POWERMEMS 2023

The 22nd international conference on Micro and Nanotechnology for power generation and energy conversion applications

Abu Dhabi, UAE
11-14 December 2023

Final Program

Conference Chair:
Mohammed Daqaq, NYU Abu Dhabi, UAE

Technical Program Chair:
Paul Mitcheson, Imperial College London, UK

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WELCOME

Dear PowerMEMS Attendees,

The Steering Committee of the 22nd International Conference on Micro and Nanotechnology for Power Generation and Energy Conversion Applications (PowerMEMS 2023) is happy to welcome you to Abu Dhabi, the capital of the United Arab Emirates. As in past years, our goal is to provide a casual and friendly forum for the exchange of ideas to catalyze innovation in micro- and nano-technology for power/energy generation, conversion, and storage applications.

This year the conference is full of interesting activities. We have a Welcome Dinner Reception on Tuesday; a Tour of Abu Dhabi/Sheikh Zayed Mosque and a Banquet Dinner on Wednesday, and an exciting Desert Safari with Dinner Under the Stars on Thursday.

Sincere thanks go to the generous support of New York University, Abu Dhabi (NYUAD) and its institute for hosting this version of the conference. In its effort to ensure diversity and inclusiveness of PowerMEMS2023, NYUAD provided funding for a new inclusion initiative through which we were able to provide conference support (travel and accommodations) to 4 participants who represent racial and/or ethnic minorities or reside in underserved communities that are not typically represented in this conference.

The planning for this conference has been a significant team effort, including members of the IEEE MEMS Technical Community. The Conference Officials and the International Steering Committee were critical to our success. We must also recognize the contributions of the chairs, co-chairs, keynote and invited speakers, and PowerMEMS2023 school participants. Our thanks go to them for assembling such an outstanding technical program. We appreciate the generous support from our sponsors: IEEE, NYUAD through its Institute, the NYUAD Center for Smart Engineering Materials, and MDPI. Finally, it goes without saying that you, the authors, are the key element for the success of every version of PowerMEMS. Our special appreciation goes to you.

Sincerely,
Mohammed F. Daqaq
New York University, Abu Dhabi (NYUAD)
Conference Chair

GENERAL INFORMATION

Wireless Internet

- Select **PowerMEMS** from network options
- Password: nyuad2023 (case sensitive)

Breaks

All scheduled breaks will be held in the A6-Atrium. Coffee will be served during scheduled breaks only.

Name Badges

All attendees must wear their name badge at all times.

Chimes

The chimes will ring five minutes before the end of each scheduled break. The sessions will begin on time, so please return to the sessions when you hear the chimes.

Cellular Phones and Alarms

Out of courtesy to our speakers and other attendees, please turn off any cellular phones and alarms during sessions.

Meeting Room

See floorplan on page 7.

PowerMEMS School A6-004
Plenary Presentations ..... Auditorium - A6-008
Concurrent Session A A6-004
Concurrent Session B A6-005
Poster Sessions A6-Atrium
Breaks A6-Atrium
Lunch A6-Atrium

SOCIAL EVENTS

Your paid registration fee includes the below social events. If you did not reserve your seat for each event via email, please visit the conference registration desk for availability.

Welcome Reception Dinner

Tuesday, 12 December

Sunset Life Restaurant and Cafe

Buses will depart at 18:45 from the conference venue and will return at the end of the evening at approximately 20:45.

Abu Dhabi and Sheikh Zayed Mosque Tour and Conference Banquet

Wednesday, 13 December

Shangri-La Hotel

Buses will depart at 17:00 from the conference venue and will return at the end of the evening at approximately 20:45. Please note that buses will depart from the University to the Mosque and then directly to the dinner venue. People who wish to leave after the tour or to join dinner without the tour, must arrange their own transportation.

Closing Event - Desert Safari and Dinner Under the Stars

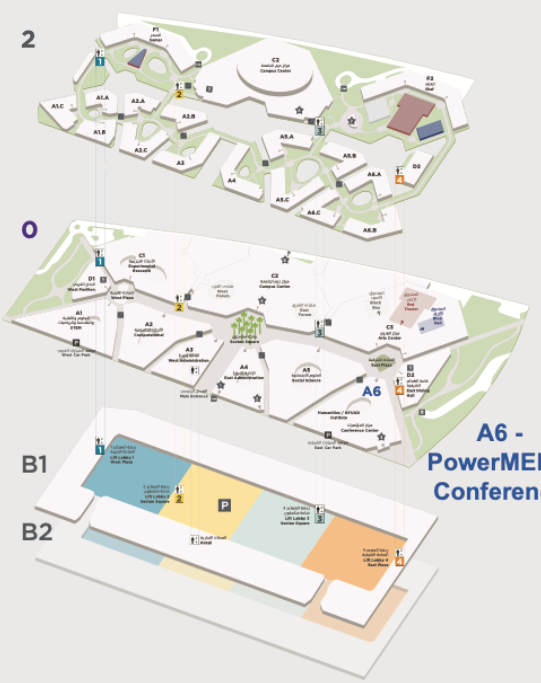
Thursday, 14 December

Buses will depart at 15:00 from the conference venue and buses will return at the end of the evening at approximately 22:00. Please plan on wearing warm clothes as temperatures may be cool.

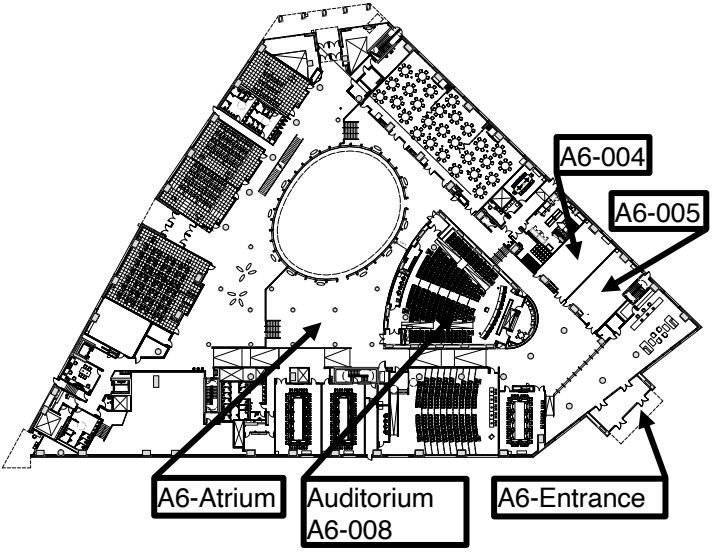
Activities:

- Dune Bashing Session (4x4 Ride Over the Sand Dunes)
- Sand Skiing
- Belly Dancing
- Henna Painting Hands or Feet
- Visit to Camel Farm
- Camel Riding

خريطة الحرم الجامعي
Campus Map



BUILDING MAP



PowerMEMS School	A6-004
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ACKNOWLEDGEMENTS

The PowerMEMS 2023 Executive Committee would like to thank the following companies and organizations for their support, encouragement, and involvement in the 22nd International Conference on Micro and Nanotechnology for Power Generation and Energy Conversion Applications.

