



# SENSORS 2022 CONFERENCE PROGRAM

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## WELCOME IEEE SENSORS 2022

Howdy! Welcome to the SENSORS 2022!

On behalf of the organizing committee of the 2022 IEEE SENSORS Conference, we are excited to welcome you to the City of Dallas, Texas, USA. The IEEE SENSORS Conference will be held on Oct. 30 – Nov. 2, 2022 at the Hyatt Regency Dallas. We are enthusiastic and excited about the first in-person conference after two years of virtual meetings due to the pandemic. There is no doubt that we all miss face-to-face interaction and networking opportunities. The organizing committee, in addition to working with the technical program committee and the track chairs to ensure paper quality, has planned several special focus and social programs, and recruited invited speakers from the pool of IEEE Sensors Journal authors to enhance the attendees' experience.

Despite the pandemic, environmental and economic challenges, 2022 marks an unprecedented time to be involved in sensor technologies. The technical areas for sensors and their applications face exciting, urgent opportunities. IEEE SENSORS 2022 brings together research scientists, engineers, practitioners and society leaders from around the world to present their latest research, ideas, findings, and opinions. The IEEE SENSORS conference continues to be the platform for researchers to share their exciting presentations as well as for attendees to experience a synergistic environment for inspiration and collaboration.

The 2022 SENSORS features three keynote speakers. Dr. Baher Haroun, Senior Fellow at Texas Instruments Inc. and Director of Advanced Technology Exploration at Kilby Labs, TI, will present a speech titled "Smart Sensing: Mixed Signal Active Sensing for Precision and Energy Efficiency". Dr. Sarah Lisanby, Director of the Division of Translational Research at the National Institute of Mental Health (NIMH), will present a speech titled "Brain-Behavior Quantification and Synchronization". Last but not least, Dr. Katia Grenier, who is heading a research team at the LAAS-CNRS, France, will give a presentation on "Microwaving Cells for Molecular, Cellular and Tissue Sensing: Which Status, Challenges and Prospects for Health and Medicine". The keynote speakers will share their visions on diverse topics of sensing technologies and applications.

The 2022 SENSORS Conference started a new initiative of inviting IEEE Sensors Journal authors to present their research work published in 2021. The invitations were based on the numbers of paper downloads on the IEEE Xplore website between January 2021 and March 2022. 95 international speakers have accepted our invitation and will present their works in the 17 oral sessions. Besides these, on Oct. 30, 6 tutorials will be offered in two tracks. On Nov. 1, as part of the Industry Day programs, two oral Industry



Track sessions will host 7 invited industry experts on standards, product research and development. Panel discussion in these two sessions will provide an opportunity for sharing industry and commercialization experiences. On Nov. 2, at the Meet the Editors panel participants can meet and discuss with Editors-in-Chief and Topical Editors of Sensors Council sponsored journals, including IEEE Sensors Journal, IEEE Sensors Letters, IEEE Internet of Things Journal, and IEEE Journal on Flexible Electronics.

2022 SENSORS also features 17 invited international speakers in the 14 technical tracks and 3 focused session tracks. The speakers were invited according to their expertise and accomplishments in the specific tracks. This year, we received a total of 654 paper submissions, of which 389 were accepted after a rigorous peer-review process. These submissions will be presented during the conference, as 178 papers in the 32 oral presentation sessions and 211 papers in two interactive forum poster sessions. The accepted papers will be published in the Conference Proceedings and electronically archived in the IEEE Xplore digital library. Submissions were from academia (86.4 %), research facilities and government laboratories (5.5 %), industry (7.5 %), and other (0.6 %). The submitted papers came from all the regions of the world, with about 29.2 % from Europe, 32.7 % from Asia/Pacific, 34.1 % from North America, and about 4 % from Latin America and Middle East/Africa. Three Best Student Paper and three Best Paper awards, as well as one Best Industry Practice Paper and one Live Demo award will be presented to the awardees in the closing ceremony on Nov. 2.

The 2022 SENSORS Conference launched an initiative of promoting female researchers and leaders' participation in the organization of the conference. Twelve of the 25 organizing committee members are female. The number of female track co-chairs increased from 1 in 2021 to 8 (24.24%) in 2022. The organizing committee members and track co-chairs were nominated and invited also based on geographical balance and continuity consideration, including researchers with experience from the past conferences, while also opening the door to new volunteers who committed to serve in the next conference as well. We appreciate very much the nomination support from many researchers all over the world and feel very honored by the enthusiasm expressed by female colleagues in the IEEE technical societies and the Sensors Council.

This year, the Women in Sensors (Wise) committee will host two programs. Four female leaders in academia and industry were invited to share their research and management experiences: Prof. Elizabeth Loboa, Provost of Southern Methodist University; Prof. Celia Shahnaz from Bangladesh University of Engineering and Technology who serves as the IEEE Women In Engineering (WIE) Chair-Elect; Dr. Bérengère Lebental from CNRS, Research Director at Université Gustave Eiffel and LPICM; and Prof. Pooi See Lee from Nanyang Technological University, Singapore. An interactive panel will be facilitated for communication between the speakers and audience. For the first time in the SENSORS Conference, a Big Idea Pitch competition is sponsored by IEEE Sensors Council WiSe Committee and Young Professionals (YP) Committee to motivate young students and researchers to pursue business ideas based on their research and learn from coaches and judges how to pitch their visions.

The 2022 SENSORS organizing committee also works closely with the Sensors Council Outreach Initiative team and several Sensors Council local chapters to promote the participation of researchers who reside in Africa and Latin America. Travel grants and registration discounts are available for application. We also host a meeting for local chapter chairs for networking and discussion of promoting membership. Travel supplement grants are also available for students to apply as an effort to encourage their participation.

We invite all attendees to join us in the cowgirl/cowboy-theme welcome reception in the evening of Oct. 30, and the Gala banquet dinner followed by Texas line dance to country music on Nov. 1. On Oct 31, IEEE Sensors Council Young Professionals (YP) committee will host a YP reception for networking and old-fashion Halloween fun.

The 2022 SENSORS conference welcomes everyone to participate in the multidisciplinary conversation in order to accelerate technologies advancing sensors for benefiting and enriching humanity. We sincerely thank all the organizing committee and technical committee members for volunteering and working hard to organize this conference and for the strong support from everyone involved.

We welcome everyone with Southern Hospitality to enjoy the culture, arts, sports, sightseeing, shopping, and gastronomy in the Dallas Fort-Worth Metroplex.

We look forward to seeing y'all in Dallas. Howdy!

**Zeynep Celik, J.-C. Chiao**

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**Rolland Vida, Jeong Bong (JB) Lee**

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J.-C. Chiao, Southern Methodist University, USA

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# IEEE SENSORS 2022 Track Chairs

## **Track 1: Sensor Phenomenology, Modeling and Evaluation**

Tarikul Islam, Jamia Millia Islamia (Central University), India  
Octavian Postolache, Instituto de Telecomunicacoes and Iscte-University Institute of Lisbon, Portugal

## **Track 2: Sensor Materials, Fabrication and Packaging**

M. Asadnia, Macquarie University, Sydney, Australia  
Arum Han, Texas A&M University, USA

## **Track 3: Chemical, Electrochemical and Gas Sensors**

D. M. G. Preethichandra, Central Queensland University, Australia  
Xiaoshan Zhu, University of Nevada Reno, USA  
Hamida Hallil, Bordeaux University, France

## **Track 4: Microfluidics and Biosensors**

Chirasree RoyChaudhuri, Indian Institute of Engineering Science and Technology (IIST), India  
Hyejin Moon, University of Texas at Arlington, USA

## **Track 5: Optical Sensors**

Cristian Manzoni, Institute for Photonics and Nanotechnologies (IFN) - CNR, Italy  
Rona Chandrawati, University of New South Wales (UNSW Sydney), Australia

## **Track 6: Physical Sensors: Temperature, Mechanical, Magnetic and Others**

Siavash Pourkamali, University of Texas at Dallas, USA  
Hadi Heidari, University of Glasgow, Scotland, UK  
Dong-Weon Lee, Chonnam National University, Korea

## **Track 7: Acoustic and Ultrasonic Sensors**

H. F. Zhang, University of North Texas, USA  
Bernhard Jakoby, Johannes Kepler University Linz, Austria

## **Track 8: Sensor Networks and IOT**

Yacine Ghamri-Doudane, La Rochelle University, France  
Elena Gaura, Coventry University, UK  
Henry Leung, University of Calgary, Canada

## **Track 9: Emerging Sensor Technologies and Applications**

Mark Cheng, The University of Alabama, USA  
Theerawit Wilaiprasitporn, Vidyasirimedhi Institute of Science and Technology, Thailand

## **Track 10: Sensor Systems: Signals, Processing and Interfaces**

Sara Moccia, The BioRobotics Institute and Department of Excellence in Robotics & AI, Scuola Superiore Sant'Anna, Italy  
Boby George, Indian Institute of Technology Madras, India



### **Track 11: Actuators, Energy Harvesting and Powering Sensors**

Smitha Rao Hatti, Michigan Technological University, USA

D. Kourtiche, Lorraine University, France

### **Track 12: Sensor Data Processing**

Marco Jose da Silva, Federal University of Technology Parana, Brazil

Valérie Renaudin, University Gustave Eiffel, France

### **Track 13: Wearable Sensors and Systems**

Hung Cao, UC Irvine, CA, USA

John S. Ho, National University of Singapore, Singapore

### **Track 14: Sensors in Industrial Practices**

Stephen F. Bart, MEMS Sensor Business Group || TDK – InvenSense, USA

J. P. Brusey, Coventry University, UK

### **Track 15: Live Demonstration of Sensors and Sensing Technologies**

Tao Li, University of Cincinnati, USA

Calogero Maria Oddo, Sant'Anna School of Advanced Studies, Pisa, Italy

### **Track 16.1 Focused Session: In-field Detection of Chemical, Biological and Security Threats**

Eduard Llobet, Universitat Rovira i Virgili, (URV) Spain

M.P. Pina, Instituto de Nanociencia y Materiales de Aragón (CSIC-Unizar). Chemical & Environmental Engineering Department, University of Zaragoza, Spain

### **Track 16.2 Focused Session: Microwave and Hot Carrier based Sensors**

Karthik Shankar, University of Alberta, Canada

Mohammad Hossein Zarifi, The University of British Columbia, Canada

### **Track 16.3 Focused Session: Bio-Remote Sensing and Integrated Artificial Intelligence Systems**

Kianoush Rassels, TU-Delft, The Netherlands

Paddy French, TU-Delft, The Netherlands

### **Track 16.4 Focused Session: Photoplethysmography Sensors and Applications**

Antti Vehkaoja, Tampere University, Finland

Christoph Hoog Antink, Technical University Darmstadt, Germany

### **Track 16.5 Focused Session: Nanomaterials based Sensors**

Sameer Sonkusale, Tufts University, USA

Shideh Kabiri Ameri, Queen's University, Canada

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Marco Jose da Silva, Federal University of Technology – Parana, Brazil

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# Council Appointed Positions (2022-2023)

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Indian Institute of Science  
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## GOLD PATRONS

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## SILVER PATRONS

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## AWARDS

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## EXHIBITORS

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## KEYNOTE

### Brain-Behavior Quantification and Synchronization

**Sarah Lisanby**, Director, Division of Translational Research, National Institute of Mental Health (NIMH), USA



Behavior is the primary output of the brain, so understanding its neural origins is key to advancing neuroscience and supporting brain health. Understanding behavior in its full complexity requires a detailed, multidimensional analysis of a broad range of behaviors in the context of the environment. Tools for quantifying neural activity with high temporal and spatial resolution already exist,

but behavior is often measured at lower resolution, making discovery of causal linkages challenging. Tools for measuring the full richness of species-appropriate behaviors, and synchronizing these to neural activity, are presently lacking. Recognizing this gap, the Brain Research Through Advancing Innovative Neurotechnologies (BRAIN) Initiative 2.0 Report calls for more sophisticated methods of quantifying behavioral, environmental, and internal state influences on individuals. This talk will survey the current state of the art of brain-behavior quantification and synchronization, highlighting gaps where novel tool development could make a transformative impact. We envision opportunities to link brain and behavior at the same resolution in real time, to bring neural recording into real world settings with ambulatory systems, to infer internal states from quantified behaviors, and artificial intelligence tools to decode internal states from tagged neural activity. Realizing that vision will entail the development of novel sensors, data fusion platforms, and advanced computational approaches for high dimensionality and multi-modal data streams. New paradigms to establish causal relationships between neural activity and behavior across species may ultimately enable the development of closed-loop therapeutic interventions for patients with complex neurobehavioral disorders that currently lack effective treatments.

