

PROCEEDINGS OF SPIE

Active and Passive Smart Structures and Integrated Systems XIX

**Xiaopeng Li
Yangyang Chen
Guoliang Huang
Mostafa A. Nough
Christopher Sugino
Serife Tol
Jinkyu Yang**
Editors

**17–21 March 2025
Vancouver, B.C., Canada**

Sponsored and Published by
SPIE

Volume 13432

Proceedings of SPIE 0277-786X, V. 13432

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 *Active and Passive Smart Structures and Integrated Systems XIX*, edited by Xiaopeng Li, Yangyang Chen, Guoliang Huang, Mostafa A. Nouh, Christopher Sugino, Serife Tol, Jinkyu Yang, Proc. of SPIE 13432, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510686502

ISBN: 9781510686519 (electronic)

Published by

SPIE

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

Telephone +1 360 676 3290 (Pacific Time)

SPIE.org

Copyright © 2025 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*

METAMATERIALS AND METASTRUCTURES I

- 13432 03 **Modeling and performance of a metamaterial beam with magnetically coupled resonators**
[13432-3]
- 13432 04 **Computational design of a large dataset of viscoelastic metastructures for inverse design in low-frequency vibration attenuation** [13432-4]

PHONONIC CRYSTALS AND ACOUSTIC/ELASTIC METAMATERIALS

- 13432 07 **Dynamic cloaking in elastic thin plates using architected metamaterials** [13432-8]

PIEZOELECTRIC METAMATERIALS

- 13432 09 **Tunable fluid-like metasurface for elastic mode decoupling** [13432-12]
- 13432 0D **A piezoelectric-based, high-frequency flow valve for noncontact excitation of turbomachinery for flutter boundary mapping** [13432-54]

METAMATERIALS AND METASTRUCTURES II

- 13432 0H **Investigating the effects of auxetic structures on galloping energy harvesting performance**
[13432-24]

AUTONOMOUS MATERIALS AND STRUCTURES

- 13432 0I **Self-powered frequency tuning via energy harvesting** [13432-17]
- 13432 0J **Optimization of a novel electromagnetic energy harvester for road infrastructures**
[13432-18]
- 13432 0K **Resource-efficient FPGA-based machine learning control for active structural damping in shock environments** [13432-19]

WILLIS METAMATERIALS

- 13432 ON **Retrieving method for elastic Willis metamaterials with mode couplings** [13432-46]

PASSIVE AND ACTIVE VIBRATION ISOLATION SYSTEMS

- 13432 OP **Design guidelines on piezoelectric transducers properties for multilayer structures hybrid damping: analytical predictions and experimental comparisons** [13432-27]
- 13432 OR **High-static low-dynamic stiffness systems: a study on quasi-zero stiffness mechanisms for optimal vibration isolation** [13432-31]

ENERGY HARVESTING AND SCAVENGING I

- 13432 OS **Harnessing human motion energy by a rolling-swing electromagnetic energy harvester with counter-rotations** [13432-33]
- 13432 OU **Predicting dynamic responses of piezoelectric energy harvesters using long short-term memory (LSTM) neural networks** [13432-37]
- 13432 OV **Investigating electrode pattern effects on piezoelectric energy harvesting using cGAN and eFEA integration** [13432-38]

ENERGY HARVESTING AND SCAVENGING II

- 13432 OW **A MEMS electrostatic energy harvester with quasi-zero stiffness control for ultra-low-frequency operation** [13432-39]
- 13432 OX **Vibration modes switching induced triple frequency up-converting and the application in wireless sensing** [13432-40]

MAGNETO RHEOLOGICAL SYSTEMS

- 13432 OY **A hybrid magnetorheological material for enhanced controllable dynamic range in vibration control applications** [13432-41]
- 13432 IO **Numerical investigation of a smart control system for enhancing seismic performance in the horizontal and vertical vibrations of a cabinet** [13432-43]

SMART SENSING

- 13432 11 **A self-powered piezoelectric sensor with dual-branch CNN for timing belt health monitoring** [13432-48]
- 13432 12 **Lorentz attractor excitation-based bolt loosening identification using enhanced transformer** [13432-49]

SMA- AND PIEZO-BASED MATERIALS AND SYSTEMS

- 13432 13 **Development of a vibration-based deicing system for aircraft wings** [13432-51]
- 13432 14 **Enhanced shape memory alloy-driven Fin Ray gripper system** [13432-52]
- 13432 15 **Design and development of a miniature self-propelled ultrasonic piezoelectric plate motor** [13432-55]

MODELING, OPTIMIZATION, SIGNAL PROCESSING, CONTROL, AND DESIGN OF INTEGRATED SYSTEM

- 13432 17 **Design of a deployable solar concentrator using Fresnel lenses for space-based solar power applications** [13432-57]
- 13432 18 **Precision control of a multi-axis robotic arm using sliding mode control with PID control method** [13432-58]
- 13432 19 **Modeling material nonlinearities in ultrasonic power transmission through metals** [13432-59]
- 13432 1A **Modeling post-process indenting using the discrete element method for particle density control in additively manufactured dampers** [13432-60]
- 13432 1B **Power optimization for an oscillating surge wave energy converter with motion amplitude constraints** [13432-61]

POSTER SESSION

- 13432 1C **Analytical and experimental verification of morphing bistable composites for aerospace thermal management** [13432-62]
- 13432 1D **Design of weight function for using response level in active vibration control of elevator rope** [13432-63]
- 13432 1E **Multiband reflective optical tracking system** [13432-64]

13432 1F **On the implementation of flexible pendulum vibration absorbers in a multi degree-of-freedom system** [13432-65]

13432 1H **Solution to the contact problem of multilayer capacitive dielectric elastomer sensor: laser-engraved elastomer buffer layer** [13432-50]

DIGITAL POSTER SESSION

13432 1I **Numerical study of a locally resonant frictional metamaterial for seismic vibration control of liquid storage tanks** [13432-5]

13432 1J **Frequency up-conversion electromagnetic energy harvester for generating electrical power from vibration of beams under moving load** [13432-32]