoring and Diagnostics

## 2001 NDE Best Paper Award to be presented at the 2002 NDE symposium:

*1st Place:*  
**Nondestructive characterization of fatigue damage with thermography**, Henrik Roesner, Fraunhofer Institute Nondestructive Testing (Germany); Shamachary Sathish, Norbert Meyendorf, Univ. of Dayton .. [4336-24]

*2nd Place:*  
**Development of acoustography for NDE of aging structures**, Jaswinder Sandhu, Honghui Wang, Witold Popek, Santec Systems, Inc.; Patrick Sincebaugh, Army Research Lab. .... [4335-13]

*3rd Place:*  
**Integrated NDE and FEM characterization of composite rotors**, Ali Abdul-Aziz, George Baaklini, Jeffrey Trudell, NASA Glenn Research Ctr. .... [4336-5]

## 2001 NDE Best Student Paper Award to be presented at the 2002 NDE symposium:

*1st Place:*  
**Acoustic and thermographic evaluation of polymeric corrosion protective coatings on aluminum alloy airframe structures**, Jochen Hoffman, Angela Mahan, Mohammad Khobaib, Shamachary Sathish, Norbert Meyendorf, Univ. of Dayton ..... [4336-11]

*2nd Place:*  
**Health monitoring of FRP bridge decks**, Marybeth Miceli, Mochael Horne, John Duke, Virginia Polytechnic Institute and State Univ. .... [4335-15]

*3rd Place:*  
**Full-scale study of the behavior of tall buildings under winds**, Tracy Kijewski, Ahsan Kareem, Univ. of Notre Dame ..... [4337-54]

## Conference 4702

**Room: Royal Palm III**  
Mon.–Wed. 18–20 March 2002  
*Proceedings of SPIE* Vol. 4702

## Smart NDE and Health Monitoring of Structural and Biological Systems

*Conference Chair:* Tribikram Kundu, Univ. of Arizona

*Cochairs:* Yoseph Bar-Cohen, Jet Propulsion Lab.; Jürgen Bereiter-Hahn, J.W. Goethe Univ. (Germany)

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## Conference 4703

**Room: Royal Palm IV**  
Mon.–Tues. 18–19 March 2002  
*Proceedings of SPIE* Vol. 4703

## Nondestructive Evaluation and Reliability of Micro- and Nanomaterial Systems

*Conference Chairs:* Norbert Meyendorf, Univ. of Dayton; George Y. Baaklini, NASA Glenn Research Ctr.; Bernd Michel, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration (Germany)

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## Conference 4704

**Room: Royal Palm V**  
Mon.–Tues. 18–19 March 2002  
*Proceedings of SPIE* Vol. 4704

## NDE and Health Monitoring of Aerospace Materials and Civil Infrastructures

*Conference Chairs:* Andrew L. Gyekenyesi, OAI/NASA Glenn Research Ctr.; Steven M. Shepard, Thermal Wave Imaging, Inc.; Dryver R. Huston, Univ. of Vermont; A. Emin Aktan, Drexel Univ.; Peter J. Shull, The Pennsylvania State Univ.

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# NDE for Health Monitoring and Diagnostics

Conference 4702

Room: Royal Palm III

Conference 4703

Room: Royal Palm IV

Conference 4704

Room: Royal Palm V

Monday 18 March

8:00 to 8:45 am • Pacific Salon 1

**NDE Best Student Paper Award • NDE Best Paper Awards • NDE Achievement Awards**

Presenter: **George Y. Baaklini**, NASA Glenn Research Ctr.

Special Presentation: **NDE Reliability: the Past, Present, and Future**

Dr. **Steven R. Doctor**, Pacific Northwest National Lab. by **NDE Achievement Award Winner**

## SESSION 1

Room: Royal Palm III  
Mon. 9:00 am

### Session 1

Chair: **Tribikram Kundu**, Univ. of Arizona

9:00 am: **Forensic science: the truth is out there**, (Invited Paper), L. D. Herold, Los Angeles County Sheriff's Dept. .... [4702-01]

9:30 am: **Multi-element adjustable transducer arrays for ultrasonic scanning of aging aircraft**, I. N. Komsky, Northwestern Univ. .... [4702-02]

9:50 am: **Piezoceramic and carbon nanotube materials for health monitoring**, M. J. Sundaresan, North Carolina A&T State Univ.; M. J. Schulz, Univ. of Cincinnati ..... [4702-03]

Coffee Break ..... 10:10 to 10:30 am

## SESSION 2

Room: Royal Palm III  
Mon. 10:30 am

### Session 2

Chairs: **Daniel L. Balageas**, ONERA (France); **Joseph A. Turner**, Univ. of Nebraska/Lincoln

10:30 am: **Built-in diagnostics for monitoring crack growth in aircraft structures**, J.-B. Ihn, F.-K. Chang, Stanford Univ. .... [4702-04]

10:50 am: **Robots as future artificial inspectors using biologically inspired technologies**, Y. Bar-Cohen, Jet Propulsion Lab. .... [4702-05]

11:10 am: **Artificial nerve system for structural monitoring**, W. N. Martin, North Carolina A&T State Univ.; A. Ghoshal, Arizona State Univ.; M. J. Sundaresan, North Carolina A&T State Univ.; M. J. Schulz, Univ. of Cincinnati; G. Lebby, North Carolina A&T State Univ. .... [4702-06]

11:30 am: **Shaped-field eddy-current sensors and arrays**, A. P. Washabaugh, V. A. Zilberstein, D. E. Schlicker, Y. Sheiretov, D. Grundy, N. J. Goldfine, JENTEK Sensors, Inc. .... [4702-07]

11:50 am: **Smart piezotronic skin using a polymeric composite matrix and its application in health monitoring**, A. Talaie, Tohoku Univ. (Japan) ..... [4702-08]

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

## SESSION 1

Room: Royal Palm IV  
Mon. 9:20 am

### Session 1

Chair: **Norbert Meyendorf**, Univ. of Dayton

9:20 am: **Determination of elastic properties of advanced nanocrystalline and microcrystalline materials using laser-based surface acoustic waves** (Invited Paper), P. Hess, Univ. Heidelberg (Germany) ..... [4703-01]

Coffee Break ..... 10:00 to 10:30 am

10:30 am: **Laser-ultrasonic characterization of a zinc layer on a steel substrate using Rayleigh surface acoustic waves**, B. Chenni, Univ. du Havre (France); A. Moreau, National Research Council Canada ..... [4703-02]

10:50 am: **Measurement and simulation of the laser-based thermo-elastic excitation and propagation of acoustic pulses for thin film and MEMS inspection**, D. M. Profunser, J. Vollmann, J. Bryner, J. Dual, Swiss Federal Institute of Technology (Switzerland) ..... [4703-03]

11:10 am: **Nondestructive evaluation of bonding characteristics of TiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub> gas sensors**, G. Newaz, B. Feng, G. W. Auner, Wayne State Univ.; S. Akbar, The Ohio State Univ. .... [4703-04]

11:30 am: **In-situ x-ray reflectivity measurement of the surface roughness of the tantalum peroxides thin film during the rf magnetron sputtering deposition**, C. H. Lee, T. W. Huang, National Tsing Hua Univ. (Taiwan); H. Y. Lee, Y. W. Hsieh, Synchrotron Radiation Research Ctr. (Taiwan) ..... [4703-05]

11:50 am: **Subsurface detection and characterization of Hertzian cracks in advanced ceramic materials using optical coherence tomography**, M. Bashkansky, J. F. Reintjes, Naval Research Lab. .... [4703-06]

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

## SESSION 1

Room: Royal Palm V  
Mon. 9:00 am

### NDE and Health Monitoring of Civil Infrastructure I

Chairs: **Dryver R. Huston**, Univ. of Vermont; **A. Emin Aktan**, Drexel Univ.

