

PROCEEDINGS OF SPIE

Health Monitoring of Structural and Biological Systems XII

Tribikram Kundu

Editor

5–8 March 2018

Denver, Colorado, United States

Sponsored by

SPIE

Cosponsored by

OZ Optics, Ltd. (United States)

Polytec, Inc. (United States)

Cooperating Organizations

Jet Propulsion Laboratory (United States)

Colorado Photonics Industry Association (United States)

Published by

SPIE

Volume 10600

Proceedings of SPIE 0277-786X, V. 10600

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

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 *Health Monitoring of Structural and Biological Systems XII*, edited by Tribikram Kundu, Proceedings of SPIE Vol. 10600 (SPIE, Bellingham, WA, 2018) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510616967

ISBN: 9781510616974 (electronic)

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 © 2018, 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/18/\$18.00.

Printed in the United States of America V m7 i ffUb '5 gg: WJUH' g' bW'zi bXYf' JW bgY' Z'ca 'GD-9.

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 seven-digit CID article numbering system structured as follows:

- The first five 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

ix	<i>Authors</i>
xi	<i>Conference Committee</i>
xv	<i>Introduction</i>

SESSION 1 DISTRIBUTED SENSORS FOR SHM

10600 02	Multi-rosettes sensing analysis for an impact assessment in composite plate-like structure [10600-1]
10600 03	High-frequency ultrasonic sensor arrays based on optical micro-ring resonators [10600-2]
10600 04	Preliminary studies for the optimization of sensor placement for electro-mechanical impedance based damage detection [10600-3]
10600 05	Quantitative monitoring of hole-edge damage growth using eddy current array sensor-based intelligent bolt [10600-4]

SESSION 2 NONLINEAR ULTRASONIC TECHNIQUES

10600 07	Damage characterization based on nonlinear guided wave simulation and chirplet matching pursuit algorithm [10600-6]
10600 08	Nondestructive detection and assessment of high temperature hydrogen attack damage in carbon steel pressure vessels [10600-7]
10600 09	Evaluation of crack orientation using fatigue crack-induced contact acoustic nonlinearity [10600-8]
10600 0A	Nonlinear scattering features of guided waves from fatigue cracks [10600-9]

SESSION 3 GUIDED WAVE FOR SHM/NDE

10600 0B	Active health monitoring of TN32 dry cask using a scaled down model [10600-10]
10600 0C	Composite structures defect imaging [10600-11]
10600 0D	Hybrid guided wave based SHM system for composite structures for impact and delamination detection combining fiber Bragg grating sensing and piezoelectric patches [10600-12]

- 10600 OE **Reverse engineering stiffened plates using guided wave-based nondestructive testing methods** [10600-13]
- 10600 OF **Effects of transducers on guided wave based structural health monitoring** [10600-14]
- 10600 OG **Silicon wafer defect detection using high frequency guided waves** [10600-15]
- 10600 OH **Development of a de-icing system for aerodynamic surfaces based on ultrasonic waves** [10600-16]
- 10600 OI **Comparative study of deterioration of composite due to moisture using strain, electromechanical impedance, and guided waves** [10600-17]

SESSION 4 CIVIL INFRASTRUCTURE MONITORING I

- 10600 OJ **High-speed non-contact ultrasound system for rail track integrity evaluation** [10600-18]
- 10600 OL **Shaking table tests for evaluating the damage features under earthquake excitations using smartphones** [10600-20]
- 10600 OM **Applying video magnification for vision-based operating deflection shape evaluation on a wind turbine blade cross-section** [10600-21]
- 10600 OO **MRI myocardium T^*_2 measurement by a new PCA-based object recognition algorithm** [10600-23]

SESSION 5 ADVANCED MODELING TECHNIQUES

- 10600 OP **Predictive 1D and 2D guided-wave propagation in composite plates using the SAFE approach** [10600-24]
- 10600 OQ **Computational wave modeling of multilayered anisotropic plates** [10600-25]
- 10600 OR **X-ray ray tracing simulation and flaw parameters for crack detection** [10600-26]

SESSION 6 MEDICAL/BIOMEDICAL APPLICATIONS

- 10600 OT **Identification of bone fracture in osseointegrated prostheses using Rayleigh wave methods** [10600-28]
- 10600 OU **Imaging platforms for registering and analyzing the skin microrelief structure** [10600-29]
- 10600 OV **Visualization of the scattering of focused ultrasonic waves at solid-fluid interfaces** [10600-30]
- 10600 OW **Characterization of dental tissue by reflection and transmission ultrasound microscopy** [10600-31]

10600 0X **Imaging the superficial vascular structure for mapping and identification** [10600-32]

SESSION 7 ELASTIC AND METAMATERIAL I

10600 11 **A new membrane-type metamaterial for multiple peaks absorption at low frequencies** [10600-36]

10600 14 **Dispersion behavior of a hybrid phononic resonator** [10600-39]

10600 15 **Far-field superresolution imaging using shaped acoustic vortices** [10600-40]

SESSION 8A ELASTIC AND METAMATERIAL II

10600 1A **Numerical and experimental study of broadband elastic wave filtering in anisotropic pentamode material** [10600-45]

