

PROCEEDINGS OF SPIE

Health Monitoring of Structural and Biological Systems XV

Paul Fromme
Zhongqing Su
Editors

22–26 March 2021
Online Only, United States

Sponsored and Published by
SPIE

Volume 11593

Proceedings of SPIE 0277-786X, V. 11593

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 XV*, edited by Paul Fromme, Zhongqing Su, Proc. of SPIE 11593, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510640153

ISBN: 9781510640160 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time)

SPIE.org

Copyright © 2021 Society of Photo-Optical Instrumentation Engineers (SPIE).

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 fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center 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.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

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

**SPIE. DIGITAL
LIBRARY**

SPIDigitalLibrary.org

Paper Numbering: A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE 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

GUIDED WAVES I: SHM

- 11593 05 **Modeling of guided waves for aerospace applications (Keynote Paper)** [11593-1]
- 11593 07 **Imaging guided wave evolution using wavenumber-distance spectrogram** [11593-3]

SENSORS AND ELECTROMECHANICAL IMPEDANCE-BASED SHM

- 11593 09 **Fault detection and diagnosis for PZT sensors with electro-mechanical impedance technique by using one-dimensional convolutional autoencoder** [11593-5]
- 11593 0B **Crack size monitoring in necked double shear lugs using the electro-mechanical impedance method** [11593-7]
- 11593 0D **Dynamic strain sensing system using a SOA based fiber ring laser with fiber Bragg gratings and an AWG demodulator** [11593-9]

GUIDED WAVES II: SENSORS FOR SHM

- 11593 0E **An omnidirectional shear horizontal wave transducer based on thickness-mode (d_{33}) piezoelectric wafer active sensors** [11593-10]
- 11593 0F **Application of ellipse and hyperbola methods for guided waves based structural health monitoring using fiber Bragg grating sensors** [11593-11]
- 11593 0H **Safe dispersion: a graphical user interface for modelling guided wave propagation in elastic solids** [11593-13]
- 11593 0I **Converting Lamb modes into shear horizontal waves using a resonance-based metamaterial** [11593-14]

CIVIL INFRASTRUCTURE MONITORING

- 11593 0K **Structural health monitoring of transmission tower based on inclinometer sensing system** [11593-16]
- 11593 0M **1D-CNNs for autonomous defect detection in bridge decks using ground penetrating radar** [11593-18]

11593 0N **Vibro-acoustic analysis of auxetic hexagonal and anti-tetrachiral stepped cantilever beams**
[11593-19]

GUIDED WAVES III: SHM OF COMPOSITES

11593 0O **Lamb waves based assessment of impact damage in multilayered CFRP plate** [11593-20]

11593 0P **Pure SH0 wave tomography for delamination detection in aerospace composites** [11593-21]

11593 0Q **Guided wave propagation and scattering at composite delaminations** [11593-22]

11593 0R **Full wavefield method for damage detection in stiffened CFRP panel** [11593-23]

11593 0S **Static behavior of a disbanded stringer in a co-infused stiffened panel** [11593-24]

11593 0T **Analysis of elastic wave propagation excited by acoustic non-contact method** [11593-25]

11593 0U **Inverse fuzzy arithmetic for material characterization of composites using guided waves**
[11593-26]

11593 0W **An influence of fiber Bragg grating sensor embedded into additive manufactured polymeric structure durability** [11593-28]

MEDICAL AND BIOMEDICAL APPLICATIONS

11593 0X **Performance analysis of triboelectric energy harvester designs for knee implants** [11593-29]

11593 0Y **Design and performance simulation of a triboelectric energy harvester for total hip replacement implants** [11593-30]

11593 0Z **An implantable, battery-free sensing system for monitoring of spinal fusion** [11593-31]

11593 10 **Characterization of interfacial failure in cemented total joint replacements via self-sensing bone cement, electrical impedance tomography, and machine learning** [11593-32]

11593 11 **Iterative learning control for high-intensity focused ultrasound treatments** [11593-33]

11593 12 **Biosafety of low-intensity pulsed transcranial focused ultrasound brain stimulation: a human skull study** [11593-34]

