# PROCEEDINGS OF SPIE

# Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil Infrastructure, and Homeland Security 2011

H. Felix Wu Editor

7–10 March 2011 San Diego, California, United States

Sponsored by SPIE

Cosponsored by American Society of Mechanical Engineers (United States)

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

Published by SPIE

Part One of Two Parts

**Volume 7983** 

Proceedings of SPIE, 0277-786X, v. 7983

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 2011, edited by H. Felix Wu, Proceedings of SPIE Vol. 7983 (SPIE, Bellingham, WA, 2011) Article CID Number.

ISSN 0277-786X ISBN 9780819485458

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445 SPIE.org

Copyright © 2011, 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 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/11/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.



**Paper Numbering:** 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 as 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. Numbers in the index correspond to the last two digits of the six-digit CID number.

## **Contents**

### Part One

xv xix	Conference Committee Introduction
	PLENARY SESSION
7983 02	The upcoming revolution in ultrasonic guided waves (Plenary Paper) [7983-157] J. L. Rose, The Pennsylvania State Univ. (United States) and FBS Inc. (United States)
	LASER, ULTRASOUND, ACOUSTIC EMISSION NDE I
7983 03	Continuous acoustic emission monitoring of reinforced concrete under accelerated corrosion [7983-110] M. Di Benedetti, Univ. of Miami (United States); G. Loreto, Univ. degli Studi di Napoli Federico II (Italy); A. Nanni, Univ. of Miami (United States); F. Matta, Univ. of South Carolina (United States); M. A. Gonzalez-Nunez, MISTRAS Group, Inc. (United States)
7983 04	Early state damage detection of aluminum 7075-T6 plate based on acoustic emission [7983-01] D. Ozevin, Univ. of Illinois at Chicago (United States); Z. Li, Xi-an Aircraft Strength Research Institute (China); Z. Heidary, Univ. of Illinois at Chicago (United States)
7983 05	Environmentally induced acoustic emission from reinforced concrete [7983-02] A. A. Pollock, M. Gonzalez-Nunez, MISTRAS Group, Inc. (United States); T. Shokri, Univ. of Miami (United States)
7983 06	Micromechanics models and innovative sensor technologies to evaluate internal-frost damage of concrete [7983-04] Q. Dai, Michigan Technological Univ. (United States); X. Yu, Case Western Reserve Univ. (United States); K. Ng, J. Zhou, Michigan Technological Univ. (United States)
	NDE IN CIVIL INFRASTRUCTURE I
7983 07	Study of concrete drilling for automated non-destructive evaluation and rehabilitation system for bridge decks [7983-05] M. Trkov, F. Liu, J. Yi, H. Baruh, Rutgers, The State Univ. of New Jersey (United States)
7983 08	Nanoscale materials for non-destructive repair of transportation infrastructures [7983-06] M. Klein, G. Venkiteela, H. Najm, P. Balaguru, Rutgers, The State Univ. of New Jersey (United States)
7983 09	Multisensor data fusion for nondestructive evaluation of bridge decks [7983-07] Y. Zhang, X. Wei, Z. Xie, Georgia Institute of Technology (United States)

7983 0A Evaluation of corrosion effect in reinforced concrete by chloride exposure [7983-08] G. Loreto, Univ. of Napoli Federico II (Italy); M. Di Benedetti, Univ. of Miami (United States); R. Iovino, Univ. of Napoli Federico II (Italy); A. Nanni, Univ. of Miami (United States) and Univ. of Napoli Federico II (Italy); M. A. Gonzalez-Nunez, MISTRAS Group, Inc. (United States) LASER, ULTRASOUND, ACOUSTIC EMISSION NDE II 7983 OB Assessment of carbon fiber-reinforced polyphenylene sulfide by means of laser ultrasound [7983-09] M. Kalms, Bremer Institut für angewandte Strahltechnik GmbH (Germany); C. Peters, Faserinstitut Bremen e.V. (Germany); R. Wierbos, TenCate Advanced Composites B.V. (Netherlands) 7983 OE Vibration modulated Lamb waves for structure health monitoring [7983-12] J. Jiao, G. Song, C. He, B. Wu, Beijing Univ. of Technology (China) 7983 OF Development of a portable ultrasonic phased array inspection imaging apparatus for NDT [7983-13] B. Shan, J. Li, X. Liu, J. Lou, H. Wang, Harbin Institute of Technology (China); J. Ou, Harbin Institute of Technology (China) and Dalian Univ. of Technology (China) NDE IN CIVIL INFRASTRUCTURE II 7983 OI Temperature effect on modal frequencies for a rigid continous bridge based on long term **monitoring** [7983-16] L. Wang, Harbin Institute of Technology (China); J. Hou, Dalian Univ. of Technology (China); J. Ou, Harbin Institute of Technology (China) and Dalian Univ. of Technology (China) 7983 OJ Bridge reliability assessment based on the PDF of long-term monitored extreme strains [7983-17] M. Jiao, L. Sun, Tongii Univ. (China) 7983 OK Risk based bridge data collection and asset management and the role of structural health **monitoring** [7983-18] P. Omenzetter, The Univ. of Auckland (New Zealand); S. Bush, The Univ. of Auckland (New Zealand) and Opus International Consultants (New Zealand); T. Henning, The Univ. of Auckland (New Zealand); P. McCarten, Opus International Consultants (New Zealand) NASA-BASED NDE/SHM ACTIVITIES 7983 OL High-speed AMB machining spindle model updating and model validation [7983-19] A. C. Wroblewski, J. T. Sawicki, A. H. Pesch, Cleveland State Univ. (United States) 7983 ON Detecting cracks in ceramic matrix composites by electrical resistance [7983-21] C. Smith, A. Gyekenyesi, Ohio Aerospace Institute (United States)

