

PROCEEDINGS OF SPIE

Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems 2016

Jerome P. Lynch
Editor

21–24 March 2016
Las Vegas, Nevada, United States

Sponsored by
SPIE

Co-sponsored by
Polytec, Inc. (United States) • OZ Optics, Ltd. (United States) • APS Dynamics, Inc. (United States) • The ElectroForce Systems Group of TA Electroforce Corporation (United States) • The Institute of Physics (United Kingdom) • American Elements (United States)

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

Published by
SPIE

Volume 9803

Proceedings of SPIE 0277-786X, V. 9803

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems 2016,
edited by Jerome P. Lynch, Proc. of SPIE Vol. 9803, 980301 · © 2016 SPIE
CCC code: 0277-786X/16/\$18 · doi: 10.1117/12.2241909

Proc. of SPIE Vol. 9803 980301-1

The papers 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. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIDigitalLibrary.org.

The papers 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 these proceedings:

Author(s), "Title of Paper," in *Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems 2016*, edited by Jerome P. Lynch, Proceedings of SPIE Vol. 9803 (SPIE, Bellingham, WA, 2016) Six-digit Article CID Number.

ISSN: 0277-786X
ISSN: 1996-756X (electronic)
ISBN: 9781510600447

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 © 2016, 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/16/\$18.00.

Printed in the United States of America.

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

SPIE. DIGITAL LIBRARY
SPIDigitalLibrary.org

Paper Numbering: *Proceedings of SPIE* follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article at the time of 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 and print versions of the publication. SPIE uses a six-digit CID article numbering system structured as follows:

- 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.

Contents

Part One

xiii *Authors*
xvii *Conference Committee*

SESSION 1A KEYNOTE SESSION

- 9803 02 **Disaster mitigation based on smart structures/materials (Keynote Paper)** [9803-1]
9803 03 **Networking of optical fiber sensors for extreme environments (Keynote Paper)** [9803-2]

SESSION 1B HUMAN-STRUCTURE INTERACTION: SENSING AND ANALYSIS

- 9803 04 **Extending human proprioception to cyber-physical systems** [9803-3]
9803 05 **Characterizing wave propagation to improve indoor step-level person localization using floor vibration** [9803-4]
9803 06 **Occupant traffic estimation through structural vibration sensing** [9803-5]
9803 07 **Gait parameters extraction by using mobile robot equipped with Kinect v2** [9803-6]

SESSION 2A ENERGY HARVESTING DEVICES AND METHODS

- 9803 09 **A mechanical energy harvested magnetorheological damper with linear-rotary motion converter** [9803-8]
9803 0A **Energy harvesting from mastication forces via a smart tooth** [9803-9]

SESSION 2B STRUCTURAL HEALTH MONITORING OF BRIDGES

- 9803 0D **A self-sensing magnetorheological elastomer-based adaptive bridge bearing with a wireless data monitoring system** [9803-12]
9803 0E **Rapid cable tension estimation using dynamic and mechanical properties** [9803-14]
9803 0F **Structural health monitoring approach for detecting ice accretion on bridge cable using the Haar Wavelet Transform** [9803-15]
9803 0G **Statistical analysis of modal properties of a cable-stayed bridge through long-term structural health monitoring with wireless smart sensor networks** [9803-16]

SESSION 3A ADVANCES IN ACOUSTIC AND ULTRASONIC TRANSDUCERS

- 9803 0H **In-plane shear piezoelectric wafer active sensor phased arrays for structural health monitoring** [9803-17]
- 9803 0I **A self-diagnostic adhesive for monitoring bonded joints in aerospace structures** [9803-18]
- 9803 0J **Optimization of ultrasonic transducers for selective guided wave actuation** [9803-19]
- 9803 0K **All-optically driven system in ultrasonic-wave-based structural health monitoring** [9803-20]
- 9803 0M **Advanced instrumentation for acousto-ultrasonic-based structural health monitoring** [9803-22]
- 9803 0N **Interdigital transducers in structural health monitoring based on Lamb waves: a state of the art** [9803-23]

SESSION 3B NANOENGINEERED THIN FILM SENSORS FOR SHM

- 9803 0O **Electrical conductivity of nanocomposites based on carbon nanotubes: a 3D multiscale modeling approach** [9803-24]
- 9803 0Q **Performance assessment of a remotely readable graphite oxide (GO)-based tamper-evident seal** [9803-27]
- 9803 0R **Distributed thin film sensor array for damage detection and localization** [9803-28]
- 9803 0S **Fully integrated patterned carbon nanotube strain sensors on flexible sensing skin substrates for structural health monitoring** [9803-29]
- 9803 0T **High-sensitivity strain visualization using electroluminescence technologies** [9803-30]

SESSION 4A ADVANCES IN THERMOGRAPHY

- 9803 0U **Extraction of thermal Green's function using diffuse fields: a passive approach applied to thermography** [9803-31]
- 9803 0V **3D temperature field reconstruction using ultrasound sensing system** [9803-32]

SESSION 4B SMART STRUCTURE METHODS FOR DISASTER MITIGATION

- 9803 0W **Smart disaster mitigation in Thailand** [9803-33]

SESSION 5A DAMAGE DETECTION BY TOMOGRAPHIC METHODS

- 9803 0Y **An application of fractional calculus to the tomographic identification of structural damage** [9803-35]

- 9803 0Z **Unpowered wireless ultrasound tomography system** [9803-36]
- 9803 10 **Electrical resistance tomography with constrained sine wave solutions for impact damage identification in glass fiber/epoxy/carbon black laminate composites** [9803-37]
- 9803 11 **In-plane motion measurement by using digital sampling moiré method** [9803-38]