GUIDED WAVES IV: ARTIFICIAL INTELLIGENCE

- 11593 16 **Decomposition of multi-mode signals using dispersion curves and Bayesian linear regression** [11593-37]
- 11593 17 **Delamination detection in aerospace composite panels using convolutional autoencoders** [11593-38]
- 11593 18 **Simulation of waves propagation into composites thin shells by FEM methodologies for training of deep neural networks aimed at damage reconstruction** [11593-39]
- 11593 19 **Temperature compensation for guided waves using convolutional denoising autoencoders** [11593-40]
- 11593 1A **Ultrasonic fiber Bragg grating sensor placement optimization in structural health monitoring using covariance matrix adaptation evolutionary strategy** [11593-41]

GUIDED WAVES V: SHM AND NDE

- 11593 1F **Modulating Lamb waves with a tunable ultrasonic lens** [11593-46]
- 11593 1I **Corrosion thickness loss monitoring using high-frequency guided ultrasonic waves** [11593-49]

RECENT ADVANCES IN NONLINEAR ULTRASONICS-BASED NDE AND SHM

- 11593 1R **Impact damage imaging and quantification in composite structures utilizing nonlinear ultrasonics measured by scanning laser Doppler vibrometry** [11593-58]

ULTRASONIC AND ACOUSTIC WAVES

- 11593 22 **Acoustic communication in deep ice at ocean worlds** [11593-69]
- 11593 23 **Using requirements on merit ratios for assessing reliability of NDE flaw detection** [11593-99]
- 11593 24 **Ultrasonic imaging in solids using time reversal operator and coherent matched-field processing** [11593-71]
- 11593 25 **Instantaneous ultrasound computed tomography using deep convolutional neural networks** [11593-72]
- 11593 26 **Acoustic source localization on a thin isotropic spherical shell** [11593-73]
- 11593 27 **Non-contact passive sensing of acoustic emission signal using the air-coupled transducer** [11593-74]

11593 28 **A data-driven matched field processing approach for primary/secondary source localization in plates: proof of concept** [11593-104]

OPTICAL SENSING AND MACHINE LEARNING FOR SHM AND NDE I

11593 2A **Automated damage detection of bridge's sub-surface defects from infrared images using machine learning** [11593-75]

11593 2B **Surface crack detection in concrete structures using video processing techniques** [11593-76]

11593 2D **Bayesian localisation of acoustic emission sources for wind turbine bearings** [11593-78]

HEALTH MONITORING OF AEROSPACE AND COMPOSITE STRUCTURES

11593 2G **THz spectroscopy application for fibre reinforced polymer structures under influence of simultaneous temperature and humidity action** [11593-81]

11593 2I **Thermography application for fibre reinforced polymer structures under influence of simultaneous temperature and humidity action** [11593-83]

11593 2J **Modeling reliability of NDE method providing C-scan, a case of flaw field simulation** [11593-70]

11593 2K **Using requirements on merit ratios for assessing reliability of NDE flaw detection in multi-hit detection in digital radiography** [11593-100]

11593 2L **Experimental assessment of an active (acoustic) liner prototype in an acoustic flow duct facility** [11593-84]

11593 2M **Composite porosity characterization using x-ray edge illumination phase contrast and ultrasonic techniques** [11593-85]

OPTICAL SENSING AND MACHINE LEARNING FOR SHM AND NDE II

11593 2N **An improvement of visualized images from vibration for plastic gear early failure detection using convolutional neural network** [11593-86]

11593 2O **Real-time damage identification of discrete structures via neural networks subjected to dynamic loading** [11593-87]

11593 2P **Bridge damage detection using machine learning algorithms** [11593-88]

11593 2Q **Delayed comparison error minimization for frequency domain state estimation in structures subjected to high-rate boundary change** [11593-89]

POSTER SESSION

- 11593 2U **3D printed Ni-based superalloy structures for energy industry application** [11593-92]
- 11593 2V **Lamb wave-based nondestructive inspection using a mobile robotic platform** [11593-93]
- 11593 2W **Large volumetric optical-resolution photoacoustic microscopy based on a tunable acoustic gradient lens and fiber delay network** [11593-94]
- 11593 2X **Automated analysis of microscopy images using deep convolutional neural networks**
[11593-95]
- 11593 30 **Temperature numerical analysis for a support structure of jacket-type offshore wind turbine**
[11593-98]
- 11593 31 **Method of separating temperature effect of daily solar radiation from strain monitoring of a concrete bridge** [11593-101]
- 11593 33 **Simulation of Gaussian-beam photothermal effect of gastric tumor based on COMSOL**
[11593-108]