PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 6531

, "Front Matter: Volume 6531," Proc. SPIE 6531, Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil Infrastructure, and Homeland Security 2007, 653101 (21 April 2009); doi: 10.1117/12.736264

SPIE.

Event: SPIE Smart Structures and Materials + Nondestructive Evaluation and Health Monitoring, 2007, San Diego, California, United States

PROCEEDINGS OF SPIE

Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil Infrastructure, and Homeland Security 2007

**H. Felix Wu
Aaron A. Diaz
Peter J. Shull**
Editors

**20–22 March 2007
San Diego, California, USA**

Sponsored and Published by
SPIE—The International Society of Optical Engineering

Cosponsored by
American Society of Mechanical Engineers (USA)

Cooperating Organizations
Intelligent Materials Forum (Japan)
Jet Propulsion Laboratory (USA)
National Science Foundation (USA)

Volume 6531

**The International Society
for Optical Engineering**

Proceedings of SPIE—The International Society for Optical Engineering, 9780819466525, v. 6531

SPIE is an international technical society dedicated to advancing engineering and scientific applications of optical, photonic, imaging, electronic, and optoelectronic technologies.

The papers included in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. The papers published in these proceedings reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from this book:

Author(s), "Title of Paper," in *Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil Infrastructure, and Homeland Security 2007*, edited by H. Felix Wu, Aaron A. Diaz, Peter J. Shull, Proceedings of SPIE Vol. 6531 (SPIE, Bellingham, WA, 2007) Article CID Number.

ISSN 0277-786X
ISBN 9780819466525

Published by
SPIE—The International Society for Optical Engineering
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone 1 360/676-3290 (Pacific Time) • Fax 1 360/647-1445
<http://www.spie.org>

Copyright © 2007, The Society of Photo-Optical Instrumentation Engineers

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at <http://www.copyright.com>. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/07/\$18.00.

Printed in the United States of America.

Contents

- vii *Symposium Committee*
ix *Conference Committee*

SESSION 1 NONDESTRUCTIVE DETECTION IN STRUCTURAL AND MECHANICAL SYSTEMS

- 653102 **Damage assessment of composite laminate by using fiber optic AE sensor based on fused-tapered coupler** [6531-01]
J. Leng, J. Hao, Harbin Institute of Technology (China)
- 653103 **Sensing inaccessible damage in a structure using frequency response functions** [6531-02]
S. T. Quek, X. Hou, National Univ. of Singapore (Singapore)
- 653106 **Soft matter acoustics: non-destructive health monitoring of polymer blend films** [6531-05]
A. E. Kamanyi, Univ. of Leipzig (Germany); W. Ngwa, Univ. of Central Florida (USA);
T. Kundu, Univ. of Arizona (USA); W. Grill, Univ. of Leipzig (Germany)
- 653107 **Quantification of damage detection schemes using receiver operating characteristic (ROC) curves** [6531-06]
S. Trickey, M. Seaver, J. Nichols, Naval Research Lab. (USA)
- 653108 **Nondestructive detection of delamination and debonding of CFRP by a laser-based ultrasonic visualization method** [6531-07]
J. Takatsubo, S. Yashiro, H. Tsuda, N. Toyama, J. Lee, AIST (Japan); T. Ogisu, Fuji Heavy Industries Ltd. (Japan)
- 653109 **Responsive satellites and the need for structural health monitoring** [6531-08]
B. J. Arritt, Air Force Research Lab. (USA); A. Kumar, Acellent Technologies, Inc. (USA);
S. Buckley, Air Force Research Lab. (USA); R. Hannum, Acellent Technologies, Inc. (USA);
J. Welsh, Air Force Research Lab. (USA); S. Beard, X. Qin, Acellent Technologies, Inc. (USA);
P. Wegner, Air Force Research Lab. (USA)
- 65310A **Possibility of electrical discharge pulse sound for hammering test** [6531-09]
Y. Akematsu, K. Kageyama, N. Mohri, H. Murayama, M. Kanai, The Univ. of Tokyo (Japan)

Pagination: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc.

The CID number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages.