SESSION 5B BIG DATA AND SHM INFORMATICS

- 9803 12 **Sub-Nyquist signal-reconstruction-free operational modal analysis and damage detection in the presence of noise** [9803-39]
- 9803 13 **A cloud-based information repository for bridge monitoring applications** [9803-40]
- 9803 15 **Big data and high-performance analytics in structural health monitoring for bridge management** [9803-42]

SESSION 6A SMART STRUCTURAL COMPOSITES BASED ON NANOFILLERS

- 9803 16 **In-situ material state monitoring using embedded CdSe quantum dots** [9803-43]
- 9803 18 **Surface and subsurface damage detection in cement-based materials using electrical resistance tomography** [9803-45]
- 9803 19 **Strain sensitivity of carbon nanotube cement-based composites for structural health monitoring** [9803-46]
- 9803 1A **Alignment of carbon iron into polydimethylsiloxane to create conductive composite with low percolation threshold and high piezoresistivity** [9803-47]

SESSION 6B SENSING FOR HEALTH ASSESSMENT OF TRANSPORTATION SYSTEMS

- 9803 1B **Real-time image processing for non-contact monitoring of dynamic displacements using smartphone technologies** [9803-48]
- 9803 1C **Thermal stress measurement in continuous welded rails using the hole-drilling method** [9803-49]
- 9803 1D **A smart solution for the vibration suppression in cables for the electric power distribution** [9803-50]
- 9803 1E **Field validation of road roughness evaluation using in-pavement strain sensors** [9803-51]
- 9803 1F **Corrosivity monitoring system using RFID-based sensors** [9803-52]

SESSION 7A APPLICATION OF FIBER OPTIC SENSING FOR SHM OF STRUCTURES

- 9803 1G **In-line fiber Bragg grating sensors for steel corrosion detection** [9803-53]
- 9803 1H **Acoustic emission detection with fiber optical sensors for dry cask storage health monitoring** [9803-54]
- 9803 1I **Fiber optic approach for detecting corrosion** [9803-55]
- 9803 1L **Use of FBG sensors for health monitoring of pipelines** [9803-59]
- 9803 1M **A new strategy toward Internet of Things: structural health monitoring using a combined fiber optic and acoustic emission wireless sensor platform** [9803-189]

SESSION 7B DAMAGE DETECTION AND PROGNOSTIC OF CIVIL STRUCTURES

- 9803 1N **Angular velocity-based structural damage detection** [9803-60]
- 9803 1O **Mechanical equivalent of Bayesian inference from monitoring data** [9803-61]
- 9803 1Q **Application of time-series-based damage detection algorithms to structures under ambient excitations** [9803-63]
- 9803 1R **Updating finite element models considering environmental impacts** [9803-64]
- 9803 1S **Matrix factorization to time-frequency distribution for structural health monitoring** [9803-65]
- 9803 1T **Extended Kalman filter based structural damage detection for MR damper controlled structures** [9803-66]

SESSION 8A FUSION OF FIBER OPTIC AND ULTRASONIC SENSING I

- 9803 1U **Ultrasound generation from an optical fiber sidewall** [9803-67]

SESSION 8B UAV TECHNOLOGY FOR SYSTEM MONITORING

- 9803 1W **Artificial hair sensor designs for flow measurement of UAVs with different scales** [9803-69]
- 9803 1X **Demonstration of UAV deployment and control of mobile wireless sensing networks for modal analysis of structures** [9803-70]

SESSION 9A FUSION OF FIBER OPTIC AND ULTRASONIC SENSING II

- 9803 1Y **Ultrasonic temperature measurements with fiber optic system** [9803-71]
- 9803 1Z **Monitoring cure properties of out-of-autoclave BMI composites using IFPI sensor** [9803-72]

- 9803 20 **Characterization of embedded fiber optic strain sensors into metallic structures via ultrasonic additive manufacturing** [9803-73]
- 9803 21 **Metal-core piezoelectric fiber-based smart layer for damage detection using sparse virtual element boundary measurement** [9803-74]

SESSION 9B SYSTEM ID AND SHM OF CIVIL AND MECHANICAL SYSTEMS

- 9803 23 **Likelihood-free Bayesian computation for structural model calibration: a feasibility study** [9803-76]
- 9803 25 **Experimental model updating using frequency response functions** [9803-78]
- 9803 26 **A hybrid method for damage detection and quantification in advanced X-COR composite structures** [9803-79]
- 9803 27 **A formula for the arc length of a superhelix** [9803-80]

Part Two

SESSION 10A CONTROL OF AEROELASTIC STRUCTURES USING SMART MATERIALS

- 9803 28 **Experimental and finite element analyses of multifunctional skins for morphing wing applications** [9803-81]
- 9803 29 **Estimation of morphing airfoil shape and aerodynamic load using artificial hair sensors** [9803-82]
- 9803 2A **Numerical design of an adaptive aileron** [9803-83]

SESSION 10B NOVEL METHODS IN CONTROL OF SEISMICALLY EXCITED STRUCTURES

- 9803 2C **Performance and robustness of hybrid model predictive control for controllable dampers in building models** [9803-85]
- 9803 2D **Identification of ground motion features for high-tech facility under far field seismic waves using wavelet packet transform** [9803-86]

SESSION 11A GUIDED WAVE METHODS FOR DAMAGE IDENTIFICATION

- 9803 2G **Impacts of structural vibration on the performance of ultrasound sensor networks powered by vibration-harvested energy** [9803-89]
- 9803 2H **Regularized discriminant analysis for multi-sensor decision fusion and damage detection with Lamb waves** [9803-90]

- 9803 2J **Damage sensitivity investigations of EMI technique on different materials through coupled field analysis** [9803-92]
- 9803 2L **Nonlinear ultrasonic fatigue crack detection using a single piezoelectric transducer** [9803-94]