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TECHNICAL PROGRAM INFORMATION

Guide to Understanding Paper Numbering
Each paper in the technical program is assigned a unique number (**T1A-03)** which indicates when the paper is presented. The number of each paper is shown before the paper title.

The first letter (i.e. **T**) indicates the day of the Conference:
T = Tuesday W = Wednesday Th = Thursday

The second number (i.e., **1**) indicates the session

The third letter (i.e., **A**) indicates which room the session is held in:
A = A6-004 B = A6-005

The fourth number (i.e. 04) indicates the number of the paper in the session.

Guide to Understanding Poster Numbering
Each poster is also assigned a unique number (**P1-01a**).

The second character (i.e., **1**) indicates the presentation time.
1 = 14:30 - 15:00 2 = 16:30 - 17:00

The third character (i.e., **01**) is the poster position.

The last character (i.e., **a**) shows the classification of the poster.

a Applications and Innovations in Micro Energy Systems (including PowerMEMS in Action)
b Electrical Energy Harvesting, Management, Storage and Transfer
c **I**nnovative Materials for Energy Conversion
d Mechanics and Mechanisms of Energy Harvesting Systems (Kinetic, Thermal, Solar, Bio, Triboelectric, RF, etc)
e Nonlinear Phenomenon in Energy Transduction Systems
f Thermal, Chemical Technologies for Power, Fuel Cells, Propulsion, and Cooling
g Ultra-Low- Power Sensors and Systems for IoT, industry 4.0, Wireless Sensor Networks
h Wireless Power Transfer

Monday, 11 December

All indicated times are Gulf Standard Time (GST).
Buses will depart from the Beach Rotana Hotel at 08:15

09:00-17:50 **PowerMEMS School**
A6-004

09:00 - 10:00

BATTERIES NOT INCLUDED: CIRCUITS AND SYSTEMS THAT SENSE AND SELF-POWER
Matthew Johnston
Oregon State University, USA

10:00 - 11:00

A JOURNEY THROUGH MOTION-BASED ENERGY HARVESTING: FROM DEVICES TO CIRCUITS
Adrien Morel
Université Savoie Mont Blanc, FRANCE

11:00 - 12:00

BUILDING BLOCKS OF PHOTOVOLTAIC ENERGY HARVESTING SYSTEMS
Dina El-Damak
German University in Cairo, EGYPT

12:00 **Lunch**
A6-Atrium

13:30 - 14:30

BODY-COUPLED POWERING FOR PERVASIVE WEARABLES
Jerald Yoo
National University of Singapore, SINGAPORE

14:30 - 15:30

METHODS OF WIRELESS POWER DELIVERY AND DATA TELEMETRY FOR CM-SCALE LINK DISTANCE IMPLANTS
Chul Kim
Korea Advanced Institute of Science and Technology (KAIST), KOREA

15:30 **Break**
A6-Atrium

15:50 - 16:50

ULTRASOUND WIRELESS POWER TRANSFER TO MINIATURIZED BIOMEDICAL IMPLANTS
Mehdi Kiani
Pennsylvania State University, USA

16:50 - 17:50

MAGNETOELECTRIC POWER AND DATA TRANSFERS TO MILLIMETER-SCALE BIOELECTRONIC IMPLANTS
Kaiyuan Yang
Rice University, USA

18:30- **PowerMEMS School & TPC Dinner**
20:00 Depart from Building A6-Entrance

Join us for a dinner at the ***Four Seasons Al Maryah Island***. Buses will depart at 18:00 from the conference venue and will return to the Beach Rotana Hotel at the end of the evening at approximately 21:00.

Dinner is only available for PowerMEMS School participants and TPC members.

Tuesday, 12 December

All indicated times are Gulf Standard Time (GST).
Buses will depart from the Beach Rotana Hotel at 08:00

08:45 **Conference Welcome**

Auditorium A6-008

Conference Chair:
Mohammed Daqaq, New York University Abu Dhabi, UAE

Technical Program Chair:
Paul Mitcheson, *Imperial College London, UK*

09:00 **Plenary Session I**

Chair: Mohammed F. Daqaq, New York University, Abu Dhabi, UAE

TPA-01 **ENERGY HARVESTING: A CONTROL-THEORETIC PERSPECTIVE**
Jeff Scruggs
University of Michigan, USA

10:00 **Session T1A: Triboelectric Energy Generation**

Chairs: Stephen Beeby, University of Southampton, UK and
Dennis Hohlfeld, University of Rostock, GERMANY

10:00 - 10:30

Invited
T1A-01 **TRIBOELECTRICITY: FUNDAMENTALS AND APPLICATIONS**
James Gilbert
Purdue University, USA

10:30 - 10:50

T1A-02 **NATURE-DERIVED BEETROOT BASED HIGHLY POSITIVE TRIBOELECTRIC LAYER FOR SELF-POWERED FOOTBALL PLAYER MONITORING**
S M Sohel Rana1, Tamanna Yasmin2, Anamika Barua1, and Kamaruzzaman1
[1]Noakhali Science and Technology University, BANGLADESH and [2]Korea Institute of Science and Technology (KIST), KOREA

10:50 - 11:10

T1A-03 **CATIONIC POLYMER FUNCTIONALIZED NANOFIBER MAT-BASED TRIBOELECTRIC NANOGENERATOR FOR SELF-POWERED HUMAN MOTION MONITORING**