- 65310B **A wavelength multiplexed interferometric inertial sensor network for nondestructive evaluation and distributed monitoring** [6531-10]
M. A. Perez, A. M. Shkel, Univ. of California, Irvine (USA)
- 65310C **Integrated acoustic emission/vibration sensor for detecting damage in aircraft drive train components** [6531-11]
V. F. Godínez-Azcuaga, D. Ozevin, R. D. Finlayson, Physical Acoustics Corp. (USA);
A. Anastasopoulos, A. Tsimogiannis, Envirocoustics (Greece)

SESSION 2 NONDESTRUCTIVE EVALUATION IN COMPOSITE MATERIALS AND AEROSPACE ENGINEERING

- 65310E **The use of composite materials increase the availability of oil and gas and reduce the cost of drilling and production operations** [6531-13]
J. C. Leslie, ACPT, Inc. (USA)
- 65310F **Single crystal piezoelectric composites for advanced NDT ultrasound** [6531-14]
X. Jiang, K. Snook, W. S. Hackenberger, TRS Technologies, Inc. (USA); X. Geng, Blatek, Inc. (USA)
- 65310G **Design of piezoelectric transducers for health monitoring of composite aircraft structures** [6531-15]
T. Stepinski, M. Engholm, Uppsala Univ. (Sweden)
- 65310H **NDI technique development for new technologies** [6531-16]
S. Ruth, The Aerospace Corp. (USA)
- 65310I **Lamb wave propagation in composite laminates using a higher-order plate theory** [6531-17]
L. Wang, F. G. Yuan, North Carolina State Univ. (USA)
- 65310J **A scaleable integrated sensing and control system for NDE, monitoring, and control of medium to very large composite smart structures** [6531-19]
J. Jones, V. Rhoades, N. A. Tech. Inc. (USA); R. Arner, Apex Mountain Engineering (USA);
T. Clem, A. Cuneo, N. A. Tech. Inc. (USA)

SESSION 3 CIVIL INFRASTRUCTURE HEALTH MONITORING

- 65310L **Structural identification, damage identification, and structural health monitoring** [6531-21]
S. Alampalli, New York State Department of Transportation (USA); M. Ettouney, Weidlinger Associates, Inc. (USA)
- 65310M **Application of statistical pattern classification methods for damage detection to field data** [6531-22]
C. Cabrera, A. Cheung, P. Sarabandi, Sensametrics, Inc. (USA) and Stanford Univ. (USA);
K. K. Nair, A. Kiremidjian, Stanford Univ. (USA)
- 65310N **Application of PDE methods for image-based concrete surface damage detection** [6531-23]
Z. Chen, T. C. Hutchinson, Univ. of California, San Diego (USA)

- 65310O **Long term health monitoring systems for bridges** [6531-24]
M. L. Wang, Univ. of Illinois, Chicago (USA)
- 65310P **Integrity monitoring of an old steel bridge using fiber optic distributed sensors based on Brillouin scattering** [6531-25]
B. Glišić, D. Posenato, D. Inaudi, Smartec SA (Switzerland)
- 65310Q **Structural health monitoring of Lindquist bridge** [6531-26]
D. D. Sargent, Sargent and Associates Engineering Ltd. (Canada); E. R. Murison, ISIS Canada (Canada); B. Bakht, JMBT Structures Research Inc. (Canada); A. A. Mufti, ISIS Canada (Canada)
- 65310R **Monitoring fatigue life in concrete bridge deck slabs** [6531-27]
J. Newhook, Dalhousie Univ. (Canada); V. Limaye, MacDonnell Group Consulting Ltd. (Canada)
- 65310S **Self repair of impact, higher energy impact, and earthquake damage in infrastructure systems made of polymers and concrete** [6531-28]
C. Dry, Natural Process Design, Inc. (USA)
- 65310T **Predicting deflections of a simply supported pre-stressed concrete girder subjected to static loads from observed strains** [6531-29]
A. Mufti, ISIS Canada Research Network (Canada); L. Jaeger, Dalhousie Univ. (Canada); C. Klowak, N. Kyriakopoulos, B. Bakht, G. Tadros, ISIS Canada Research Network (Canada)