9:00 am: **Damage identification in a structure utilizing the sequential probability ratio test**, D. W. Allen, H. Sohn, C. R. Farrar, Los Alamos National Lab.; K. Worden, Univ. of Sheffield (UK) ..... [4704-01]

9:20 am: **Continuous structural integrity monitoring of rehabilitated buried pipelines through embedded MEMS sensors**, A. K. Tayebi, M. Haque, Louisiana Tech Univ. .... [4704-02]

9:40 am: **Development of GIS-based bridge structural health monitoring and management system**, W. Z. Shi, Hong Kong Polytechnic Univ. (Hong Kong); P. G. Cheng, Hong Kong Polytechnic Univ. and East China Geologic Institute (Hong Kong); J. M. Ko, Hong Kong Polytechnic Univ. (Hong Kong) ..... [4704-03]

Coffee Break ..... 10:00 to 10:30 am

10:30 am: **Nondestructive parameter identification of structures**, C. G. Koh, S. L. Zhao, C. Y. Liaw, National Univ. of Singapore [4704-04]

10:50 am: **Development of a general model of smart monitoring system and algorithm for the maintenance of long-span bridges**, K. H. Kwak, S. J. Jo, K. H. Kwak, Wonkwang Univ. (Korea) ..... [4704-05]

11:10 am: **Optical reflectometry for health monitoring of civil transportation systems**, O. G. Morozov, Tupolev Kazan State Technical Univ. (Russia) ..... [4704-06]

11:30 am: **Reengineering organizations for optical deployment of smart materials and intelligent devices in civil infrastructure**, T. E. El-Diraby, Univ. of Toronto (Canada) ..... [4704-07]

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

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## Conference 4702

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### Monday 18 March

#### SESSION 3

Room: Royal Palm III

Mon. 1:30 pm

#### Session 3

*Chairs: Roy Ikegami*, Boeing Phantom Works; **Damianos A. Sotiropoulos**, New York Blood Ctr.

1:30 pm: **Investigating the use of ultrasonic guided waves for aging wire insulation assessment**, R. F. Anastasi, E. I. Madaras, NASA Langley Research Ctr. .... [4702-09]

1:50 pm: **Application of NDE in aerospace coatings**, A. Fahr, B. Roge, M. Safizadeh, S. Giguere, K. McRae, National Research Council Canada ..... [4702-10]

2:10 pm: **Health assessment of power plant equipment by NDE**, S. Baskaran, V. Raghavendran, Industrial Quality Concepts (India) ... [4702-11]

2:30 pm: **Intelligent image correlation using genetic algorithms for real-time health monitoring of rotating blades**, J. W. Maudlin, A. Mahajan, T. Chu, Southern Illinois Univ./Carbondale [4702-12]

2:50 pm: **Continuous health monitoring of graphite epoxy motorcases (GEM)**, R. D. Finlayson, Physical Acoustics Corp.; D. T. Schaafsma, IPIITEK; M. Luzzio, R. K. Miller, Physical Acoustics Corp. .... [4702-13]

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

#### SESSION 4

Room: Royal Palm III

Mon. 3:40 pm

#### Session 4

*Chair: Kam W. Ng*, Office of Naval Research

3:40 pm: **Practical considerations for health monitoring systems**, T. W. Frison, chaotic.com; E. Mitchell, Boeing Co. .... [4702-14]

4:00 pm: **Current issues in vibration-based fault diagnostics and prognostics**, V. Giurgiutiu, Univ. of South Carolina ..... [4702-15]

4:20 pm: **Geometric time domain methods of vibration based damage detection**, S. Trickey, M. D. Todd, Naval Research Lab.; J. M. Nichols, Duke Univ.; M. E. Seaver, Naval Research Lab. [4702-16]

4:40 pm: **Computational study on plate damage identification**, S. A. Wimmer, Nova Research, Inc.; V. G. DeGiorgi, Naval Research Lab. ... [4702-17]

#### Panel Discussion

Room: Royal Palm III

Mon. 5:00 to 6:20 pm

#### Structural Health Monitoring Issues and Future Directions

*Moderator: Kam W. Ng*, Office of Naval Research

*Panelists: S.-C. Liu*, Alison B. Flatau, National Science Foundation; **Ted W. Frison**, chaotic.com; **Victor Giurgiutiu**, Univ. of South Carolina; **Stephen Trickey**, Naval Research Lab.; **Stephanie A. Wimmer**, Nova Research, Inc.; **Michael D. Todd**, Naval Research Lab.

#### SESSION 2

Room: Royal Palm IV

Mon. 1:30 pm

#### Session 2

*Chair: Bernd Michel*, Fraunhofer-Institut für Zuverlaessigkeit und Mikrointegration (Germany)

1:30 pm: **Quantitative contact spectroscopy by atomic force acoustic microscopy (Invited Paper)**, W. Arnold, Univ. Saarbruecken (Germany) [4703-07]

2:10 pm: **Quantitative elastic-property information with acoustic AFM: measurements and modeling**, D. C. Hurley, National Institute of Standards and Technology; J. S. Wiehn, J. A. Turner, Univ. of Nebraska/Lincoln; P. Rice, National Institute of Standards and Technology ..... [4703-08]

2:30 pm: **Nonlinear vibrations in atomic force microscopy**, J. A. Turner, Univ. of Nebraska/Lincoln ..... [4703-09]

Coffee Break ..... 2:50 to 3:40 pm

#### SESSION 3

Room: Royal Palm IV

Mon. 3:40 pm

#### Session 3

*Chair: D. C. Hurley*, National Institute of Standards and Technology

3:40 pm: **Ultrasonic atomic force microscopy with real-time mapping of resonance frequency and Q factor (Invited Paper)**, K. Yamanaka, Tohoku Univ. (Japan) ..... [4703-10]

4:20 pm: **Finite element simulations of nonlinear vibrations of atomic force microscope cantilevers**, K. Shen, J. A. Turner, Univ. of Nebraska/Lincoln ..... [4703-11]

4:40 pm: **Improving atomic force microscopy images with the adaptation of ultrasonic force microscopy**, C. J. Druffner, L. Shen, S. Sathish, Univ. of Dayton ..... [4703-12]

#### SESSION 2

Room: Royal Palm V

Mon. 1:30 pm

#### Damage Detection in Composites

*Chairs: Ali Abdul-Aziz*, Laura M. Harmon, Cleveland State Univ.

1:30 pm: **Nondestructive evaluation of ceramic matrix composites coupled with finite element analyses**, A. Abdul-Aziz, G. Y. Baaklini, NASA Glenn Research Ctr.; R. Bhatt, U.S. Army Aviation System Command and NASA Glenn Research Ctr. .... [4704-07]

1:50 pm: **Correlation between cumulative damage behavior and electrical resistance change in CFRP laminates under static and fatigue loading**, D. Y. Song, Y. Hirata, N. Takeda, Univ. of Tokyo (Japan); A. Kitano, Toray Industries, Inc. (Japan) [4704-08]

2:10 pm: **Quantitative evaluation of the electrically conductive internal network in CFRP composites**, J. B. Park, Univ. of Tokyo (Japan); T. Okabe, National Institute of Advanced Industrial Science (Japan); A. Yoshimura, N. Takeda, Univ. of Tokyo (Japan); W. A. Curtin, Brown Univ. [4704-09]

2:30 pm: **Experimental verification of tapping sound analysis for the inspection of laminated composite structures**, S. J. Kim, J. S. Hwang, Seoul National Univ. (Korea) ..... [4704-10]

2:50 pm: **Effect of thermal residual stress on the reflection spectrum from FBG sensors embedded in CFRP composites**, Y. Okabe, Univ. of Tokyo (Japan); S. Yashiro, Hitachi, Ltd. (Japan); R. Tsuji, T. Mizutani, N. Takeda, Univ. of Tokyo (Japan) ..... [4704-11]

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

3:40 pm: **Experimental damage study of Gr/PEEK composite laminates**, S. Wang, J. Tong, Z. Wang, M. Shen, L. Li, Tianjin Univ. (China) ... [4704-12]

#### SESSION 3

Room: Royal Palm V

Mon. 4:00 pm

#### Thermal Wave Imaging and Full Field NDE

*Chairs: Steven M. Shepard*, Thermal Wave Imaging, Inc.; **Richard E. Martin**, NASA Glenn Research Ctr.