M.Robiul Islam, Omar Faruk, S M Sohel Rana, Gagan Bahadur Pradhan, and Jae Yeong Park

Kwangwoon University, KOREA

11:10 - 11:30

T1A-04 **A STRETCHABLE TRIBOELECTRIC NANOGENERATOR BASED ON MOLYBDENUM DISULFIDE FOR WEARABLE SELF-POWERED BIOMOTION MONITORING**

HongSeok Kim, S M Sohel Rana, Omar Faruk, M. Robiul Islam, and Jae Y. Park

Kwangwoon University, KOREA

11:30 **Refreshment Break**

A6-Atrium

Session T2A: Low-Power Gas Sensing	**Session T2B: Wireless Power Transfer**
Chairs: Huicong Liu, Soochow University, CHINA and Eric Yeatman, Imperial College London, UK	Chair: Sohmyung Ha, New York University, Abu Dhabi, UAE and Jae Yeong Park, Kwangwoon University, KOREA
12:00 - 12:20	
T2A-01 **DYNAMICS OF A PIEZOELECTRIC MEMS GAS SENSOR BASED ON COUPLED MICROMACHINED RESONATORS** Zhengliang Fang, Stephanos Theodossiades, Fasil Dejene, and Amal Z. Hajjaj *Loughbrough University, UK*	**T2B-01** **GAN CLASS E WIRELESS POWER TRANSFER SYSTEM: A NEW DESIGN METHOD RELYING ON THE ADVANCED MODELING OF PARASITIC ELEMENTS** Nathis Côte, Nicolas Garraud, Léo Sterna, Pierre Périchon, François Frassati, and Sébastien Boisseau *CEA-Leti, Université Grenoble Alpes, FRANCE*

12:20 - 12:40	
T2A-02 **ENHANCEMENT OF GREENHOUSE GAS SENSING PERFORMANCE USING A HEATED MICRO-RESONATOR WITH LORENTZ-FORCES** *Ahmad T. Shalabi[1], Sofiane Ben Mbarek[2], Hassen M. Ouakad[3], and Nouha Alcheikh[1]* *[1]Khalifa University of Science and Technology, UAE, [2]Queen's University Belfast, UK, and [3]Mediterranean Institute of Technology, TUNISIA*	**T2B-02** **ELECTRODYNAMIC WIRELESS POWER TRANSFER TO HIGH PERFORMANCE ROTATING MAGNET RECEIVERS** Vernon S. Crasto, Matthew G. Stormant, and David P. Arnold *University of Florida, USA*
12:40 - 13:00	
T2A-03 **THE SENSOR FOR H_2 CONTENT MEASUREMENTS IN HYDROGENATED GASEOUS FUEL** Pawel Knapkiewicz, Tomasz Grzebyk, and Jan A. Dziuban *Wroclaw University of Science and Technology, POLAND*	**T2B-03** **ENERGY MANAGEMENT SYSTEM FOR ELECTROMAGNETIC HALBACH ARRAY WIRELESS POWER TRANSFER SYSTEM** Tamuno-Omie Gogo[1], Mould Cam[1], and Dibin Zhu[2] *[1]University of Exeter, UK and [2]Shanghai Jiao Tong University, CHINA*

13:00 **Lunch**

A6-Atrium

14:30 **Poster Session A**

A6-Atrium

Presentations are listed by topic category with their assigned number starting on page 30.

Session T3A: Innovative Materials for Energy Harvesting	Session T3B: Modeling and Optimization of Micro-Transduction Mechanisms
Chair: Onur Bilgen, Rutgers University, USA and Yu Jia, Aston University, UK	Chair: Shad Roundy, University of Utah, USA and Stephanos Theodossiades, Loughborough University, UK
15:00 - 15:20	
T3A-01 **V_2CT_X /PVDF-HFP COMPOSITE NANOFIBERS-BASED SELF-POWERED PRESSURE SENSOR FOR HUMAN FOOT PRESSURE AND ACTIVITY MONITORING** Omar Faruk, M. Robiul Islam, SM Sohel Rana, Kumar Shrestha, and Jae Yeong Park *Kwangwoon University, KOREA*	**T3B-01** **MATRIX INTERPOLATION-BASED PARAMETRIC MODEL ORDER REDUCTION OF A MINIATURIZED ELECTROMAGNETIC ENERGY HARVESTER MODEL** Chengdong Yuan[1,2], Arwed Schütz[1], Dennis Hohlfeld[2], and Tamara Bechtold[1,2] *[1]Jade University of Applied Sciences, GERMANY and [2]University of Rostock, GERMANY*
15:20 - 15:40	
T3A-02 **INVESTIGATION OF THE RELATIONSHIP BETWEEN SURFACE POTENTIAL AND FILM THICKNESS OF MICRO-PATTERNED SELF-ASSEMBLED ELECTRETS** Ruichen Li[1], Satoru Hosoi[1], Kyoichi Kakuno[1], Yuichiro Sunagawa[1], Ayato Jingu[2], Ryo Koike[2], Reiki Sugimoto[1], Yuya Tanaka[2], and Daisuke Yamane[1] *[1]Ritsumeikan University, JAPAN and [2]Gunma University, JAPAN*	**T3B-02** **ON THE ARM SWING MODEL DURING HUMAN WALKING FOR WRIST-WORN ROTATIONAL ELECTRET ENERGY HARVESTER** Tomoya Miyoshi, Xutao Mei, and Yuji Suzuki *University of Tokyo, JAPAN*

15:40 - 16:00	
T3A-03 **IMPACT OF ABSORPTION ON THE BULK PHOTOVOLTAIC EFFECT OF POLYCRYSTALLINE BISMUTH FERRITE THIN FILMS** Suirong Xie, Shipei Zhang, Ghulam Hussain, Xiaoqi Zhou, and Xiawa Wang *Duke Kunshan University, CHINA*	**T3B-03** **ADVANCEMENTS IN MODELING THE SPACE CHARGE INDUCED FLEXOELECTRIC EFFECT** Arash Kazemi[1], Travis Peters[2], Susan Trolier-McKinstry[2], and Shad Roundy[1] *[1]University of Utah, USA and [2]Pennsylvania State University, USA*

16:00 **Refreshment Break**

A6-Atrium

16:30 **Poster Session B**

A6-Atrium

Presentations are listed by topic category with their assigned number starting on page 33.