	NDE IN COMPOSITES
7983 OP	Carbon nanotube yarn sensors for structural health monitoring of composites [7983-23] H. Zhao, FG. Yuan, North Carolina State Univ. (United States)
7983 0Q	Interaction of surface waves induced by IDT sensors with flaws in fiberglass composite panels [7983-24]  J. K. Na, V. Nalladega, Univ. of Dayton (United States); C. Druffner, Mound Laser & Photonics Ctr. Inc. (United States)
7983 OR	Non-invasive damage detection in composite beams using marker extraction and wavelets [7983-25] YZ. Song, C. Bowen, H. A. Kim, A. Nassehi, J. Padget, N. Gathercore, A. Dent, Univ. of Bath (United Kingdom)
7983 OS	Characterization of random heterogeneities in polycrystalline microstructures using wave propagation simulation [7983-125]  A. Noshadravan, R. Ghanem, The Univ. of Southern California (United States); P. Peralta, Arizona State Univ. (United States)
7983 OU	Coupled attenuation and multiscale damage model for composite structures [7983-27] A. M. Moncada, A. Chattopadhyay, Arizona State Univ. (United States); B. Bednarcyk, S. M. Arnold, NASA Glenn Research Ctr. (United States)
7983 OV	Effect of fiber surface conditioning on the acoustic emission behavior of steel fiber reinforced concrete [7983-28] D. G. Aggelis, D. V. Soulioti, E. Gatselou, N. M. Barkoula, A. Paipetis, T. E. Matikas, Univ. of loannina (Greece)
7983 OW	Inspection for kissing bonds in composite materials using vibration measurements [7983-29] D. E. Adams, N. D. Sharp, N. Myrent, R. Sterkenburg, Purdue Univ. (United States)
	PNNL-BASED NDE IN HOMELAND SECURITY APPLICATIONS
7983 OX	X-ray scan detection for cargo integrity [7983-30] J. Valencia, S. Miller, Pacific Northwest National Lab. (United States)
7983 OY	A wireless sensor tag platform for container security and integrity [7983-31] I. A. Amaya, J. V. Cree, F. J. Mauss, Pacific Northwest National Lab. (United States)
7983 OZ	Application and assessment of ultrasonic inspection methods for flaw detection and characterization of manganese steel frogs [7983-32] A. Cinson, A. Diaz, M. Prowant, Pacific Northwest National Lab. (United States)

	NIST TECHNOLOGY INNOVATION PROGRAM ON CIVIL INFRASTRUCTURE CRITICAL NATIONAL NEED: ADVANCED SENSING TECHNOLOGIES FOR THE INFRASTRUCTURE: BRIDGES, ROADS, HIGHWAYS, AND WATER SYSTEMS I
7983 12	Long-term assessment of an autonomous wireless structural health monitoring system at the new Carquinez Suspension Bridge [7983-35] M. Kurata, J. Kim, Y. Zhang, J. P. Lynch, Univ. of Michigan (United States); G. W. van der Linden, V. Jacob, SC Solutions, Inc. (United States); E. Thometz, P. Hipley, LH. Sheng, California Dept. of Transportation (United States)
7983 13	Networked computing in wireless sensor networks for structural health monitoring [7983-36] A. Jindal, M. Liu, Univ. of Michigan (United States)
7983 14	Energy harvesting of radio frequency and vibration energy to enable wireless sensor monitoring of civil infrastructure [7983-37] T. Galchev, J. McCullagh, R. L. Peterson, K. Najafi, A. Mortazawi, Univ. of Michigan (United States)
7983 15	The development of chloride ion selective polypyrrole thin film on a layer-by-layer carbon nanotube working electrode [7983-38] Y. Liu, J. Lynch, Univ. of Michigan (United States)
7983 16	Mechanical and electrical characterization of self-sensing carbon black ECC [7983-39] V. W. J. Lin, M. Li, J. P. Lynch, V. C. Li, Univ. of Michigan (United States)
	FIBER OPTICS SENSORS TECHNOLOGIES
7983 17	A quasi-distributed optical fiber sensor network for large strain and high-temperature measurements of structures [7983-40] Y. Huang, G. Chen, H. Xiao, Y. Zhang, Z. Zhou, Missouri Univ. of Science and Technology (United States)
7983 18	Highly dense strain measurement of concrete retrofitted with smart fabric [7983-41] M. Imai, H. Suzuki, Kajima Technical Research Institute (Japan)
7983 19	Stability and reliability of fiber optic measurement systems: basic conditions for successful long term structural health monitoring [7983-42] P. S. Muley, Y. Yang, W. L. Sham, Nanyang Technological Univ. (Singapore)
7983 1A	Nanofilm-coated long-period fiber grating humidity sensors for corrosion detection in structural health monitoring [7983-43] S. Zheng, Y. Zhu, S. Krishnaswamy, Northwestern Univ. (United States)
7983 1B	Condition monitoring and life-cycle cost design of stay cable by embedded OFBG sensors [7983-44] C. M. Lan, Y. Ju, China Univ. of Mining and Technology (China); H. Li, Harbin Institute of Technology (China)