4:00 pm: **Reconstruction and enhancement of thermographic sequence data for NDE**, S. M. Shepard, Thermal Wave Imaging, Inc. . [4704-13]

4:20 pm: **Acoustography-based ultrasonic testing**, J. S. Sandhu, H. Wang, M. Sonpatki, Santec Systems, Inc. .... [4704-14]

4:40 pm: **Pulsed thermography of ceramic matrix composites**, R. E. Martin, Cleveland State Univ.; A. L. Gyekenyesi, OAI/NASA Glenn Research Ctr. .... [4704-15]

5:00 pm: **Damage location and identification using infrared thermography and thermo-elastic stress analysis**, P. Cunningham, J. M. Dulieu-Barton, R. A. Sheno, Univ. of Southampton (UK) ..... [4704-16]

5:20 pm: **Quality control of FRP bond thickness using infrared thermography**, R. L. Limerick, P. V. Mtenga, J. O. Sobanjo, Florida A&M Univ. and Florida State Univ. .... [4704-17]



# NDE for Health Monitoring and Diagnostics

Conference 4702

Room: Royal Palm III

Conference 4703

Room: Royal Palm IV

Conference 4704

Room: Royal Palm V

Tuesday 19 March

8:00 to 8:45 am • Room: Town & Country

ASME Adaptive Structures and Materials Systems Best Paper Awards

Presenter: ASME Adaptive Structures and Materials Systems Technical Committee

Plenary Presentation **Multifunctional Materials**

Speaker: Dr. Leo Christodolou, DARPA, Arlington, VA

**SESSION 5**  
Room: Royal Palm III  
Tues. 9:00 am

Session 5

*Chairs:* Shiv P. Joshi, Univ. of Texas/Arlington;  
Yoseph Bar-Cohen, Jet Propulsion Lab.

9:00 am: **Application of frequency domain ARX features for linear and nonlinear structural damage identification**, D. E. Adams, Purdue Univ.; C. R. Farrar, Los Alamos National Lab. . . . [4702-19]

9:20 am: **Simulation of effect of bending stress on the ultrasonic beam**, A. M. Koshti, Boeing Co. . . . . [4702-20]

9:40 am: **Theoretical study of ultrasonic sensors: dependence of acoustic pressure on the sensor geometry in presence of an interface**, D. Placko, Ecole Normale Supérieure de Cachan (France); T. Kundu, Univ. of Arizona . . . . . [4702-21]

Coffee/Exhibition Break . . . . . 10:00 to 10:30 am

**SESSION 6**  
Room: Royal Palm III  
Tues. 10:30 am

Session 6

*Chairs:* Jaswinder S. Sandhu, Santec Systems, Inc.; Alison B. Flatau, National Science Foundation

10:30 am: **Structural health monitoring system design using finite element analysis**, C. R. Farrar, Los Alamos National Lab.; D. W. Stinemas, Georgia Institute of Technology; F. Hemez, H. Sohn, Los Alamos National Lab. . . . . [4702-22]

10:50 am: **Nonlinear damage detection using a time-domain minimum rank perturbation theory**, F. Lopez, D. C. Zimmerman, Univ. of Houston . . . . . [4702-23]

11:10 am: **Estimating temperature rise in pulsed thermography using irreversible temperature indicators**, A. M. Koshti, Boeing Co. . . . [4702-24]

11:30 am: **Transmission line matrix model for ultrasound imaging**, R. Ciocan, N. Ida, Univ. of Akron . . . . . [4702-25]

11:50 am: **Bearing fault detection in machine tools using empirical mode decomposition/Hilbert-Huang transform analysis**, G. G. Leisk, N. N. Hsu, National Institute of Standards and Technology; N. E. Huang, NASA Goddard Space Flight Ctr. . . . . [4702-26]

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

**SESSION 4**  
Room: Royal Palm IV  
Tues. 9:20 am

Session 4

*Chair:* M. Werner, Deutsche Bank Microelectronic Innovation Team (Germany)

**Keynote Presentation**  
9:20 am: **MicroMaterials Center Berlin: reliability research for MEMS** (*Keynote Address*), B. Michel, Fraunhofer Institut Zuverlässigkeit und Mikrointegration (Germany) . . . . . [4703-13]

Coffee/Exhibition Break . . . . . 10:00 to 10:30 am

10:30 am: **Damage detection and characterization in smart CFRP composites**, G. Mook, J. Pohl, F. Michel, S. Herold, Otto-von-Güricke-Univ. Magdeburg (Germany) . . [4703-14]

10:50 am: **Characterization of epoxy coating degradation using NDE imaging techniques**, J. Hoffmann, V. Kramb, S. V. Davis, Univ. of Dayton; J. Johnson, Air Force Research Lab.; N. Meyendorf, Univ. of Dayton . . . . . [4703-15]

11:10 am: **Relations between crack opening behavior and crack tip diffraction of longitudinal wave**, T. Mihara, M. Nomura, K. Yamanaka, Tohoku Univ. (Japan) . . . . . [4703-16]

11:30 am: **Characterization of miniaturized tensile specimens using micromagnetic techniques**, H. Roesner, Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (Germany); N. Meyendorf, Univ. of Dayton . . . . . [4703-17]

11:50 am: **Output signal prediction of an open-ended waveguide probe when scanning elliptical-shape cracks in metals**, H. Sadeghi, F. Mazlumi, R. Moini, Amirkabir Univ. of Technology (Iran) . . . . . [4703-18]

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

**SESSION 4**  
Room: Royal Palm V  
Tues. 9:00 am

**NDE and Health Monitoring of Aerospace Systems**

*Chairs:* Jerzy T. Sawicki, Cleveland State Univ.; Bernhard R. Tittmann, The Pennsylvania State Univ.

9:00 am: **Recent advances in aerospace composite NDE**, G. E. Georgeson, Boeing Co. . . . . [4704-18]

9:20 am: **Study of the feasibility of "healing" delamination in an AS4/PEEK composite plate**, B. R. Tittmann, M. Laczynski, S. B. Jayaraman, C. Miyasaka, The Pennsylvania State Univ. [4704-19]

9:40 am: **Air-coupled guided wave ultrasonics for NDE of aging aircraft components**, F. L. di Scalea, Univ. of California/San Diego; D. Tuzzeo, M. Bonomo, Univ. di Palermo (Italy) . . . . [4704-20]

Coffee/Exhibition Break . . . . . 10:00 to 10:30 am

10:30 am: **Vibration-based diagnostics of cracked rotors**, J. T. Sawicki, Cleveland State Univ.; A. L. Gyekenyesi, OAI/NASA Glenn Research Ctr.; G. Y. Baaklini, NASA Glenn Research Ctr. . . [4704-21]

10:50 am: **Detection, discrimination, and real-time tracking of cracks in rotating disks**, W. C. Haase, M. J. Drumm, Exsell Inc. . . . . [4704-22]

11:10 am: **Near-DC eddy current measurement of aluminum multilayers using MR sensors and commodity low-cost computer technology**, A. R. Perry, PAMURRAY . . . . . [4704-23]