SESSION 11B NOVEL SENSING TRANSDUCERS FOR SMART STRUCTURE APPLICATION

- 9803 2O **High-pressure sensor using piezoelectric bending resonators** [9803-97]
- 9803 2P **Model calibration for a soft elastomeric capacitor sensor considering slippage under fatigue cracks** [9803-99]
- 9803 2Q **A novel class of MEMS accelerometers for very high-G munitions environment** [9803-100]
- 9803 2R **Triaxial tunable mechanical monolithic sensors for large band low frequency monitoring and characterization of sites and structures** [9803-101]
- 9803 2S **A piezoelectric shear stress sensor** [9803-102]
- 9803 2T **Autonomous stress imaging cores: from concept to reality** [9803-103]

SESSION 12A ADVANCES IN PIEZOELECTRIC TRANSDUCERS

- 9803 2V **Experimental studies on fatigue behavior of macro fiber composite (MFC) under mechanical loading** [9803-105]

SESSION 12B NON-CONTACT SENSING METHODS

- 9803 2X **Practical application of RINO, a smartphone-based dynamic displacement sensing application for wind tunnel tests** [9803-107]
- 9803 2Y **Hyperspectral range imaging for transportation systems evaluation** [9803-108]

SESSION 13A APPLICATIONS OF ACOUSTIC AND ULTRASONICS FOR SHM

- 9803 2Z **Energy harvesting from arterial blood pressure for powering embedded brain sensors** [9803-109]
- 9803 30 **Corrosion monitoring using high-frequency guided waves** [9803-110]
- 9803 31 **Hidden disbond detection in spent nuclear fuel storage systems using air-coupled ultrasonics** [9803-111]

SESSION 13B MONITORING AND CONTROL OF FLUID-STRUCTURE INTERACTION

- 9803 33 **Analysis and characterization of structurally embedded vascular antennas using liquid metals** [9803-113]
- 9803 34 **Characterization of hydrophobic nanoporous particle liquids for energy absorption** [9803-114]
- 9803 35 **Dynamic monitoring of compliant bodies impacting the water surface through local strain measurements** [9803-115]

SESSION 14A SMART MATERIAL SOLUTIONS FOR CONTROL APPLICATIONS

- 9803 37 **Structural integrated sensor and actuator systems for active flow control** [9803-117]
- 9803 38 **Micro acoustic resonant chambers for heating/agitating/mixing (MARCHAM)** [9803-118]
- 9803 3A **Active vertical tail buffeting suppression based on macro fiber composites** [9803-186]
- 9803 3B **A small-scale study of magneto-rheological track vibration isolation system** [9803-120]
- 9803 3C **A SMA-based redundant actuation locking device for rotary feed structure using self-locking principle** [9803-121]

SESSION 14B ADVANCES IN WIRELESS MONITORING TECHNOLOGY

- 9803 3D **A reliable low cost integrated wireless sensor network for water quality monitoring and level control system in UAE** [9803-122]
- 9803 3E **An investigation on wireless sensors for asset management and health monitoring of civil structures** [9803-123]
- 9803 3F **A hybrid system identification methodology for wireless structural health monitoring systems based on dynamic substructuring** [9803-124]
- 9803 3G **Design of external sensors board based on Bluetooth interface of smart phones for structural health monitoring system** [9803-125]
- 9803 3H **A wirelessly programmable actuation and sensing system for structural health monitoring** [9803-126]

SESSION 15A ACOUSTIC AND ULTRASONIC WAVES: MODELS AND EXPERIMENTS

- 9803 3I **A guided ultrasonic imaging approach in isotropic plate structures using edge reflections** [9803-127]
- 9803 3J **Microcrack modeling and simulation for nonlinear wave modulation** [9803-128]

- 9803 3K **Compensating temperature-induced ultrasonic phase and amplitude changes** [9803-129]
- 9803 3L **Reconstruction of moving acoustic sources in heterogeneous elastic solid** [9803-130]
- 9803 3O **Ultrasonic guided wave detection of scatterers on large clad steel plates** [9803-133]

SESSION 15B ADVANCES IN FBG SENSING

- 9803 3P **Planar waveguide Bragg grating sensors for composite monitoring** [9803-134]
- 9803 3Q **Sensitivity of contact-free fiber Bragg grating sensor to ultrasonic Lamb wave** [9803-135]
- 9803 3R **Experimental investigation on acousto-ultrasonic sensing using polarization-maintaining fiber Bragg gratings** [9803-136]
- 9803 3S **A sliding-mode-based observer to identify faults in FBG sensors embedded in composite structures** [9803-137]
- 9803 3U **Limits to acoustic sensing and modal decomposition using FBGs** [9803-139]

POSTER SESSION

- 9803 3W **Application of 3D digital image correlation for development and validation of FEM model of self-supporting metal plates structures** [9803-141]
- 9803 3X **Instability signature for detecting snap-through buckling of dome structures** [9803-142]
- 9803 3Y **Progressive collapse analysis using updated models for alternate path analysis after a blast** [9803-143]
- 9803 40 **Corrosion monitoring along infrastructures using distributed fiber optic sensing** [9803-145]
- 9803 45 **Acoustic metamaterial panels based on multi frequency vibration absorbers** [9803-150]
- 9803 46 **Strain monitoring of a composite wing** [9803-151]
- 9803 48 **Multi-metric strain estimation at unmeasured locations of plate structures using augmented Kalman filter** [9803-153]
- 9803 49 **A smart-hose for concrete displacing booms** [9803-155]
- 9803 4B **Simultaneous sensing of film thickness and temperature using an InSb Hall element** [9803-157]
- 9803 4D **Modeling of PZT-induced Lamb wave propagation in structures by using a novel two-layer spectral finite element** [9803-159]
- 9803 4E **Crane hoisting monitoring using smartphone** [9803-160]

