

PROCEEDINGS OF SPIE

Active and Passive Smart Structures and Integrated Systems 2012

Henry A. Sodano
Editor

12–15 March 2012
San Diego, California, United States

Sponsored by
SPIE

Cosponsored by
American Society of Mechanical Engineers (United States)

Cooperating Organizations
Intelligent Materials Forum (Japan)
Jet Propulsion Laboratory (United States)
National Science Foundation (United States)

Published by
SPIE

Volume 8341

Proceedings of SPIE, 0277-786X, v. 8341

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

The papers included 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. The papers published in these proceedings 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 this book:

Author(s), "Title of Paper," in *Active and Passive Smart Structures and Integrated Systems 2012*, edited by Henry A. Sodano, Proceedings of SPIE Vol. 8341 (SPIE, Bellingham, WA, 2012) Article CID Number.

ISSN 0277-786X
ISBN 9780819489982

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 © 2012, 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/12/\$18.00.

Printed in the United States of America.

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, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first 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, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four 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. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID number.

Contents

xi *Conference Committee*

SESSION 1 ENERGY HARVESTING AND SCAVENGING I: NONLINEAR ENERGY HARVESTING

- 8341 02 **Performance analysis of frequency up-converting energy harvesters for human locomotion** [8341-01]
B. Anderson, A. Wickenheiser, The George Washington Univ. (United States)
- 8341 03 **Harvestable vibrational energy from an avian source: theoretical predictions vs. measured values** [8341-02]
M. W. Shafer, R. MacCurdy, E. Garcia, D. Winkler, Cornell Univ. (United States)
- 8341 04 **Vibration energy harvesting using the nonlinear oscillations of a magnetostrictive material** [8341-03]
E. Tsutsumi, Z. del Rosario, C. Lee, Franklin W. Olin College of Engineering (United States)
- 8341 05 **A statistical linearization approach to optimal nonlinear energy harvesting** [8341-04]
I. L. Cassidy, Duke Univ. (United States); J. T. Scruggs, Univ. of Michigan (United States)

SESSION 2 PASSIVE AND ACTIVE VIBRATION ISOLATION I

- 8341 06 **New method of negative capacitance shunt tuning for vibration control** [8341-06]
B. S. Beck, K. A. Cunefare, Georgia Institute of Technology (United States); M. Collet, FEMTO-ST, CNRS (France); M. Ruzzene, Georgia Institute of Technology (United States)
- 8341 07 **Optimization of a passive piezoelectric damper for a viscously damped main system** [8341-07]
S. M. Schwarzendahl, M. Neubauer, J. Wallaschek, Leibniz Univ. Hannover (Germany)
- 8341 08 **Novel controller design demonstration for vibration alleviation of helicopter rotor blades** [8341-08]
F. D. Ulker, National Research Council of Canada (Canada); F. Nitzsche, Carleton Univ. (Canada)
- 8341 09 **Macro composites with non-classical inclusions for vibration damping in wind turbine** [8341-09]
F. Agnese, F. Scarpa, Univ. of Bristol (United Kingdom)
- 8341 0A **A bi-stable oscillator for increasing damping and providing passive adaptability** [8341-05]
D. R. Johnson, M. Thota, Univ. of Michigan (United States); F. Semperlotti, Univ. of Notre Dame (United States); K. W. Wang, Univ. of Michigan (United States)

SESSION 3 ENERGY HARVESTING AND SCAVENGING II: FLUID AND BIOLOGICAL ENERGY HARVESTING

- 8341 0C **Nonlinear dynamics of the bi-stable piezoelectric wind energy harvester** [8341-11]
M. A. Karami, Univ. of Michigan (United States); J. R. Farmer, Virginia Polytechnic Institute and State Univ. (United States); D. J. Inman, Univ. of Michigan (United States)
- 8341 0D **Design and wind tunnel experimentation of a variable blade drag type vertical axis wind turbine** [8341-12]
S. Mays, B. Bahr, California State Univ., Long Beach (United States)
- 8341 0E **Power and efficiency analysis of a flapping wing wind energy harvester** [8341-13]
M. Bryant, M. W. Shafer, E. Garcia, Cornell Univ. (United States)
- 8341 0F **A short investigation of the effect of an energy harvesting backpack on the human gait** [8341-14]
E. Papatheou, P. Green, V. Racic, J. M. W. Brownjohn, N. D. Sims, The Univ. of Sheffield (United Kingdom)
- 8341 0G **An evaluation on low-level vibration energy harvesting using piezoelectret foam** [8341-69]
S. R. Anton, K. M. Farinholt, Los Alamos National Lab. (United States)