Session T4A: Ultra-Low- Power Devices for IoT, Industry 4.0, WSN	**Session T4B: Low-Power Systems and Devices**
Chair: Daewon Kim, Kyung Hee University, KOREA and Qingshuo Wei, AIST, JAPAN	Chair: Arata Masuda, Kyoto Institute of Technology, JAPAN and Peter Woias, University Freiburg, GERMANY
17:00 – 17:20	
T4A-01 **INTELLIGENT WIRELESS SELF-SUSTAINED SENSING CUBIC NODE TOWARD AIOT READY SMART CITY** Manjuan Huang[1], Tingting Zhao[1], Guoqing Jin[1], Xiaojing Mu[2], and Huicong Liu[1] *[1]Soochow University, CHINA and [2]Chongqing University, CHINA*	**T4B-01** **A FIRE DETECTION SYSTEM EMPOWERED BY PLANT WEARABLE PATCH** Farhan Sadik Sium, Steven Tran, Seungbeom Noh, and Hanseup Kim *University of Utah, USA*

17:20 – 17:40	
T4A-02 **HIGH PERFORMANCE MEMS MAGNETOMETER FOR INDUSTRIAL APPLICATIONS** Raed Alahmdi[1], Usman Yaqoob[2], Mohammad I. Younis[2,3], and Nouha Alcheikh[4] *[1]Saudi Aramco, SAUDI ARABIA, [2]King Abdullah University of Science and Technology, SAUDI ARABIA, [3]Binghamton University State University of New York, USA, and [4]Khalifa University of Science and Technology, UAE*	**T4B-02** **ELECTROSTATIC CHARGE INJECTION FOR SUSTAINABLE FACE MASK REUSE: MECHANISMS AND PERFORMANCE ENHANCEMENT** Zehua Peng[1,2], Zhuomin Zhang[1,2], Yuanyi Wang[2], and Zhengbao Yang[1,2] *[1]City University of Hong Kong, HONG KONG and [2]Hong Kong University of Science and Technology, HONG KONG*
17:40 - 18:00	
T4A-03 **COMPARATIVE STUDY OF ULTRA-LOW-POWER MICROCONTROLLERS IN ENERGY-AUTONOMOUS ENVIRONMENTAL WIRELESS SENSOR NODES (WSN)** Uttunga G. Shinde, Timm Luhmann, Laura M. Comella, and Peter Woias *University of Freiburg - IMTEK, GERMANY*	**T4B-03** **A BI-DIRECTIONAL LOW-G MEMS INERTIAL SWITCH WITH MULTIPLE THRESHOLDS FOR PASSIVE SHOCK SEVERITY QUANTIFICATION** Yousef Algoos[1], Raed Alahmdi[2], AlHammam Niyazi[3], Qiu Xu[1], Eric Feron[1], and Mohammad I. Younis[1,4] *[1]King Abdullah University of Science and Technology, SAUDI ARABIA, [2]Saudi Aramco, SAUDI ARABIA, [3]Purdue University, USA, and [4]State University of New York, Binghamton, USA*

18:00 – 18:20	
T4A-04 **IOT DEDICATED SELF-POWERED ROTATION SPEED SENSOR** Pawel Knapkiewicz, Kuba Chwialkiewicz, and Tymon Janisz *Wroclaw University of Science and Technology, POLAND*	**T4B-04** **LOW POWER MINIATURIZED DEVICE FOR GRIPPING APPLICATIONS** Solomon Apuu[1], Yousef Algoos[1], Fahimullah Khan[1], Nazek Elatab[1], and Nouha Alcheikh[2] *[1]King Abdullah University of Science and Technology, SAUDI ARABIA and [2]Khalifa University of Science and Technology, UAE*
18:20 - 18:40	
T4A-05 **FLEXIBLE PHOTOCAPACITOR DEVICE USING REDUCED GRAPHENE OXIDE@MOS_2 NANO SHEETS FOR FUTURE FLEXIBLE AND WEARABLE ELECTRONIC AND IOT DEVICES** Sambasivam Sangaraju[1], Saifudeen Kabeer[1], Nanda Kumar Reddy Nallabala[2], and B. Arjun Kumar[1] *[1]United Arab Emirates University, UAE and [2]Madanapalle Institute of Technology and Science, INDIA*	

18:45- **Welcome Dinner Reception** (included in registration)

20:45 Depart from Building A6-Entrance

Join us for a dinner at the ***Sunset Life Restaurant and Cafe***. Buses will depart at 18:45 from the conference venue and will return at the end of the evening to the Rotana Beach Hotel at approximately 20:45.

Wednesday, 13 December

All indicated times are Gulf Standard Time (GST).
Buses will depart from the Beach Rotana Hotel at 08:15

08:50 **Announcements**

Auditorium A6-004

09:00 **Plenary Session II**

Chair: Eric Yeatman, Imperial College London, UK

WPA-01 **REMOVING THE RELIANCE ON BATTERIES: ENERGY HARVESTING BASED POWER SUPPLIES FOR RAIL AND WEARABLE APPLICATIONS**
Stephen P. Beeby
University of Southampton, UK

10:00 **Session W5A: Nonlinearity for Enhanced Vibration Energy Harvesting**

Chair: Philippe Basset, University Gustave Eiffel, FRANCE and Francesco Cottone, Università degli Studi di Perugia, ITALY

10:00 - 10:30

INVITED

W5A-01 **CONCEPT DESIGNS FOR VIBRATION ENERGY HARVESTING EMPLOYING NONLINEAR DYNAMICS**
Stephanos Theodossiades[1] and Panagiotis Alevras[2]
[1]Loughborough University, UK and
[2]Technical University of Crete, GREECE

10:30 - 10:50

W5A-02 **AN IDEAL SOFTENING RESONATOR FOR NONLINEAR VIBRATION ENERGY HARVESTING WITH FLAT POWER CHARACTERISTICS**
Yu Yoshida, Motoaki Hiraga, Nanako Miura, and Arata Masuda
Kyoto Institute of Technology, JAPAN

10:50 - 11:10

W5A-03 **COEXISTENCE MECHANISM OF BI-STABILITY AND RESONANCE IN PIEZOELECTRIC ENERGY HARVESTERS THROUGH TOTAL ENERGY ANALYSIS**