## KEYNOTE

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### **Smart Sensing: Mixed Signal Active Sensing for Precision and Energy Efficiency**

**Baher Haroun**, Senior Fellow, FIEEE, Kilby Labs, Texas Instruments Inc., USA



Many sensing methods have been used for decades to measure fundamental parameters. There is increasing need for more precise, lower cost and more pervasive sensing, driven by autonomous vehicles, robotics, industrial automation, security and health/wellness needs. This talk will go over multiple active sensing examples to highlight methods where mixed signal monitoring around the sensor or Actuator/Sensor can enhance precision and/or energy efficiency. Examples in magnetic, ultrasonic, mmWave and optical sensing systems will be discussed.



## KEYNOTE

### **Microwaving Cells for Molecular, Cellular and Tissue Sensing: Which Status, Challenges and Prospects for Health and Medicine**

**Katia Grenier**, LAAS-CNRS, France



Microwaves and millimeterwaves constitute a current and quasi ubiquitous element of our surrounding and living environment. They are not only used for rapid food heating but also widely known and increasingly exploited for wireless communications, automotive radars, home automation and now with the explosion of data transfer from connected objects. In addition, microwave and millimeterwave dielectric spectroscopy is a powerful technique

to non-destructively and non-invasively sense materials. This method exploits the interaction of the electromagnetic field with matter and probes the dynamics of molecule reorientation, predominantly water molecules with its relaxation phenomenon centered around 20 GHz for bulk water, and the variations between the bulk and bounded contributions. Investigations such as macroscale moisture content measurements in agronomy, water detection in soils have been successfully carried out and exploited in industry. Dealing with biological research and biomedical applications, where non-invasive, label-free and contact-less abilities as well as in-liquid measurements constitute important leitmotifs, investigations have been conducted for long with a strong emphasis on microwave imaging for cancer detection, as well as treatments and ablations with localized heated probes. With the advent of microtechnologies and the miniaturization of microwave sensors in association to microfluidic implementations, the non-destructive and label-free analysis of molecules, cells and tissues by microwave dielectric spectroscopy has become possible. The talk will therefore provide a status on the developed sensors and the associated instrumentation, as well as on the reached sensing capabilities demonstrated on different biological and living materials and at different scales, from the molecular, cellular to the tissue level and more recently with the microtissues. It will more particularly highlight the major challenges that needed to be addressed and the remaining ones to face. Based on the illustration of the main achievements, prospects will be given towards a better biological understanding, the early diagnostic of diseases and their treatment, and towards personalized medicine.

# Tutorials

## Sensing using THz radiation



**Michael S. Shur**, Rensselaer Polytechnic Institute, USA

Terahertz sensing is enabling technology for detection of biological and chemical hazardous agents, cancer detection, detection of mines and explosives, providing security in buildings, airports, and other public space, short-range covert communications (in THz and sub-THz windows), and applications in radioastronomy, space research, defense, VLSI fabrication, and hardware cyber security. Sub-THz detection will become the key technology for the WIFI 6G enabled by Si CMOS at 3 nm and below technology nodes. This tutorial will review the-state-of-the-art of existing THz sources, detectors, sensing systems, and applications.

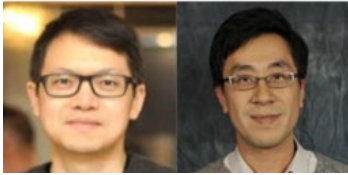
## Printed Nanostructures Based Sensors



**Ravinder Dahiya**, University of Glasgow, UK

Semiconducting nanostructures such as nanowires (NWs) and Nanoribbons (NRs) have attracted significant attention in recent years for various type of sensing as they offer attractive physical, chemical and optical properties. They have been developed using conventional micro/nanofabrication methods as well as using printing technologies. The latter is particularly attractive because of resource efficiency of printing methods and that they could open interesting avenues for next generation manufacturing of sustainable electronics. As a result, the nanostructure based electronic layers have been printed on different types of substrates to develop sensors, energy devices, and electronic devices and circuits in flexible form factors. This tutorial will present such recent advances related to printed nanostructures-based sensors. The tutorials will cover topics such as – semiconducting nanowire growth mechanisms, methods for printed electronics layers, fabrication of various sensors (photodetectors, touch, temperature, bio/chemical etc.) based on printed nanostructures, and application of these sensors in robotics, prosthetics and wearable systems.

## Low Power Sensors and Machine Learning for Industrial IoT



**Nan Xie**, University of Calgary, Canada  
**Henry Leung**, University of Calgary, Canada

It is believed that low power and ultra-low power sensors would outnumber any other IoT devices by 2030. LPWAN (Low Power, Wide Area Network) technology

has stood out as a promising low cost, long-range solution that enables battery-powered or energy-harvesting sensors to provide multiple years of services. In this tutorial, we will provide a comprehensive overview of LPWAN and compare various technologies including LoRa, Sigfox, ZigBee, BLE, LTE-M, and NB-IoT etc. Industrial battery-powered sensor applications for smart cities and field study for underground sensor deployment will be illustrated. We will also walk through the end-to-end data integration steps from sensors, radio gateway, network server to the cloud data platform using real life use case examples. Important security challenges and best practices for battery-powered sensors will be elaborated. Since low power sensors are constrained by power and resources, integration with computationally intensive Machine Learning (ML) for intelligent processing and decision making becomes a unique challenge. This tutorial will discuss and review various methods for applying ML to low power sensor solutions, including traditional centralized learning, federated ML, and TinyML for edge computing. Development trend and future research opportunities for low power sensors will also be presented.

## Optical Fibre Sensors – Past, Present and Future



**Gilberto Brambilla**, University of Southampton, UK

Optical Fibre Sensors represents a 2 billion dollar market, which is expected to reach \$ 4 billions by the end of the decade. This tutorial will provide a review of the most important sensors, including distributed optical fibre sensors, gyroscopes, chemical sensors, electromagnetic sensors, focusing on the sensing principles and the main applications. The review will also investigate prospects for future developments and possible future research in the field.

## Trends for Wearable and Medical Devices



**Subhas Chandra Mukhopadhyay**, Macquarie University, Australia

An increase in world population along with a significant aging portion is forcing rapid rises in healthcare costs. The healthcare system is going through a transformation in which continuous monitoring of inhabitants is possible even without hospitalization. Moreover, independent lifestyle and the need forces almost one-third of population in cities to live alone which increases the possibility of unforeseen incidents. The advancement of sensing technologies, embedded systems, wireless communication technologies, nano-technologies, and miniaturization makes it possible to develop smart medical systems to monitor activities of human beings continuously. Wearable sensors detect abnormal and/or unforeseen situations by monitoring physiological parameters along with other symptoms. Therefore, necessary help can be provided in times of dire need. This tutorial reviews the latest reported systems and the trends on wearable and medical devices to monitor activities of humans and issues to be addressed to tackle the challenges.

## Emerging Multivariable Gas Sensors: Moving on Beyond the Midlife Crisis of Gas Sensor Arrays



**Radislav A. Potyrailo**, Indiana University, USA

Contemporary demanding gas-monitoring needs are bringing existing gas sensor designs to their fundamental performance limits in their accuracy and stability in real-world deployments. This tutorial will focus on bridging the gap between existing and required gas detection capabilities as provided by available single-output sensors, sensor arrays, and traditional analytical instruments. We will stimulate scientific and engineering senses of attendees by (1) posing “quiz” questions on design rules of traditional analytical instruments, (2) posing questions on possibilities for new principles of gas sensing and (3) by demonstrating on how these questions are addressed in building multivariable sensors that provide new performance capabilities. We will show how individual multivariable gas sensors are designed based on multi-dimensional response principles to overcome insufficient multi-gas selectivity and stability of existing single-output sensors and sensor arrays. Such performance is attractive in scenarios when traditional analytical instruments cannot be used because of their size, power, and periodic maintenance requirements. By the end of the tutorial, attendees will have a good understanding of design rules for building stable multi-gas sensors, will see practical examples of operation of multivariable gas sensors, and will relate to how these sensors may be utilized in their envisioned applications.



# TECHNICAL PROGRAM: SUNDAY, 30 OCTOBER 2022

## 9:00 – 10:30

Registration

Room: Reunion Foyer

## 10:30 – 12:00

Printed Nanostructures Based Sensors

Ravinder Dahiya

Room: Cumberland FG

Session Chair(s): Wai Lee & J. B. Lee

## 10:30 – 12:00

Sensing Using THz Radiation

Michael S. Shur

Room: Cumberland L

Session Chair(s): Danling Wang, Brent Lunceford

## 12:00 – 13:30

Lunch

Room: Marsalis B

## 13:30 – 15:00

Trends for Wearable and Medical Devices

Subhas Chandra Mukhopadhyay

Room: Cumberland FG

Session Chair(s): Venkat Bhethanabotla & Wai Lee

## 13:30 – 15:00

Optical Fibre Sensors – Past, Present and Future

Gilberto Brambilla

Room: Cumberland L

Session Chair(s): Brent Lunceford & Sue Gong

## 15:00 – 15:30

Coffee Break

Room: Reunion Foyer

## 15:30 – 17:00

Low Power Sensors and Machine Learning for Industrial IoT

Nan Xie and Henry Leung

Room: Cumberland L

Session Chair(s): Sue Gong & Danling Wang

## 15:30 – 17:00

Emerging Multivariable Gas Sensors: Moving on Beyond the Midlife Crisis of Gas Sensor Arrays

Radislav A. Potyrailo

Room: Cumberland FG

Session Chair(s): J.B. Lee & Venkat Bhethanabotla

## 18:00 – 20:00

Welcome Reception

Room: Marsalis B

# TECHNICAL PROGRAM: MONDAY, 31 OCTOBER 2022

**7:00 – 8:30**

Registration

Room: Reunion Foyer

**8:30 – 9:00**

Opening Ceremony

Room: Reunion Ballroom

**9:00 – 10:00**

Brain-Behavior Quantification and Synchronization

Sarah Lisanby

Room: Reunion Ballroom

Session Chair(s): J.-C. Chiao & Zeynep Celik

**10:00 – 10:30**

Coffee Break

Room: Marsalis A

**10:30 – 12:00**

Sensor Materials, Fabrication & Packaging I

Room: Cumberland F

Session Chair(s): Arum Han & Hyejin Moon

**10:30**

2668: INVITED: Large-Scale 2D Surface-Micromachined Optical Ultrasound Transducer (SMOUT) Array for 3D Acoustic Tomography  
Zhiyu Yan, Jun Zou

Texas A&M University, United States

**11:00**

2128: Combining Electrothermal Actuation with Piezoelectric Actuation and Sensing in a Dynamic Mode AFM Microcantilever

Hazhir Mahmoodi Nasrabadi, Nastaran Nikooienejad, M. Bulut Coskun, S. O. Reza Moheimani

University of Texas at Dallas, United States

**11:15**

2202: Design of Density-Variable Devices for Excretable Rumen Sensors for Cattle

Yusuke Yashiro, Michitaka Yamamoto, Seiichi Takamatsu, Toshihiro Itoh

University of Tokyo, Japan

**11:30**

2578: An Inkjet-Printed Piezoresistive Bidirectional Flow Sensor

Debarun Sengupta<sup>{2}</sup>, Srikanth Birudula<sup>{2}</sup>, Heinrich Wortche<sup>{1}</sup>, Ajay Giri Prakash Kottapalli<sup>{2}</sup>

<sup>{1}</sup>Hanze University of Applied Sciences, Netherlands; <sup>{2}</sup>University of Groningen, Netherlands

**11:45**

2215: A Fully Integrated Miniatured Capacitive Angle Encoder Based on MEMS Fabrication and ASIC Implementation

Jiahui Shi, Hua Liao, Bowen Xing, Bin Zhou, Qi Wei, Rong Zhang  
Tsinghua University, China

## **10:30 – 12:00**

### **Microfluidics & Biosensors I**

Room: Cumberland G

Session Chair(s): Weihua Guan & Chirasree RoyChaudhuri

**10:30**

2664: INVITED: Lab-on-a-Smartphone (LOS): A Smartphoneintegrated, Optoelectrowetting-Driven Environmental Sensor for On-Site Detection of Water Quality

Si Kuan Thio{1}, Sung-Yong Park{2}

{1}National University of Singapore, Singapore; {2}San Diego State University, United States