SESSION 4 BIOLOGICAL-INSPIRED SYSTEMS AND BIO-MEMS

- 8341 0H **Fabrication and characterization of fluidic artificial muscles having millimeter-scale diameters** [8341-15]
E. G. Hocking, N. M. Wereley, Univ. of Maryland, College Park (United States)
- 8341 0I **Haptics using a smart material for eyes free interaction in mobile devices** [8341-16]
H. Wang, D. Kaleas, R. Ruuspaakka, R. Tartz, Qualcomm Inc. (United States)
- 8341 0J **Experiments on the focusing and use of acoustic energy to accelerate polymer healing** [8341-17]
A. J. Cushman, B. C. Fehrman, S. D. Gruenig, U. A. Korde, South Dakota School of Mines and Technology (United States)

SESSION 5 OPTIMIZATION AND DESIGN OF INTEGRATED SYSTEMS I

- 8341 0L **Uncertainty quantification of acoustic emission filtering techniques** [8341-19]
B. A. Zárate, J. M. Caicedo, P. Ziehl, Univ. of South Carolina (United States)
- 8341 0M **Optimal design of viscous damper connectors for adjacent structures using genetic algorithm and Nelder-Mead algorithm** [8341-20]
K. Bigdeli, W. Hare, S. Tesfamariam, The Univ. of British Columbia (Canada)
- 8341 0N **A modified command feedforward tracking control system applied to the PRRR-RR parallel mechanism** [8341-21]
J. A. Parkins, J. F. O'Brien, Univ. of Wyoming (United States)

SESSION 6 MAGNETO RHEOLOGICAL SYSTEMS I

- 8341 0O **High shear rate characterization of magnetorheological fluids** [8341-22]
A. C. Bechel, W. Hu, N. M. Wereley, Univ. of Maryland, College Park (United States)
- 8341 0P **Realization of a MRF-safety-clutch for high torsional moments based on a novel ball-clutch design** [8341-23]
M. Matthias, B. Seipel, M. Jackel, J. Kloepfer, Fraunhofer Institute Structural Durability and System Reliability (Germany)
- 8341 0Q **Feasibility study of self-powered magnetorheological damper systems** [8341-24]
C. Chen, W.-H. Liao, The Chinese Univ. of Hong Kong (Hong Kong, China)
- 8341 0S **Structural damping using encapsulated shear thickening fluids** [8341-26]
M. Soutrenon, V. Michaud, Ecole Polytechnique Fédérale de Lausanne (Switzerland)

SESSION 7 ENERGY HARVESTING AND SCAVENGING III: GENERAL ENERGY HARVESTING I

- 8341 0T **Investigating the energy harvesting potential of ferro-fluids sloshing in base-excited containers** [8341-27]
A. Bibo, R. Masana, A. King, G. Li, M. F. Daqaq, Clemson Univ. (United States)
- 8341 0W **Impedance optimization of wireless electromagnetic energy harvesters for maximum output efficiency at μ W input power** [8341-30]
A. Nimo, D. Grgić, L. M. Reindl, Albert-Ludwigs-Univ. of Freiburg (Germany)
- 8341 0X **Multiple piezoelectric energy harvesters connected to different interface circuits** [8341-31]
I. C. Lien, Y. C. Shu, National Taiwan Univ. (Taiwan)
- 8341 0Y **Electromagnetic vibration energy harvesting with high power density using a magnet array** [8341-68]
X. Tang, T. Lin, L. Zuo, SUNY at Stony Brook (United States)

SESSION 8 AIRCRAFT, MAV/UAV, AND MORPHING SYSTEMS I

- 8341 0Z **Steerable Adaptive Bullet (StAB) piezoelectric flight control system** [8341-32]
R. Barrett, R. Barnhart, R. Bramlette, The Univ. of Kansas (United States)