- 9803 4F **Development of three-axis inkjet printer for gear sensors** [9803-161]
- 9803 4G **Large band high sensitivity motion measurement and control of spacecrafts and satellites** [9803-162]
- 9803 4I **Analysis of longitudinal seismic response of bridge with magneto-rheological elastomeric bearings** [9803-164]
- 9803 4J **Multiple damage identification and imaging in an aluminum plate using effective Lamb wave response automatic extraction technology** [9803-165]
- 9803 4K **Development of a numerical model for vehicle-bridge interaction analysis of railway bridges** [9803-166]
- 9803 4M **The state of the art on innovative monitoring system in Korea** [9803-169]
- 9803 4N **Monitoring global climate change using SLR data from LARES and other geodetic satellites** [9803-170]
- 9803 4O **Lifelog-based lighting design for biofied building** [9803-171]
- 9803 4P **Experimental characterization of an adaptive aileron: lab tests and FE correlation** [9803-172]
- 9803 4R **Detection of flaws on surface of civil infrastructures and their profiling using imaging system with laser displacement sensor** [9803-175]
- 9803 4T **Experimental study of frost heaving force based on transient shock response using piezoceramic sensors** [9803-177]
- 9803 4U **Proposal of honeycomb-based deployable breakwater** [9803-178]
- 9803 4W **Wireless sensor node for detection of freight train derailment** [9803-181]
- 9803 4X **Locate damage based on change in structural shape for civil space structures** [9803-182]
- 9803 4Y **Adhesive bond failure monitoring with triboluminescent optical fiber sensor** [9803-183]
- 9803 50 **Stereovision vibration measurement test of a masonry building model** [9803-185]
- 9803 52 **Dof-based submatrix scaling factors for damage detection in reinforced concrete bridges** [9803-188]
- 9803 53 **Stress-strain sensor for monitoring seismic precursors and fault activities in the sand** [9803-190]

Authors

Numbers in the index correspond to the last two digits of the six-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first four digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Abou-Elnour, Ahmad, 3D
Abou-Elnour, Ali, 3D
Acernese, F., 2R, 4G
Adachi, K., 02
Adams, Douglas E., 16
Adhikari, Sailesh, 2J
Aimmanee, S., 02, 0W
Aktan, A. Emin, 3E
Alampalli, Sandeep, 15
Alampalli, Sharada, 15
Alhandawi, Khalil B., 1F, 40
Amendola, Gianluca, 2A, 4P
Amoroso, Francesco, 4P
An, Yun-Kyu, 2L
Anandan, Sudharshan, 1Z
Andre, Julia, 0F
Arockiarajan, A., 2V
Asadollahi, Parisa, 0G
Asanuma, Hiroshi, 02, 0W, 1L, 4U
Atwood, Don, 2Y
Azarmi, Fardad, 1G
Bani-Hani, Muath, 0A
Banks, Curtis E., 3R
Bao, Jingjing, 1H
Bao, Xiaoqi, 2O
Barone, F., 2R, 4G
Bartoli, Ivan, 3E
Baur, Jeffrey W., 33
Behr, Christian, 37
Behrooz, Majid, 0D
Bennett, Caroline, 2P
Berges, Mario, 3O
Bertolaccini, Kelly, 3Y
Bhalla, Suresh, 2J
Bi, Siwen, 0K, 1U, 1Y
Biscarini, Chiara, 35
Biswas, Subir, 2G
Bolognani, Denise, 1O
Borkowski, Luke, 26
Bossert, Jason A., 0Q
Bradford, Philip, 3Q
Bradford, Robyn L., 33
Bridgelall, Raj, 1E, 2Y
Brooks, Chris, 2T
Brubaker, Cole D., 16
Bucca, Giuseppe, 49
Buonocore, Salvatore, 0Y
Burton, Andrew R., 0S
Buscemi, Marco, 1D
Butler, Nathan S., 29
Büyüközürk, Oral, 3H
Cao, Chengyu, 0V, 1Y
Cappello, Carlo, 1O
Capriotti, Margherita, 0U
Cattaneo, Alessandro, 04, 0Q
Cazzulani, Gabriele, 1D, 3S
Chan, Chuan-Kai, 1Q
Chandrashekhara, K., 1Z
Chang, Chia-Ming, 1S
Chang, Chih-Chen, 11
Chang, Fu-Kuo, 0I
Chattopadhyay, Aditi, 26
Chen, Chin-Tsun, 2D
Chen, Shiwei, 4I
Chen, Xinxing, 11
Cheng, Li, 21
Chiesura, Gabriele, 3P
Cho, Eun Sang, 4K
Christenson, Richard E., 0E, 1T
Chu, Ki Sum, 09
Cinquemani, Simone, 3S
Ciufolini, Ignazio, 4N
Collins, William, 2P
Concilio, Antonio, 2A
Costa, Andrea, 4W
D'Alessandro, Antonella, 19
Dapino, Marcelo J., 20
Das, Saptarshi, 2G
Davis, Claire, 1I, 3U
Degriek, Joris, 3P
Deng, Fodan, 1E, 1G
DeVitis, John, 3E
Dickstein, Leah, 04
Dietzel, Andreas, 37
Dimino, Ignazio, 2A, 4P
Dong, Bo, 2G
Dong, Shuai, 1A
Dong, Xinjun, 25
Downey, Austin, 0R
Dragos, Kosmas, 3F
Du, Qiujiào, 53
Duan, Qihua, 3X
Dubuc, Brennan, 3I
Dumont, Joseph H., 0Q
Ebendorff-Heidepriem, Heike, 1I
Ebrahimkhanlou, Arvin, 3I
Ekkawatpanit, C., 0W
Elhaddad, Wael M., 2C