**11:00**

2485: Ex Vivo Blood Viscosity Monitoring with Piezoelectric MEMS Resonators

Michael Schneider{2}, Júlia Santasusagna{2}, Ingrid Anna Maria Magnet{1}, Ulrich Schmid{2}

{1}Medical University of Vienna, Austria; {2}Technische Universität Wien, Austria

**11:15**

2113: A Miniature Microclimate Thermal Flow Sensor for Horticultural Applications

Dennis Alveringh{3}, Daniël Bijsterveld{1}, Tomas van Den Berg{1}, Henk-Willem Veltkamp{1}, Kevin Batenburg{1}, Remco Sanders{1}, Joost Lötters{2}, Remco Wiegerink{1}

{1}University of Twente, Netherlands; {2}University of Twente and Bronkhorst High-Tech B.V., Netherlands; {3}University of Twente and Salland Engineering Europe B.V., Netherlands

**11:30**

2205: Tunable Microfluidic Chip for Single-Cell Deformation Study

Ruiyun Zhang, Shuaihua Zhang, Ziyu Han, Xuexin Duan

Tianjin University, China

**11:45**

2067: Modular Microfluidic PDMS Blocks Using a Magnetic Connection System

Rafael Ecker, Manuel Langwiesner, Tina Mitteramskogler, Andreas Fuchsluger, Marcus Hintermüller, Bernhard Jakoby

Johannes Kepler University Linz, Austria

## 10:30 – 12:00

### Miscellaneous Physical Sensors

Room: Cumberland H

Session Chair(s): Hadi Heidari & Massood Tabib-Azar

#### 10:30

2674: INVITED: Near-Zero Power Integrated Microsystems for the IoT  
Matteo Rinaldi

Northeastern University, United States

#### 11:00

2380: A Wireless, Zero-Power and Multiplexed Sensor for Wound Monitoring

Zhilu Ye, Minye Yang, Nabeel Alsaab, Pai-Yen Chen

University of Illinois Chicago, United States

#### 11:15

2087: A Magnetic Sensor Based on a Nanometric Spin Transfer Torque Magnetic Tunnel Junction Suitable for Monolithic Integration

Hugo Nicolas<sup>{2}</sup>, Ricardo Sousa<sup>{1}</sup>, Ariam Mora-Hernández<sup>{1}</sup>, Ioan-Lucian Prejbeanu<sup>{1}</sup>, Luc Hebrard<sup>{4}</sup>, Jean-Baptiste Kammerer<sup>{4}</sup>, Joris Pascal<sup>{3}</sup>

<sup>{1}</sup>CEA Spintec, France; <sup>{2}</sup>FHNW, Switzerland; <sup>{3}</sup>University of Applied Sciences and Arts Northwestern, Switzerland; <sup>{4}</sup>University of Strasbourg, France

#### 11:30

2474: An X-Band Microwave Thermoelectric Power Detector in 0.18- $\mu\text{m}$  CMOS Technology

Jian-Hua Li, Xiaoping Liao

Southeast University, China

#### 11:45

2023: Influence of Size Effect on Dynamic Characteristics of Hot-Film Wall Shear Stress Sensor

Peng Pang, Binghe Ma, Zhonggang Zhang, Jian Luo, Jinjun Deng

Northwestern Polytechnical University, China

## 10:30 – 12:00

### Biomedical Applications

Room: Cumberland J

Session Chair(s): Theerawit Wilaiprasitporn & Jose L. Contreras-Vi

**10:30**

2672: INVITED: Towards Low-Cost, Wearable, Wireless EEG-Based Headset for Closed-Loop BCI Applications

Jose Contreras-Vidal<sup>{2}</sup>, Alexander Craik<sup>{2}</sup>, Jose Gonzalez-Espana<sup>{2}</sup>, Ayman Alami<sup>{1}</sup>, Jeff Feng<sup>{2}</sup>

<sup>{1}</sup>University of Houston, United States; <sup>{2}</sup>University of Houston, United States

**11:00**

2097: Millirobot Magnetic Manipulation for Ocular Drug Delivery with Sub Millimeter Precision

Céline Vergne<sup>{2}</sup>, José Inácio<sup>{2}</sup>, Thomas Quirin<sup>{2}</sup>, David Sargent<sup>{1}</sup>, Joris Pascal<sup>{2}</sup>

<sup>{1}</sup>Magnebotix AG, Switzerland; <sup>{2}</sup>University of Applied Sciences and Arts Northwestern, Switzerland

**11:15**

2477: Terahertz Detection of Deoxyribonucleic Bases, Viruses and Nano Particles

Massood Tabib-Azar

University of Utah, United States

**11:30**

2659: Classification of Colorectal Cancer Polyps via Transfer Learning and Vision-Based Tactile Sensing

Nethra Venkatayogi<sup>{2}</sup>, Ozdemir Can Kara<sup>{2}</sup>, Jeff Bonyun<sup>{2}</sup>, Naruhiko Ikoma<sup>{1}</sup>, Farshid Alambeigi<sup>{2}</sup>

<sup>{1}</sup>MD Anderson Cancer Center, United States; <sup>{2}</sup>University of Texas at Austin, United States

**11:45**

2046: Flexible Multilayer Tactile Sensor on a Soft Robotic Fingertip

Sriramana Sankar<sup>{2}</sup>, Ariel Slepian<sup>{2}</sup>, Mark Iskarous<sup>{2}</sup>, Wen-Yu Cheng<sup>{1}</sup>, Rene Debrabander<sup>{2}</sup>, Jinghua Zhang<sup>{2}</sup>, Arnav Gupta<sup>{3}</sup>, Nitish Thakor<sup>{2}</sup>

<sup>{1}</sup>Florida Atlantic University, United States; <sup>{2}</sup>Johns Hopkins University, United States; <sup>{3}</sup>University of Illinois Chicago, United States

## **10:30 – 12:00**

### **Wearables I**

Room: Cumberland K

Session Chair(s): Antti Vehkaoja & John Ho

**10:30**

2670: INVITED: Photoplethysmography – the Present and Future Workhorse of Wearable Physiological Monitoring

Steven LeBoeuf

Valencell, Inc., United States

**11:00**

2547: Detection of Normal and Paradoxical Splitting in Second Heart Sound (S2) Using a Wearable Accelerometer Contact Microphone

Brian Sang<sup>{1}</sup>, Haoran Wen<sup>{5}</sup>, Pranav Gupta<sup>{1}</sup>, Arash Shokouhmand<sup>{6}</sup>, Samiha Khan<sup>{3}</sup>, Joseph A. Puma<sup>{4}</sup>, Amisha Patel<sup>{4}</sup>, Philip Green<sup>{4}</sup>, Negar Tavassolian<sup>{6}</sup>, Farrokh Ayazi<sup>{2}</sup>  
<sup>{1}</sup>Georgia Institute of Technology, United States; <sup>{2}</sup>Georgia Institute of Technology, StethX Microsystems Inc., United States; <sup>{3}</sup>New York Institute of Technology College of Osteopathic Medicine, United States; <sup>{4}</sup>Sorin Medical P.C., United States; <sup>{5}</sup>St

**11:15**

2486: Sleep Monitoring with Intraorally Measured Photoplethysmography (PPG) Signals

Seyedfakhreddin Nabavi, John Cogan, Asim Roy, Brandon Canfield, Robert Kibler, Collin Emerick

Dianyx Innovations Inc., United States

**11:30**

2257: Wearable Bioimpedance Sensing for Quantifying Knee Health in Juvenile Idiopathic Arthritis

Emily Moise<sup>{2}</sup>, Samer Mabrouk<sup>{2}</sup>, Priya Brito<sup>{1}</sup>, Lori Ponder<sup>{1}</sup>, Sampath Prahalad<sup>{1}</sup>, Omer T. Inan<sup>{2}</sup>

<sup>{1}</sup>Emory University, United States; <sup>{2}</sup>Georgia Institute of Technology, United States

**11:45**

2131: A Low-Cost, Open Source Wireless Body Area Network for Clinical Gait Rehabilitation

Jack Twiddy<sup>{1}</sup>, Kaila Peterson<sup>{1}</sup>, Grace Maddocks<sup>{1}</sup>, Ryan MacPherson<sup>{2}</sup>, Ricky Pimentel<sup>{2}</sup>, Max Yates<sup>{1}</sup>, Cortney Armitano-Lago<sup>{2}</sup>, Adam Kiefer<sup>{2}</sup>, Brian Pietrosimone<sup>{2}</sup>, Jason Franz<sup>{2}</sup>, Michael Daniele<sup>{1}</sup>

<sup>{1}</sup>North Carolina State University, United States; <sup>{2}</sup>University of North Carolina at Chapel Hill, United States

**10:30 – 12:00**

**Journal Presentations – Introduction**

Room: Cumberland L

Session Chair(s): John Vig

**10:30**

2705: 20 Years of IEEE Sensors Journal

Sandro Carrara<sup>{1}</sup>, Gerald Gerlach<sup>{2}</sup>

<sup>{1}</sup>École Polytechnique Fédérale de Lausanne, Switzerland; <sup>{2}</sup>Technische Universität Dresden, Germany

**11:00**

2695: How to Bridge the Gap Between Academic and Industry-Oriented Sensor Research

Gerald Gerlach

Technische Universität Dresden, Germany

**11:30**

2757: Self-Packaged, Flexible, Bendable MEMS Sensors and Energy Harvesters

Zeynep Çelik-Butler, H. M. Ashfiquel Hamid

University of Texas at Arlington, United States

**11:45**

2715: Frequency-Modulated MEMS Gyroscopes: a Review

Xin Zhou, Xingjing Ren, Sheng Yu, Xuezhong Wu, Dingbang Xiao

National University of Defense Technology, China

## **10:30 – 12:00**

### **Journal Presentations – Optical Technologies**

Room: Cumberland B

Session Chair(s): Chang-hee Won

**10:30**

2775: Tactile Sensing Systems for Tumor Characterization: a Review

Chang-Hee Won<sup>{3}</sup>, Jong-Ha Lee<sup>{2}</sup>, Firdous Saleheen<sup>{1}</sup>

<sup>{1}</sup>EDDA Technology Inc., United States; <sup>{2}</sup>Keimyung University, Korea;

<sup>{3}</sup>Temple University, United States

**10:45**

2718: Towards Robust Blood Pressure Estimation from Pulse Wave Velocity Measured by Photoplethysmography Sensors

Richard Byfield, Morgan Miller, Jonathan Miles, Giovanna Guidoboni, Jian Lin

University of Missouri, United States

**11:00**

2691: A Hybrid Camera System for High-Resolutionization of Target Objects in Omnidirectional Images

Chinthaka Premachandra, Masaya Tamaki

Shibaura Institute of Technology, Japan

**11:15**

2724: Tuning Electrical Properties of Amorphous Ga<sub>2</sub>O<sub>3</sub> Thin Films for Deep UV Phototransistors

Maria Isabel Pintor-Monroy<sup>{1}</sup>, Martin Gregorio Reyes-Banda<sup>{2}</sup>, Carlos Avila-Avendano<sup>{2}</sup>, Manuel A. Quevedo-López<sup>{2}</sup>

<sup>{1}</sup>imec, Belgium; <sup>{2}</sup>University of Texas at Dallas, United States



**11:30**

2785: Deep UV Sensors Enabling Solar-Blind Flame Detectors for Large-Area Applications

Carlos Avila-Avendano{2}, Maria Isabel Pintor-Monroy{2}, Adelmo Ortiz-Conde{1}, Jesus A. Caraveo-Frescas{2}, Manuel A. Quevedo-López{2}

{1}Universidad Simón Bolívar, Venezuela; {2}University of Texas at Dallas, United States

**11:45**

2748: Development of an Optical Detection-Based Universal Biochemical Blood Analysis Platform

Sangeeta Palekar, Jayu Kalambe

Shri Ramdeobaba College of Engineering and Management, India

**12:00 – 13:30**

Lunch

Room: Marsalis B

**13:30 – 15:30**

WiSe Session

Room: Cumberland L

**13:30 – 15:30**

Interactive Forum: Sensor Materials, Fabrication & Packaging III

Room: Marsalis A

Session Chair(s): Arum Han

2095: A Heat Conduction Structure for the Etching Process of MEMS Devices With Support Anchors

Jianjun Ma{2}, Bowen Xing{2}, Pu Chen{1}, Bin Zhou{2}, Qi Wei{2}, Rong Zhang{2}

{1}East China Institute of Photo-Electron IC, China; {2}Tsinghua University, China