Shiyu Lu[1], Ling Bu[1], and Xiaohong Wang[2]
[1]China University of Geosciences, CHINA and
[2]Tsinghua University, CHINA

11:10 **Refreshment Break**

A6-Atrium

11:40 **Session W6A: Low-Frequency/Rotational Energy Harvesting**

Chair: Michele Bonnin, Politecnico di Torino, ITALY and
Einar Halvorsen, University of South-Eastern, NORWAY

11:40 - 12:00

W6A-01 **DESIGN OF A LOW-FREQUENCY VIBRATION ENERGY HARVESTER BASED ON MOTION-SYNCHRONIZED MULTI-LAYER ELECTROSTATIC GENERATOR**

Zeyuan Cao, Seng-Hong Lee, Junchi Teng, and Xiongying Ye
Tsinghua University, CHINA

12:00 - 12:20

W6A-02 **AN ECCENTRIC PENDULUM ENERGY HARVESTER FOR HIGH-SPEED ROTATIONAL APPLICATIONS**

Sayed N. Masabi[1], Hailing Fu[2], James A. Flint[1],
and Stephanos Theodossiades[1]
[1]Loughborough University, UK and
[2]Beijing Institute of Technology, CHINA

12:20 - 12:40

W6A-03 **MEMS AIN PIEZOELECTRIC BEAMS WITH INTEGRATED NdFeB MAGNETS FOR POWER LINE AND ROTATIONAL MOTION ENERGY HARVESTING**

Ian Ge[1], Yiheng Jiang[1], Torben Dankwort[2], Steven W. Wright[1],
Michail E. Kiziroglou[1,3], and Eric M. Yeatman[1]
[1]Imperial College London, UK, [2]Fraunhofer ISIT, GERMANY, and
[3]International Hellenic University, GREECE

12:40 - 13:00

W6A-04 **AN ELECTRET ENERGY HARVESTER FOR KINETIC ENERGY AT ULTRA-LOW FREQUENCY**
Weihan Xu, Anxin Luo, and Fei Wang
Southern University of Science and Technology, CHINA

13:00 **Lunch**
A6-Atrium

Session W7A: Piezoelectric/Triboelectric Energy Harvesting	**Session W7B: Flow Energy Harvesting**
Chair: Mohammed F. Daqaq, New York University, Abu Dhabi, UAE and James M. Gibert, Purdue University, USA	Chair: Ahmed S. Dalaq, King Fahd University of Petroleum and Minerals, SAUDI ARABIA and Dibin Zhu, Shanghai Jiao Tong University, CHINA
14:30 - 14:50	
W7A-01 **HIGH FORCE COMPRESSION MODE TO SHEAR MODE PIEZOELECTRIC ENERGY HARVESTING** Fergus J.E. Crawley and Zhenhua Luo *Cranfield University, UK*	**W7B-01** **MODELING THE EFFECTS OF A PROTECTIVE FILM FOR SPONTANEOUSLY-POLARIZED ELECTRETS ON THE POWER HARVESTING PERFORMANCE OF A WIND ENERGY HARVESTER** Seyedali Sabzpoushan and Peter Woias *University of Freiburg, GERMANY*
14:50 - 15:10	
W7A-02 **OPTIMIZING THE SUBSTRATE-TO-PIEZOELECTRIC THICKNESS RATIO OF MICRO-FABRICATED ALN-ON-SI VIBRATION ENERGY HARVESTING** Yu Jia[1], Emanuelle Arroyo[2], and Ashwin A. Seshia[2] *[1]Aston University, UK and*	**W7B-02** **ROTATION-INDUCED AIRFLOW ENERGY HARVESTING USING TRANSVERSE GALLOPING FOR SELF-POWERED TOOL CONDITION MONITORING** John Morton[1] and Hailing Fu[2] *[1]Loughborough University, UK and [2]Beijing Institute of Technology, CHINA*

[2]University of Cambridge, UK	
15:10 - 15:30	
W7A-03 **SIMPLE TECHNIC FOR THE ELECTRICAL CHARACTERIZATION OF TRIBOELECTRIC NANOGENERATORS AND OTHER KINETIC ENERGY HARVESTERS WITH ELECTRET** Ahmad Delbani[1], Armine Karami[2], Dimitri Galayko[3], Malal Kane[1], and Philippe Basset[2] *[1]Université Gustave Eiffel, Pays de la Loire, FRANCE, [2]Université Gustave Eiffel, Marne-la-Vallée, FRANCE, and [3]Sorbonne Université, FRANCE*	**W7B-03** **OPTIMIZING CURVED BLUFF BODIES FOR GALLOPING MICRO-POWER GENERATORS VIA MACHINE LEARNING** Hussam Alhussein[1], Ahmad S. Dalaq[2], and Mohammed F. Daqaq[1] *[1]New York University Abu Dhabi, UAE and [2]King Fahd University of Petroleum and Minerals, SAUDI ARABIA*