SESSION 8B MODELING/SIMULATION AND EXPERIMENT FOR NONLINEAR/LINEAR ULTRASONIC TECHNIQUES I

10600 1C **Quantitative evaluation of yield strength degradation by using nonlinear ultrasonic techniques** [10600-47]

10600 1D **Flexible multibody dynamics formulation by using Peridynamic theory** [10600-48]

SESSION 9A ELASTIC AND METAMATERIAL III

10600 1E **Inducing and tuning edge-states in a weak topological phononic waveguide** [10600-49]

10600 1H **Avoided crossings and band sorting in two-dimensional phononic crystals** [10600-52]

10600 1I **Reconfigurable metasurfaces for directional acoustic sensing** [10600-53]

10600 1J **Design of smart metamaterials for vibration control: extension of Bloch approach to handle finite system boundary conditions** [10600-54]

SESSION 9B COMPOSITE MONITORING

10600 1M **A damage index for identifying incipient delamination in CFRP laminated plates relying on 2D multi-resolution modal Teager-Kaiser energy** [10600-57]

10600 1N **Effect of multiscale precursor damage on wave propagation through modulated constitutive properties of composite materials** [10600-58]

10600 1O **Single-sensor acoustic emission source localization in plate-like structures: a deep learning approach** [10600-59]

- 10600 1Q **Mechanical characterization of bistable laminates for very small aircraft morphing applications** [10600-61]
- 10600 1R **Composite samples with different contaminations analysed with THz spectrometry** [10600-62]

SESSION 10A ELASTIC AND METAMATERIAL IV

- 10600 1T **Interpreting phononic Bragg band gaps through finite system dynamics and transfer functions** [10600-64]
- 10600 1X **Optimized phononic crystals for bandgap and metamaterial properties** [10600-68]
- 10600 1Y **Nanoscale surface phononic crystals for characterization of complex and periodic materials using extreme ultraviolet light** [10600-69]

SESSION 10B MODELING/SIMULATION AND EXPERIMENT FOR NONLINEAR/LINEAR ULTRASONIC TECHNIQUES II

- 10600 1Z **A spectral method for computing the effect of stress on guided modes in plates and rods** [10600-70]
- 10600 20 **Passive and active monitoring for defect detection and quantification in composites** [10600-71]
- 10600 23 **Non-destructive evaluation of a plantation eucalyptus** [10600-75]

SESSION 11A ELASTIC AND METAMATERIAL V

- 10600 24 **Challenges and constraints in the application of resonance-based metamaterials for vibration isolation** [10600-76]

SESSION 11B MODELING/SIMULATION AND EXPERIMENT FOR NONLINEAR/LINEAR ULTRASONIC TECHNIQUES III

- 10600 28 **Analysis of S0/A0 guided wave mode conversion phenomenon** [10600-80]
- 10600 2B **SHM of aerospace bonded structures with improved techniques based on NEWS** [10600-96]

SESSION 12A CIVIL INFRASTRUCTURE MONITORING II

- 10600 2C **Monitoring-based decision support system for optimal management of Colle Isarco viaduct** [10600-85]

- 10600 2D **The conditional value of information of SHM: what if the manager is not the owner?**
[10600-87]
- 10600 2H **On-line safety monitoring of pressure-retaining equipment in power plants: a review**
[10600-91]
- 10600 2I **Optical fiber sensor for monitoring the strain of concrete which is subject to freezing and thawing test** [10600-92]

SESSION 12B EMERGING AND FUTURISTIC TECHNIQUES

- 10600 2J **Statistical damage detection based on full-field covariance of circumferential scan ultrasonic measurement** [10600-93]
- 10600 2K **Structural operating deflection shape estimation via a hybrid computer-vision algorithm**
[10600-94]
- 10600 2N **Identifying structural damage with data driven impedance response calibration**
[10600-98]
- 10600 2O **Structural health monitoring based on omni-directional SH wave piezoelectric transducers**
[10600-99]
- 10600 2P **Improved statistical damage classification in an experimental wind turbine blade based on vector autoregressive coefficients and sequential projection pursuit** [10600-100]
- 10600 2R **Reliability of surface response to excitation method for data-driven prognostics using Gaussian process regression** [10600-102]

10600, Health Monitoring of Structural and Biological Systems XII. KEYWORDS: Polarization, Visualization, Crystals, Composites, Wave propagation. Read Abstract +. 9438, Health Monitoring of Structural and Biological Systems 2015. KEYWORDS: MATLAB, Modulation, Matrices, Crystals, Composites, Photonic crystals, Inverse problems, Epoxies, Chemical elements, Optimization (mathematics). Read Abstract +. More Details about Our Structural Health Monitoring Systems. Data Acquisition (DAQ) Systems for Structural Monitoring and Control. The versatility of our modular DAQ systems allows them to be customized for each application. Modular Design. The modular architecture of our GRANITE[®] system allows each measurement module to independently connect to a PC or DAQ. Campbell Scientific's GRANITE[®] monitoring systems are used for a variety of structural and seismic applications. Monitoring possibilities on an overpass could include: Case Studies. Canada: Structural Health Monitoring of an Overpass GKM Consultants was contracted by a nationally leading engineering firm to develop, commission, and install.read more.