SESSION 9 AIRCRAFT, MAV/UAV, AND MORPHING SYSTEMS II

- 8341 13 **Material characterization for morphing purposes in order to match flight requirements** [8341-37]
S. Geier, M. Kintscher, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany);
O. Heintze, Invent GmbH (Germany); P. Wierach, H.-P. Monner, M. Wiedemann, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany)
- 8341 14 **Experimental characterization of simultaneous gust alleviation and energy harvesting for multifunctional wing spars** [8341-102]
Y. Wang, D. J. Inman, Virginia Polytechnic Institute and State Univ. (United States)

SESSION 10A MODELING, SIMULATION, SIGNAL PROCESSING, AND CONTROL OF INTEGRATED SYSTEMS I

- 8341 15 **Piezoelectric Low Net Passive Stiffness (LNPS) flutter test vane** [8341-38]
R. Barnhart, R. M. Barrett, The Univ. of Kansas (United States)
- 8341 16 **Mechanical and vibration testing of carbon fiber composite material with embedded piezoelectric sensors** [8341-39]
K. P. Duffy, The Univ. of Toledo (United States) and NASA Glenn Research Ctr. (United States); B. A. Lerch, NASA Glenn Research Ctr. (United States); N. G. Wilmoth, ASRC Aerospace Corp. (United States) and NASA Glenn Research Ctr. (United States); N. Kray, G. Gemeinhardt, GE Aviation Systems (United States)
- 8341 17 **Vibroacoustic studies on sounding rocket bulkheads** [8341-40]
J. L. Comrie, U. A. Korde, South Dakota School of Mines and Technology (United States)
- 8341 19 **Mathematical modelling of postbuckling in a slender beam column for active stabilisation control with respect to uncertainty** [8341-42]
G. C. Enss, Technische Univ. Darmstadt (Germany); R. Platz, Fraunhofer Institute for Structural Durability and System Reliability (Germany); H. Hanselka, Technische Univ. Darmstadt (Germany) and Fraunhofer Institute for Structural Durability and System Reliability (Germany)

SESSION 10B ENERGY HARVESTING AND SCAVENGING III: GENERAL ENERGY HARVESTING II

- 8341 1B **Stabilization of a wide-band nonlinear vibration energy harvester by using a nonlinear self-excitation circuit** [8341-44]
A. Masuda, A. Senda, Kyoto Institute of Technology (Japan)
- 8341 1C **Energy harvesting device for power generation onboard gravity-dropped weapons** [8341-45]
J. Rastegar, R. Murray, Omnitek Partners, LLC (United States); M. Bridge, Air Force Research Lab. (United States)
- 8341 1D **Improved piezoelectric energy harvester for powering a pulse rate sensor** [8341-46]
A. Marin, Virginia Polytechnic Institute and State Univ. (United States); P. Heitzmann, J. Twiefel, Virginia Polytechnic Institute and State Univ. (United States) and Leibniz Univ. Hannover (Germany); S. Priya, Virginia Polytechnic Institute and State Univ. (United States)
- 8341 1E **Modeling and experiment of a multiple-DOF piezoelectric energy harvester** [8341-47]
L. Tang, Y. Yang, H. Wu, Nanyang Technological Univ. (Singapore)

SESSION 11 MODELING, SIMULATION, SIGNAL PROCESSING, AND CONTROL OF INTEGRATED SYSTEMS II

- 8341 1F **Seismic fragility assessment of concrete bridge pier reinforced with shape memory alloy considering residual displacement** [8341-48]
A. H. M. Muntasir Billah, M. Shahría Alam, The Univ. of British Columbia (Canada)
- 8341 1G **On the optimization of piezoresistive plate-based sensors with distribution of piezoresistive material** [8341-49]
L. A. M. Mello, E. C. N. Silva, Univ. of São Paulo (Brazil)

- 8341 1H **Vibration reduction on a nonlinear flexible structure through resonant control and disturbance estimator** [8341-50]
G. Cazzulani, F. Resta, F. Ripamonti, Politecnico di Milano (Italy)
- 8341 1I **Control of structures featuring a new MRE isolator system** [8341-51]
M. Behrooz, X. Wang, F. Gordaninejad, Univ. of Nevada, Reno (United States)
- 8341 1J **Measurement of strain distribution in smart materials by electron Moiré method** [8341-52]
S. Kishimoto, National Institute for Materials Science (Japan); H. Asanuma, Chiba Univ. (Japan); Y. Tanaka, Y. Kagawa, National Institute for Materials Science (Japan)