SESSION 4 **PROGRESS IN NONDESTRUCTURE EVALUATION**

- 65310V **Progress in air-coupled ultrasound** [6531-32]
S. Jayaraman, D. Pellkofer, I. Lucas, M. Bezdek, B. Tittmann, The Pennsylvania State Univ. (USA)
- 65310W **Terahertz NDE application for corrosion detection and evaluation under shuttle tiles** [6531-33]
R. F. Anastasi, Army Research Lab., NASA Langley Research Ctr. (USA); E. I. Madaras, NASA Langley Research Ctr. (USA); J. P. Seebo, Lockheed Martin, NASA Langley Research Ctr. (USA); S. W. Smith, NASA Langley Research Ctr. (USA); J. K. Lomness, P. E. Hintze, NASA Kennedy Space Ctr. (USA); C. C. Kammerer, United Space Alliance, NASA Kennedy Space Ctr. (USA); W. P. Winfree, NASA Langley Research Ctr. (USA); R. W. Russell, NASA Kennedy Space Ctr. (USA)
- 65310X **Capacitance sensors for the nondestructive measurement of moisture content in in-shell peanuts** [6531-34]
C. V. Kandala, C. L. Butts, USDA Agricultural Research Service (USA)
- 653110 **Filtering of NDT signals obtained from wrapped steel cables** [6531-37]
R. Christen, A. Novakovic, A. Bergamini, M. Motavalli, Empa (Switzerland)

SESSION 5 REMOTE SENSING AND HOMELAND SECURITY APPLICATIONS

- 653113 **Performance evaluation of decentralized wireless sensing and control in civil structures**
[6531-40]
Y. Wang, Stanford Univ. (USA); R. A. Swartz, J. P. Lynch, Univ. of Michigan (USA); K. H. Law, Stanford Univ. (USA); C.-H. Loh, National Taiwan Univ. (Taiwan)
- 653114 **A passive wireless displacement sensor for structural health monitoring of civil structures**
[6531-41]
A. Hladio, D. Card, D. J. Thomson, G. E. Bridges, Univ. of Manitoba (Canada); C. Klowak, A. Muffi, ISIS Canada (Canada) and Univ. of Manitoba (Canada)
- 653115 **Significance evaluation of geometric features in classification of chinese facial images**
[6531-42]
J. Liu, Chongqing Univ. (China) and Univ. of Hawaii at Manoa (USA); Y. Lan, Y. Zhou, Chongqing Univ. (China); T. Ma, Univ. of Hawaii at Manoa (USA); Y. Pan, W. Gong, Chongqing Univ. (China)

SESSION 6 APPLIED IMAGING

- 653118 **On an image reconstruction method for ECT** [6531-45]
A. Sasamoto, T. Suzuki, Y. Nishimura, National Institute of Advanced Industrial Science and Technology (Japan)
- 653119 **Sampling phased array: a new technique for signal processing and ultrasonic imaging**
[6531-46]
M. Kröning, A. Bulavinov, K. M. Reddy, Fraunhofer Institute for Non-Destructive Testing, Univ. Gebäude (Germany); L. von Bernus, Q Net Engineering GmbH (Germany); D. Joneit, Fraunhofer Institute for Non-Destructive Testing Dresden (Germany)

Symposium Plenary Presentation:

Revolutionary transitions of GE technology in NDE prognostics and health monitoring
Ed Hindle, Thadd Patton, GE Aviation (USA); Tom Batzinger, GE Global Research Ctr. (USA)

Author Index

Symposium Committee

Symposium Chairs

Yoseph Bar-Cohen, Jet Propulsion Laboratory (USA)
Alison B. Flatau, University of Maryland, College Park (USA)
Norbert G. Meyendorf, University of Dayton (USA) and Fraunhofer Institute
of Non-Destructive Testing (Germany)
George Y. Baaklini, NASA Glenn Research Center (USA)