# 7983 1D Integrating single-point vibrometer and full-field electronic speckle pattern interferometer to evaluate a micro-speaker [7983-46]

W.-C. Chang, Y.-C. Chen, C.-J. Chien, A.-B. Wang, National Taiwan Univ. (Taiwan); C.-K. Lee, National Taiwan Univ. (Taiwan) and Institute for Information Industry (Taiwan)

# NIST TECHNOLOGY INNOVATION PROGRAM ON CIVIL INFRASTRUCTURE CRITICAL NATIONAL NEED: ADVANCED SENSING TECHNOLOGIES FOR THE INFRASTRUCTURE: BRIDGES, ROADS, HIGHWAYS, AND WATER SYSTEMS II

# 7983 1E A fast inversion analysis algorithm for the spectral analysis of surface wave (SASW) method (Invited Paper) [7983-47]

Y. Cao, Y. Lu, Y. Zhang, Northeastern Univ. (United States); J. G. McDaniel, Boston Univ. (United States); M. L. Wang, Northeastern Univ. (United States)

# 7983 1F Wave number estimation based method on in situ pavement ground truth with near source-receiver sensing [7983-48]

Y. Lu, Y. Cao, Northeastern Univ. (United States); J. G. McDaniel, Boston Univ. (United States); M. L. Wang, Northeastern Univ. (United States)

# 7983 1G Compact programmable ground-penetrating radar system for roadway and bridge deck characterization [7983-49]

D. Busuioc, DBCGroup, Inc. (United States); T. Xia, A. Venkatachalam, D. Huston, The Univ. of Vermont (United States); R. Birken, M. Wang, Northeastern Univ. (United States)

### 7983 1H Novel low-cost millimeter-wave system for road surface characterization [7983-50]

D. Busuioc, DBCGroup, Inc. (United States); K. Anstey, C. Rappaport, R. Birken, J. Doughty, M. Wang, Northeastern Univ. (United States)

### **RADAR/LIDAR NDE TECHNOLOGIES**

# 7983 1J Geometric analysis for the size estimation of subsurface delamination in transient electromagnetic response [7983-52]

T.-Y. Yu, B. Boyaci, Univ. of Massachusetts Lowell (United States)

# 7983 1K Development of a baseline model for a steel girder bridge using remote sensing and load tests [7983-53]

K. Dai, S.-E. Chen, J. Scott, The Univ. of North Carolina at Charlotte (United States); M. Schmieder, IE-Consulting (Canada); W. Liu, Dalian Univ. of Technology (China); E. Hauser, The Univ. of North Carolina at Charlotte (United States)

### 7983 1L Bridge deck joints evaluation using lidar and aerial photography [7983-54]

H. Bian, S.-E. Chen, C. Watson, E. Hauser, The Univ. of North Carolina at Charlotte (United States)

### 7983 1M 3D terrestrial lidar for operational bridge clearance measurements [7983-55]

C. Watson, S.-E. Chen, H. Bian, E. Hauser, The Univ. of North Carolina at Charlotte (United States)

7983 1N Reliability analysis of 3D lidar bridge evaluation [7983-56]

W. Liu, Dalian Univ. of Technology (China); S.-E. Chen, The Univ. of North Carolina at Charlotte (China)

### **Part Two**

NIST TECHNOLOGY INNOVATION PROGRAM ON CIVIL INFRASTRUCTURE CRITICAL NATIONAL NEED: ADVANCED SENSING TECHNOLOGIES FOR THE INFRASTRUCTURE: BRIDGES, ROADS, HIGHWAYS, AND WATER SYSTEMS III: PART 1

7983 10 Development of high-toughness low-viscosity nano-molecular resins for reinforcing pothole patching materials [7983-57]

W. Yuan, M. Yuan, L. Zou, J.-M. Yang, W. Ju, W. Kao, L. Carlson, Univ. of California, Los Angeles (United States); B. Edgecombe, T. Stephen, Materia, Inc. (United States); R. Villacorta, R. Solamon, Standards Division, City of Los Angeles (United States)