11:30 am: **Vibration isolation techniques for portable electronic speckle pattern interferometry**, D. Findeis, J. Gryzagoridis, Univ. of Cape Town (South Africa) . . . . . [4704-24]

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

# NDE for Health Monitoring and Diagnostics

## Conference 4702

Room: Royal Palm III

**SESSION 7**  
Room: Royal Palm III  
Tues. 1:30 pm

### Session 7

*Chairs: S.-C. Liu, National Science Foundation; Joseph A. Turner, Univ. of Nebraska/Lincoln*

1:30 pm: **Nonlinear active wave modulation approach for evaluating bond conditions between adhesively bonded FRP sheet/concrete substrate**, H.-C. Wu, K. Warnemuende, Wayne State Univ. . . . . [4702-27]

1:50 pm: **Scattering of ultrasound in damaged concrete**, L. Yang, J. A. Turner, Univ. of Nebraska/Lincoln . . . . . [4702-28]

2:10 pm: **Nondestructive inspection of concrete structures with the use of photorefractive two-wave mixing**, O. Kotiaev, S. Uchida, Osaka Univ. (Japan) . . . . . [4702-29]

2:30 pm: **Advances in health monitoring of railroad tracks**, F. Lanza di Scalea, J. D. McNamara, Univ. of California/San Diego . . . . . [4702-30]

2:50 pm: **Health monitoring of light-rail train aerial structural system**, R. L. Yuan, M. Bourland, Univ. of Texas/Arlington; E. Ugarte, Dallas Area Rapid Transit; I. Hwang, CPY Inc. . . . . [4702-31]

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

**SESSION 8**  
Room: Royal Palm III  
Tues. 3:40 pm

### Session 8

*Chairs: Dominique Placko, Ecole Normale Supérieure de Cachan (France); Jaswinder S. Sandhu, Santec Systems, Inc.*

3:40 pm: **Health monitoring system for composite material using electromagnetic field measurement**, M. Lemistre, D. L. Balageas, ONERA (France) . . . . . [4702-32]

4:00 pm: **Magnetostrictive sensor for health monitoring in structures**, G. M. Light, H. Kwun, S. Kim, R. L. Spinks, Southwest Research Institute . . . . . [4702-33]

4:20 pm: **Health monitoring of aging aerospace structures using the electro-mechanical impedance method**, A. Zagrai, V. Giurgiutiu, Univ. of South Carolina . . . . . [4702-34]

4:40 pm: **Reducing the cost of impedance-based structural health monitoring**, D. M. Peairs, G. Park, D. J. Inman, Virginia Polytechnic Institute and State Univ. . . . . [4702-36]

5:00 pm: **Fermi-Pasta-Ulam (FPU) spectrum raying for NDE purposes**, A. A. Berezin, Oil and Gas Research Institute (Russia) . . . . . [4702-35]

## Conference 4703

Room: Royal Palm IV

## Tuesday 19 March

**SESSION 5**  
Room: Royal Palm IV  
Tues. 1:30 pm

### Session 5

*Chair: Walter Arnold, Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (Germany)*

1:30 pm: **Accelerated life testing in microelectronics and photonics: its role, challenges, pitfalls, and interaction with qualification tests** (*Keynote Address*), E. Suhir, Iolon, Inc. . . . . [4703-19]

2:10 pm: **Micro-characterization of MEMS ultrasonic transducers using laser interferometry**, J. L. Blackshire, Air Force Research Lab.; S. Sathish, Univ. of Dayton . . . . . [4703-20]

2:30 pm: **Micro and nanoDAC: a powerful technique for nondestructive microcrack evaluation**, B. Michel, D. Vogel, Fraunhofer Institut Zuverlässigkeit und Mikrointegration (Germany) . . . . . [4703-21]

2:50 pm: **Investigation of tight disbonds with ultrasonic spectroscopy** (*Presentation Only*), L. M. Harmon, Cleveland State Univ.; A. L. Gyekenyesi, Ohio Aerospace Institute/NASA Glenn Research Ctr.; R. E. Martin, Cleveland State Univ. and NASA Glenn Research Ctr.; G. Y. Baaklini, NASA Glenn Research Ctr. . . . . [4704-25]

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

**SESSION 6**  
Room: Royal Palm IV  
Tues. 3:40 pm

### Session 6

*Chair: Ephraim Suhir, Iolon, Inc.*

3:40 pm: **Nondestructive characterization and application of doped and undoped polycrystalline diamond films** (*Keynote Address*), M. Werner, T. Köhler, S. Mietke, Deutsche Bank AG (Germany); C. Johnston, AEA Technology plc (UK); H. Fecht, Univ. Ulm (Germany); E. Wörner, Fraunhofer-Institut für Angewandte Festkörperphysik (Germany) . . . . . [4703-23]

4:20 pm: **Analytical modeling of flash thermography results of a layered sample**, M. Goldammer, Siemens AG (Germany) . . . . . [4703-24]

4:40 pm: **Diffusion-based approach to thermal tomography**, R. A. Kline, San Diego State Univ.; W. P. Winfree, NASA Langley Research Ctr. [4703-25]

End of Conference 4703 ■

## Conference 4704

Room: Royal Palm V

**SESSION 5**  
Room: Royal Palm V  
Tues. 1:30 pm

### Developments in Ultrasonics and Field Theory

*Chairs: Andrew L. Gyekenyesi, OAI/NASA Glenn Research Ctr.; Richard E. Martin, NASA Glenn Research Ctr.*

1:30 pm: **Investigation of tight disbonds with ultrasonic spectroscopy**, L. M. Harmon, Cleveland State Univ.; A. L. Gyekenyesi, OAI/NASA Glenn Research Ctr.; R. E. Martin, G. Y. Baaklini, NASA Glenn Research Ctr. . . . . [4704-25]

1:50 pm: **Effect of experimental conditions on acousto-ultrasonic reproducibility**, A. L. Gyekenyesi, OAI/NASA Glenn Research Ctr.; L. M. Harmon, Cleveland State Univ. and NASA Glenn Research Ctr. . . . . [4704-26]

2:10 pm: **Ultrasonic attenuation and backscattering in duplex alloys for materials characterization**, P. D. Panetta, Pacific Northwest National Lab.; R. B. Thompson, Iowa State Univ. . . . . [4704-27]

2:30 pm: **Non-contact ultrasonic thickness gauging of aluminium sheet with sub-micron accuracy using electromagnetic acoustic transducers (EMATs)**, S. B. Palmer, S. Dixon, C. Edwards, Univ. of Warwick (UK) . . . . . [4704-29]

2:50 pm: **Non-contact measurements of laser-generated Lamb waves using fiber optic Sagnac interferometer and its propagation characteristics**, T. S. Jang, J. J. Lee, Korea Advanced Institute of Science and Technology (Korea); S. S. Lee, Korea Research Institute of Standards and Science (Korea) . . . . . [4704-30]

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

**SESSION 6**  
Room: Royal Palm V  
Tues. 3:40 pm

### NDE and Health Monitoring of Civil Infrastructure II

*Chairs: A. Emin Aktan, Drexel Univ.; Dryver R. Huston, Univ. of Vermont*

3:40 pm: **Fiber optic chemo-sensing for civil infrastructure**, M. Ghandehari, C. Vimer, P. Spellane, Polytechnic Univ. . . . . [4704-37]

4:00 pm: **Assessment of integrity of concrete bridge structures by acoustic emission technique**, D. J. Yoon, P. Park, J. C. Jung, S. S. Lee, Korea Research Institute of Standards and Science (Korea) . . . . . [4704-32]

4:20 pm: **Structural health monitoring using wireless sensing systems with embedded processing**, N. Tanner, C. R. Farrar, H. Sohn, Los Alamos National Lab.; K. Worden, Univ. of Sheffield (UK) . . . . . [4704-35]