SESSION 12A ENERGY HARVESTING AND SCAVENGING III: GENERAL ENERGY HARVESTING III

- 8341 1K **The concurrent suppression of an energy harvesting from surface vibrations: experimental investigations** [8341-53]
R. L. Harne, Virginia Polytechnic Institute and State Univ. (United States)
- 8341 1L **Multi-mechanism vibration harvester combining inductive and piezoelectric mechanisms** [8341-54]
A. Marin, S. Priya, Virginia Polytechnic Institute and State Univ. (United States)
- 8341 1M **Novel motion-doubling mechanism for improved piezoelectric energy-harvesting performance** [8341-55]
J. Rastegar, R. Murray, Omnitek Partners, LLC (United States); C. Pereira, U.S. Army Armament Research, Development and Engineering Ctr. (United States)

SESSION 12B SMA- AND PIEZO-BASED MATERIALS AND SYSTEMS I

- 8341 1O **Multifunctional smart material system (MSMS) using shape memory alloys and shape memory polymers** [8341-57]
P. Ghosh, A. Rao, A. R. Srinivasa, Texas A&M Univ. (United States)
- 8341 1P **Reducing vibration in carbon fiber structures with piezoelectric actuators and fiber Bragg grating sensors** [8341-58]
G. Cazzulani, S. Cinquemani, L. Comolli, A. Gardella, Politecnico di Milano (Italy)

SESSION 13A MICRO AND NANO INTEGRATED SYSTEMS

- 8341 1T **Photo-responsible gel actuator developed with scanning microscopic light scattering** [8341-62]
H. Furukawa, Yamagata Univ. (Japan); M. Yoshikawa, K. Yamada, T. Watanabe, Tokyo Univ. of Agriculture and Technology (Japan); R. Hidema, Yamagata Univ. (Japan); K. Horie, Japan Synchrotron Radiation Research Institute (Japan)

SESSION 13B SMA- AND PIEZO-BASED MATERIALS AND SYSTEMS II

- 8341 1U **Power enhancement of piezoelectric transformers by adding thermal pad** [8341-63]
Y. H. Su, Y. P. Liu, National Taiwan Univ. (Taiwan) and Ecole Normale Supérieure de Cachan (France); D. Vasic, Ecole Normale Supérieure de Cachan (France) and Univ. de Cergy-Pontoise (France); F. Costa, Ecole Normale Supérieure de Cachan (France) and Univ. Paris Est Créteil (France)
- 8341 1V **Linear and non-linear systems identification for adaptive control in mechanical applications vibration suppression** [8341-64]
G. Cazzulani, F. Resta, F. Ripamonti, Politecnico di Milano (Italy)
- 8341 1W **Development of d_{33} -mode piezocomposite generating element** [8341-65]
J. Zhao, Z. Xuan, N. S. Goo, Konkuk Univ. (Korea, Republic of)

SESSION 14A ENERGY HARVESTING AND SCAVENGING IV: DESIGN OF ENERGY HARVESTING SYSTEMS

- 8341 1Y **Multi-link piezoelectric structure for vibration energy harvesting** [8341-67]
R. M. Aryanpur, R. D. White, Tufts Univ. (United States)

SESSION 14B MAGNETO RHEOLOGICAL SYSTEMS II

- 8341 20 **Dynamic behavior of thick magnetorheological elastomers** [8341-72]
N. Johnson, X. Wang, F. Gordaninejad, Univ. of Nevada, Reno (United States)
- 8341 21 **MRF actuators with reduced no-load losses** [8341-73]
D. Güth, J. Maas, Ostwestfalen-Lippe Univ. of Applied Sciences (Germany)
- 8341 22 **A tunable 'negative' stiffness system for vibration control** [8341-104]
Z. Li, Nanjing Univ. of Science & Technology (China) and Nanjing Forestry Univ. (China); X. Wang, M. Behrooz, N. Maus, F. Gordaninejad, Univ. of Nevada, Reno (United States)
- 8341 23 **A bi-annular-gap magnetorheological energy absorber for shock and vibration mitigation** [8341-75]
X.-X. Bai, Chongqing Univ. (China) and Univ. of Maryland, College Park (United States); N. M. Wereley, Y.-T. Choi, Univ. of Maryland, College Park (United States); D.-H. Wang, Chongqing Univ. (China)