- 7983 1P **Development of a wireless monitoring system for fracture-critical bridges** [7983-58]
  J. Fasl, V. Samaras, M. Reichenbach, T. Helwig, S. L. Wood, The Univ. of Texas at Austin (United States); D. Potter, National Instruments Corp. (United States); R. Lindenberg, Wiss, Janney, Elstner Associates, Inc. (United States); K. Frank, Hirschfeld Industries (United States)
- 7983 1Q **Low-cost passive sensors for monitoring corrosion in concrete structures** [7983-59]
  A. E. Abu-Yosef, P. Pasupathy, S. L. Wood, D. P. Neikirk, The Univ. of Texas at Austin (United States)
- 7983 1R Nondestructive corrosion detection in concrete through integrated heat induction and IR thermography [7983-60]

S.-J. Kwon, Korea Conformity Labs. (Korea, Republic of); H. Xue, California State Polytechnic Univ. (United States); M. Q. Feng, S. Baek, Univ. of California, Irvine (United States)

On energy harvesting module for scalable cognitive autonomous nondestructive sensing network (SCANS<sup>n</sup>) system for bridge health monitoring [7983-62]

J. Turner, J. Cartwright, D. S. Ha, Virginia Polytechnic Institute and State Univ. (United States); D. Zhang, S. Banerjee, Acellent Technologies, Inc. (United States)

### THERMAL, INFRARED, AND RADIOGRAPHIC NDE TECHNOLOGIES

7983 1U In service damage assessment of bonded composite repairs with full field thermographic techniques [7983-63]

A. S. Paipetis, S. A. Grammatikos, E. Z. Kordatos, N.-M. Barkoula, T. E. Matikas, Univ. of Ioannina (Greece)

7983 1V Detection of surface breaking cracks using thermographic and non-contact ultrasonic methods [7983-64]

S. B. Palmer, S. E. Burrows, S. Dixon, The Univ. of Warwick (United Kingdom)

7983 1W Feasibility of using line scanning thermography in NDE of wind turbine blades [7983-65] O. Ley, V. Godinez, MISTRAS Group, Inc. (United States)

7983 1X	Nondestructive vision-based approaches for condition assessment of structures [7983-113] M. R. Jahanshahi, S. F. Masri, The Univ. of Southern California (United States)				
7983 IY	Model updating and prognosis of acoustic emission data in compact test specimens under cyclic loading [7983-121]  B. A. Zárate, J. M. Caicedo, J. Yu, P. Ziehl, Univ. of South Carolina (United States)				
	NIST TECHNOLOGY INNOVATION PROGRAM ON CIVIL INFRASTRUCTURE CRITICAL NATIONAL NEED: ADVANCED SENSING TECHNOLOGIES FOR THE INFRASTRUCTURE: BRIDGES, ROADS, HIGHWAYS, AND WATER SYSTEMS III: PART 2				
7983 21	ANDERS: future of concrete bridge deck evaluation and rehabilitation (Invited Paper) [7983-68]				
	N. Gucunski, Rutgers, The State Univ. of New Jersey (United States); F. Moon, Drexel Univ. (United States)				
7983 22	Rapid impact testing for quantitative assessment of large populations of bridges [7983-69] Y. Zhou, J. Prader, J. DeVitis, A. Deal, J. Zhang, F. Moon, A. E. Aktan, Drexel Univ. (United States)				
7983 24	Determination of chloride ion concentration in concrete by means of near infra-red spectroscopy [7983-71] V. S. Ban, B. L. Volodin, S. Dolgi, PD-LD, Inc. (United States)				
7983 25	Recent advances in the development of a self-powered wireless sensor network for structural health prognosis [7983-72] V. F. Godínez-Azcuaga, MISTRAS Group, Inc. (United States); D. J. Inman, Virginia Polytechnic Institute and State Univ. (United States); P. H. Ziehl, V. Giurgiutiu, Univ. of South Carolina (United States); A. Nanni, Univ. of Miami (United States)				
7983 26	Piezoelectric power generation for civil infrastructure systems [7983-73]  A. Erturk, D. J. Inman, Virginia Polytechnic Institute and State Univ. (United States)				
7983 27	Adaptation of PWAS transducers to acoustic emission sensors [7983-74] L. Yu, Univ. of South Carolina (United States); S. Momeni, V. Godinez, MISTRAS Group, Inc. (United States); V. Giurgiutiu, Univ. of South Carolina (United States)				
	NIST TECHNOLOGY INNOVATION PROGRAM ON CIVIL INFRASTRUCTURE CRITICAL NATIONAL NEED: ADVANCED SENSING TECHNOLOGIES FOR THE INFRASTRUCTURE: BRIDGES, ROADS, HIGHWAYS, AND WATER SYSTEMS IV				
7983 28	Lessons from two field tests on pipeline damage detection using acceleration measurement (Invited Paper) [7983-75] M. Shinozuka, S. Lee, S. Kim, P. H. Chou, Univ. of California, Irvine (United States)				
7983 29	Experimental and analytical study of water pipe's rupture for damage identification purposes [7983-76] K. G. Papakonstantinou, M. Shinozuka, Univ. of California, Irvine (United States); M. Beikae, Metropolitan Water District of Southern California (United States)				