Eskew, Edward, 3Y
Ettouney, Mohammed, 15
Faridazar, Fred, 3E
Fateh, Mahmood, 1C
Fava, Victor, 49
Felli, Ferdinando, 02, 1L
Feng, Dake, 2Q
Feng, Ruociang, 4X
Fisher, Anita M., 38
Frank, Geoffrey J., 33
Freckler, Talitha M., 16
Fromme, P., 30
Furkan, Mustafa, 3E
Furuya, Y., 02
Galea, Steve, 0M, 2T
Gao, Shunde, 4E
Gao, Yunli, 50
Geier, Sebastian, 28
Gelo, Nikolas J., 1B
Georgakis, Christos, 0F
Giardalis, Agathoklis, 12
Giordano, G., 2R, 4G
Giri, Paritosh, 4R
Giurgiutiu, Victor, 1H
Gkoktsi, Kyriaki, 12
Gong, Peng, 3K, 3O
Gopalarathnam, Ashok, 2S
Gordaninejad, Faramarz, 0D
Grabowski, Krzysztof, 0O
Greenwood, William, 1X
Greve, David W., 3K, 3O
Grunthaner, Frank, 38
Gu, Jinliang, 45
Gupta, Gautam, 0Q
Hackney, Drew, 3Q
Hahn, Heidi A., 04
Ham, Jun Su, 4K
Hammel, Emily C., 4Y
Han, Soonhung, 27
Harley, Joel B., 3O
Hartl, Darren J., 33
Hay, Thomas R., 3K
Hehr, Adam J., 20
Hihara, L., 02
Hirose, Mitsuhiro, 1X
Hong, Jung-Wuk, 3J
Hong, Yu, 25
Hou, Rui, 13
Hsu, Yi, 34
Hu, Dianylin, 3C
Hu, Xiaolei, 45
Hua, Xugang, 3X
Huang, Haiying, 0Z
Huang, Shieh-Kung, 1S, 2D
Huang, Ying, 1E, 1G
Huff, Daniel W., 26
Huff, Gregory H., 33
Huffer, Fred W., 2H
Iba, Daisuke, 4F
Iizuka, Takashi, 4F

Itani, Ahmad, 0D
Jang, Shinae, 0E, 1T, 3Y
Jannelli, Elio, 35
Jennings, G. Kane, 16
Jeong, Chanseok, 3L
Jeong, Jong-Hyun, 2X
Jeong, Seongwoon, 13
Jiang, Xiaoning, 2S
Jiang, Zhaoshuo, 1T
Jiao, Bo, 4E
Jin, Chenhao, 1T
Jin, Seung-Seop, 23
Jin, Suyeong, 3J
Jo, Hongki, 0T, 1B, 2X, 48
Johnson, Erik A., 2C
Joshi, Bhriugu, 2J
Jung, George, 0M
Jung, Hyung-Jo, 23
Jung, Sungmoon, 2H
Junker, Warren R., 3K, 3O
Kake, Fumika, 4O
Kamat, Vineet, 1X
Kamimoto, Takahiro, 4F
Karami, M. Amin, 0A, 2Z
Kaur, Amardeep, 1Z, 46
Keller, Kevin, 04
Kenny, Josè M., 19
Khaleeq, Hyder, 3D
Kharkovsky, Sergey, 4R
Khodabandeloo, Babak, 48
Kim, Byungchul, 4M
Kim, Hee Ju, 4K, 4M
Kim, Jinwook, 2S
Kim, Tae Heon, 4K, 4M
Kim, Taeyang, 2S
Kintscher, Markus, 28
Kiremidjian, Anne S., 0F, 1N
Knez, Kyle Philip, 2X
Kong, Xiangxiong, 2P
Kopsaftopoulos, Fotis, 0I
Kostecki, Roman, 1I
Kujawińska, Małgorzata, 3W
Kurata, Masahiro, 0S
Laflamme, Simon, 0R, 19, 2P
Lanza di Scalea, Francesco, 0U, 1C
Law, Kincho H., 13
Lawand, Lydia, 1F, 40
Lee, Chung-Hsien, 1Q
Lee, Dong Jun, 2L
Lee, Sang Eon, 3J
Lee, Seung-Woo, 2X
Leester-Schädel, Monika, 37
Li, Bin, 3A
Li, Dongsheng, 3G
Li, Hui, 0H
Li, Jian, 0G, 2P
Li, Lianghai, 3C
Li, Rui, 3B, 4I
Li, Xi, 4I
Li, Yu-hung, 0I