SESSION 15 PASSIVE AND ACTIVE VIBRATION ISOLATION II

- 8341 25 **Multiband damping of resonant vibrating piezoelectric structures by using digital adaptive passive shunting** [8341-77]
H. Wernick, J. Korak, PROFACTOR GmbH (Austria)
- 8341 26 **Integrated framework for jitter analysis combining disturbance, structure, vibration isolator and optical model** [8341-78]
D.-O. Lee, J.-S. Yoon, J.-H. Han, KAIST (Korea, Republic of)

- 8341 27 **Development and performance study of a magnetic aerostatic vibration isolation platform** [8341-80]
K.-N. Chang, K.-Y. Huang, National Taiwan Univ. (Taiwan)

POSTER SESSION

- 8341 29 **Peeling stress analysis of piezo-bonded laminated composite plate** [8341-84]
B. Huang, H. S. Kim, Dongguk Univ. (Korea, Republic of)
- 8341 2B **Inter-crosslinking network gels having both shape memory and high ductility** [8341-86]
Y. Amano, R. Hidema, H. Furukawa, Yamagata Univ. (Japan)
- 8341 2C **Soft and wet actuator developed with responsible high-strength gels** [8341-87]
S. Harada, R. Hidema, H. Furukawa, Yamagata Univ. (Japan)
- 8341 2F **Active vibration control of a submerged cylindrical shell by piezoelectric sensors and actuators** [8341-90]
M. K. Kwak, D.-H. Yang, J.-H. Lee, Dongguk Univ. (Korea, Republic of)
- 8341 2H **A novel method for piezoelectric energy harvesting from keyboard** [8341-92]
L. Beker, A. Muhtaroglu, H. Kulah, Middle East Technical Univ. (Turkey)
- 8341 2I **Maximizing PV module harvested output power using a computer-based automatic sun tracker** [8341-93]
A. Abou-Elmour, A. Altamimi, T. Anajamrooz, O. Abo-Elmor, Ajman Univ. of Science & Technology (United Arab Emirates)
- 8341 2J **Dynamic control of beams acted by multiple moving masses in resonance state using piezo-ceramic actuators** [8341-94]
M. Mofid, Sharif Univ. of Technology (Iran, Islamic Republic of); S. Effekhar Azama, R. Afghani Khorasgani, Politecnico di Milano (Italy)
- 8341 2K **Three-dimensional base-isolation system using thick rubber bearings** [8341-96]
T. Wang, F. Wang, China Earthquake Administration (China)
- 8341 2L **Optimization of bond transducer vibrations using active and semiactive control** [8341-97]
M. Neubauer, Leibniz Univ. Hannover (Germany); M. Brökelmann, Hesse und Knipps GmbH (Germany); S. M. Schwarzendahl, Leibniz Univ. Hannover (Germany); H.-J. Hesse, Hesse und Knipps GmbH (Germany); J. Wallaschek, Leibniz Univ. Hannover (Germany)
- 8341 2M **Optimal vibration control of a rotating plate with self-sensing active constrained layer damping** [8341-98]
Z. Xie, P. K. Wong, K. H. Lo, Univ. of Macau (Macao, China)
- 8341 2N **Development of cantilevered energy harvesters coupled with a topologically optimized piezoelectric layer oscillating in vortex** [8341-99]
C. Kim, J.-U. Shin, J.-Y. Kim, Kyungpook National Univ. (Korea, Republic of)

8341 2Q

Optimization of piezoelectric bistable composite plates for broadband vibrational energy harvesting [8341-103]

D. N. Betts, H. A. Kim, C. R. Bowen, Univ. of Bath (United States); D. J. Inman, Univ. of Michigan (United States)

Author Index

Conference Committee

Symposium Chairs

Norbert G. Meyendorf, Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (Germany) and University of Dayton (United States)
Norman M. Wereley, University of Maryland, College Park (United States)

Symposium Cochairs

Victor Giurgiutiu, University of South Carolina (United States)
Christopher S. Lynch, University of California, Los Angeles (United States)

Conference Chair

Henry A. Sodano, University of Florida (United States)

Conference Cochairs

Wei-Hsin Liao, The Chinese University of Hong Kong (Hong Kong, China)
Gyuhae Park, Los Alamos National Laboratory (United States)