2142: Design and Fabrication of a Selective Sensor for the Measurement of CO Gas

Anjitha R G, Palash Kumar Basu

Indian Institute of Space Science and Technology, Trivandrum, India

2396: Ultrasensitive and Low-Cost Insole for Gait Analysis Using Piezoelectrets

Omar Ben Dali{2}, Youssef Sellami{2}, Sergey Zhukov{2}, Heinz von Seggern{2}, Niklas Schäfer{2}, Bastian Latsch{2}, Gerhard Martin Sessler{2}, Philipp Beckerle{1}, Mario Kupnik{2}

{1}Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany; {2}Technische Universität Darmstadt, Germany

#### 2434: Organophosphate Pesticide Sensor Using Copper Oxide Modified on Homemade Screen-Printed Carbon Electrodes

Thithat Tantiraksachai{1}, Natnarin Pudchakarn{1}, Pattapol Punsuwan{1}, Porpin Pungetmongkol{1}, Chanchana Thanachayanont{2}

{1}Chulalongkorn University, Thailand; {2}National Science and Technology Development Agency, Thailand

#### 2460: Silicon Nanostructure Based Surface Acoustic Wave Gas Sensor

Muhammad Izzudin Ahmad Asri{1}, Mohammed Nazibul Hasan{1}, Yusri Md Yunos{1}, Marwan Nafea{2}, Mohamed Sultan Mohamed Ali{1}

{1}Universiti Teknologi Malaysia, Malaysia; {2}University of Nottingham, Malaysia

#### 2552: A Method of Fabricating Dielectric with Enhanced Dielectrostriction Effect by Applying Electric Field

Huiyang Yu{1}, Xin Ye{1}, Yifei Pan{1}, Chenxi Guo{1}, Zefang Chen{1}, Jiacheng Tu{1}, Zhe Wu{1}, Qingying Ren{2}, Jianqiu Huang{3}, Yifeng Li{1}

{1}Nanjing Tech University, China; {2}Nanjing University of Posts and Telecommunications, China; {3}Southeast University, China

#### 2012: Effects of the Bias Magnetic Field and Annealing on the Magnetization of Terfenol-D Films

Keli Zhao, Yuhui Zhang, Guangyao Pei, Jian Luo, Binghe Ma  
Northwestern Polytechnical University, China

#### 2036: Highly Sensitive and Stretchable Multifunctional Sensor Utilized Deep Eutectic Solvent Based Ionic Skin

Jia Yu Yang, Cheng Hsin Chuang  
National Sun Yat-sen University, Taiwan

#### 2040: A Needle-Shaped Electrochemical Sensor in Platinum for Robust Monitoring of Anaesthetics

Federica Barbeni, Sandro Carrara  
École Polytechnique Fédérale de Lausanne, Switzerland

#### 2164: Integration of a Humidity Sensor with Power Electronic Applications

Weiyi Chen, Alexander Berwald, Alicia Hauke, Victoria Zimmermann, Christoph Bayer, Michael Jank  
Fraunhofer Institute for Integrated Systems and Device Technology IISB, Germany

#### 2367: Stiction Reduction in MEMS Fabrication via Naphthalene Sublimation

Hamed Nikfarjam, Sepehr Sheikhlari, Siavash Pourkamali  
University of Texas at Dallas, United States

### 2397: ZnO Nanoparticle Printing for UV Sensor Fabrication

Hendrik Joost van Ginkel, Mattia Orvietani, Joost Romijn, Guo Qi Zhang, Sten Vollebregt

Delft University of Technology, Netherlands

### 2639: Stencil Printing of Low-Cost Carbon-Based Stretchable Strain Sensors

Visva Moorthy, Panagiotis Kassanos, Etienne Burdet, Eric Yeatman

Imperial College London, United Kingdom

## 13:30 – 15:30

### Interactive Forum: Microfluidics & Biosensors IV

Room: Marsalis A

Session Chair(s): Sung-Yong Park & Hyejin Moon

### 2006: Sensitive Detection of Adrenaline Using Electrochemically Surface-Treated rGO-AuNPs Electrode

Haodong Lu{2}, Yue Huang{2}, Xiaoshan Zhu{2}, William R. Heineman{1}  
{1}University of Cincinnati, United States; {2}University of Nevada Reno, United States

### 2104: Dual-Mode Annular Spoof Surface Plasmon Polariton Based THz Compact Bio-Sensors with Increased Sensitivity and Bandwidth

Anirban Sarkar{1}, G M Hasan UI Banna{2}, Bige Unluturk{2}, Wen Li{2}  
{1}Indian Institute of Technology Mandi, India; {2}Michigan State University, United States

### 2132: Toward an Aptasensor for Monitoring of Tacrolimus

Bang Hyun Lee, Angélica Farias-Aroche, Stefano Menegatti, Michael Daniele

North Carolina State University, United States

### 2169: Micro Coriolis Mass Flow Sensor with Large Channel Diameter by Wet Etching of Silicon

Qihui Yu{1}, Mahdieh Yariesbouei{1}, Remco Wiegerink{1}, Joost Lötters{2}  
{1}University of Twente, Netherlands; {2}University of Twente and Bronkhorst High-Tech B.V., Netherlands

### 2181: Ionic Polymer Metal Composite-Based Microfluidic Flow Sensor for Bio-MEMS Applications

Paul Motreuil-Ragot, Gabriel Turcan, Bjorn de Wagenaar, Andres Hunt, Pasqualina Sarro, Massimo Mastrangeli

Delft University of Technology, Netherlands

### 2301: Micro Coriolis Mass Flow Sensor Based on Electroplated Nickel Tubes

Mahdieh Yariesbouei{1}, Remco Sanders{1}, Remco Wiegerink{1}, Joost Lötters{2}  
{1}University of Twente, Netherlands; {2}University of Twente and Bronkhorst High-Tech B.V., Netherlands

### 2310: Dielectric Characterisation of Body Phantoms Using Microstrip Line Coupled Complementary Split Ring Resonators

Muhammad Qamar, Muhammad Usman Ejaz, Akram Alomainy, Mohamed Thaha

Queen Mary University of London, United Kingdom

### 2317: Effects of Ions on Liposome-Immobilized Biosensors for the Detection of Alpha-Synuclein

Kotaro Kamitani{1}, Masanori Sawamura{2}, Hodaka Yamakado{2}, Yuya Takahashi{1}, Carl Frederik Werner{1}, Masayuki Sohga{3}, Minoru Noda{1}

{1}Kyoto Institute of Technology, Japan; {2}Kyoto University, Japan; {3}Niigata University, Japan

### 2373: Immuno-Microfluidic System with Electrospun Polystyrene Microfibrous Reactor: Application for Rapid Salivary Cortisol Detection

Yecan Wang{2}, Hiroshi Murakami{2}, Toshihiro Kasama{2}, Shigenobu Mitsuzawa{1}, Satoru Shinkawa{1}, Ryo Miyake{2}, Madoka Takai{2}

{1}Honda Motor Co., Ltd., Japan; {2}University of Tokyo, Japan

### 2378: On the Effect of Hematocrit on Dielectric Blood Coagulometry Measurements

Liam Matthews, Dante Disharoon, Sina Pourang, Anirban Sen Gupta, Michael Suster, Pedram Mohseni

Case Western Reserve University, United States

### 2395: Colorectal Cancer Biosensor Using Vertically-Oriented Silicon Nanowires

Daniel Keefe{2}, Rasheid Smith{2}, Bingtao Gao{2}, Walla Malkawi{2}, Sean Geary{2}, Pashtoon Kasi{1}, Saima Sharif{2}, Aliasger Salem{2}, Fatima Toor{2}

{1}Cornell University, United States; {2}University of Iowa, United States

### 2432: Electro-Mechanical Measurement of Cardiomyocytes for Drug Toxicity Screening

Pooja P. Kanade{2}, Nomin-Erdene Oyunbaatar{1}, Dong-Su Kim{1}, Dong-Weon Lee{1}

{1}Chonnam National University, Korea; {2}MEMS and Nanotechnology Lab, Chonnam National University, Korea

### 2439: Microfluidic Droplet-Based High-Throughput Screening of Filamentous Fungi

Yuwen Li, Jing Dai, Won-Bo Shim, Arum Han  
Texas A&M University, United States

2512: Utilizing Lateral Plate Transducer Modes for High Quality Acoustofluidics in Silicon-Based Chips

Andreas Fuchsluger{1}, Annalisa De Pastina{2}, Norbert Cselyuska{2}, Nikolai Andrianov{2}, Ali Roshanghias{2}, Tina Mitteramskogler{1}, Rafael Ecker{1}, Thomas Voglhuber-Brunnmaier{1}, Mohssen Moridi{2}, Bernhard Jakoby{1}

{1}Johannes Kepler University Linz, Austria; {2}Silicon Austria Labs GmbH, Austria

## 13:30 – 15:30

### Interactive Forum: Physical Sensors I

Room: Marsalis A

Session Chair(s): Hadi Heidari

2035: Fully Integrated Front-End CMOS-MEMS Transducer for Low-Cost Real-Time Breath Monitoring

Rafel Perelló-Roig, Francisca Orvay, Ivan de Paúl, Jaume Verd, Sebastia Bota, Jaume Segura

University of the Balearic Islands, Spain

2079: In Situ Resistance Trimming of Directly Deposited Thin-Film Strain Gauges

Rico Ottermann{2}, Shuowen Zhang{2}, Berend Denkena{3}, Heinrich Klemme{3}, Dennis Kowalke{3}, Michael Korbacher{1}, Folke Dencker{2}, Marc Christopher Wurz{2}

{1}Bosch Rexroth AG, Germany; {2}Leibniz University Hannover, Institute of Micro Production Technology, Germany; {3}Leibniz University Hannover, Institute of Production Engineering and Machine Tools, Germany

2102: Sensitive Stretchable Textile Transducer Based on Lycra1880/PEGDA/PEDOT:PSS

Hankai Wu, Cyril Lahuec, Fabrice Seguin, Laurent Dupont, Alexandre Khaldi

IMT Atlantique, France

2155: Reflective-Mode Submersible Microwave Sensor

Lijuan Su{1}, Pau Casacuberta{1}, Paris Vélez{1}, Jonathan Muñoz-Enano{1}, Marta Gil{2}, Ferran Martín{1}

{1}GEMMA/CIMITEC, Universitat Autònoma de Barcelona, Spain; {2}Universidad Politécnica de Madrid, Spain

2162: An Electric Field Microsensor with Self-Compensation for Sensitivity Drift

Zhaozhi Chu{3}, Pengfei Yang{2}, Xiaolong Wen{4}, Chunrong Peng{1}

{1}Aerospace Information Research Institute, Chinese Academy of Sciences, China; {2}Beijing Information Science and Technology University, China; {3}Institute of Microelectronics of Chinese Academy of Sciences, China; {4}University of Science and Technology

#### 2185: Investigation of Mechanical Properties of a Smart Hydrogel-Based Impedimetric Bending Sensor Platform

Benozir Ahmed{2}, Christopher Reiche{2}, Florian Solzbacher{2}, Julia Körner{1}

{1}Leibniz University Hannover, Institute of Electrical Engineering and Measurement Technology, Germany; {2}University of Utah, United States

#### 2200: Single Layer Piezoresistive Polyimide Pressure Sensor Based on Carbon Nanotubes

Tim Mike de Rijk{2}, Marco Antonio Cen-Puc{2}, Jan Kleine Piening{2}, Walter Lang{1}

{1}IMSAS, University of Bremen, Germany; {2}Universität Bremen, Germany

#### 2232: Non-Orthogonality and Amplitude Mismatch of Vertical Hall Based Angular Sensors Due to In-Plane Shear Stress

Reto Besserer{2}, Yves Mermoud{2}, Tobias Gnos{2}, Serge Reymond{1}, Pavel Kejik{1}, Jens Muttersbach{1}, Christoph Würsch{2}, Samuel Huber{2}

{1}MPS Tech Switzerland Sàrl, Switzerland; {2}OST Eastern Switzerland University of Applied Sciences, Switzerland

#### 2236: Imageless Electrical Impedance Tomography for Highly Sensitive Object Dynamics Detection

Mingde Zheng, Hassan Jahanandish, Bibek Samanta

Nokia Bell Labs, United States

#### 2253: Light Harvesting Self-Powered Strain Sensor Using 3C-SiC/Si Heterostructure

Viet Thanh Nguyen{4}, Duy Van Nguyen{4}, La Thanh Hung Nguyen{4}, Braiden Tong{1}, Canh-Dung Tran{4}, Hidetoshi Takahashi{3}, Van Thanh Dau{1}, Nam-Trung Nguyen{1}, Dzung Viet Dao{2}, Toan Dinh{4}