7983 2A	Smart wireless sensor system for lifeline health monitoring under a disaster event [7983-77] S. Kim, E. Yoon, TC. Chien, H. Mustafa, Univ. of California, Irvine (United States); P. H. Chou, Univ. of California, Irvine (United States) and National Tsing Hua Univ. (Taiwan); M. Shinozuka, Univ. of California, Irvine (United States)					
7983 2B	Mitigation of the consequence of seismically induced damage on a utility water network by means of next generation SCADA [7983-78]  J. Robertson, M. Shinozuka, Univ. of California, Irvine (United States); F. Wu, National Institute of Standards and Technology (United States)					
7983 2C	An automated repair method of water pipe infrastructure using carbon fiber bundles [7983-79] S. Wisotzkey, H. Carr, Fibrwrap Construction, LP (United States); E. Fyfe, Fyfe Co., LLC (United States)					
7983 2D	Development of a frequency-tunable optical phase lock loop (OPLL) for high resolution fiber optic distributed sensing [7983-80]  V. Kuperschmidt, L. Stolpner, P. Mols, M. Alalusi, A. Mehnert, R. Barsan, Redfern Integrated Optics, Inc. (United States); F. Ansari, Univ. of Illinois at Chicago (United States)					
7983 2H	Remote monitoring and prognosis of fatigue cracking in steel bridges with acoustic emission [7983-84] J. P. Yu, P. Ziehl, Univ. of South Carolina (United States); A. Pollock, MISTRAS Group, Inc. (United States)					
7983 21	Detection of active corrosion in reinforced and prestressed concrete: overview of NIST TIP project [7983-85] M. A. Gonzalez-Nunez, MISTRAS Group, Inc. (United States); A. Nanni, Univ. of Miami (United States); F. Matta, P. Ziehl, Univ. of South Carolina (United States)					
	WIRELESS SENSOR NETWORK AND ENERGY HARVESTING					
7983 2L	Embedded passive wireless sensors for detecting conductivity within RC structures [7983-88] J. Y. Kim, P. Pasupathy, CC. Chou, S. L. Wood, D. P. Neikirk, The Univ. of Texas at Austin (United States)					
7983 2M	Sensitivity analysis of transmissibility functions for structural damage detection [7983-89] D. Zhu, X. Yi, Y. Wang, Georgia Institute of Technology (United States)					
	VIBRATION-BASED NDE TECHNOLOGIES					
7983 2P	Utilization of strong motion data for damage assessment of reinforced concrete bridges [7983-92]					
	R. Baghaei, M. Q. Feng, Univ. of California, Irvine (United States)					
7983 2Q	Modal parameter identification of civil engineering structures under operational conditions [7983-93] H. S. Ulusoy, M. Q. Feng, Univ. of California, Irvine (United States)					
	11. 3. 51030y, M. W. 16119, 5111v. Of Camornia, fivilite (6111164 314165)					

7983 2R	Alternative determination of cable forces using flexural theory of axially loaded member [7983-94]
	CP. Yu, CC. Cheng, CH. Chiang, Chaoyang Univ. of Technology (Taiwan)
7983 2S	Monitoring vibration-based structural health using nonlinear approach [7983-95] W. Punurai, Mahidol Univ. (Thailand); T. Chanpheng, Kasetsart Univ. (Thailand); T. Sookjit, Mahidol Univ. (Thailand)
	SMART MATERIALS SENSING TECHNOLOGIES
7983 2T	The improvement of accuracy of standalone GPS with an alternative positioning algorithm [7983-96]
	J. Zhang, Y. Zhang, M. Wang, Northeastern Univ. (United States)
7983 2U	On suitability of feature extraction techniques for local damage detection [7983-97] S. K. Yadav, The Univ. of Arizona (United States); S. Banerjee, The Univ. of Arizona (United States) and Acellent Technologies, Inc. (United States); T. Kundu, The Univ. of Arizona (United States)
7983 2V	A high temperature piezoelectric sensor for structure health monitoring [7983-98] K. Kim, X. Jiang, North Carolina State Univ. (United States); S. Zhang, The Pennsylvania State Univ. (United States)
7983 2Y	Fatigue crack detection in thick steel structures with piezoelectric wafer active sensors [7983-101] M. Gresil, L. Yu, V. Giurgiutiu, Univ. of South Carolina (United States)
	W. Oresil, E. 10, V. Clorgiono, eriiv. or seem carellina (eriilea states)
	POSTER SESSION
7983 32	Utilization of ultrasonic guided waves to detect delamination in aviation industries [7983-105]
	M. Riahi, H. R. Behnia, Iran Univ. of Science and Technology (Iran, Islamic Republic of)
7983 35	Long-term monitoring and field testing of an innovative multistory timber building [7983-108] P. Omenzetter, H. Morris, M. Worth, The Univ. of Auckland (New Zealand); V. Kohli, Univ. of California, Berkeley (United States); S. R. Uma, GNS Science (New Zealand)
7983 36	Galloping comparative analysis for transient main cables of suspension bridge during construction [7983-109]
	S. Li, Zhengzhou Univ. (China); G. Peng, The Construction Quality Supervision Ctr. of Zhengzhou (United States); H. Zhang, North China Univ. of Water Resources and Electric Power (United States); H. Chen, Zhengzhou Univ. (China)
	rever (ermed erares), in errori, zhengzhee ermit (ermita)
7983 37	Pipe performance analysis with nonparametric regression [7983-111]  Z. Liu, Y. Hu, National Research Council Canada (Canada); W. Wu, National Research Council Canada (Canada) and Sichuan Univ. (China)