15:30 **Refreshment Break**

A6-Atrium

Session W8A: Innovative Materials for Energy Harvesting	Session W8B: Modeling & Optimization of Transduction Mechanisms
Chair: Yuji Suzuki, University of Tokyo, JAPAN and Daisuke Yamane, Ritsumeikan University, JAPAN	Chair: Luc Frechette, Université de Sherbrooke, CANADA and Jerry Luo, Cranfield University, UK
16:00 - 16:20	
W8A-01 **CHARACTERIZING THE ELECTRICAL PROPERTIES OF (002)-ORIENTATED ALUMINUM-NITRIDE FILMS SYNTHESIZED DIRECTLY ON SINGLE CRYSTAL (100) SI BY REACTIVE SPUTTERING** Mostafa Keshavarzi[1], Rajesh Pandiyan[1], André Dompierre[2], Simon Loquai[2], Gabriel Droulers[2], Thierry Courcier[1], and Luc G. Fréchette[1] *[1]Université of Sherbrooke, CANADA and [2]Teledyne DALSA Semiconductor, CANADA*	**W8B-01** **TOWARDS MAXIMUM POWER CONVERSION FROM REALISTIC VIBRATIONS: LIMITS FOR SIZE-CONSTRAINED INERTIAL KINETIC ENERGY HARVESTERS UNDER BI-CHROMATIC VIBRATION INPUTS** Armine Karami[1], Moein Rahmani[1], Dimitri Galayko[2], and Philippe Basset[1] *[1]Université Gustave Eiffel, FRANCE and [2]Sorbonne Université, FRANCE*
16:20 - 16:40	
W8A-02 **INVESTIGATION OF PIEZOELECTRET PROPERTIES OF 3D PRINTED FOAMED POLYLACTIC ACID FOR ENERGY CONVERSION APPLICATIONS** Gabriele Perna, Giacomo Clementi, Alessandro Di Michele, Maurizio Mattarelli, Igor Neri, Debora Puglia, and Francesco Cottone *University of Perugia, ITALY*	**W8B-02** **A POSITION CONTROL MODELING METHOD FOR AN ORIGAMI-INSPIRED FLEXURE-BASED PIEZOELECTRIC-ACTUATED MANIPULATOR** Xu Chen[1], Einar Halvorsen[1,2], Michail E. Kiziroglou[1], and Eric M. Yeatman[1] *[1]Imperial College London, UK and [2]University of South-Eastern Norway, NORWAY*

16:40 - 17:00	
W8A-03 **SIGNIFICANT ENHANCEMENT OF PIEZOELECTRIC PROPERTIES IN MgHf HIGHLY CO-DOPED AlN THIN FILMS FOR ADVANCED SENSORS AND MICROGENERATORS** Hung H. Nguyen[1,2], Hiroyuki Oguchi[3], Le V. Minh[1], and Hiroki Kuwano[1,2] *[1]Tohoku University, JAPAN, [2]Sendai Smart Machines Co., Ltd., JAPAN, and [3]Shibaura Institute of Technology, JAPAN*	**W8B-03** **FIBER-BASED PIEZOCOMPOSITE DEVICES WITH MULTIPLE POLARIZATION REGIONS** Hesam Sharghi and Onur Bilgen *Rutgers University, USA*

17:00-21:45 **Abu Dhabi /Sheikh Zayed Mosque Tour followed by the Banquet & Award Ceremony**
(included in registration)
Depart from Building A6-Entrance

Join us for a bus tour of Abu Dhabi and a visit to the Sheikh Zayed Mosque followed by a dinner at the ***Shangri-La Hotel***. Buses will depart at 17:00 from the conference venue and will return at the end of the evening to the Rotana Beach Hotel at approximately 21:45.

Please note that buses will depart from the University to the Mosque and then directly to the dinner venue. People who wish to leave after the tour or to join dinner without the tour, must arrange their own transportation.

Thursday, 14 December

All indicated times are Gulf Standard Time (GST).

08:50 **Announcements**

A6-Atrium

09:00 **Plenary Session III**

Chair: Paul Mitcheson, Imperial College London, UK

ThPA-01 **ENERGY-AUTONOMOUS EMBEDDED SYSTEMS: WHERE DO WE STAND, WHERE TO GO?**

Peter Woias

University of Freiburg, GERMANY

10:00 **Session Th9A: Circuits & Sensors**

Chair: Paul Mitcheson, Imperial College London, UK and Zhengbao Yang, Hong Kong University of Science and Technology, CHINA

10:00 - 10:30

INVITED

Th9A-01 **CIRCUIT THEORY INSPIRED SOLUTIONS FOR ENERGY HARVESTING APPLICATIONS**

Michele Bonnin[1], Kailing Song[1,2], Fabio Lorenzo Traversa[3], and Fabrizio Bonani[1]

[1]Politecnico di Torino, ITALY, [2]IUSS University School for Advanced Studies, ITALY, and [3]Memcomputing Inc., USA

10:30 - 10:50

Th9A-02 **PHASE SHIFTED MULTI-INPUT SECE FOR POWER ENHANCEMENT IN STRONGLY-COUPLED PIEZOELECTRIC TRANSDUCERS**

Zhiwei Wang[1], Ling Bu[1], and Xiaohong Wang[2]

[1]China University of Geosciences, CHINA and [2]Tsinghua University, CHINA

10:50 - 11:10

Th9A-03 NOISE-DRIVEN MOF-COATED NEMS SENSORS

Hamza Mouharrar[1], Masoud Akbari[1,2], Kevin Musselman[1], David Muñoz-Rojas[2], Mustafa Yavuz[1], and Eihab Abdel-Rahman[1]
[1]University of Waterloo, CANADA and
[2]University of Grenoble, FRANCE

11:10 - 11:30

Th9A-04 ASSESSMENT OF THE SECURITY OF MEMS GYROSCOPES UNDER ACOUSTIC ATTACKS

Shadi Khazaaleh[1,2], Georgios Korres[1], Mohamad Eid[1,2], Mahmoud Rasras[1,2], and Mohammed F. Daqaq[1,2]
[1]New York University, Abu Dhabi, UAE and
[2]New York University, USA

11:30 Refreshment Break

A6-Atrium

Session Th10A: Thermal and Thermoelectric Energy Harvesting	**Session Th10B: Advanced Fabrication**
Chair: Mohammed F. Daqaq, New York University, Abu Dhabi, UAE and Shad Roundy, University of Utah, USA	Chair: Yu Jia, Southern University of Science and Technology, CHINA and Xiaohong "Ellen" Wang, Tsinghua University, CHINA
12:00 - 12:20	
Th10A-01 DESIGN AND FABRICATION OF FLEXIBLE SHEET-TYPE ORGANIC THERMOELECTRIC MODULES Masakazu Mukaida and Qingshuo Wei *National Institute of Advanced Industrial Science and Technology, JAPAN*	**Th10B-01 MONOLITHICALLY 3D-PRINTED, SELF-HEATING MICROFLUIDICS** Jorge Cañada and Luis F. Velásquez-García *Massachusetts Institute of Technology, USA*

