

PROCEEDINGS OF SPIE

Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems 2024

Branko Glišić
Maria Pina Limongelli
Ching Tai Ng
Editors

25–28 March 2024
Long Beach, California, United States

Sponsored and Published by
SPIE

Volume 12949

Proceedings of SPIE 0277-786X, V. 12949

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 2024,
edited by Branko Glišić, Maria Pina Limongelli, Ching Tai Ng, Proc. of SPIE Vol. 12949,
1294901 · © 2024 SPIE · 0277-786X · doi: 10.1117/12.3034231

Proc. of SPIE Vol. 12949 1294901-1

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 2024*, edited by Branko Glišić, Maria Pina Limongelli, Ching Tai Ng, Proc. of SPIE 12949, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510672048
ISBN: 9781510672055 (electronic)

Published by
SPIE
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time)
SPIE.org
Copyright © 2024 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

vii *Conference Committee*

APPLICATIONS OF SENSORY SYSTEMS AND SMART STRUCTURES I

- 12949 04 **Experimental study of heat damage evaluation using nonlinear ultrasonic guided waves** [12949-2]
- 12949 05 **Integrating piezoelectric sensors for enhanced failure prediction of residential buildings in hurricane** [12949-3]
- 12949 06 **Research on real-time laser targeting through calibration of laser mirror scanner and LiDAR camera** [12949-4]

SENSOR AND SMART STRUCTURE DESIGN, FABRICATION, AND IMPLEMENTATION I

- 12949 07 **Advancing seismic monitoring of masonry structures with smart bricks: recent developments and future prospects (Invited Paper)** [12949-6]
- 12949 08 **Characterization of surface parallel mirror actuation using preloaded commercial lead zirconate titanate (PZT) stacks** [12949-7]
- 12949 09 **Multifrequency MEMS sensor for single-point source localization in dispersive media using modal acoustic emission and wavelet transformation** [12949-8]
- 12949 0A **Mitigation of radiation-induced attenuation of optical fibers through photobleaching: study of power dependence at cryogenic temperatures** [12949-9]
- 12949 0B **Experimental study for nondestructive evaluation of steel rods in ground anchor using an EMI sensor: optimal design of EMI sensor through finite element simulation** [12949-10]

ADVANCES IN SENSING AND SMART STRUCTURE TECHNOLOGIES I

- 12949 0C **Optimizing transmission of acoustic signals to monitor internal conditions of canisters for dry storage of commercial spent nuclear fuel** [12949-11]
- 12949 0E **Towards hydrogen fueled aircraft: metal hydrides for optical hydrogen sensors operating above room temperature** [12949-13]

- 12949 OF **Multimodal AI-based water pipeline data accumulation and leakage prediction research using image and ultrasound data** [12949-14]
- 12949 OG **Development of a new lateral shearing wavefront analyzer** [12949-15]

ADVANCES IN SENSING AND SMART STRUCTURE TECHNOLOGIES II

- 12949 OI **Piezoelectric motor for cryogenic applications** [12949-65]
- 12949 OJ **Fungal circuitry: mycelium as a living sensor for smart structures** [12949-17]
- 12949 OK **Structural health monitoring of civil infrastructures using smart sensor networks** [12949-18]
- 12949 OL **Control of a multidirection piezoelectric linear motor using a gyroscopic feedback control** [12949-19]

PHYSICS-BASED AND DATA-DRIVEN ANALYSIS OF SENSORY SYSTEMS AND SMART STRUCTURES I

- 12949 ON **Acoustic scattering simulations via physics-informed neural network** [12949-22]
- 12949 OO **Bayesian data fusion approach for InSAR and topographic bridge displacement monitoring (Keynote Paper)** [12949-24]

APPLICATIONS OF SENSORY SYSTEMS AND SMART STRUCTURES II

- 12949 OP **Acoustics and RF communication through deep ice for application to ocean worlds exploration (Invited Paper)** [12949-62]
- 12949 OQ **A non-contact method for robotic measurement of warping in steel girders: case study of I-95 overpass after fire** [12949-25]
- 12949 OR **Analysis of thermal behavior of prestressed double-T beam made of sustainable carbon-capturing concrete** [12949-26]
- 12949 OS **Applications of a magnetorheological damper to vibration suppression of a three-story building** [12949-28]

PHYSICS-BASED AND DATA-DRIVEN ANALYSIS OF SENSORY SYSTEMS AND SMART STRUCTURES II

- 12949 OT **Advancing precision in multiagent systems: a neuromorphic approach with spiking neural network-modified sliding innovation filter** [12949-50]

- 12949 0U **Harnessing deep learning for hierarchical sensor anomaly detection in structure health monitoring of pressure vessel** [12949-29]
- 12949 0V **Cold water saturation and vacuum saturation porosity comparison for in situ ground penetrating radar measurement in mature concrete** [12949-30]
- 12949 0W **Gear health monitoring using smart gears with printed sensor/antenna circuits by running tests** [12949-31]

SENSOR AND SMART STRUCTURE DESIGN, FABRICATION, AND IMPLEMENTATION II

- 12949 0Y **The inherent resilience of large cities to natural hazards: records, evidence, and predictions (Keynote Paper)** [12949-33]
- 12949 0Z **Experimental study on the durability of an in-line sensor epoxy membrane under pipeline cleaning events** [12949-35]
- 12949 10 **Multiphysics characterization of light intensity and wavelength of mechanoluminescent ZnS:Cu-PDMS microcomposites** [12949-36]