7983 3A	Detection of sub-surface crack in railway wheel using a new sensing system [7983-115] S. J. Kwon, J. W. Seo, D. H. Lee, W. J. You, Korea Railroad Research Institute (Korea, Republic of)				
7983 3B	Inspection of corrosion in carbody and under frame for rolling stocks using pulsed eddy current testing [7983-116]				
	C. W. Lee, J. D. Chung, Korea Railroad Research Institute (Korea, Republic of)				
7983 3D	Mechanical degradation of cross-ply laminates monitored by acoustic emission [7983-118 A. Paipetis, M. Xyrafa, N. M. Barkoula, T. E. Matikas, D. G. Aggelis, Univ. of Ioannina (Greece				
7983 3E	Development of a C-Scan phased array ultrasonic imaging system using a 64-element				
	<b>35MHz transducer</b> [7983-119] F. Zheng, C. Hu, L. Zhang, The Univ. of Southern California (United States); K. Snook, Y. Liang W. S. Hackenberger, TRS Technologies, Inc. (United States); R. Liu, X. Geng, Blatek, Inc. (United States); X. Jiang, North Carolina State Univ. (United States); K. K. Shung, The Univ. of Southern California (United States)				
7983 3F	Static test of the embedded fiber Bragg gratings composite wind turbine blades [7983-122] Z. Zhang, Harbin Institute of Technology (China); Z. Huang, Harbin Institute of Technology (China) and China Nuclear Power Engineering Co., Ltd (China); Y. Liu, J. Leng, Harbin Institute of Technology (China)				
7983 3G	Assessment of PZT transducer bonding techniques under drop-weight impact loading in				
	composites [7983-123] K. R. Mulligan, PC. Ostiguy, P. Masson, S. Elkoun, N. Quaegebeur, Univ. de Sherbrooke (Canada)				
7983 3H	Physics-based classification of acoustic emission waveforms [7983-124] D. Rajendra, T. Knighton, A. Esterline, M. J. Sundaresan, North Carolina A&T State Univ. (United States)				
7983 3I	Residual capacity estimation of bridges using structural health monitoring data [7983-126] R. Baghaei, M. Q. Feng, M. Torbol, Univ. of California, Irvine (United States)				
7983 3J	Laser ultrasound technique for material characterization of Zircaloy cladding tubes in elevated temperature environment [7983-127] CH. Yeh, CH. Yang, National Taipei Univ. of Technology (Taiwan)				
7983 3L	Laser ultrasound technique for ray tracing investigation of Lamb wave tomography [7983-129]				
	CH. Wu, CH. Yang, National Taipei Univ. of Technology (Taiwan)				
7983 3M	Fabrication of 1-3 piezo-composites using new micro PZT fibers [7983-130] C. Chen, J. Liu, Jiangsu Univ. (China); X. Jiang, North Carolina State Univ. (United States); Y. Luo, Jiangsu Univ. (China); FG. Yuan, North Carolina State Univ. (United States); X. Han, J. Liao, Jiangsu Univ. (China)				
7983 3N	Application of anti-symmetric flexural modes for the detection of moisture [7983-131] PH. Tung, CH. Yang, National Taipei Univ. of Technology (Taiwan)				

7983 30	A novel fatigue monitoring system utilizing bio-inspiration concept of data track of tree rings [7983-134] S. Bai, Harbin Institute of Technology (China); Z. Zhou, J. Ou, Dalian Univ. of Technology
	(China);
7983 3P	Thermal protection system (TPS) monitoring using acoustic emission [7983-135] D. A. Hurley, D. R. Huston, D. G. Fletcher, W. P. Owens, The Univ. of Vermont (United States)
7983 3Q	Combination of a GMR sensor and reconstruction algorithm: a novel magnetic sensing
	system [7983-136] A. Sasamoto, T. Suzuki, National Institute of Advanced Industrial Science and Technology (Japan)
7983 3R	Live feed and variable snapshot recording of embedded magnetostrictive particulate sensors [7983-137]
	D. L. Spayde, O. J. Myers, Mississippi State Univ. (United States)
7983 3S	Research status on aerodynamic interference effects of wind-resistant performance of pylon [7983-138]
	S. LI, Y. Lu, D. Wang, H. Chen, Zhengzhou Univ. (China)
7983 3T	Feasibility research report of villa constructed of glass fiber reinforced concrete [7983-139] S. Li, Y. Lu, D. Wang, Zhengzhou Univ. (China)
	Author Index