{1}Griffith University, Australia; {2}Griffith University, Queensland Micro- and Nanotechnology Centre, Australia; {3}Keio University, Japan; {4}University of Southern Queensland, Australia

## 13:30 – 15:30

### Interactive Forum: Physical Sensors II

Room: Marsalis A

Session Chair(s): Dong-Weon Lee

#### 2268: Nano-Gap Contact MEMS Torsional Mode Acceleration Switch Wake-Up Sensor

Yul Koh{2}, Duan Jian Goh{2}, Sagnik Ghosh{2}, Han Xuan Wong{2}, Jaibir Sharma{2}, Amit Lal{1}, Eldwin J. Ng{2}, Joshua En-Yuan Lee{2}

{1}Cornell University, United States; {2}IME, Agency for Science, Technology and Research, Singapore

2358: MEMS Self-Packaged Capacitive Absolute Pressure and Force Sensors for High-Temperature Application

Muhannad Ghanam, Thomas Bilger, Frank Goldschmidtboeing, Peter Woias

Laboratory for Design of Microsystems, IMTEK, Albert-Ludwigs-Universität Freiburg, Germany

2375: A Passive Micromechanical Counting Mechanism

Philip Schmitt, Martin Hoffmann

Ruhr-Universität Bochum, Germany

2376: Contactless Sensing of Soil Electrical Conductivity Using High Frequency Electromagnetic Induction

Dorijan Špikić, Matija Švraka, Darko Vasić

University of Zagreb, Croatia

2407: Real-Time Machine Learning Enabled Low-Cost Magnetometer System

Talha Siddique, Md Shaad Mahmud

University of New Hampshire, United States

2509: A Printed Paper-Based RFID Tag for Wireless Humidity Sensing

Seyedfakhreddin Nabavi, Hossein Anabestani, Sharmistha Bhadra

McGill University, Canada

2608: Development of a FHE Based Temperature and Humidity Sensing System for Asset Monitoring Applications

Masoud Panahi, Anthony Hanson, Dinesh Maddipatla, Simin Masihi,

Valliammai Palaniappan, Himanaga Rama Krishn Emani, Binu

Narakathu, Bradley Bazuin, Massood Atashbar

Western Michigan University, United States

## 13:30 – 15:30

Interactive Forum: Ultrasonic Sensors & Sensor Systems

Room: Marsalis A

Session Chair(s): Shahrzad Towfighian & Corinne Dejous

2064: Design and Characterization of Macroscopic Indirect Photoacoustic Gas Sensor

Ananya Srivastava<sup>{1}</sup>, Yuanji Tian<sup>{2}</sup>, Achim Bittner<sup>{1}</sup>, Alfons Dehé<sup>{2}</sup>

<sup>{1}</sup>Hahn-Schickard Gesellschaft, Germany; <sup>{2}</sup>Hahn-Schickard

Gesellschaft / IMTEK, Albert-Ludwigs-Universität Freiburg, Germany

2172: Guided Wave Resonance to Identify Damage in Thin Composite Plates

Subhadeep Basu, Supriya Gain, Arijit Sinharay, Tapas Chakravarty

Tata Consultancy Services Limited TCS Research, India



2241: Effects of Droplet Volumes on Acoustothermal Heating in 128° YX LiNbO<sub>3</sub> Substrates

Pradipta Das, Yuqi Huang, Theresa Evans-Nguyen, Venkat Bhethanabotla

University of South Florida, United States

2294: Microbalance Humidity Sensors Based on Electrospun Graphene Oxide Composites

Shuo Xu, Jie He, Zhenyu Wei, Jianqiu Huang

Southeast University, China

2339: 3D Sonar on Mars

Jaime Aru<sup>{1}</sup>, Erik Verreycken<sup>{2}</sup>, Dennis Laurijssen<sup>{2}</sup>, Jan Steckel<sup>{2}</sup>  
<sup>{1}</sup>Cosys-Lab University of Antwerp, Belgium; <sup>{2}</sup>Cosys-Lab, University of Antwerp, Belgium

2426: A Design and Modeling Software Tool for Prototyping for Ultrasonic Transceivers

Fred Livingston, Edward Grant

North Carolina State University, United States

## 13:30 – 15:30

### Interactive Forum: Prototype Emerging Sensors

Room: Marsalis A

Session Chair(s): Massood Tabib-Azar & Mark Cheng

2084: Compact High-Performance Vibration Sensor Based on Single-Backplate MEMS Technology

Somu Ashutosh Goswami<sup>{1}</sup>, Christian Bretthauer<sup>{1}</sup>, Andreas Bogner<sup>{1}</sup>, Abhiraj Basavanna<sup>{1}</sup>, Sebastian Anzinger<sup>{1}</sup>, Marco Haubold<sup>{1}</sup>, Gunar Lorenz<sup>{1}</sup>, Johann Strasser<sup>{1}</sup>, Daniel Weber<sup>{1}</sup>, Lorenzo Servadei<sup>{2}</sup>, Robert Wille<sup>{3}</sup>

<sup>{1}</sup>Infineon Technologies AG, Germany; <sup>{2}</sup>Infineon Technologies AG, Technical University of Munich, Germany; <sup>{3}</sup>Technische Universität München, Germany

2292: Smart Electronic Cigarettes with Built-In Aerosol Sensors

Hao Jiang

Lawrence Technological University, United States

2369: All-Digital Plug and Play Passive RFID Sensors for Indoor Temperature and Humidity Monitoring

Xuran Zhu<sup>{1}</sup>, Qi Zhang<sup>{1}</sup>, Mark Matlin<sup>{2}</sup>, Yizheng Chen<sup>{1}</sup>, Ying Yang<sup>{1}</sup>, Tingxuan Li<sup>{1}</sup>, Wenge Zhu<sup>{1}</sup>, Yongji Wu<sup>{1}</sup>, Huijuan Zhao<sup>{1}</sup>, Rich Pollack<sup>{2}</sup>, Marek Urban<sup>{1}</sup>, Hai Xiao<sup>{1}</sup>

<sup>{1}</sup>Clemson University, United States; <sup>{2}</sup>Phase IV Engineering, United States

2391: Wireless Power Transfer Through Soil for Energizing an Underground Soil Moisture Sensor

Sheng Ding{1}, John Sanchez{1}, Aidan Jackson{1}, Shad Roundy{1}, Ramesh Goel{1}, Cody Zesiger{2}, Darrin Young{1}

{1}University of Utah, United States; {2}Utah State University, United States

2565: A Novel In-Situ Method for Measuring Soil Organic Carbon Using Photoacoustic Sensor

Md Faishal Yousuf{2}, Md Shaad Mahmud{2}, Baikun Li{1}, Yu Lei{1}, Haiying Tao{1}

{1}University of Connecticut, United States; {2}University of New Hampshire, United States

2584: A Facile Coplanar Reverse Electrowetting-on-Dielectric Configuration for More Flexible and Integratable Force/Motion Sensing Applications

Anotidaishe Moyo{1}, Muhammad Wakil Shahzad{1}, Jonathan Terry{2}, Yoshio Mita{3}, Yifan Li{1}

{1}Northumbria University, United Kingdom; {2}University of Edinburgh, United Kingdom; {3}University of Tokyo, Japan

2593: GatorByte: A Water-Quality Mapping Buoy for Locating Watershed Pollution Sources

Piyush Agade{2}, Eban Bean{2}, Robert Dean{1}, David Blersch{1}, Jose Vasconscelos{1}, Thorsten Knappenberger{1}, Eve Brantley{1}

{1}Auburn University, United States; {2}University of Florida, United States

2611: HySenSe: A Hyper-Sensitive and High-Fidelity Vision-Based Tactile Sensor

Ozdemir Can Kara{2}, Naruhiko Ikoma{1}, Farshid Alambeigi{2}

{1}MD Anderson Cancer Center, United States; {2}University of Texas at Austin, United States

2642: Toward Distributed Fiber Optic Shape Sensing of Continuum Manipulators: A Cost-Effective and Simple Manufacturing of Sensor Assembly

Nathan Nguyen, Morgan Parker, Ozdemir Can Kara, Farshid Alambeigi  
University of Texas at Austin, United States

2657: Thermo-Phototronic Effect for Self-Powered Photodetector Using n-3C-SiC/p-Si Heterostructure

La Thanh Hung Nguyen{4}, Viet Thanh Nguyen{4}, Duy Van Nguyen{4}, Hoang-Phuong Phan{3}, Nam-Trung Nguyen{1}, Dzung Viet Dao{2}, John Bell{4}, Toan Dinh{4}

{1}Griffith University, Australia; {2}Griffith University, Queensland Micro- and Nanotechnology Centre, Australia; {3}University of New South Wales, Australia; {4}University of Southern Queensland, Australia

## 13:30 – 15:30

### Interactive Forum: Data Processing & Robotics

Room: Marsalis A

Session Chair(s): Jose L. Contreras-Vi & Mark Cheng

#### 2114: Development and Evaluation of Chip-Enabled Raised Pavement Markers for Lane Line Detection

Sachin Sharma{2}, Ali Riza Ekti{1}, Johan Fanas Rojas{2}, Nicolas Brown{2}, David Pesin{1}, Chieh Wang{1}, Shean Huff{1}, Tim LaClair{1}, Zachary Asher{2}, Richard Meyer{2}

{1}Oak Ridge National Laboratory, United States; {2}Western Michigan University, United States

#### 2267: Visible Light Positioning Using Arrays of Time-of-Flight Pixels

Zhibin Liu{2}, Nobby Stevens{1}, Miguel Heredia Conde{2}

{1}Katholieke Universiteit Leuven, Belgium; {2}Universität Siegen, Germany

#### 2286: Indoor Spatial-Environment Measurement Using Ultra-Wideband Positioning System

Mayu Yoshikawa{2}, Shinichiro Mito{2}, Hiroshi Kanasugi{1}

{1}Locationmind inc., Japan; {2}National Institute of Technology, Tokyo College, Japan

#### 2324: Vicarious Calibration of the TUBIN Infrared Sensor Suite

Julian Bartholomäus{2}, Merlin Barschke{1}, Philipp Werner{2}, Enrico Stoll{2}

{1}Deutsches ElektronenSynchrotron DESY, Germany; {2}Technische Universität Berlin, Germany

#### 2443: Low-Cost Thermal Infrared Aided Drone for Dry Patch Detection in an Intelligent Irrigation System

Harikrishnan Muraleedharan Jalajamony, Midhun Nair, Sunday Ajala, Kiara Chambers, Derricka Jones, Jailyn Battle, Patricia Mead, Renny Fernandez

Norfolk State University, United States

#### 2521: Performance Analysis of a Postural Balance Assessment Mat Prototype Using Inertial Sensor

Maryam Ghahramani{3}, Iman Hosseini{1}, Damith Herath{2}

{1}Australian National University, Australia; {2}Human Centered Technology University of Canberra, Australia; {3}University of Canberra, Australia

#### 2570: Improved Joint Estimation for Body-Mounted Motion Capture Sensors Using Human Kinematics Prior Knowledge

Shaun Stevens{2}, Paulo Garcia{3}, Hyong Kim{1}

{1}Carnegie Mellon University, United States; {2}Carnegie Mellon University, CMKL University, Thailand; {3}CMKL University, Thailand

2614: 3D Printed Soft Robotic Actuator with Embedded Strain Sensing for Position Estimation

Gerjan Wolterink, Stijn Kolkman, Gijs Krijnen

University of Twente, Netherlands

2562: An Effect of Limb Position in Motor Imagery Training Paradigm in Immersive Virtual Environment

Suktapol Kiatthaveephong{3}, Suvichak Santiwongkarn{1}, Rattanaphon Chaisaen{3}, Chutimon Rungsilp{3}, Tohru Yagi{2}, Theerawit Wilaiprasitporn{3}

{1}Sirindhorn International Institute of Technology, Thailand; {2}Tokyo Institute of Technology, Japan; {3}Vidyasirimedhi Institute of Science and Technology, Thailand

2513: A Distributed Policy Gradient Algorithm for Optimal Coordination of Mobile Sensor Networks

Jing Wang{2}, Khanh Pham{1}

{1}Air Force Research Laboratory, United States; {2}Bradley University, United States

## 13:30 – 15:30

### Interactive Forum: Sensor Signals, Processing & Applications

Room: Marsalis A

Session Chair(s): Sinisa Djurovic & Smitha Rao

2049: A Study on the Appropriateness of Visual-Related EEG Electrodes for Cybersickness Measurement