12:20 - 12:40	
Th10A-02 **MULTIFUNCTIONAL TEG-PCM-ACTUATOR FOR A THERMOELECTRIC METAMATERIAL** Stefano Morese[1,2], Swathi K. Subhash[1,2], Kiran P. Nalli[1,2], William F.C. Ordoñez[1,2], Peter Woias[1,2], and Uwe Pelz[1,2] *[1]University of Freiburg, GERMANY and [2]Cluster of Excellence livMatS @ FIT, GERMANY*	**Th10B-02** **COMPARATIVE STUDY OF DIFFERENT MICROCHANNELS FOR MICROFLUIDIC PACKAGES WITH INTEGRATED THERMAL MANAGEMENT IN POWER APPLICATIONS** Bhushan Lohani, Peter Sanchez, and Robert C. Roberts *University of Texas at El Paso, USA*
12:40 - 13:00	
Th10A-03 **A HEAT-DRIVEN MICRO JET PUMP USING A SELF-OSCILLATING FLUIDIC HEAT ENGINE (SOFHE): FIRST DEMONSTRATION** Nooshin Karami, Étienne Léveillé, Amrid Amnache, and Luc G. Fréchette *Université de Sherbrooke, CANADA*	**Th10B-03** **ON CHIP INTERDIGITATED MICRO-SUPERCAPACITORS BASED ON ADDITIVE MANUFACTURING DERIVED METAL FREE 3D PYROLYTIC CARBON ELECTRODES FEATURING HIERARCHICAL MICRO- AND NANOSTRUCTURES** Swetha V. Kanakkottu, Babak Rezaei, and Stephen S. Keller *Technical University of Denmark, DENMARK*

13:00 - 13:20	
Th10A-04 **IMPLANTABLE THERMOELECTRIC GENERATOR WITH HIGH ASPECT RATIO THERMOLEGS AND INTEGRATED VOLTAGE CONVERTER** Yongchen Rao[1,2], Matthias Voss[1], Tamara Bechtold[1,2], and Dennis Hohlfeld[1] *[1]University of Rostock, GERMANY and [2]Jade University of Applied Sciences, GERMANY*	**Th10B-04** **MICROPRINTING OF BIORESORBABLE PIEZOELECTRIC RACEMIC AMINO ACID FILMS WITH ALIGNED GRAINS FOR POWER GENERATION AND IMPLANTABLE DEVICES** Zhuomin Zhang[1,2], Xuemu Li[1,2], Yuanyi Wang[1,2], Zehua Peng[1,2], and Zhengbao Yang[1,2] *[1]Hong Kong University of Science and Technology, HONG KONG and [2]City University of Hong Kong, HONG KONG*
13:20 - 13:40	
	Th10B-05 **MONOLITHICALLY 3D-PRINTED MICROFLUIDIC FLOW DISTRIBUTOR FOR UNIFORM OPERATION OF MULTIPLEXED ELECTROSPRAY DROPLET CUBESAT THRUSTERS** Hyeonseok Kim and Luis F. Velásquez-García *Massachusetts Institute of Technology, USA*

13:40	**Lunch** A6-Atrium
15:00-22:00	**Closing Event - Desert Safari and Dinner Under the Stars** (included in registration) Depart from Building A6-Entrance

Join us as we depart for a Desert Safari Banquet. Buses will depart at 15:00 from the conference venue and buses will return to Beach Rotana Hotel at approximately 22:00. Please plan on wearing warm clothes as temperatures may be cool.

Poster Session A

Tuesday, 12 December
14:30 - 15:00

a - Applications and Innovations in Micro Energy Systems (including PowerMEMS in Action)

P1-01a **DEVELOPMENT OF AN ENERGY-AUTONOMOUS PRESSURE MEASUREMENT SYSTEM USING HIGH-TEMPERATURE SHIELDED CAPACITIVE SENSORS**
Muhannad Ghanam, Utham Dev Selvaraj, Frank Goldschmidtboeing, and Peter Woias
University of Freiburg, GERMANY

b - Electrical Energy Harvesting, Management, Storage and Transfer

P1-02b **CHARGE PUMP CONCEPT BASED OSCILLATING TRIBOELECTRIC NANOGENERATOR WITH ONE FIXED POINT-STRUCTURE**
Inkyum Kim and Daewon Kim
Kyung Hee University, KOREA

c - Innovative Materials for Energy Conversion

P1-03c **DESIGN OF MINIATURE MAGNETOELECTRIC MULTI-BAND ANTENNA**
Pawan Gaire[1], Markus Novak[2], and Shubhendu Bhardwaj[1]
[1]University of Nebraska, Lincoln, USA and [2]Novaa Ltd., USA

d - Mechanics and Mechanisms of Energy Harvesting Systems (Kinetic, Thermal, Solar, Bio, Triboelectric, RF, etc)

P1-04d **A VERTICAL TURBINE-BASED UNDERWATER ENERGY HARVESTER AUTONOMOUS IN-PIPE MONITORING**
Dibin Zhu[1], George Terry[2], and Tamuno-Omie Gogo[2]
[1]Shanghai Jiao Tong University, CHINA and
[2]University of Exeter, UK

P1-05d **IMPROVEMENT IN POWER GENERATION CAPABILITY OF SELF-POWERED VIBRATION SENSOR FOR BRIDGE STRUCTURAL HEALTH MONITORING SYSTEM**

Masaya Hatanaka, Shinji Koganezawa, Hiroshi Tani, Renguo Lu, and Shouhei Kawada
Kansai University, JAPAN

P1-06d **PERFORMANCE EVALUATION OF DIRECT ELECTRIFICATION DEVICES BY USING NANOPARTICLES BETWEEN PARALLEL METAL ELECTRODES**

Jian Lu[1], Lars M. Andersson[2], Masahiro Goto[2], Lan Zhang[1], and Hiroshi Goto[2]
[1]National Institute of Advanced Industrial Science and Technology (AIST), JAPAN and [2]GCE Institute Inc., JAPAN

e - Nonlinear Phenomenon in Energy Transduction Systems

P1-07e **A NONLINEAR ENERGY HARVESTER USING BI-STABILITY FOR SELF-POWERED HEALTH MONITORING OF HIGH-SPEED TRAINS**

Mengzhou Liu[1], Yong Qin[1], Hailing Fu[2], Yin Tian[3], Dilong Tu[1], and Haixia Jia[1]
[1]Beijing Jiaotong University, CHINA,
[2]Beijing Institute of Technology, CHINA, and
[3]CRRC Academy Corporation Limited, CHINA

f - Thermal, Chemical Technologies for Power, Fuel Cells, Propulsion, and Cooling