4:40 pm: **Multilevel structural health monitoring using an inverse wave propagation method**, F. J. Carrion, Institut Mexicano Del Transporte (Mexico); J. F. Doyle, Purdue Univ.; A. Lozano, Consejo de Ciencia y Tecnología del Estado de Querétaro (Mexico) . . . . . [4704-34]

5:00 pm: **Cure monitoring of concretes by measurement of dielectric constant in time domain**, L. Shi, Stanford Univ.; Q. Xu, C. Gao, Y. Li, Nanjing Engineering Institute (China) . . . . . [4704-31]

5:20 pm: **Implementation issues of novelty detection technique for cable-supported bridges instrumented with a long-term monitoring system**, Y. Q. Ni, H. Li, J. Y. Wang, J. M. Ko, Hong Kong Polytechnic Univ. (Hong Kong) . . . . . [4704-33]

End of Conference 4704 ■

# NDE for Health Monitoring and Diagnostics

Tuesday 19 March

## ✓ Posters—Tuesday

*The following posters will be displayed in the formal poster session and Exhibit Reception on Tuesday evening from 6:00 to 7:30 pm. Authors will be present at this time for discussion. Poster authors will be able to set up their poster papers between 10:00 am and 3:00 pm Tuesday. Poster papers can be previewed from 3:00 to 4:00 pm before the formal poster session begins at 6:00 pm.*

### Conference 4702

- ✓ **Thermal acupuncture arrangement design for rehabilitation in post-operation period**, A. G. Shayko-Shaykovsky, A. A. Ascheulov, I. M. Rublenik, I. D. Palinchuk, National State Univ. of Chernivtsi (Ukraine) ..... [4702-55]
- ✓ **Portable monitoring consistency of carbon monoxide device**, Q. Zheng, F. Liang, G. Liu, X. Wang, Beijing Institute of Machinery (China) ..... [4702-56]
- ✓ **Metal-polymer intramedular fixators designs used for osteosynthesis of long bones**, A. G. Shayko-Shaykovsky, I. M. Rublenik, A. A. Ashcheulov, A. L. Kovalyk, I. D. Palinchuk, National State Univ. of Chernivtsi (Ukraine) ..... [4702-57]
- ✓ **Wireless temperature sensors for health monitoring of aerospace thermal protection systems**, (Presentation Only), F. S. Milos, J. B. Pallix, NASA Ames Research Ctr. [4702-58]
- ✓ **Incompressibility and guided waves in anisotropic layered materials**, D. A. Sotiropoulos, E. Babatsouli, Univ. of Texas/ Brownsville ..... [4702-59]

### Conference 4703

- ✓ **Thermal nondestructive characterization by the thermal transfer function and the numerical method of control volumes**, S. Belattar, A. Tmiri, A. Elouahlouli, Lab. d'Energetique et de Traitement de Signal (Morocco) ..... [4703-27]

### Conference 4704

- ✓ **Television measuring methods for systems with microwave visualization of NDE monitoring objects**, D. L. Ovchinnikov, Tupolev Kazan State Technical Univ. (Russia); R. A. Akhtiamov, Applied Electronics (Russia); G. A. Morozov, O. G. Morozov, Tupolev Kazan State Technical Univ. (Russia); R. K. Galimov, JSC "IrkenNeft" (Russia); M. R. Galimov, Tupolev Kazan State Technical Univ. (Russia); R. G. Zalyalov, Tatarstan Ministry of Communications (Russia); Y. A. Korpatchev, Tupolev Kazan State Technical Univ. (Russia) ..... [4704-36]
- ✓ **Fleet-strategies for condition assessment and health monitoring**, F. N. Catbas, A. Aktan, Drexel Univ. .... [4704-38]
- ✓ **Experimental and analytical issues for ambient vibration surveys of long-span bridges**, F. N. Catbas, K. Ciloglu, A. Aktan, Drexel Univ. .... [4704-39]
- ✓ **Monitoring and control of microfloor vibrations in a new research building**, D. R. Huston, X. Zhao, B. Esser, J. Plumpton, Univ. of Vermont ..... [4704-41]

# NDE for Health Monitoring and Diagnostics

Conference 4702

Room: Royal Palm III

## Wednesday 20 March

8:00 to 8:45 am • Town & Country

**Smart Structures and Materials Best Student Paper Awards**

*Presenter: Dr. Alison Flatau, National Science Foundation*

*Plenary Presentation: Structural Damage Detection and Health Monitoring: A Myth or Reality*

*Speaker: Dr. Anne S. Kiremidjian, Professor and Director, Stanford Univ./The John A. Blume Earthquake Engineering Ctr., Stanford, CA*

### SESSION 9

Room: Royal Palm III 8 Wed. 9:00 am

*Chairs: Victor Giurgiutiu, Univ. of South Carolina; George Zentai, Varian Medical Systems, Inc.*

9:00 am: **Three-dimensional root canal computer modeling for advanced endodontic treatment**, S. Y. Hong, J. Dong, Columbia Univ. . . . . [4702-37]

9:20 am: **Design of a new controller to treat the obstructive sleep apnea**, T. Netzel, Univ. der Bundeswehr Hamburg (Germany) . . . [4702-38]

9:40 am: **Photomechanics of the thermo-mechanical functional adaptation in human tooth**, A. K. Asundi, A. Kishen, Nanyang Technological Univ. (Singapore) . . . . [4702-39]

Coffee/Exhibition Break . . . . 10:00 to 10:30 am

### SESSION 10

Room: Royal Palm III • Wed. 10:30 am

*Chairs: Shane Y. Hong, Columbia Univ.; Shiv P. Joshi, Univ. of Texas/Arlington*

10:30 am: **Interaction of focused ultrasound with biological materials**, A. K. Mal, F. Feng, M. Kabo, Univ. of California/Los Angeles; Y. Bar-Cohen, Jet Propulsion Lab.; J. Wang, Univ. of California/Los Angeles . . . . . [4702-40]

10:50 am: **High-power acoustic insult to living cultured cells as studied by high-frequency scanning acoustic microscopy**, C. Miyasaka, B. R. Tittmann, The Pennsylvania State Univ. [4702-42]

11:10 am: **Novel method for the in-vivo detection of single leg separation failures in prosthetic heart valves**, J. Long, S. S. Udpa, Y. Sun, Iowa State Univ. . . . . [4702-43]

11:30 am: **EMAT: a novel nondestructive approach for intact outlet strut detection of Bjørk-Shiley Convexo-Concave heart valve**, J. Long, S. S. Udpa, Y. Sun, Iowa State Univ. . . . . [4702-44]

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

### SESSION 11

Room: Royal Palm III • Wed. 1:30 pm

*Chairs: Ajit K. Mal, Univ. of California/Los Angeles; George Zentai, Varian Medical Systems, Inc.*

1:30 pm: **Identifying damage in plate-like structures by analysis of Lamb wave propagation characteristics**, M. Kehlenbach, S. Das, European Aeronautic Defence and Space Company (Germany) . . . . . [4702-45]

1:50 pm: **Detection and estimation of defects in a circular plate using operational deflection shapes**, P. F. Pai, Y. Oh, B.-S. Kim, Univ. of Missouri/Columbia . . . . . [4702-46]

2:10 pm: **Elastic properties of cBN films by surface Brillouin scattering**, P. Zinin, M. H. Manghnani, X. Zhang, Univ. of Hawaii; H. Feldermann, C. Ronning, H. Hofsäss, Georg-August-Univ. Goettingen (Germany) . . [4702-47]

2:30 pm: **Acoustic spectroscopy for elastomer and elastomeric composites**, T. Craychee, C. J. O'Brien, J. Du, C. Miyasaka, B. R. Tittmann, The Pennsylvania State Univ. . . . . [4702-48]