Program Committee

Gregory S. Agnes, Jet Propulsion Laboratory (United States)
Mehdi Ahmadian, Virginia Polytechnic Institute and State University (United States)
Eric H. Anderson, CSA Engineering, Inc. (United States)
Hiroshi Asanuma, Chiba University (Japan)
Amr M. Baz, University of Maryland, College Park (United States)
Diann E. Brei, University of Michigan (United States)
Gregory P. Carman, University of California, Los Angeles (United States)
Aditi Chattopadhyay, Arizona State University (United States)
Seung-Bok Choi, Inha University (Korea, Republic of)
William W. Clark, University of Pittsburgh (United States)
Alison B. Flatau, University of Maryland, College Park (United States)
Farhan Gandhi, The Pennsylvania State University (United States)
Ephraim Garcia, Cornell University (United States)
Mehrdad N. Ghasemi-Nejhad, University of Hawai'i at Manoa (United States)
Victor Giurgiutiu, University of South Carolina (United States)
Fernando D. Goncalves, Lord Corporation (United States)

Faramarz Gordaninejad, University of Nevada, Reno (United States)
Nakhiah C. Goulbourne, University of Michigan (United States)
Tristram Tupper Hyde, NASA Goddard Space Flight Center
(United States)
Daniel J. Inman, Virginia Polytechnic Institute and State University
(United States)
Conor D. Johnson, CSA Engineering, Inc. (United States)
Seung Jo Kim, Seoul National University (Korea, Republic of)
Yuji Matsuzaki, Nagoya University (Japan)
Roger Ohayon, Conservatoire National des Arts et Métiers (France)
Mohammad Rastgaar Aagaah, Massachusetts Institute of Technology
(United States)
Norbert Schwesinger, Technische Universität München (Germany)
Steve Southward, Virginia Polytechnic Institute and State University
(United States)
Roger Stanway, The University of Sheffield (United Kingdom)
Kon-Well Wang, University of Michigan (United States)
Norman M. Wereley, University of Maryland, College Park
(United States)

Session Chairs

Energy Harvesting and Scavenging I: Nonlinear Energy Harvesting
Henry A. Sodano, University of Florida (United States)

Passive and Active Vibration Isolation I
Ya D. Wang, Virginia Polytechnic Institute and State University
(United States)

Energy Harvesting and Scavenging II: Fluid and Biological Energy Harvesting
Jeffrey T. Scruggs, University of Michigan (United States)

Biological-inspired Systems and Bio-MEMS
Alison B. Flatau, University of Maryland, College Park (United States)

Optimization and Design of Integrated Systems I
Kon-Well Wang, University of Michigan (United States)

Magneto Rheological Systems I
Norman M. Wereley, University of Maryland, College Park
(United States)

Energy Harvesting and Scavenging III: General Energy Harvesting I
Norbert Schwesinger, Technische Universität München (Germany)

Aircraft, MAV/UAV, and Morphing Systems I
Matthew J. Brayant, Cornell University (United States)

Aircraft, MAV/UAV, and Morphing Systems II
Matthew J. Brayant, Cornell University (United States)

Energy Harvesting and Scavenging III: General Energy Harvesting II
Henry A. Sodano, University of Florida (United States)

Modeling, Simulation, Signal Processing, and Control of Integrated Systems II
Oliver J. Myers, Mississippi State University (United States)

Energy Harvesting and Scavenging III: General Energy Harvesting III
Gyuhae Park, Los Alamos National Laboratory (United States)

SMA- and Piezo-based Materials and Systems I
Stuart G. Taylor, Los Alamos National Laboratory (United States)

Micro and Nano Integrated Systems
Wei-Hsin Liao, The Chinese University of Hong Kong
(Hong Kong, China)

SMA- and Piezo-based Materials and Systems II
Gyuhae Park, Los Alamos National Laboratory (United States)

Energy Harvesting and Scavenging IV: Design of Energy Harvesting Systems
Wei-Hsin Liao, The Chinese University of Hong Kong
(Hong Kong, China)

Magneto Rheological Systems II
Faramarz Gordaninejad, University of Nevada, Reno (United States)

Passive and Active Vibration Isolation II
Gyuhae Park, Los Alamos National Laboratory (United States)