Liang, Li, 3A
 Liao, Wei-Hsin, 09
 Liao, Yizheng, 0F, 1N
 Lim, Sungyeop, 27
 Lin, Bin, 1H
 Lis, Jerzy, 0J
 Liu, Xi, 25
 Liu, Xiaotong, 4D, 4J
 Liu, Yingtao, 34
 Liu, Yuqian, 0V, 1Y
 Lloyd, Stephen F., 3L
 Loh, Chin-Hsiung, 1N, 1Q, 2D
 Long, James, 3H
 Luyckx, Geert, 3P
 Lynch, Jerome P., 0S, 13, 1X
 Ma, Tong, 0V, 1Y
 Macke, David C., 46
 Magnifico, Marco, 2A
 Mahrholz, Thorsten, 28
 Malesa, Marcin, 3W
 Malowany, Krzysztof, 3W
 Mańka, Michał, 0N
 Mao, Qiang, 3E
 Mar, David, 0D
 Marchi, Alexandria N., 0Q
 Mariani, Stefano, 0U
 Martínez-Castro, Rosana E., 0E
 Martowicz, Adam, 0N
 Mascareñas, David D. L., 04, 0Q
 Masuda, Arata, 4F
 Materazzi, Annibale L., 19
 Mazzotti, Matteo, 3E
 McAdam, Grant, 1I
 Melvin, Dyan, 48
 Milani, Damiano, 4W
 Min, Jae-Hong, 1B, 2X
 Mirshekari, Mostafa, 05, 06
 Mishra, Spandan, 2H
 Missinne, Jeroen, 3P
 Miszczynski, Mateusz, 0J
 Mita, Akira, 07, 4O
 Miura, Nanako, 4F
 Monner, Hans-Peter, 28
 Monroe, Tanya M., 1I
 Moon, Franklin, 3E
 Moriwaki, Ichiro, 4F
 Mu, Wenjun, 3B
 Muzinich, Blake, 0D
 Nakamura, Morimasa, 4F
 Nanda, Aditya, 2Z
 Neerukatti, Rajesh Kumar, 26
 Nejhad, M., 02
 Nguyen, A. D., 1M
 Nishino, Hiromichi, 0S
 Njoroge, Ian, 16
 Noell, Aaron C., 38
 Noh, Hae Young, 05, 06
 Norman, Patrick, 3U
 Ogawa, Ami, 07
 Okabe, S., 4U
 Okoli, Okenwa O., 4Y
 Olawale, David O., 4Y
 Oppenheim, Irving J., 3K, 3O
 Ou, Jinping, 3G
 Ouyang, Qinghua, 4D, 4J
 Packo, Pawel, 0J, 0O
 Page, C., 1M
 Palmieri, Frank L., 2S
 Pan, Hong, 33
 Pan, Shijia, 05, 06
 Pancioli, Riccardo, 35
 Pandey, Akash, 2V
 Paolozzi, Antonio, 02, 1L, 4N
 Paris, Claudio, 1L, 4N
 Park, Ki Tae, 4K, 4M
 Park, Kyeongtaek, 52
 Pavlis, Erricos C., 4N
 Pecora, Rosario, 2A, 4P
 Pekcan, Gokhan, 0D
 Peng, Tongxiao, 4T
 Peters, Kara, 03, 3Q
 Phan, Nam, 1Z
 Piekarczyk, Artur, 3W
 Pinuelas, Nathan, 0D
 Popovics, John S., 31
 Poursaee, A., 18
 Powlesland, Ian, 0M
 Pu, Qianhui, 25
 Publicover, Nelson G., 0D
 Qin, Xiaoyu, 3C
 Qiu, Jinhao, 21
 Rafert, J. Bruce, 2Y
 Rajadas, Abhishek, 26
 Rajagopal, Ram, 0F, 1N
 Rajic, Nik, 0M, 2T, 3U
 Rallini, Marco, 19
 Rastegar, Jahangir, 2Q
 Rathod, Vivek T., 0N
 Reich, Gregory W., 1W, 29
 Resta, Ferruccio, 1D, 49, 4W
 Ripamonti, Francesco, 1D, 49
 Robinson, Ethan, 04
 Rodriguez Lopez, Ricardo, 4F
 Romano, R., 2R, 4G
 Ronchi, Marco, 3S
 Rosalie, Cédric, 3U
 Rosenthal, Sandra J., 16
 Rostron, Paul, 1F
 Ruan, T., 18
 Saini, Aditya, 2S
 Salamone, Salvatore, 3I
 Schomer, John J., 20
 Schwerter, Martin, 37
 Semperlotti, Fabio, 0Y
 Sen, Mihir, 0Y
 Shahinpoor, M., 02
 Shan, Baohua, 50
 Shane, Dylan O., 16
 Shen, Yu, 50
 Sheritt, Stewart, 2O, 38