Seula Kye, Cho-I Moon, Jiwon Lee, Onseok Lee

Soonchunhyang University, Korea

2107: Sensor Fusion of 3D Time-of-Flight and Thermal Infrared Camera for Presence Detection of Living Beings

Moritz Oppliger, Jonas Gutknecht, Roman Gubler, Matthias Ludwig, Teddy Loeliger

ZHAW Zurich University of Applied Sciences, Switzerland

2146: IMU-Based Real Time Four Type Gait Analysis and Classification and Circuit Implementation

Che Wei Chang{1}, Jiun-Lin Yan{3}, Chen-Nen Chang{3}, Kuei-Ann Wen{2}

{1}Institute of Electronics National, Yang Ming Chiao Tung University, Taiwan; {2}Institute of Electronics, National Yang Ming Chiao Tung University, Taiwan; {3}Keelung Chang Gung Memorial Hospital, Taiwan

2147: The Assessments of Jumping Movement Quality and Control by Using IMU and its Clinical Applications

Yu-Jie Huang{1}, Jiun-Lin Yan{2}, Chen-Nen Chang{2}, Pao-Min Chu{1}, Kuei-Ann Wen{1}

{1}Institute of Electronics, National Yang Ming Chiao Tung University, Taiwan; {2}Keelung Chang Gung Memorial Hospital, Taiwan

### 2188: Comparative Study on Electromagnetic Tracking and Fiber Bragg Grating-Based Catheter Shape Sensing

Xuan Thao Ha{1}, Izadyar Tamadon{2}, Mouloud Ourak{1}, Gianni Borghesan{1}, Arianna Mencias{2}, Emmanuel Vander Poorten{1}  
{1}Katholieke Universiteit Leuven, Belgium; {2}Scuola Superiore Sant'Anna, Italy

### 2309: Data Resolution Optimisation to Address Wireless Connectivity in Infrasound Measurement Systems

Samir-Sharif El Rhaz{2}, Antoine Courtay{2}, Anthony Hue{1}, Olivier Berder{2}

{1}SeismoWave, France; {2}Université de Rennes 1, CNRS, France

### 2329: Construction of an Electronic Nose for Disinfectant Concentration Detection in Cold Chain Environment

Guishuai Zhang{2}, Guangfen Wei{2}, Ru Yin{2}, Nannan Shen{2}, Zhilin Zhu{2}, Jun Yu{1}

{1}Dalian University of Technology, China; {2}Shandong Technology and Business University, China

### 2340: Predicting Visual Stimuli from Cortical Response Recorded with Widefield Imaging in a Mouse

Daniela De Luca{1}, Sara Moccia{3}, Leonardo Lupori{2}, Raffaele Mazziotti{4}, Tommaso Pizzorusso{2}, Silvestro Micera{3}

{1}Sant'Anna School of Advanced Studies, Italy; {2}Scuola Normale Superiore, Italy; {3}Scuola Superiore Sant'Anna, Italy; {4}University of Florence, Italy

### 2377: Low-Power Level-Crossing Rate-Based Diver Detection System

Fran Penić{2}, Marko Gazivoda{1}, Nikola Mišković{2}, Vedran Bilas{2}

{1}INTIS d.o.o., Croatia; {2}University of Zagreb, Croatia

### 2490: Differential Phase Shift Detection System for High Sensitivity High Resolution Optical Sensing of Nanostructured Plasmonic Thin-Films

Guido Di Patrizio Stanchieri{1}, Andrea De Marcellis{1}, Marco Faccio{1}, Elia Palange{1}, Annalisa Scroccarello{2}, Flavio Della Pelle{2}, Dario Compagnone{2}

{1}University of L'Aquila, Italy; {2}University of Teramo, Italy

### 2518: A Highly Linear Current Steering DAC for Neural Stimulation of an Artificial Retinal Prostheses

Mohamed Taha, Khaled M. Morsi, Ahmed Naguib

Military Technical College, Egypt

### 2543: Preliminary Results on Sensing Pillow to Monitor Head Movement Using Strain Sensing Threads

Minghan Liu, Ruben Del-Rio-Ruiz, Atul Sharma, Cihan Asci, Rachel E. Owyung, Sameer Sonkusale

Tufts University, United States

**13:30 – 15:30**

## Interactive Forum: Wearables IV

Room: Marsalis A

Session Chair(s): John Ho & Theerawit Wilaiprasitporn

**205I: Voice Processing by Wideband Accelerometers with Immunity to Environmental Acoustic Noise**

Enrico Rosario Alessi, Ivana Guarneri, Fabio Passaniti, Michele Dellutri  
STMicroelectronics, Italy

**206I: Heartbeat Waveform Measurement Results of Several Persons Using a Small Card-Sized VHF-Band Heartbeat Sensor Module**

Saki Wada<sup>{2}</sup>, Kengo Nishimoto<sup>{2}</sup>, Yoshio Inasawa<sup>{2}</sup>, Shintaro Izumi<sup>{1}</sup>  
<sup>{1}</sup>Kobe University, Japan; <sup>{2}</sup>Mitsubishi Electric Corporation, Japan

**2075: Near-Infrared Photodetectors Based on a Liquid Crystalline Organic Semiconductor for Photoplethysmography Applications**

Shahriar Kabir, Yukiko Takayashiki, Jun-Ichi Hanna, Hiroaki Iino  
Tokyo Institute of Technology, Japan

**2077: vMic: A Surface Vibration Microphone**

Chun-Ming Huang, Fu-Cheng Cheng, Jin-Ju Chue, Wei-Lin Lai, Yi-Jie Hsieh, Chih-Chyau Yang, Chien-Ming Wu

Taiwan Semiconductor Research Institute, Taiwan

**2100: Wearable Pressure Sensor Suit for Real-Time Detection of Incorrect Exercise Techniques**

Ivin Kuriakose, Shirley Chauhan, Anis Fatema, Aftab Hussain  
International Institute of Information Technology, Hyderabad, India

**2110: Radiooculogram (ROG) for Eye Movement Sensing with Eyes Closed**

Zijing Zhang, Edwin Kan

Cornell University, United States

**2138: Highly Sensitivity and Resolution Pseudocapacitive Iontronic Sensor Within Wide Working Range for Underwater Disturbance Detection**

Chengxiu Yang, Shaowei Wu, Jiafei Hu, Mengchun Pan, Weicheng Qiu, Peisen Li, Junping Peng, Qi Zhang

National University of Defense Technology, China

**220I: Effects of Sensor Design on the Performance of Wearable Sweat Monitors**

Zixin Wang<sup>{2}</sup>, Aula Alwattar<sup>{2}</sup>, Peter Quayle<sup>{2}</sup>, John Batchelor<sup>{1}</sup>, Alexander Casson<sup>{2}</sup>

<sup>{1}</sup>University of Kent, United Kingdom; <sup>{2}</sup>University of Manchester, United Kingdom

**2210: A Sensorized High Heel Footwear for Gait Analysis**

Francesca Giannetti, Lucia Arcarisi, Carlotta Marinai, Francesco Di Rienzo, Carlo Vallati, Nicola Carbonaro, Alessandro Tognetti

University of Pisa, Italy

## 2230: A Synthetic Seismocardiogram and Electrocardiogram Generator Phantom

Mohammad Nikbakht, David J. Lin, Asim H. Gazi, Omer T. Inan  
Georgia Institute of Technology, United States

## 2233: Gait Monitoring Using an Ankle-Worn Stereo Camera System

Jiangang Chen{1}, Jianwei Ke{2}, Francis Lu{2}, Jayar Fernandes{2},  
Barbara King{2}, Yu Hen Hu{2}, Hongrui Jiang{2}  
{1}University of Wisconsin–Madison, United States; {2}University of  
Wisconsin–Madison, United States

## 2279: A 3D-Printed Wearable Ring Sensor for Long-Term Accurate Monitoring of Human Cardiovascular Condition

Brendon Young{2}, Weijie Luo{1}, Darrin Young{1}  
{1}University of Utah, United States; {2}West High School, United States

## 13:30 – 15:30

### Interactive Forum: Wearables V

Room: Marsalis A

Session Chair(s): Hung Cao & Shawana Tabassum

## 2306: Capacitive Tactile Sensor with Stacked Structure and Hybrid Fabrication for Multiaxial Force Decoupling

Jie-Ying Wu{2}, Padmanabh Pancham{2}, Tzu-Yi Hsu{2}, Anupam  
Mukherjee{1}, Cheng-Yao Lo{2}  
{1}General Silicones, Taiwan; {2}National Tsing Hua University, Taiwan

## 2330: A New Type of Respiration Sensing System for Continuous Monitoring

Mahdi Shaban, Daniel Spencer, Neil White  
University of Southampton, United Kingdom

## 2364: Comparison of Electrode Configurations for Impedance Plethysmography Based Heart Rate Estimation at the Forearm

Kardelen Yilmaz{2}, Akinlabi Adeyemi{2}, Christoph Hoog Antink{3}, Antti  
Vehkaoja{1}  
{1}Tampere University, Finland; {2}Tampere University, Finland; {3}  
Technische Universität Darmstadt, Germany

## 2438: Porous Silicon-Based Microspectral Unit for Real-Time Moisture Detection in a Battery-Less Smart Mask

Harikrishnan Muraleedharan Jalajamony, Renny Fernandez  
Norfolk State University, United States

## 2451: Visualization of Body Supporting Force Field of the Elderly in Everyday Environment

Ayano Nomura, Yoshifumi Nishida  
Tokyo Institute of Technology, Japan



#### 2487: Effects of Geometry on Performances of Optically Unobtrusive Zeolite-Based Electrodes

Venkata Deepa Kota<sup>{2}</sup>, Salvatore Andrea Pullano<sup>{1}</sup>, Antonino S. Fiorillo<sup>{1}</sup>, Ifana Mahbub<sup>{2}</sup>

<sup>{1}</sup>University "Magna Graecia" of Catanzaro, Italy; <sup>{2}</sup>University of North Texas, United States

#### 2567: A Step Towards Design and Validation of a Wearable Multi-Sensory Smart-Textile System for Respiration Monitoring

Dhaval Solanki, Gozde Cay, Md Abdullah Al Rumon, Vignesh Ravichandran, Kunal Mankodiya

University of Rhode Island, United States

#### 2599: Subcutaneous Remote Auto-Injector for Smartwatch Monitored Anaphylaxis

Youssef Kotb, Dina Khattab, Omar Ibrahim, Amir Haroun, Fares Fawzi, Mohamed Serry

American University in Cairo, Egypt

#### 2623: Fruit-FIT: Drone Interfaced Multiplexed Sensor Suite to Determine the Fruit Ripeness

Nafize Ishtiaque Hossain, Shawana Tabassum

University of Texas at Tyler, United States

#### 2654: Wearable Perspiration Volume Sensor Using Dual-Frequency Impedance Measurement

Ryo Takamatsu<sup>{1}</sup>, Shogo Amano<sup>{2}</sup>, Shintaro Izumi<sup>{1}</sup>, Hiroshi Ohta<sup>{2}</sup>, Toshikazu Nezu<sup>{2}</sup>, Yuki Noda<sup>{2}</sup>, Teppei Araki<sup>{2}</sup>, Takafumi Uemura<sup>{2}</sup>, Tsuyoshi Sekitani<sup>{2}</sup>, Hiroshi Kawaguchi<sup>{1}</sup>

<sup>{1}</sup>Kobe University, Japan; <sup>{2}</sup>Osaka University, Japan

### 13:30 – 15:30

#### Live Demonstration of Sensors & Sensing Technologies

Room: Marsalis A

Session Chair(s): Calogero Oddo & Tao Li

#### 2066: Live Demonstration: A Trimodal Time-of-Flight Camera with Enhanced Material Imaging

Miguel Heredia Conde, Rajababu Udainarayan Singh

Universität Siegen, Germany

#### 2156: Live Demonstration: An AI-Assisted e-Tongue for Fast and Portable Fingerprinting of Liquids

Michal Muszynski<sup>{1}</sup>, Gianmarco Gabrieli<sup>{1}</sup>, Lukas Zimmerli<sup>{1}</sup>, Yuksel Temiz<sup>{1}</sup>, Ralph Heller<sup>{1}</sup>, Aaron Cox<sup>{3}</sup>, Keiji Matsumoto<sup>{2}</sup>, Kitahiro Kaneda<sup>{4}</sup>, Patrick Ruch<sup>{1}</sup>