2:50 pm: **Ultrasonic waves in foams**, A. K. Mal, S. Banerjee, Univ. of California/Los Angeles [4702-49]

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

### SESSION 12

Room: Royal Palm III

Wed. 3:40 pm

*Chairs: Yuris A. Dzenis, Univ. of Nebraska/Lincoln; Hwai-Chung Wu, Wayne State Univ.*

3:40 pm: **Simulation of ultrasonic measurement on a bolt in a shear joint**, A. M. Koshti, Boeing Co. . . . . [4702-50]

4:00 pm: **Simulation of ultrasonic preload measurement on a bolt in an interference fit joint**, A. M. Koshti, Boeing Co. . . . . [4702-51]

4:20 pm: **Distributed GA for large system identification problems**, C. G. Koh, L. P. Wu, C. Y. Liaw, National Univ. of Singapore . . . [4702-52]

4:40 pm: **Structural integrity inspection of working fluid pipes using a scanning laser vibrometer**, P. F. Pai, S. Gopalkrishnamoorthy, Univ. of Missouri/Columbia . . . . . [4702-53]

5:00 pm: **Large area mercuric iodide thick film x-ray detectors for fluoroscopic (on-line) imaging**, G. Zentai, L. D. Partain, R. Pavlyuchkova, G. F. Virshup, Varian Medical Systems, Inc. [4702-54]

### Panel Discussion

Room: Royal Palm III

Wed. 5:20 to 6:20 pm

### Homeland Defense Using NDE Technology

*Moderator: Yoseph Bar-Cohen, Jet Propulsion Lab.*

*Panelists: Lynne D. Herold, Los Angeles County Sheriff's Dept.; George Zentai, Varian Medical Systems, Inc.; Kam W. Ng, Office of Naval Research; Alison B. Flatau, Shih-Chi Liu, National Science Foundation*

End of Conference 4702 ■



# NDE for Health Monitoring and Diagnostics

## Participants List

Names appearing in boldface are members of SPIE.

### A

Abdul-Aziz, Ali 4704 ProgComm, 4704 S2 Chr, (4704-07)S2  
**Adams, Douglas E.** (4702-19)S5  
Akbar, Sheikh (4703-04)S1  
**Akhtiamov, Rishad A.** (4704-36)S7  
Aktan, A. Emin 4704 Chr, 4704 S1 Chr, 4704 S6 Chr, (4704-38)S7, (4704-39)S7  
Allen, David W. (4704-01)S1  
Anastasi, Robert F. (4702-09)S3  
Arnold, Walter (4703-07)S2, 4703 S5 Chr  
Ascheulov, A. A. (4702-55)S13  
Ashcheulov, A. A. (4702-57)S3  
**Asundi, Anand Krishna** (4702-39)S9  
Auner, Gregory W. (4703-04)S1

### B

Baaklini, George Y. SympChr, 4703 Chr, (4703-22)S5, (4704-07)S2, (4704-21)S4, (4704-25)S5  
Babatsouli, E. (4702-59)S13  
**Balageas, Daniel L.** 4702 ProgComm, 4702 S2 Chr, (4702-32)S8  
Banerjee, Sauvit (4702-49)S11  
**Bar-Cohen, Yoseph** 4702 Cochr, (4702-40)S10, (4702-05)S2, 4702 Panel, 4702 S5 Chr  
Bashkansky, Mark (4703-06)S1  
Baskaran, Sundaram (4702-11)S3  
Baumann, J. 4703 ProgComm  
Bazhenov, Viktor G. (4703-26)S7  
Belattar, Sougrati (4703-27)S7  
Bereiter-Hahn, Juergen 4702 Cochr  
Berezin, Andrey A. (4702-35)S8  
Bhatt, Ramakrishna (4704-07)S2  
**Blackshire, James L.** (4703-20)S5  
Bonomo, Massimo (4704-20)S4  
Bourland, Mark (4702-31)S7  
Briggs, G. A. D. 4703 ProgComm  
Bryner, Jeurg (4703-03)S1

### C

**Carrion, Francisco J.** (4704-34)S6  
Catbas, Fikret Nacati (4704-38)S7, (4704-39)S7  
**Chang, Fu-Kuo** (4702-04)S2  
Cheng, P. G. (4704-03)S1  
Chenni, Bouzid (4703-02)S1  
Chu, Tsuchin (4702-12)S3  
Ciloglu, Korhan (4704-39)S7  
Ciocan, Razvan (4702-25)S6  
Craychee, Timothy (4702-48)S11  
Cunningham, Paul (4704-16)S3  
Curtin, William A. (4704-09)S2

### D

Das, Santanu (4702-45)S11  
Davis, Stephen V. (4703-15)S4  
DeGiorgi, Virginia G. (4702-17)S4  
di Scalea, Francesco Lanza (4704-20)S4  
Dixon, Stephen (4704-29)S5  
Dong, Janet (4702-37)S9  
Doyle, James F. (4704-34)S6  
Druffner, Carl J. (4703-12)S3  
Drumm, Michael J. (4704-22)S4  
Du, Jikai (4702-48)S11  
Dual, Juerg 4703 ProgComm, (4703-03)S1  
Dulieu-Barton, Janice M. (4704-16)S3  
Dzenis, Yuris A. 4702 ProgComm, 4702 S12 Chr

### E

Edwards, Christopher (4704-29)S5  
El-Diraby, Tamer E. (4704-40)S1  
Elouahlouli, Amderrahim (4703-27)S7  
**Esser, Brian** (4704-41)S7

### F

Fahr, Abbas (4702-10)S3  
Farrar, Charles R. (4702-19)S5, (4702-22)S6, (4704-01)S1, (4704-35)S6  
Fecht, Hans-Joerg (4703-23)S6  
Feldermann, Horst (4702-47)S11  
Feng, Bin (4703-04)S1  
Feng, Feng (4702-40)S10  
Findeis, Dirk (4704-24)S4  
Finlayson, Richard David (4702-13)S3  
**Flatau, Alison B.** 4702 ProgComm, 4702 Panel, 4702 Panel, 4702 S6 Chr  
Frison, Ted W. 4702 Panel, (4702-14)S4

### G

Galimov, Marat R. (4704-36)S7  
Galimov, Razif K. (4704-36)S7  
Gao, Cheng (4704-31)S6  
Georgeson, Gary E. (4704-18)S4  
**Ghandehari, Masoud** (4704-37)S6  
**Ghoshal, Anindya** (4702-06)S2  
Giguere, Sylvain (4702-10)S3  
Giurgiutiu, Victor 4702 ProgComm, 4702 Panel, (4702-15)S4, (4702-34)S8, 4702 S9 Chr  
Goldammer, Mattias (4703-24)S6  
Goldfine, Neil J. (4702-07)S2  
Gopalkrishnamoorthy, Sharath (4702-53)S12  
Grundy, David (4702-07)S2  
Gryzagoridis, Jasson (4704-24)S4  
Gyekenyesi, Andrew L. (4703-22)S5, 4704 Chr, (4704-15)S3, (4704-21)S4, 4704 S5 Chr, (4704-25)S5, (4704-26)S5