### **Conference Committee**

### Symposium Chairs

**Donald J. Leo**, Virginia Polytechnic Institute and State University (United States)

Kara J. Peters, North Carolina State University (United States)

### Symposium Chairs

Norbert G. Meyendorf, Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (Germany) and University of Dayton (United States) Norman M. Wereley, University of Maryland, College Park (United States)

### Conference Chair

**H. Felix Wu**, National Institute of Standards and Technology (United States)

### Conference Cochairs

**Aaron A. Diaz**, Pacific Northwest National Laboratory (United States) **Andrew Gyekenyesi**, NASA Glenn Research Center (United States) **Peter J. Shull**, The Pennsylvania State University (United States)

### Program Committee

A. Emin Aktan, Drexel University (United States)

**Sreenivas Alampalli**, New York State Department of Transportation (United States)

Farhad Ansari, University of Illinois at Chicago (United States)

George Y. Baaklini, NASA Glenn Research Center (United States)

Yoseph Bar-Cohen, Jet Propulsion Laboratory (United States)

Radu Barsan, Redfern Integrated Optics, Inc. (United States)

**Shawn J. Beard,** Acellent Technologies, Inc. (United States)

Fu-Kuo Chang, Stanford University (United States)

Steven Chase, University of Virginia (United States)

Aditi Chattopadhyay, Arizona State University (United States)

**Genda Chen**, Missouri University of Science and Technology (United States)

**Shenen Chen**, The University of North Carolina at Charlotte (United States)

Maria Q. Feng, University of California, Irvine (United States)

**Masoud Ghandehari**, Polytechnic Institute of New York University (United States)

Hamid Ghasemi, Federal Highway Administration (United States)

Valery Godinez-Azcuaga, Mistras Group, Inc. (United States)

**Nenad Gucunski**, Rutgers, The State University of New Jersey (United States)

Frank Jalinoos, Federal Highway Administration (United States)

Xiaoning Jiang, North Carolina State University (United States)

Amrita Kumar, The Florida State University (United States)

Jerome P. Lynch, University of Michigan (United States)

**Richard E. Martin**, Cleveland State University (United States)

Theodore E. Matikas, University of Ioannina (Greece)

**Paul Mlakar**, U.S. Army Engineer Research and Development Center (United States)

**Didem Ozevin**, University of Illinois at Chicago (United States)

Masanobu Shinozuka, University of California, Irvine (United States)

Kurt Silvers, Pacific Northwest National Laboratory (United States)

Caesar Singh, U.S. Deptartment of Transportation (United States)

Pei-Chen Su, National Taiwan University (Taiwan)

Bernhard R. Tittmann, The Pennsylvania State University (United States)

**Brian J. Tucker**, Pacific Northwest National Laboratory (United States)

**Dietmar W. Vogel**, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration (Germany)

Ming L. Wang, Northeastern University (United States)

Yang Wang, Georgia Institute of Technology (United States)

Tzu-Yang Yu, University of Massachusetts Lowell (United States)

Ying Zhang, Georgia Institute of Technology (United States)

### Session Chairs

1A Laser, Ultrasound, Acoustic Emission NDE I

**Xiaoning Jiang**, North Carolina State University (United States) **Didem Ozevin**, University of Illinois at Chicago (United States)

1B NDE in Civil Infrastructure I

A. Emin Aktan, Drexel University (United States)

**Genda Chen**, Missouri University of Science and Technology (United States)

2A Laser, Ultrasound, Acoustic Emission NDE II

**Xiaoning Jiang**, North Carolina State University (United States) **Didem Ozevin**, University of Illinois at Chicago (United States)

2B NDE in Civil Infrastructure II

A. Emin Aktan, Drexel University (United States)

**Genda Chen**, Missouri University of Science and Technology (United States)

3A NASA-based NDE/SHM Activities Adam Wroblewski, NASA Glenn Research Center (United States)

Craig Smith, NASA Glenn Research Center (United States)

3B NDE in Composites

**Aditi Chattopadhyay**, Arizona State University (United States) **Lingyu Yu**, University of South Carolina (United States)

4 PNNL-based NDE in Homeland Security Applications **Juan D. Valencia**, Pacific Northwest National Laboratory

(United States)

Ryan M. Meyer, Pacific Northwest National Laboratory (United States)

5A NIST Technology Innovation Program on Civil Infrastructure Critical National Need: Advanced Sensing Technologies for the Infrastructure: Bridges, Roads, Highways, and Water Systems I

**H. Felix Wu**, National Institute of Standards and Technology (United States)

Maria Q. Feng, University of California, Irvine (United States)

5B Fiber Optics Sensors Technologies

**Shenen Chen**, The University of North Carolina at Charlotte (United States)

Li Cheng, Stanford University (United States)