Executive Committee

Mehdi Ahmadian, Virginia Polytechnic Institute and State University (USA)
George Y. Baaklini, NASA Glenn Research Center (USA)
Yoseph Bar-Cohen, Jet Propulsion Laboratory (USA)
Marcelo J. Dapino, The Ohio State University (USA)
L. Porter Davis, Honeywell, Inc. (USA)
Michael A. Demetriou, Worcester Polytechnic Institute (USA)
Aaron A. Diaz, Pacific Northwest National Laboratory (USA)
Alison B. Flatau, University of Maryland, College Park (USA)
Victor Giurgiutiu, University of South Carolina (USA)
B. K. Henderson, Air Force Research Laboratory (USA)
Kumar Jata, Air Force Research Laboratory (USA)
Gabor M., Kovacs, EMPA (Switzerland)
Tribikram Kundu, The University of Arizona (USA)
Donald J. Leo, DARPA (USA) and Virginia Polytechnic Institute and State
University (USA)
Douglas K. Lindner, Virginia Polytechnic Institute and State University
(USA)
Ajit K. Mal, University of California, Los Angeles (USA)
Yuji Matsuzaki, Nagoya University (Japan)
M. Brett McMickell, Honeywell, Inc. (USA)
Norbert G. Meyendorf, University of Dayton (USA)
Zoubeida Ounaies, Texas A&M University (USA)
Kara J. Peters, North Carolina State University (USA)
Peter J. Shull, The Pennsylvania State University (USA)
Masayoshi Tomizuka, University of California, Berkeley (USA)
Eric Udd, Columbia Gorge Research (USA)
Vijay K. Varadan, University of Arkansas (USA)
Dietmar W. Vogel, Fraunhofer-Institut für Zuverlässigkeit und
Mikrointegration (Germany)
H. Felix Wu, National Institute of Standards and Technology (USA)
Chung-Bang Yun, Korea Advanced Institute of Science and Technology
(South Korea)

Conference Committee

Conference Chair

H. Felix Wu, National Institute of Standards and Technology (USA)

Conference Cochairs

Aaron A. Diaz, Pacific Northwest National Laboratory (USA)

Peter J. Shull, The Pennsylvania State University (USA)

Program Committee

A. Emin Aktan, Drexel University (USA)

Farhad Ansari, University of Illinois at Chicago (USA)

George Y. Baaklini, NASA Glenn Research Center (USA)

Yoseph Bar-Cohen, Jet Propulsion Laboratory (USA)

Fu-Kuo Chang, Stanford University (USA)

Andrew L. Gyekenyesi, NASA Glenn Research Center (USA)

Garo K. Kiremidjian, Sensametrics, Inc. (USA)

James C. Leslie, Advanced Composite Products and Technology, Inc. (USA)

Richard E. Martin, NASA Glenn Research Center (USA)

Aftab A. Mufti, University of Manitoba (Canada) and ISIS Canada Research Network (Canada)

Kurt Silvers, Pacific Northwest National Laboratory (USA)

Lizhi Sun, University of California, Irvine (USA)

Bernhard R. Tittmann, The Pennsylvania State University (USA)

Brian J. Tucker, Pacific Northwest National Laboratory (USA)

Glenn A. Washer, University of Missouri, Columbia (USA)

Session Chairs

- 1 Nondestructive Detection in Structural and Mechanical Systems
Bernhard R. Tittmann, The Pennsylvania State University (USA)
Ming L. Wang, University of Illinois, Chicago (USA)
- 2 Nondestructive Evaluation in Composite Materials and Aerospace Engineering
Lizhi Sun, University of California, Irvine (USA)
James C. Leslie, Advanced Composite Products and Technology, Inc. (USA)

- 3 Civil Infrastructure Health Monitoring
Aftab A. Mufi, University of Manitoba (Canada) and ISIS Canada
Research Network (Canada)
Hua Gu, Caterpillar, Inc. (USA)
- 4 Progress in Nondestructive Evaluation
Masoud Ghandehari, Polytechnic University (USA)
Brian J. Tucker, Pacific Northwest National Laboratory (USA)
- 5 Remote Sensing and Homeland Security Applications
Pooya Sarabandi, Sensametrics, Inc. (USA) and Stanford University (USA)
- 6 Applied Imaging
Aaron A. Diaz, Pacific Northwest National Laboratory (USA)
Robert Hannum, Acellent Technologies, Inc. (USA)