Nondestructive Characterization and Monitoring of Advanced Materials, Aerospace, Civil Infrastructure, and Transportation XIII

Andrew L. Gyekenyesi
Tzu-Yang Yu
H. Felix Wu
Peter J. Shull
Editors

4–7 March 2019
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 10971
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 SPIEDigitalLibrary.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:


ISSN: 0277-786X
ISSN: 1996-756X (electronic)
ISBN: 9781510625976

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 © 2019, 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/19/$18.00.

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
SPIEDigitalLibrary.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

| 10971 03 | Long-term wireless monitoring solution for the risk management of highway retaining walls [10971-1] |
| 10971 04 | Optimized spatial placement of structural bolts in connections for effective ultrasonic inspection [10971-2] |
| 10971 05 | Electromagnetic sensing of a subsurface metallic object at different depths [10971-3] |
| 10971 06 | Characterization of textile effects on concrete panel using synthetic aperture radar imaging [10971-4] |

### SHM-NDE OF CIVIL STRUCTURES/INFRASTRUCTURE II

| 10971 07 | Effect of rebar geometries on ultrasonic waves propagation in reinforced concrete structures using finite element method [10971-5] |

### SHM-NDE OF CIVIL STRUCTURES/INFRASTRUCTURE III

<p>| 10971 0C | Bistable wind-induced vibration energy harvester for self-powered wireless sensors in smart bridge monitoring systems [10971-11] |
| 10971 0D | Detecting damages and stress changes in concrete structures using coda wave interferometry [10971-12] |
| 10971 0E | 3D InspectionNet: a deep 3D convolutional neural networks based approach for 3D defect detection on concrete columns [10971-13] |
| 10971 0G | Stress measurement of a pressurized vessel using candle soot nanocomposite based photoacoustic excitation [10971-15] |
| 10971 0H | Acoustic emission monitoring of strengthened steel bridges: Inferring the mechanical behavior of post-installed shear connectors [10971-16] |
| 10971 0I | Concrete performance prediction using boosting smooth transition regression trees (BooST) [10971-17] |</p>
<table>
<thead>
<tr>
<th>ID</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>10971 0J</td>
<td>Verification of probabilistic risk assessment method AMETA for aircraft fatigue life management</td>
<td>18</td>
</tr>
<tr>
<td>10971 0K</td>
<td>Nondestructive evaluation of coated steel plates using a 94GHz microwave interferometer</td>
<td>19</td>
</tr>
<tr>
<td>10971 0L</td>
<td>Assessing reliability of NDE flaw detection using smaller number of demonstration data points</td>
<td>20</td>
</tr>
<tr>
<td>10971 0M</td>
<td>NDE flaw detectability validation using smaller number of signal response data points</td>
<td>21</td>
</tr>
<tr>
<td>10971 0N</td>
<td>In-line quality control using dimensional metrology of 3D metal parts printed by laser beam melting</td>
<td>22</td>
</tr>
<tr>
<td>10971 0O</td>
<td>Structural health monitoring using embedded magnetic shape memory alloys for magnetic sensing</td>
<td>23</td>
</tr>
<tr>
<td>10971 0P</td>
<td>Control of thermal deflection in concrete structures using iron-based shape memory alloys</td>
<td>24</td>
</tr>
<tr>
<td>10971 0R</td>
<td>Non-contact assessment of thermal damage of concrete using a nonlinear wave modulation technique</td>
<td>26</td>
</tr>
<tr>
<td>10971 0S</td>
<td>Characterization of dielectric constant of masonry wall using synthetic aperture radar imaging</td>
<td>27</td>
</tr>
<tr>
<td>10971 0T</td>
<td>Automated construction of bridge condition inventory using natural language processing and historical inspection reports</td>
<td>28</td>
</tr>
<tr>
<td>10971 0U</td>
<td>Detection of grain angle in wood specimens using synthetic aperture radar imaging</td>
<td>29</td>
</tr>
<tr>
<td>10971 0V</td>
<td>IoT-powered remote sensing system and portable tools for real-time evaluation of strain imaging sheets affixed to old outdoor structures</td>
<td>30</td>
</tr>
<tr>
<td>10971 0W</td>
<td>Machine vision-based concrete beam crack pattern identification using fractal theory</td>
<td>31</td>
</tr>
</tbody>
</table>
Grain effect on the accuracy of defect detection in wood structure by using acoustic-laser technique [10971-32]