NIST Technology Innovation Program on Civil Infrastructure Critical National Need: Advanced Sensing Technologies for the Infrastructure: Bridges, Roads, Highways, and Water Systems II

**Nenad Gucunski**, Rutgers, The State University of New Jersey (United States)

Dryver R. Huston, The University of Vermont (United States)

6B Radar/Lidar NDE Technologies **Paul H. Ziehl**, University of South Carolina (United States)

7A NIST Technology Innovation Program on Civil Infrastructure Critical National Need: Advanced Sensing Technologies for the Infrastructure: Bridges, Roads, Highways, and Water Systems III: Part 1

Nenad Gucunski, Rutgers, The State University of New Jersey
(United States)

Dryver R. Huston, The University of Vermont (United States)

Thermal, Infrared, and Radiographic NDE Technologies
 Theodore E. Matikas, University of Ioannina (Greece)
 Ryan M. Meyer, Pacific Northwest National Laboratory (United States)

- 8 NIST Technology Innovation Program on Civil Infrastructure Critical National Need: Advanced Sensing Technologies for the Infrastructure: Bridges, Roads, Highways, and Water Systems III: Part 2 Ming L. Wang, Northeastern University (United States) Valery Francisco Godinez-Azcuaga, MISTRAS Group, Inc. (United States)
- 9 NIST Technology Innovation Program on Civil Infrastructure Critical National Need: Advanced Sensing Technologies for the Infrastructure: Bridges, Roads, Highways, and Water Systems IV Daniel J. Inman, Virginia Polytechnic Institute and State University (United States) Tzu-Yang Yu, University of Massachusetts Lowell (United States)
- Wireless Sensor Network and Energy Harvesting
   Yang Wang, Georgia Institute of Technology (United States)
   Akira Sasamoto, National Institute of Advanced Industrial Science and Technology (Japan)
- Vibration-Based NDE Technologies
  Miguel A. Gonzalez-Nunez, MISTRAS Group, Inc. (United States)
  Ying Zhang, Georgia Institute of Technology (United States)
- Smart Materials Sensing Technologies
   Adam Wroblewski, NASA Glenn Research Center (United States)
   Shawn J. Beard, Acellent Technologies, Inc. (United States)

### Introduction

The Conference 7983, Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil Infrastructure, and Homeland Security V, at the 2011 SPIE Smart Structures/NDE symposium contained a total of 18 sessions with two-day concurrent sessions including Laser, Ultrasound, Acoustic Emission NDE I & II; NDE in Civil Infrastructure I & II; NDE in Composites; NASA-based NDE/SHM Activities; PNNL-based NDE in Homeland Security Applications; NIST Technology Innovation Program on Civil Infrastructure Critical National Need: Advanced Sensing Technologies for the Infrastructure: Bridges, Roads, Highways, and Water Systems I, II, III, and IV; Fiber Optics Sensors Technologies; Radar/LiDAR NDE Technologies; Thermal, Infrared, and Radiographic NDE Technologies; Wireless Sensor Network and Energy Harvesting; Vibration-based NDE Technologies; Smart Materials Sensing Technologies; and posters. The conference received more than 140 abstracts. More than 70 papers were presented in oral format and the remaining papers were presented in poster sessions. The conference was very well received and had great attendance from March 7 to 10, 2011 in San Diego, California.

Among these 140 submissions, 47 technical papers were presented by National Institute of Standards and Technology (NIST) Technology Innovation Program (TIP) recipients representing 24 different organizations from 11 ongoing TIP-funded Civil Infrastructure critical national need projects. Dr. H. Felix Wu, a Program Manager of the NIST/TIP gave an overview paper to kickoff these special events. The opportunity widely opened up an excellent opportunity for the NIST/TIP program to disseminate technologies of high-risk, high-reward research in area of Civil Infrastructure critical national need.

On behalf of Conference Chairs of Conference 7983, I wanted to thank you with my whole heart for all your support and enthusiasm by submitting your good quality papers and for serving as session chairs to shine our conference at the SPIE 2011. Indeed, we had a very successful conference this year. In addition, we had a full-house for our four Invited Papers given by Professor Maria Q. Feng, University of California at Irvine; Professor Ming L. Wang, Northeastern University; Professor Nenad Gucunski, The State University of New Jersey at Rutgers; and Professor Masanobu Shinozuka, University of California at Irvine. Many outstanding experts served on the 18 session chairs were also greatly appreciated. I hope you all enjoyed the conference that we put together. Thank you for all your hard work and excellent contributions. I cannot express anything more, but sincerely wish all of you to continue to support our next year conference.

Dr. Andrew Gyekenyesi of NASA Glenn Research Center will be the Conference Chair for SPIE 2012. Dr. Aaron Diaz of Pacific Northwest National Laboratory, Professor Peter Shull of Penn State, Professor Tzu-Yang Yu of University of Massachusetts at Lowell, and I will serve as Conference Co-Chairs to support him. I encourage all of you continue offering your support to Andy. I sincerely look forward to having another successful conference at the SPIE 2012.

H. Felix Wu