### H

Haase, Wayne C. (4704-22)S4  
Haque, Mazharul (4704-02)S1  
Harmon, Laura M. (4703-22)S5, 4704 S2 Chr, (4704-25)S5, (4704-26)S5  
Hemez, Francois (4702-22)S6  
Herold, Lynne D. (4702-01)S1, 4702 Panel  
Herold, Sven (4703-14)S4  
Hess, Peter (4703-01)S1  
Hirata, Yusuke (4704-08)S2  
Hoffmann, Jochen (4703-15)S4  
Hofsaeess, Hans (4702-47)S11  
Hong, Shane Y. 4702 S10 Chr, (4702-37)S9  
Hsieh, Yung-Wei (4703-05)S1  
Hsu, David K. 4704 ProgComm  
Hsu, Nelson N. (4702-26)S6  
Huang, Norden E. (4702-26)S6  
Huang, Tzu-Wen (4703-05)S1  
Hurley, D. C. 4703 ProgComm, (4703-08)S2, 4703 S3 Chr  
**Huston, Dryver R.** 4704 Chr, 4704 S1 Chr, 4704 S6 Chr, (4704-41)S7  
Hwang, Isaac (4702-31)S7  
Hwang, Joon Seok (4704-10)S2

### I

Ida, Nathan (4702-25)S6  
Ihn, Jeong-Beom (4702-04)S2  
Ikegami, Roy 4702 ProgComm, 4702 S3 Chr  
Inman, Daniel J. (4702-36)S8

### J

Jang, Tae Seong (4704-30)S5  
Jayaraman, Subash B. (4704-19)S4  
Jo, Sun-Jeong (4704-05)S1  
Johnson, Joel (4703-15)S4  
Johnston, Colin (4703-23)S6  
Joshi, Shiv P. 4702 ProgComm, 4702 S10 Chr, 4702 S5 Chr  
Jung, Juong-Chae (4704-32)S6

### K

Kabo, Michael (4702-40)S10  
Kehlenbach, Michael (4702-45)S11  
Kim, Byeong-Seok (4702-46)S11  
Kim, Sang (4702-33)S8  
Kim, Seung Jo (4704-10)S2  
**Kishen, Anil** (4702-39)S9  
Kitano, Akihiko (4704-08)S2  
Kline, Ronald A. (4703-25)S6  
Ko, Jan Ming (4704-03)S1, (4704-33)S6  
Koehler, Thomas (4703-23)S6  
Koh, Chan Ghee (4702-52)S12, (4704-04)S1  
Komsky, Igor N. (4702-02)S1  
Korpatchev, Yuri A. (4704-36)S7  
Koshti, Ajay M. (4702-50)S12, (4702-51)S12, (4702-20)S5, (4702-24)S6  
Kotiaev, Oleg (4702-29)S7  
Kovalyk, A. L. (4702-57)S13  
Kramb, Victoria (4703-15)S4  
**Krishnaswamy, Sridhar** 4702 ProgComm  
**Kundu, Tribikram** 4702 Chr, 4702 S1 Chr, (4702-21)S5  
Kwak, Kae-Hwan (4704-05)S1  
Kwak, Kyung-Hern (4704-05)S1  
Kwon, Hegeong (4702-33)S8

### L

Laczynski, Marie (4704-19)S4  
Lanza di Scalea, Francesco (4702-30)S7, 4704 ProgComm  
Lebby, Gary (4702-06)S2  
Lee, Chih-Hao (4703-05)S1  
Lee, Hsin-Yi (4703-05)S1  
**Lee, Jung-Ju** (4704-30)S5  
Lee, Seung-Seok (4704-30)S5, (4704-32)S6  
Leisk, Gary G. (4702-26)S6  
Lemistre, Michel (4702-32)S8  
Li, Hong (4704-33)S6  
Li, Linan (4704-12)S2  
Li, Yanxin (4704-31)S6  
Liang, Fuping (4702-56)S13  
Liang, C. Y. (4702-52)S12, (4704-04)S1  
Light, Glenn M. (4702-33)S8  
Ligomina, Sergey N. (4703-26)S7  
Limerick, Rae L. (4704-17)S3  
Liu, Gang (4702-56)S13  
Liu, S.-C. 4702 ProgComm, 4702 Panel, 4702 S7 Chr  
Liu, Shih-Chi 4702 Panel  
Long, Jie (4702-43)S10, (4702-44)S10  
Lopez, Frank (4702-23)S6  
Lozano, Alejandro (4704-34)S6  
Luzio, Marco (4702-13)S3  
Lyons, Kevin W. 4703 ProgComm

### M

Madaras, Eric I. (4702-09)S3  
Mahajan, Ajay Mohan (4702-12)S3  
**Mal, Ajit K.** 4702 ProgComm, (4702-40)S10, 4702 S11 Chr, (4702-49)S11  
Manghnani, Murli H. (4702-47)S11  
Martin, Richard E. (4703-22)S5, 4704 ProgComm, 4704 S3 Chr, (4704-15)S3, 4704 S5 Chr, (4704-25)S5  
**Martin, William N.** (4702-06)S2  
Maudlin, Jay W. (4702-12)S3  
Mazlumi, F. (4703-18)S4  
McNamara, John D. (4702-30)S7  
McRae, Kenneth (4702-10)S3  
Meyendorff, Norbert 4703 Chr, 4703 S1 Chr, (4703-15)S4, (4703-17)S4  
Michel, Bernd 4703 Chr, 4703 S2 Chr, (4703-13)S4, (4703-21)S5  
Michel, Fritz (4703-14)S4  
Mietke, Stephan (4703-23)S6  
Mihara, Tsuyoshi (4703-16)S4  
Miller, Ron K. (4702-13)S3  
Milos, Frank S. (4702-58)S13  
Mitchell, Ed (4702-14)S4  
**Miyasaka, Chiaki** (4704-42)S10, (4702-48)S11, 4704 ProgComm, (4704-19)S4  
Mizutani, Tadahito (4704-11)S2  
Moini, R. (4703-18)S4  
Mook, Gerhard (4703-14)S4  
Moreau, Andre (4703-02)S1  
Morozov, Gennady A. (4704-36)S7  
**Morozov, Oleg G.** (4704-06)S1, (4704-36)S7  
Mtenga, Primus V. (4704-17)S3

### N

Netzel, Thomas (4702-38)S9  
Newaz, Golam (4703-04)S1  
Ng, Kam W. 4702 ProgComm, 4702 Panel, 4702 Panel, 4702 S4 Chr  
Ni, Yi Qing (4704-33)S6  
Nichols, Jonathan M. (4702-16)S4  
Nomura, Masashi (4703-16)S4

### O

O'Brien, Christopher J. (4702-48)S11  
Oh, Yunje (4702-46)S11  
Okabe, Tomonaga (4704-09)S2  
Okabe, Yoji (4704-11)S2  
Ovchinnikov, Dmitry L. (4704-36)S7

### P

**Pai, Pengjin Frank** (4702-46)S11, (4702-53)S12  
Palinchuk, I. D. (4702-55)S13, (4702-57)S13  
Palmer, Stuart B. (4704-29)S5  
Panetta, Paul D. (4704-27)S5  
Park, Gyuhae (4702-36)S8  
Park, Jae Boem (4704-09)S2  
Park, Philip (4704-32)S6  
**Partain, Larry D.** (4702-54)S12  
Pavlyuchkova, Raisa (4702-54)S12  
Peairs, Daniel M. (4702-36)S8  
Perry, Alexander R. (4704-23)S4  
Placko, Dominique 4702 ProgComm, (4702-21)S5, 4702 S8 Chr  
Plumpton, James (4704-41)S7  
Pohl, Juergen (4703-14)S4  
Profunser, Dieter Michael (4703-03)S1

### R

Raghavendran, V. (4702-11)S3  
Reintjes, John F. (4703-06)S1  
Rice, Paul (4703-08)S2  
Roesner, Henrik (4703-17)S4  
Roge, Bruno (4702-10)S3  
Ronning, Carsten (4702-47)S11  
Rublenik, I. M. (4702-55)S13, (4702-57)S13