<sup>{1}</sup>IBM Research Europe, Switzerland; <sup>{2}</sup>IBM Research Tokyo, Japan; <sup>{3}</sup>IBM T.J. Watson Research Center, United States; <sup>{4}</sup>NAGASE & CO., LTD., Japan

## 2171: Live Demonstration: Mixed Reality 3D In-Air Ultrasound Applications

Dennis Laurijssen, Wouter Jansen, Jan Steckel

Cosys-Lab, University of Antwerp, Belgium

## 2179: Live Demonstration: VLC-Enabled Passive 3D Time-of-Flight Imaging

Faisal Ahmed{3}, Miguel Heredia Conde{3}, Paula López Martínez{1}, Thomas Kerstein{2}, Bernd Buxbaum{2}

{1}CiTIUS, University of Santiago de Compostela, Spain; {2}

pmdtechnologies AG, Germany; {3}Universität Siegen, Germany

## 2217: Live Demonstration: KAUSTat – A Compact Reconfigurable Electrochemical Station

Jose Ilton De Oliveira Filho, Khaled Nabil Salama

King Abdullah University of Science and Technology, Saudi Arabia

## 2224: Live Demonstration: Hammering Test on a Wall Using Ai

Jingyuan Yang{1}, Yuma Ito{1}, Masafumi Koike{3}, Katsuhiko Hibino{2}, Atsushi Ito{1}

{1}Chuo University, Japan; {2}PORT DENSHI Corporation, Japan; {3}

Utsunomiya University, Japan

## 2305: Live Demonstration: Novel Infrared Sensors for Self-Sustaining Contextual Intelligence

Tiago Salzmann

ETH Zürich, Switzerland

## 2408: Live Demonstration: Tensegrity State Estimation

Xiaonan Huang, William Johnson III, Joran Booth, Rebecca Kramer-Bottiglio

Yale University, United States

## 2503: Live Demonstration: Saliva-Based SARS-CoV-2 Self-Testing with RT-LAMP in a Mobile Device

Zifan Tang, Jiarui Cui, Aneesh Kshirsagar, Tianyi Liu, Weihua Guan

Pennsylvania State University, United States

## 2609: Live Demonstration: FBG-Based Artificial Skin for Touch Sensing in Collaborative Robotics

Mariangela Filosa, Valeria Facchetti, Domenico Camboni, Calogero Maria Oddo

Scuola Superiore Sant'Anna, Italy

**15:30 – 16:00**

Coffee Break

Room: Marsalis A

**16:00 – 17:30**

Acoustic & Ultrasonic Sensors

Room: Cumberland B

Session Chair(s): Haifeng Zhang & Massood Atashbar

**16:00**

2261: Orthogonal Surface Acoustic Wave (SAW) Sensor for Cancer Biomarker Detection with Accelerated Binding Kinetics

Yuqi Huang{2}, Maëlys Boucher{1}, Theresa Evans-Nguyen{2}, Venkat Bhethanabotla{2}

{1}Nantes University, France; {2}University of South Florida, United States

**16:15**

2336: Love Wave Acoustic Sensor Response in High Turbidity Liquid Environment

Asawari Choudhari{2}, Maxence Rube{2}, Idris Sadli{2}, Martine Sebeloue{2}, Ollivier Tamarin{2}, Corinne Dejous{1}

{1}University of Bordeaux, Bordeaux INP, CNRS, IMS, UMR 5218, France; {2}University of Guyane, France

**16:30**

2508: Ultrasound Sensor for Process and Fouling Monitoring in Emulsion Polymerization Processes

Marco Osenberg{2}, Jan Förster{1}, Sören Rust{3}, Thomas Fritsch{1}, Jan Tebrügge{1}, Werner Pauer{3}, Thomas Musch{2}

{1}KROHNE Innovation GmbH, Germany; {2}Ruhr-Universität Bochum, Germany; {3}Universität Hamburg, Germany

**16:45**

2641: PM2.5 Particles Detection by Using a LiNbO<sub>3</sub>-Based Highly Sensitive SAW Sensor

Mitali Desai, Muhammad Zubair Aslam, Shuai Ju, Haifeng Zhang  
University of North Texas, United States

**17:00**

2386: A Re-Configurable ADC for Acoustic Phased Arrays

Waseem Hassan, Morten Jørgensen, Sven Nylund

Nortek AS, Norway

**17:15**

2016: A Feasibility Study on Relative Humidity Sensing Using Silicon-on-Nothing pMUTs

Mantalena Sarafianou, David Sze Wai Choong, Yul Koh

IME, Agency for Science, Technology and Research, Singapore

**16:00 – 17:30**

**Microfluidics & Biosensors II**

Room: Cumberland F

Session Chair(s): Chirasree RoyChaudhuri & Arum Han

**16:00**

2522: Multi-Modal, Implantable Colon Activity Sensor

Steve Majerus{1}, Dario Cabal{1}, Yaneev Hachohen{1}, Brett Hanzlicek{3}, Aref Smiley{2}, Yushan Wang{4}, Wentai Liu{4}, Muriel Larauche{4}, Mulugeta Million{4}, Margot Damaser{2}, Dennis Bourbeau{3}  
{1}Case Western Reserve University, United States; {2}Cleveland Clinic Foundation, United States; {3}Cleveland VA Medical Center, United States; {4}University of California, Los Angeles, United States

**16:15**

2311: An RFID-Based Sensor for Vascular Flow Monitoring

Yaneev Hachohen, Steve Majerus

Case Western Reserve University, United States

**16:30**

2569: A Study of Bone Formation Subsequent to Intramedullary Fluid Pressure Fluctuations in Young and Old Rats

Muhammad Luqman Haider{2}, Danyah Nashawi{1}, Ziyu Chen{2}, Muhammad Parvez{2}, Amanda Sanchez{1}, Teresa Le{1}, Rhonda Prisby{1}, Jeong Bong Lee{2}

{1}University of Texas at Arlington, United States; {2}University of Texas at Dallas, United States

**16:45**

2533: Implantable and Bioresorbable Nanostructured Fluorescence Sensor for In Vivo pH Monitoring

Martina Corsi{3}, Alessandro Paghi{3}, Stefano Mariani{3}, Giulia Golinelli{4}, Aline Debrassi{1}, Gabriella Egri{1}, Giuseppina Leo{2}, Eleonora Vandini{2}, Antonietta Vilella{2}, Lars Dahne{1}, Daniela Giuliani{2}, Giuseppe Barillaro{3}

{1}Surflay Nanotec, Germany; {2}University of Modena and Reggio Emilia, Italy; {3}University of Pisa, Italy; {4}University-Hospital of Modena and Reggio Emilia, Italy

**17:00**

2650: Miniaturized Passive Bio-Mechanical Valve for Hydrocephalus Treatment

Yuna Jung, Daniel Gulick, Jennifer Blain Christen

Arizona State University, United States

**17:15**

2596: A Catheter-Free Bladder Pressure-Volume Sensor

Steve Majerus{1}, Brett Hanzlicek{3}, Yaneev Hachohen{1}, Dario Cabal{1}, Dennis Bourbeau{3}, Margot Damaser{2}

{1}Case Western Reserve University, United States; {2}Cleveland Clinic Foundation, United States; {3}Cleveland VA Medical Center, United States

## 16:00 – 17:30

### Force & Pressure Sensors

Room: Cumberland G

Session Chair(s): Siavash Pourkamali & Matteo Rinaldi

#### 16:00

2247: Free Standing Stress Amplification Structure for Ultrasensitive 3C-SiC/Si Pressure Sensor

Braiden Tong<sup>{1}</sup>, Hong-Quan Nguyen<sup>{2}</sup>, Tuan-Hung Nguyen<sup>{2}</sup>, Tuan-Khoa Nguyen<sup>{2}</sup>, Viet Thanh Nguyen<sup>{3}</sup>, Toan Dinh<sup>{3}</sup>, Trung-Hieu Vu<sup>{2}</sup>, Van Thanh Dau<sup>{1}</sup>, Dzung Viet Dao<sup>{2}</sup>

<sup>{1}</sup>Griffith University, Australia; <sup>{2}</sup>Griffith University, Queensland Micro- and Nanotechnology Centre, Australia; <sup>{3}</sup>University of Southern Queensland, Australia

#### 16:15

2080: Stretchable Multi-Mode Sensor with Yarn Structure

Hyeongjin Jo, Yonghyeon Bae, Yujun Song, Ji-Hyeon Song

Dankook University, Korea

#### 16:30

2299: Measurement System for Human Lateral Mandibular Forces

Sven Suppelt<sup>{2}</sup>, Romol Chadda<sup>{2}</sup>, Thomas Büchner<sup>{2}</sup>, Niklas Schäfer<sup>{2}</sup>, Robert Sader<sup>{1}</sup>, Mario Kupnik<sup>{2}</sup>

<sup>{1}</sup>Goethe University Frankfurt, Germany; <sup>{2}</sup>Technische Universität Darmstadt, Germany

#### 16:45

2323: Multi-Axis Force Sensor for Sensor-Integrating Bolts

Felix Herbst<sup>{2}</sup>, Romol Chadda<sup>{2}</sup>, Claas Hartmann<sup>{2}</sup>, Julian Peters<sup>{1}</sup>, David Riehl<sup>{2}</sup>, Thomas Gwosch<sup>{1}</sup>, Klaus Hofmann<sup>{2}</sup>, Sven Matthiesen<sup>{1}</sup>, Mario Kupnik<sup>{2}</sup>

<sup>{1}</sup>Karlsruher Institute of Technology, Germany; <sup>{2}</sup>Technische Universität Darmstadt, Germany

#### 17:00

2416: Miniaturized Wet-Wet Differential Pressure Sensor

Andrew Holmes<sup>{2}</sup>, Samuel Yang<sup>{2}</sup>, Michail Kiziroglou<sup>{2}</sup>, David Boyle<sup>{2}</sup>, David Lincoln<sup>{1}</sup>, Jim McCabe<sup>{1}</sup>, Paul Szasz<sup>{1}</sup>, Daryl Williams<sup>{2}</sup>, Eric Yeatman<sup>{2}</sup>

<sup>{1}</sup>ABB Ltd, United Kingdom; <sup>{1}</sup>ABB Ltd, Germany; <sup>{2}</sup>Imperial College London, United Kingdom

#### 17:15

2209: Laser-Based Signal-Injection Attack on Piezoresistive MEMS Pressure Sensors

Tatsuki Tanaka, Takeshi Sugawara

University of Electro-Communications, Japan

## 16:00 – 17:30

### Emerging Sensor Applications

Room: Cumberland H

Session Chair(s): Mark Cheng & Massood Tabib-Azar

#### 16:00

2598: SAW Coupled Diamond NV- Spin Oscillators and Quantum Sensors

Massood Tabib-Azar

University of Utah, United States

#### 16:15

2621: Fabrication and Characterization of Cellulose-Based Materials for Biodegradable Soil Moisture Sensors

Gokulanand Iyer, Anne-Marie Zaccarin, Roy Olsson III, Kevin Turner

University of Pennsylvania, United States

#### 16:30

2618: Non-Invasive Calorimetric Sensor for Waterflow Event Detection in Premise Plumbing Systems

Chandrashekhara Choudhary, Gagan Batra, Steven Buchberger, Tao Li

University of Cincinnati, United States

#### 16:45

2037: Electric-Leakage Detection System Based on Non-Contact Electric-Field Sensor for Remote Street Fixture Monitoring

Ryotaro Kawahara, Takashi Kawamoto

Hitachi, Ltd., Japan

#### 17:00

2133: Real-Time Monitoring of Plant Stalk Growth Using a Flexible Printed Circuit Board Sensor

Jack Twiddy, Matthew Taggart, James Reynolds, Chris Sharkey, Thomas Ruffy, Edgar Lobaton, Alper Bozkurt, Michael Daniele

North Carolina State University, United States

#### 17:15

2246: Realtime Hand-Gesture Recognition Based on Novel Charge Variation Sensor and IMU

Elio Reinschmidt, Christian Vogt, Michele Magno

ETH Zürich, Switzerland

## 16:00 – 17:30

### Biomedical Sensor Systems & Signal Processing

Room: Cumberland J

Session Chair(s): Preethi Preethichandra & Brent Lunceford

**16:00**

2673: INVITED: Hanging by a Thread: Unconventional Platform for Flexible Bioelectronics