P1-08f **MICRO/NANO SCALE EMISSION TIP FABRICATION FOR FIELD EMISSION ELECTRIC PROPULSION**

Won Gyo Seo[1], Jung Won Kuk[1], Hongrae Kim[2], Dongsoo Kang[1], and Jeongmoo Huh[3]
[1]Soletop Co., Ltd, KOREA, [2]Agency for Defense Development (ADD), KOREA, and [3]United Arab Emirates University, UAE

g - Ultra-Low- Power Sensors and Systems for IoT, industry 4.0, Wireless Sensor Networks

P1-09g **LOW PRESSURE MEMS SENSOR: ANALYSIS AND EXPERIMENTAL DEMONSTRATION**

Basil Alattar, Mehdi Ghommem, and Mohamed Hemid
American University of Sharjah, UAE

h - Wireless Power Transfer

P1-10h **RF ENERGY HARVESTER FOR WIRELESS AND BATTERY-FREE ACCELEROMETERS BASED ON ALL FABRIC DIPOLE ARRAY**

Irfan Ullah[1], Abiodun Komolafe[1], Mahmoud Wagih[2], and Steve Beeby[1]
[1]University of Southampton, UK and [2]University of Glasgow, UK

Poster Session B

Tuesday, 12 December
16:30 - 17:00

a - Applications and Innovations in Micro Energy Systems (including PowerMEMS in Action)

P2-11a **EVALUATION METHODS OF VIBRATION ENERGY HARVESTER RELIABILITY**
Takayuki Fujita[1], Isaku Kanno[2], and Yuji Suzuki[3]
[1]University of Hyogo, JAPAN, [2]Kobe University, JAPAN, and [3]University of Tokyo, JAPAN

b - Electrical Energy Harvesting, Management, Storage and Transfer

P2-12b **FULL SCREEN-PRINTED ZINC-ION SUPERCAPACITOR ON TEXTILE FOR WEARABLE ELECTRONICS**
Sheng Yong, Wenli Wei, and Stephen P. Beeby
University of Southampton, UK

c - Innovative Materials for Energy Conversion

P2-13c **POLYVINYLIDENE FLUORIDE, ZnO, AND GRAPHENE COMPOSITE SPIN COATING FOR PIEZOELECTRIC NANOGENERATORS**
Md. Jahirul Islam[1], Hyeji Lee[1], Kihak Lee[1], Seokyu Kim[1], Wolyoung Kim[1,2], Chanseob Cho[3], and Bonghwan Kim[1]
[1]Daegu Catholic University, KOREA, [2]SOLARLIGHT KOREA, KOREA, and [3]Kyungpook National University, KOREA

d - Mechanics and Mechanisms of Energy Harvesting Systems (Kinetic, Thermal, Solar, Bio, Triboelectric, RF, etc)

P2-14d **AN EQUIVALENT CIRCUIT MODEL OF SELF-ASSEMBLED ELECTRET MEMS VIBRATION ENERGY HARVESTERS BASED ON AN ENERGY DIAGRAM IN HARDWARE DESCRIPTION LANGUAGE**
Kyosuke Tokuno[1], Shohei Kinoshita[1], Fumihisa Sugitani[1], Toshiki Sono[1], Yuya Tanaka[2], and Daisuke Yamane[1]
[1]Ritsumeikan University, JAPAN and [2]Gunma University, JAPAN

P2-15d **IONIC LIQUID AND PVDF COMPOSITE FILMS FOR TRIBOELECTRIC NANOGENERATOR**
Hiroshi Tani[1], Yangwei Zhu[2], Shouhei Kawada[1], Renguo Lu[1], and Shinji Koganezawa[1]
[1]Kansai University, JAPAN and
[2]Graduate School of Kansai University, JAPAN

e - Nonlinear Phenomenon in Energy Transduction Systems

P2-16e **A MAGNETICALLY COUPLED PIEZOELECTRIC ROTATIONAL ENERGY HARVESTER WITH DUAL OPERATIONAL MODE FOR BOTH LOW AND HIGH ANGULAR VELOCITIES**
Md Shamim Ahmed[1], Mark Longden[2], Xianghong Ma[1], and Yu Jia[1]
[1]Aston University, UK and [2]RL Automotive Ltd., UK

P2-17e **ENHANCED FREQUENCY UP-CONVERSION OF VIBRATION ENERGY HARVESTERS VIA MODIFIED MAGNETIC FORCES**
Michele Rosso, Alberto Corigliano, and Raffaele Ardito
Politecnico di Milano, ITALY

g - Ultra-Low- Power Sensors and Systems for IoT, industry 4.0, Wireless Sensor Networks

P2-18g **AC-POWERED MEMS LOGIC FOR HARSH ENVIRONMENTS**
Einar Halvorsen[1,2] and Paul D. Mitcheson[2]
[1]University of South-Eastern Norway, NORWAY and
[2]Imperial College London, UK

h - Wireless Power Transfer

P2-19h **EMBROIDERED WPT RESONATOR WITH LOW RESISTIVE STRUCTURE**
Jinhyoung Kim, Kwonhong Lee, Kyusik Shin, and Cheolung Cha
Korea Electronics Technology Institute, KOREA

P2-20h **RF ENERGY HARVESTING SYSTEM WITH A MINI BRANCH-LINE COUPLER FOR MONITORING RAILWAY CONDITIONS**
Yuanyi Wang[1,2], Pengyu Li[1,2], Zhuomin Zhang[1,2], Zehua Peng[1,2], and Zhengbao Yang[1,2]
[1]Hong Kong University of Science and Technology, HONG KONG and [2]City University of Hong Kong, HONG KONG

NOTES

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AUSTIN, TEXAS 21-25 JANUARY

MEMS 2024

THE 37TH IEEE INTERNATIONAL CONFERENCE ON MICRO ELECTRO MECHANICAL SYSTEMS

PLENARY SPEAKERS

ALINA ALEXEENKO
Purdue University, USA

CHWEE TECK LIM
National University of Singapore, SINGAPORE

JÖRG WRACHTRUP
University of Stuttgart, GERMANY

KEVIN YASUMURA
Google, USA

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Wen Li, *Michigan State University, USA* & Dana Weinstein, *Purdue University, USA*

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