Shi, Chao, 45
 Shi, Yan, 2G
 Shirayayev, Oleg, 1F, 40
 Shohag, Md Abu S., 4Y
 Sinapius, Michael, 37
 Sindoni, Giampiero, 4N
 Skrzypczak, Paweł, 3W
 Smarsly, Kay, 3F
 Smith, Lisa, 33
 Smithard, Joel, 0M
 Smudde, Christine M., 16
 Sohn, Hoon, 13
 Sone, Akira, 4F
 Song, Homin, 31
 Song, Wei, 1R
 Staszewski, Wieslaw J., 0O
 Stepinski, Tadeusz, 0J, 0N
 Sternini, Simone, 0U
 Strathman, Joseph, 46
 Su, J., 02
 Su, Weihua, 1W, 29
 Sumitro, S. Paul, 3E
 Sun, Hongwei, 45
 Sun, Wei, 53
 Sun, Xiaorong, 1T
 Takahashi, Masaki, 07
 Takano, Nobuyuki, 2O, 38
 Tallman, T. N., 10
 TauSiesakul, Bamrung, 12
 Teigell Benéitez, Nuria, 3P
 Thapa Magar, Kaman S., 29
 Tolliver, Denver D., 2Y
 Tomasini, Gisella, 4W
 Torbol, Marco, 52
 Ubertini, Filippo, 0R, 19, 35
 Ubertini, Stefano, 35
 Ueda, Tohru, 4B
 Uhl, Tadeusz, 0J, 0O
 Vahdati, Nader, 1F, 40
 van der Velden, Stephen, 0M, 2T
 Van Steenberge, Geert, 3P
 Vanli, O. Arda, 2H
 Vendittozzi, Cristian, 1L
 Wang, Chonghe, 0H
 Wang, Gang, 3R
 Wang, Hongyuan, 21
 Wang, Ming L., 4T
 Wang, Peng, 0H
 Wang, R., 1A
 Wang, Ruolin, 4T
 Wang, Tianyu, 1I
 Wang, Wei, 3A
 Wang, Weibing, 3C
 Wang, Wentao, 0H
 Wang, Xiaojie, 1A, 3B, 4I
 Wang, Xingwei, 0K, 0V, 1U, 1Y
 Wang, Yang, 25
 Watkins, Steve E., 1Z, 46
 Wee, Junghyun, 3Q
 Wells, Brian, 3Q
 Wiatr, Kazimierz, 0J, 0O
 Więch, Przemysław, 3W
 Wiedemann, Martin, 28
 Wierach, Peter, 28, 37
 Wilson, C. L., 1M
 Wohl, Christopher J., 2S
 Wojtkiewicz, Steven F., 2C
 Wu, Nan, 0K, 1U, 1Y
 Wu, Yueyuan, 4I
 Xiao, Hai, 1Z
 Xiao, Yong, 1X
 Xu, Jian, 0T
 Yan, Guirong, 3X, 4X
 Yan, Xiaojun, 3C
 Yanaseko, T., 02
 Yarra, Siddaiah, 0D
 Yorozu, Ayanori, 07
 Yu, Jianxin, 4X
 Yu, Lingyu, 1H
 Yu, Yan, 3G, 4E
 Yuan, Lei, 1Z
 Yuji, Jun-ichiro, 4B
 Zahedi, Farshad, 0Z
 Zbyrad, Paulina, 0J, 0O
 Zekkos, Dimitrios, 1X
 Zeng, Zuoxun, 53
 Zhang, Chao, 21
 Zhang, Haifeng, 0K
 Zhang, Luyang, 3B
 Zhang, Pei, 05, 06
 Zhang, Xiaoyong, 3C
 Zhang, Yang, 4E
 Zhang, Yilan, 13
 Zhang, Z., 1E
 Zhao, Xuefeng, 3G, 4E
 Zhao, Yi, 4X
 Zhou, Hao, 1X
 Zhou, Jingcheng, 0K, 1U, 1Y
 Zhou, Li, 4D, 4J
 Zhou, Shanglian, 1R
 Zhou, Wensong, 0H
 Zhou, Yaping, 3G
 Zhu, Xuan, 1C
 Zhu, Yong, 2S
 Zhuang, Yitao, 0I
 Zonta, Daniele, 1O
 Zou, Chengzhe, 3A
 Zou, Li, 09

Conference Committee

Symposium Chairs

Jayanth N. Kudva, NextGen Aeronautics, Inc. (United States)
Theodoros E. Matikas, University of Ioannina (Greece)

Symposium Co-chairs

Tribikram Kundu, The University of Arizona (United States)
Gregory W. Reich, Air Force Research Laboratory (United States)

Conference Chair

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

Conference Co-chairs

Hoon Sohn, KAIST (Korea, Republic of)
Kon-Well Wang, University of Michigan (United States)

Conference Program Committee

Hiroshi Asanuma, Chiba University (Japan)
Xiaoyi Bao, University of Ottawa (Canada)
Chih Chen Chang, Hong Kong University of Science and Technology
(Hong Kong, China)
Genda Chen, Missouri University of Science and Technology
(United States)
Wolfgang Ecke, Leibniz-Institut für Photonische Technologien e.V.
(Germany)
Alison B. Flatau, University of Maryland, College Park (United States)
Branko Glisic, Princeton University (United States)
Faramarz Gordaninejad, University of Nevada, Reno (United States)
Benjamin K. Henderson, Air Force Research Laboratory
(United States)
Jung-Wuk Hong, KAIST (Korea, Republic of)
Neil A. Hault, Queen's University (Canada)
Haiying Huang, The University of Texas at Arlington (United States)
Ying Huang, North Dakota State University (United States)
Shinae Jang, University of Connecticut (United States)
Jeong-Tae Kim, Pukyong National University (Korea, Republic of)
Junhee Kim, Dankook University (Korea, Republic of)
Masahiro Kurata, Kyoto University (Japan)

Simon Laflamme, Iowa State University of Science and Technology
(United States)

Francesco Lanza di Scalea, University of California, San Diego
(United States)

Hui Li, Harbin Institute of Technology (China)

Wei-Hsin Liao, The Chinese University of Hong Kong
(Hong Kong, China)

Chin-Hsiung Loh, National Taiwan University (Taiwan)

Kenneth J. Loh, University of California, Davis (United States)

Bryan R. Loyola, Sandia National Laboratories (United States)

David D. Mascarenas, Los Alamos National Laboratory (United States)

Theodoros E. Matikas, University of Ioannina (Greece)

Norbert G. Meyendorf, Iowa State University of Science and
Technology (United States)

Akira Mita, Keio University (Japan)

Tomonori Nagayama, The University of Tokyo (Japan)

Yiqing Ni, The Hong Kong Polytechnic University (Hong Kong, China)

Hae Young Noh, Carnegie Mellon University (United States)

Irving J. Oppenheim, Carnegie Mellon University (United States)

Wieslaw M. Ostachowicz, The Szewalski Institute of Fluid-Flow
Machinery (Poland)

Jinping Ou, Dalian University of Technology (China)

Shamim N. Pakzad, Lehigh University (United States)

Seunghee Park, Sungkyunkwan University (Korea, Republic of)

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

Michael K. Philen, Virginia Polytechnic Institute and State University
(United States)

Paul Reynolds, University of Exeter (United Kingdom)

Massimo Ruzzene, Georgia Institute of Technology (United States)

Liming W. Salvino, Office of Naval Research Global (United States)

Jeffrey T. Scruggs, University of Michigan (United States)

Fabio Semperlotti, University of Notre Dame (United States)

Sung-Han Sim, Ulsan National Institute of Science and Technology
(Korea, Republic of)

Wei Song, The University of Alabama (United States)