Piezoelectric cement sensor and impedance analysis for concrete health monitoring [10971-33]

**SHM-NDE SCIENCE AND THEORY II**

Bayesian estimation of defect patterns in composite materials using through-thickness dielectric measurements [10971-34]

Electrical properties of copper-loaded polymer composites [10971-36]

Soft-matter damage detection systems for electronics and structures [10971-37]

Evaluating the shadow or glare effects in thermography for non-destructive testing and evaluation [10971-38]

**SHM-NDE ULTRASONICS I**

The identification of accurate and computationally efficient arrival time pick-up method for acoustic tomography [10971-39]

An experimental evaluation of Helmholtz potentials as a source of acoustic emission due to fatigue crack [10971-40]

Nonlinear phased array imaging of flaws a modulation technique [10971-41]

Development of nonlinear acoustic and air-coupled techniques for non-destructive testing [10971-42]

**SHM-NDE OF COMPOSITE MATERIALS I**

Structured illumination fiber probe for high-resolution surface feature imaging of 3D printed and composite samples [10971-43]

Enhanced piezoresistive sensing of fiber-reinforced composites via embedded nanoparticles [10971-45]

An energy efficient wireless module for on-board aircraft impact detection [10971-46]
Image analysis for classification of damaged and undamaged areas on composite structures [10971-47]

Development of a small-scale and low-cost SHM system for thin-walled CFRP structures based on acoustic emission analysis and neural networks [10971-49]

**SHM-NDE ULTRASONICS II**

Nondestructive evaluation with fully non-contact air-coupled transducer-scanning laser Doppler vibrometer Lamb wave system [10971-50]

Stress change detection from application of a stretching model to coda wave measurements [10971-51]

Analyzing nonlinear behavior of ultrasound wave in phase-space domain [10971-52]

Non-contact excitation of guided waves using air-coupled ultrasonic transmitters for damage detection [10971-53]

Measurement of stress wave attenuation in composite laminates [10971-54]

Identifying transition of fatigue cracks from tensile to shear mode based on acoustic emission signals [10971-55]

**SHM-NDE OF COMPOSITE MATERIALS II**

Eddy current non-destructive evaluation of manufacturing flaws and operational damage in CFRP composites [10971-57]

Acoustic emission localization in composites using the signal power method and embedded transducers [10971-58]

A new method for Poisson’s ratio measurement with time-of-flight technique: application to the preliminary design of smart composite structures [10971-59]

**SHM-NDE SCIENCE AND THEORY III**

Direct waveform extraction via a deep recurrent denoising autoencoder [10971-61]

NDE flaw detectability size estimation using smaller number of hit-miss data-points [10971-62]

Experimental measurements of vibrations of artificial sub-surface cracks and evaluation of identification potential for the electro-mechanical impedance method [10971-63]

Application of flexible PAUT probe for weld inspection of piping elbows [10971-73]
POSTER SESSION

10971 W  Acoustic emission characterization of PVC pipe for various joining types [10971-64]

10971 X  Numerical simulation of temperature-induced structural strain for a long-span suspension bridge [10971-65]

10971 Y  High gain DC-DC converter with coupled inductor [10971-66]

10971 Z  Ultrasonic determination of the elastic and shear modulus on aged wood [10971-67]

10971 20  Estimating the density of wood specimens using synthetic aperture radar imaging [10971-69]

10971 21  Measure of in-plane thermal conductivity of composite structures [10971-70]

10971 22  Identifying the stiffness reduction in the supporting tower of wind turbines: a numerical approach [10971-71]