### S

Sadeghi, Hesam (4703-18)S4  
Safizadeh, Mir-Saeed (4702-10)S3  
**Sandhu, Jaswinder S.** 4702 ProgComm, 4702 S6 Chr, 4702 S8 Chr, 4704 ProgComm, (4704-14)S3  
Sathish, Shamachary (4703-12)S3, (4703-20)S5  
Sawicki, Jerzy T. 4704 S4 Chr, (4704-21)S4  
Schaafsma, David T. (4702-13)S3  
Schiott Jorgensen, Claus 4702 ProgComm  
Schlicker, Darrell E. (4702-07)S2  
Schulz, Mark J. (4702-03)S1, (4702-06)S2  
Seaver, Mark E. (4702-16)S4  
Shayko-Shaykovsky, A. G. (4702-55)S13, (4702-57)S13  
Sheiretov, Yanko (4702-07)S2  
Shen, Kangzhi (4703-11)S3  
Shen, Liming (4703-12)S3  
Shen, Min (4704-12)S2  
Shenoi, R. A. (4704-16)S3  
**Shepard, Steven M.** 4704 Chr, 4704 S3 Chr, (4704-13)S3  
Shi, Lihua (4704-31)S6  
Shi, W. Z. (4704-03)S1  
Shull, Peter J. 4704 Chr  
Sobanjo, John O. (4704-17)S3  
Sohn, Hoon (4702-22)S6, (4704-01)S1, (4704-35)S6  
Song, Dong Yeul (4704-08)S2  
Sonpatki, Milind (4704-14)S3  
Sotiriopoulos, Damianos A. 4702 S3 Chr  
**Sotiropoulos, James A.** 4702 ProgComm, (4702-59)S13  
Spellane, Peter (4704-37)S6  
Spinks, Robert L. (4702-33)S8  
Stinemates, Daniel William (4702-22)S6  
Suhir, Ephraim 4703 ProgComm, (4703-19)S5, 4703 S6 Chr  
**Sun, Yushi** (4702-43)S10, (4702-44)S10  
**Sundaesan, Mannur J.** (4702-03)S1, (4702-06)S2

### T

Takeda, Nobuo (4704-08)S2, (4704-09)S2, (4704-11)S2  
Talaie, Afshad (4702-08)S2  
Tanner, Neal (4704-35)S6  
Tayebi, Abdelkader K. (4704-02)S1  
Thomas, Graham H. 4704 ProgComm  
Thompson, R. Bruce (4704-27)S5  
**Tittmann, Bernhard R.** (4702-42)S10, (4702-48)S11, 4704 ProgComm, 4704 S4 Chr, (4704-19)S4  
Tmiri, Amal (4703-27)S7  
Todd, Michael D. 4702 Panel, (4702-16)S4  
Tong, Jingwei (4704-12)S2  
Trickey, Stephen 4702 Panel, (4702-16)S4  
Tsuiji, Ryohei (4704-11)S2

Turner, Joseph A. 4702 S2 Chr,  
4702 S7 Chr, (4702-28)S7,  
(4703-08)S2, (4703-09)S2,  
(4703-11)S3

Tuzzeo, Daniel (4704-20)S4

### U

**Uchida, Shigeaki** (4702-29)S7

Udpa, Satish S. (4702-43)S10,  
(4702-44)S10

Ugarte, Eduardo (4702-31)S7

### V

Vimer, Cristian (4704-37)S6

Virshup, Gary F. (4702-54)S12

Vogel, Dietmar (4703-21)S5

Vollmann, Jacqueline (4703-03)S1

### W

Wang, Honghui (4704-14)S3

Wang, Jeffrey (4702-40)S10

Wang, Jian-Yi (4704-33)S6

Wang, Shibin (4704-12)S2

Wang, Xiaofei (4702-56)S13

Wang, Zhiyong (4704-12)S2

Warnemuende, Kraig (4702-27)S7

**Washabaugh, Andrew P.** (4702-  
07)S2

Washer, Glenn A. SympChr

Werner, M. 4703 ProgComm, 4703  
S4 Chr

Werner, Matthias (4703-23)S6

Wiehn, Joshua S. (4703-08)S2

Wimmer, Stephanie A. 4702 Panel,  
(4702-17)S4

Winfrey, William P. (4703-25)S6

Woerner, Eckhard (4703-23)S6

Worden, Keith (4704-01)S1, (4704-  
35)S6

Wu, Hwai-Chung 4702 ProgComm,  
4702 S12 Chr, (4702-27)S7

Wu, L. P. (4702-52)S12

Wu, Xiaoping 4703 ProgComm

### X

Xu, Qiwei (4704-31)S6

### Y

Yamanaka, Kazushi (4703-10)S3,  
(4703-16)S4

Yang, Liyong (4702-28)S7

Yashiro, Shigeki (4704-11)S2

Yoon, Dong-Jin (4704-32)S6

Yoshimura, Akinori (4704-09)S2

Yuan, Robert L. (4702-31)S7

### Z

Zagrai, Andrei (4702-34)S8

Zalyalov, Renat G. (4704-36)S7

**Zental, George** 4702 ProgComm,  
4702 S11 Chr, (4702-54)S12,  
4702 Panel, 4702 S9 Chr

Zhang, Xinya (4702-47)S11

Zhao, S. L. (4704-04)S1

**Zhao, XiangDong** (4704-41)S7

Zheng, Qingyu (4702-56)S13

Zilberstein, Vladimir A. (4702-  
07)S2

Zimmerman, David C. (4702-23)S6

Zinin, Pavel (4702-47)S11

## Electroactive Polymer (EAP) Actuators as Artificial Muscles

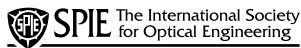
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**Yoseph Bar-Cohen**

Editor

Electroactive polymer (EAP) materials with large displacement response are showing great potential. The ability to induce large actuation strains such as stretching, squeezing, and bending makes these resilient materials remarkably similar to biological muscles. This book describes the mechanics of natural muscles and how EAP actuators mimic their actions. It examines materials, EAP function at the molecular level, and methods for predicting polymer response to external electric fields. The text discusses the future of EAP in robotics, entertainment, and medicine, among other industries.

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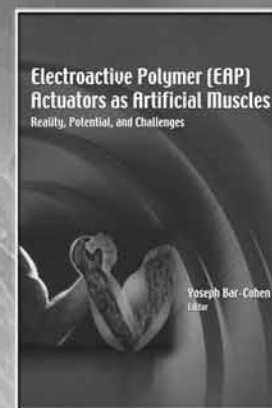
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# Smart Structures and Materials Technical Summaries

Conference 4693	
<b>Modeling, Signal Processing, and Control</b> . . . .	47
Conference 4694	
<b>Smart Sensor Technology and Measurement Systems</b> . . . . .	65
Conference 4695	
<b>Electroactive Polymer Actuators and Devices (EAPAD)</b> . . . . .	78
Conference 4696	
<b>Smart Systems for Bridges, Structures, and Highways</b> . . . . .	94
Conference 4697	
<b>Damping and Isolation</b> . . . . .	107
Conference 4698	
<b>Industrial and Commercial Applications of Smart Structures Technologies</b> . . . . .	117
Conference 4699	
<b>Active Materials: Behavior and Mechanics</b> . .	133
Conference 4700	
<b>Smart Electronics, MEMS, and Nanotechnology</b> . . . . .	152
Conference 4701	
<b>Smart Structures and Integrated Systems</b> .	161

# **NDE for Health Monitoring and Diagnostics Technical Summaries**

Conference 4702

**Smart NDE and Health Monitoring  
of Structural and Biological Systems . . . . . 177**

Conference 4703

**Nondestructive Evaluation and Reliability  
of Micro- and Nanomaterial Systems . . . . . 191**

Conference 4704

**NDE and Health Monitoring of Aerospace  
Materials and Civil Infrastructures . . . . . 198**



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