Billie F. Spencer Jr., University of Illinois at Urbana-Champaign
(United States)

Wieslaw J. Staszewski, AGH University of Science and Technology
(Poland)

R. Andrew Swartz, Michigan Technological University (United States)

Michael D. Todd, University of California, San Diego (United States)

Masayoshi Tomizuka, University of California, Berkeley (United States)

Ming L. Wang, Northeastern University (United States)

Xingwei Wang, University of Massachusetts Lowell (United States)

Yang Wang, Georgia Institute of Technology (United States)

Rosalind M. Wynne, Villanova University (United States)

Chung-Bang Yun, Ulsan National Institute of Science and Technology
(Korea, Republic of)
Yunfeng Zhang, University of Maryland, College Park (United States)
Daniele Zonta, Università degli Studi di Trento (Italy)

Session Chairs

- 1A Keynote Session
Kon-Well Wang, University of Michigan (United States)
Hoon Sohn, KAIST (Korea, Republic of)

- 1B Human-Structure Interaction: Sensing and Analysis
Hae Young Noh, Carnegie Mellon University (United States)
Alessandro Cattaneo, Los Alamos National Laboratory (United States)

- 2A Energy Harvesting Devices and Methods
Hoon Sohn, KAIST (Korea, Republic of)
Ming L. Wang, Northeastern University (United States)

- 2B Structural Health Monitoring of Bridges
Majid Behrooz, University of Nevada, Reno (United States)
Shinae Jang, University of Connecticut (United States)

- 3A Advances in Acoustic and Ultrasonic Transducers
Xingwei Wang, University of Massachusetts Lowell (United States)
Norbert G. Meyendorf, Iowa State University of Science and
Technology (United States)

- 3B Nanoengineered Thin Film Sensors for SHM
Andrew R. Burton, University of Michigan (United States)
Donghyeon Ryu, New Mexico Institute of Mining and Technology
(United States)

- 4A Advances in Thermography
Andrew R. Burton, University of Michigan (United States)

- 4B Smart Structure Methods for Disaster Mitigation
Hiroshi Asanuma, Chiba University (Japan)

- 5A Damage Detection by Tomographic Methods
Tyler Tallman, Purdue University (United States)
Fabio Semperlotti, University of Notre Dame (United States)

- 5B Big Data and SHM Informatics
Mohammed M. Ettouney, Weidlinger Associates, Inc. (United States)
Branko Glisic, Princeton University (United States)

- 6A Smart Structural Composites Based on Nanofillers
Genda Chen, Missouri University of Science and Technology
(United States)
Simon Laflamme, Iowa State University of Science and Technology
(United States)
- 6B Sensing for Health Assessment of Transportation Systems
Wei Song, The University of Alabama (United States)
Ming L. Wang, Northeastern University (United States)
- 7A Application of Fiber Optic Sensing for SHM of Structures
Hiroshi Asanuma, Chiba University (Japan)
Genda Chen, Missouri University of Science and Technology
(United States)
- 7B Damage Detection and Prognostic of Civil Structures
Chin-Hsiung Loh, National Taiwan University (Taiwan)
Hui Li, Harbin Institute of Technology (China)
- 8A Fusion of Fiber Optic and Ultrasonic Sensing I
Kara J. Peters, North Carolina State University (United States)
- 8B UAV Technology for System Monitoring
Yang Wang, Georgia Institute of Technology (United States)
- 9A Fusion of Fiber Optic and Ultrasonic Sensing II
Kara J. Peters, North Carolina State University (United States)
Wolfgang Ecke, Leibniz-Institut für Photonische Technologien e.V.
(Germany)
- 9B System ID and SHM of Civil and Mechanical Systems
Hyung-Jo Jung, KAIST (Korea, Republic of)
Daniele Zonta, Università degli Studi di Trento (Italy)
- 10A Control of Aeroelastic Structures using Smart Materials
Wieslaw J. Staszewski, AGH University of Science and Technology
(Poland)
Tyler Tallman, Purdue University (United States)
- 10B Novel Methods in Control of Seismically Excited Structures
Erik A. Johnson, The University of Southern California (United States)
Yang Wang, Georgia Institute of Technology (United States)
- 11A Guided Wave Methods for Damage Identification
Theodoros E. Matikas, University of Ioannina (Greece)
Michael D. Todd, University of California, San Diego (United States)

- 11B Novel Sensing Transducers for Smart Structure Application
Rosalind M. Wynne, Villanova University (United States)
Kenneth J. Loh, University of California, San Diego (United States)
- 12A Advances in Piezoelectric Transducers
Alessandro Cattaneo, Los Alamos National Laboratory (United States)
- 12B Non-contact Sensing Methods
Rosalind M. Wynne, Villanova University (United States)
- 13A Applications of Acoustic and Ultrasonics for SHM
Wieslaw M. Ostachowicz, The Szewalski Institute of Fluid-Flow Machinery (Poland)
Donghyeon Ryu, New Mexico Institute of Mining and Technology (United States)
- 13B Monitoring and Control of Fluid-Structure Interaction
Akira Mita, Keio University (Japan)
- 14A Smart Material Solutions for Control Applications
Haiying Huang, The University of Texas at Arlington (United States)
R. Andrew Swartz, Michigan Technological University (United States)
- 14B Advances in Wireless Monitoring Technology
Yiqing Ni, The Hong Kong Polytechnic University (Hong Kong, China)
- 15A Acoustic and Ultrasonic Waves: Models and Experiments
Irving J. Oppenheim, Carnegie Mellon University (United States)
Jung-Wuk Hong, KAIST (Korea, Republic of)
- 15B Advances in FBG Sensing
R. Andrew Swartz, Michigan Technological University (United States)
Xiaoyi Bao, University of Ottawa (Canada)