ADVANCES IN SENSING AND SMART STRUCTURE TECHNOLOGIES III

- 12949 12 **Sensing skin technology for structural health monitoring: from proof-of-concept to field validation (Invited Paper)** [12949-38]
- 12949 14 **Passive monitoring of structures using deconvolution-reconstructed waves** [12949-40]
- 12949 15 **Active control of a planner piezoelectric rotational motor using hall sensors and magnetic array** [12949-42]

ADVANCES IN SENSING AND SMART STRUCTURE TECHNOLOGIES IV

- 12949 16 **Performance evaluation of flexible capacitive sensors on non-uniform surfaces** [12949-43]
- 12949 17 **Acoustic emission monitoring of piping system for advanced nuclear reactors** [12949-45]
- 12949 1A **Adopt digital micromirror devise (DMD) for wavefront correction and wavefront sensing in adaptive optical system** [12949-48]

PHYSICS-BASED AND DATA-DRIVEN ANALYSIS OF SENSORY SYSTEMS AND SMART STRUCTURES III

- 12949 1B **Robust person identification across various shoe types using footstep-induced structural vibrations (Invited Paper)** [12949-49]

- 12949 1C **A network model for piezoelectric flexure actuators** [12949-51]
- 12949 1D **Optimizing stimuli-based 4D printed structures: a paradigm shift in programmable material response** [12949-52]

APPLICATIONS OF SENSORY SYSTEMS AND SMART STRUCTURES III

- 12949 1E **Low-cost and compact piezoelectric energy harvesting floor tile for battery-free Bluetooth smart pavement** [12949-55]

POSTER SESSION

- 12949 1F **Aerial inspection of physical structures with restricted access using a computer vision platform applied in drone** [12949-57]
- 12949 1J **Experimental investigation of corrosion monitoring on duplex-coated steel utilizing distributed fiber optic sensors** [12949-53]

DIGITAL POSTER SESSION

- 12949 1K **Neural network and ultrasonics integrated approach for identifying the geometric and spatial complexity in pipeline** [12949-5]
- 12949 1L **Characterization of tensile damage in half grouted sleeves with internal defects by acoustic emission** [12949-56]
- 12949 1M **Design of auxiliary drive mechanism for folding wing structure** [12949-63]
- 12949 1N **A classification method of flutter test signals based on CNN and HHT** [12949-64]

Conference Committee

Symposium Chairs

Haiying Huang, The University of Texas at Arlington (United States)
Hani Naguib, University of Toronto (Canada)

Symposium Chairs

Asha Hall, DEVCOM Army Research Laboratory (United States)
Jae-Hung Han, KAIST (Korea, Republic of)

Conference Chair

Branko Glišić, Princeton University (United States)

Conference Co-Chairs

Maria Pina Limongelli, Politecnico di Milano (Italy)
Ching Tai Ng, The University of Adelaide (Australia)

Conference Program Committee

Hiroshi Asanuma, Chiba University (Japan)
Tommy H. T. Chan, Queensland University of Technology (Australia)
Genda Chen, Missouri University of Science and Technology
(United States)
Benjamin L. Grisso, Naval Surface Warfare Center Carderock Division
(United States)
Ryan L. Harne, The Pennsylvania State University (United States)
Jung-Wuk Hong, KAIST (Korea, Republic of)
Neil A. Hoult, Queen's University (Canada)
Haiying Huang, The University of Texas at Arlington (United States)
Ying Huang, North Dakota State University (United States)
Mohammad Reza Jahanshahi, Purdue University (United States)
Robin James, General Motors Company (United States)
Gi-Woo Kim, Inha University (Korea, Republic of)
Simon Laflamme, Iowa State University of Science and Technology
(United States)
Hui Li, Harbin Institute of Technology (China)
Jian Li, The University of Kansas (United States)
Jun Li, Curtin University (Australia)
Suyi Li, Virginia Polytechnic Institute and State University
(United States)
Weibin Li, Xiamen University (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, San Diego (United States)

Theodore E. Matikas, University of Ioannina (Greece)

Norbert G. Meyendorf, University of Dayton (United States)

Isabel M. Morris, New Mexico Institute of Mining and Technology
(United States)

Rebecca Napolitano, The Pennsylvania State University
(United States)

Hae Young Noh, Carnegie Mellon University (United States)

Wieslaw M. Ostachowicz, The Szwedzki Institute of Fluid-Flow
Machinery, Polish Academy of Sciences (Poland)

Piervincenzo Rizzo, University of Pittsburgh (United States)

Donghyeon Ryu, New Mexico Institute of Mining and Technology
(United States)

Fabio Semperlotti, Purdue University (United States)

Zhongqing Su, The Hong Kong Polytechnic University
(Hong Kong, China)

Tyler N. Tallman, Purdue University (United States)

Jiong Tang, University of Connecticut (United States)

Marco Torbol, Ulsan National Institute of Science and Technology
(Korea, Republic of)

Enrico Tubaldi, University of Strathclyde (United Kingdom)

Chun H. Wang, The University of New South Wales (Australia)

Ming L. Wang, Northeastern University (United States)

Xingwei Wang, University of Massachusetts Lowell (United States)

Ya Wang, Texas A&M University (United States)

Yang Wang, Georgia Institute of Technology (United States)

Rosalind M. Wynne, Villanova University (United States)

Fuh-Gwo Yuan, North Carolina State University (United States) and
National Cheng Kung University (Taiwan)

Daniele Zonta, University degli Studi di Trento (Italy) and University of
Strathclyde (United Kingdom)