Sameer Sonkusale

Tufts University, United States

**16:30**

2624: Detection of Left Ventricular Ejection Fraction Abnormality Using Fusion of Acoustic and Biopotential Characteristics of Precordium  
Arash Shokouhmand<sup>{5}</sup>, Haoran Wen<sup>{4}</sup>, Samiha Khan<sup>{2}</sup>, Joseph A. Puma<sup>{3}</sup>, Amisha Patel<sup>{3}</sup>, Philip Green<sup>{3}</sup>, Farrokh Ayazi<sup>{1}</sup>, Negar Tavassolian<sup>{5}</sup>

<sup>{1}</sup>Georgia Institute of Technology, StethX Microsystems Inc., United States; <sup>{2}</sup>New York Institute of Technology College of Osteopathic Medicine, United States; <sup>{3}</sup>Sorin Medical P.C., United States; <sup>{4}</sup>StethX Microsystems Inc., United States; <sup>{5}</sup>Stevens I

**16:45**

2027: Eulerian Phase-Based Motion Magnification for High-Fidelity Vital Sign Estimation with Radar in Clinical Settings

Md Farhan Tasnim Oshim<sup>{3}</sup>, Toral Surti<sup>{5}</sup>, Charlotte Goldfine<sup>{2}</sup>, Stephanie Carreiro<sup>{4}</sup>, Deepak Ganesan<sup>{3}</sup>, Suren Jayasuriya<sup>{1}</sup>, Tauhidur Rahman<sup>{3}</sup>

<sup>{1}</sup>Arizona State University, United States; <sup>{2}</sup>Brigham and Women's Hospital, United States; <sup>{3}</sup>University of Massachusetts Amherst, United States; <sup>{4}</sup>University of Massachusetts Medical School, United States; <sup>{5}</sup>Yale University, United States

**17:00**

2042: Energy and Accuracy Characterization of a Burst-Mode Range Sensing Approach for Smart Contact Lenses

Sakthidasan Kalidasan, Chayanjit Ghosh, Adwait Deshpande, Carlos Mastrangelo, Ross Walker

University of Utah, United States

**17:15**

2121: VelGmat : Low Cost Gait Mat for Stance Phase Calculation

Mohammad Waqas Wani, Y Pawankumar Gururaj, Vivek Pareek, Sai Anirudh Karre, Raghu Reddy, Syed Azeemuddin

International Institute of Information Technology, Hyderabad, India

**16:00 – 17:30**

**Journal Presentations – Smart System & AI**

Room: Cumberland K

Session Chair(s): Paul C.-P. Chao



**16:00**

2697: The Machine Learnings Leading the Cuffless PPG Blood Pressure Sensors Into the Next Stage

Paul C.-P. Chao{2}, Chih-Cheng Wu{1}, Duc Huy Nguyen{2}, Ba-Sy Nguyen{2}, Pin-Chia Huang{2}, Van-Hung Le{2}

{1}National Taiwan University Hospital, Taiwan; {2}National Yang Ming Chiao Tung University, Taiwan

**16:15**

2696: Sensor-Driven Achieving of Smart Living: a Review

Theerawit Wilaiprasitporn{5}, Pitshaporn Leelaarporn{5}, Patcharapol Wachiraphan{5}, Thitikorn Kaewlee{5}, Tinnakit Udsa{5}, Rattanaphon Chaisaen{5}, Tanut Choksatchawathi{5}, Rawipreeya Laosirirat{3}, Payongkit Lakhan{5}, Phantharach Natnithikarat{4}, Ka

{1}Fudan University, China; {2}Macquarie University, Australia; {3}Ministry of Public Health, Nakhon Si Thammarat, Thailand; {4}Ruamrudee International School Bangkok, Thailand; {5}Vidyasirimedhi Institute of Science and Technology, Thailand

**16:30**

2706: DeepDFML-NILM: a New CNN-Based Architecture for Detection, Feature Extraction and Multi-Label Classification in NILM Signals

Lucas Nolasco{3}, André E. Lazzaretti{2}, Bruna Machado Mulinari{1}

{1}DATAPLAI, Brazil; {2}Federal University of Technology – Paraná, Brazil; {3}Federal University of Technology–Paraná, Brazil

**16:45**

2713: Extracting Walking Trajectories at Home from a Capacitive Proximity Sensing Floor

Stefan Janaqi{3}, Mélodie Sannier{2}, Vinicius Raducanu{1}, Valeriya Barysheva{1}, Hassan Ait Haddou{1}, Simon Pla{2}, Gérard Dray{2}, Benoît G. Bardy{2}

{1}LIFAM, National Superior School of Architecture of Montpellier, France; {2}University of Montpellier, France; {3}University of Montpellier, IMT Mines Alès, France

**17:00**

2778: Multispectral Biometrics System Framework: Application to Presentation Attack Detection

Mohamed Hussein{1}, Leonidas Spinoulas{5}, David Geissbühler{2}, Joe Mathai{5}, Oswin G. Almeida{4}, Guillaume Clivaz{3}, Sébastien Marcel{2}, Wael Abdalmageed{5}

{1}Alexandria University, Egypt; {2}Idiap Research Institute, Switzerland; {3}Idiap Research Institute, Martigny, Switzerland; {4}University of Southern California, United States; {5}USC Information Sciences Institute, United States

**17:15**

2693: Blockchain-Federated-Learning and Deep Learning Models for COVID-19 Detection Using CT Imaging

Jay Kumar{3}, Abdullah Aman Khan{2}, Jay Kumar{3}, Zakria Zakria{3}, Noorbakhsh Amiri Golilarz{3}, Simin Zhang{4}, Yang Ting{3}, Chengyu Zheng{1}, Wenying Wang{3}

{1}Ohio State University, United States; {2}Sichuan Artificial Intelligence Research Institute, China; {3}University of Electronic Science and Technology of China, China; {4}West China Hospital of Sichuan University, China

## **16:00 – 17:30**

### **Journal Presentations – Radar Sensing**

Room: Cumberland L

Session Chair(s): Changzhi Li

**16:00**

2708: Experimental Demonstration of Accurate Noncontact Measurement of Arterial Pulse Wave Displacements Using 79-GHz Array Radar

Takuya Sakamoto, Yuji Oyamada, Takehito Koshisaka  
Kyoto University, Japan

**16:15**

2735: A Novel Signal Processing Scheme for Static Person Localization Using M-Sequence UWB Radars

Michal Švingál{1}, Dušan Kocur{3}, Tamás Porteleky{2}, Mária Švecová{3}, Jana Fortes{3}

{1}Ilmsens GmbH, Slovakia; {2}K-Mlab Organizational Unit of Ilmsens GmbH, Slovakia; {3}Technical University of Košice, Slovakia

**16:30**

2730: Human Activity Classification Based on Point Clouds Measured by Millimeter Wave MIMO Radar with Deep Recurrent Neural Networks

Youngwook Kim{1}, Ibrahim Alnujaim{1}, Daegun Oh{2}  
{1}California State University, Fresno, United States; {2}Daegu Gyeongbuk Institute of Science and Technology, Korea

**16:45**

2737: Multiradar Data Fusion for Respiratory Measurement of Multiple People

Shunsuke Iwata, Takato Koda, Takuya Sakamoto  
Kyoto University, Japan

**17:00**

2738: Real-Time Short-Range Human Posture Estimation Using mmWave Radars and Neural Networks

Naim Dahnoun, Han Cui  
University of Bristol, United Kingdom

**17:15**

2732: Robust Cardiac Rate Estimation of an Individual

In-Oh Choi<sup>{1}</sup>, Min Kim<sup>{2}</sup>, Jae-Ho Choi<sup>{2}</sup>, Jeongki Park<sup>{2}</sup>, Sang-Hong Park<sup>{3}</sup>, Kyung-Tae Kim<sup>{2}</sup>

<sup>{1}</sup>Korea Maritime & Ocean University, Korea; <sup>{2}</sup>Pohang University of Science and Technology, Korea; <sup>{3}</sup>Pukyong National University, Korea

**17:30 – 19:00**

YP Reception/Poster Session

Room: Pegasus B

## TECHNICAL PROGRAM: TUESDAY, 1 NOVEMBER 2022

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**8:00 – 9:00**

Registration

Room: Reunion Foyer

**9:00 – 10:00**

Smart Sensing: Mixed Signal Active Sensing for Precision and Energy Efficiency

Baher Haroun

Room: Reunion Ballroom

Session Chair(s): J.-C. Chiao & Zeynep Celik

**10:00 – 10:30**

Coffee Break

Room: Marsalis A

**10:30 – 12:00**

Industry Session

Room: Moreno AB

Session Chair(s): Srikanth Chandrasekaran

**10:30 – 12:00**

Sensor Materials, Fabrication & Packaging II

Room: Cumberland F

Session Chair(s): Jun Zou

**10:30**

2594: Forming Tip Electrodes on 3D Neural Probe Arrays Using Electroplated Photoresist

Behnoush Rostami, Khalil Najafi

University of Michigan, United States

**10:45**

2270: How to Maintain Accuracy of Open Cavity Polymer Based Relative Humidity Sensors

Christy She, Josh Wyatt, Rujuta Munje, Pavani Tenneti, Alex Thompson

Texas Instruments, United States

**11:00**

2542: Humidity Sensor Based on Multi-Layer Graphene (MLG) Integrated Onto a Micro-Hotplate (MHP)

Leandro Sacco, Hanxing Meng, Sten Vollebregt

Delft University of Technology, Netherlands

**11:15**

2559: Online Cure Monitoring of Carbon Nanotube/Polyimide Films  
Marco Antonio Cen-Puc<sup>{2}</sup>, Minerva Gabriela Vargas Gleason<sup>{2}</sup>,  
Andreas Schander<sup>{2}</sup>, Walter Lang<sup>{1}</sup>  
<sup>{1}</sup>IMSAS, University of Bremen, Germany; <sup>{2}</sup>Universität Bremen,  
Germany

**11:30**

2406: Sensor Tendons for Soft Robot Shape Estimation  
William Johnson III, Anjali Agrawala, Xiaonan Huang, Joran Booth,  
Rebecca Kramer-Bottiglio  
Yale University, United States

**11:45**

2134: Eutectogel Electrodes for Long-Term Biosignal Monitoring  
Rachel E. Owyung, Wenxin Zeng, Sameer Sonkusale  
Tufts University, United States

## **10:30 – 12:00**

### **Microfluidics & Biosensors III**

Room: Cumberland G

Session Chair(s): Joost Lotters & Hyejin Moon

**10:30**

2056: Digital Ligation-Enabled Fluorescence-Coding PCR (dLiNC PCR)  
for High-Dimensional Multiplexed Nucleic Acid Detection  
Joon Soo Park, Liben Chen, Tza-Huei Wang  
Johns Hopkins University, United States

**10:45**

2103: DNA-Origami Enabled Distance-Dependent Sensing  
Jeanne Elisabeth van Dongen, Jan Cornelis Titus Eijkel, Loes Irene  
Segerink  
University of Twente, Netherlands

**11:00**

2274: Digital CRISPR-Based Quantification of HIV-1  
Reza Nouri, Yuqian Jiang, Anthony Politza, Xiaojun Lance Lian, Weihua  
Guan  
Pennsylvania State University, United States

**11:15**

2115: Development of PVC Membrane-Based Label-Free K<sup>+</sup> Image  
Sensor and Imaging Extracellular K<sup>+</sup> Dynamics in Brain Tissue  
Hideo Doi<sup>{1}</sup>, Tomoko Horio<sup>{1}</sup>, Bijay Parajuli<sup>{2}</sup>, Eiji Shigetomi<sup>{2}</sup>,  
Youichi Shinozaki<sup>{2}</sup>, Yong Joon Choi<sup>{1}</sup>, Toshiaki Hattori<sup>{1}</sup>, Kazuhiro  
Takahashi<sup>{1}</sup>, Toshihiko Noda<sup>{1}</sup>, Schuichi Koizumi<sup>{2}</sup>, Kazuaki  
Sawada<sup>{1}</sup>  
<sup>{1}</sup>Toyohashi University of Technology, Japan; <sup>{2}</sup>University of  
Yamanashi, Japan

**11:30**

2168: Fabrication of Multimodal Image Sensor Capable of Simultaneous Measurement of Pressure and pH

Mizuki Odaira{2}, Yukihiro Tatsumi{2}, Kensuke Murakami{2}, Ken Ogasahara{1}, Satoshi Shimizu{1}, Yong Joon Choi{2}, Kazuhiro Takahashi{2}, Toshihiko Noda{2}, Kazuaki Sawada{2}  
{1}TOHO KASEI Co., Ltd., Japan; {2}Toyohashi University of Technology, Japan

**11:45**

2180: Mouse Oocyte Characterization by Electrical Impedance Spectroscopy

Yuan Cao{1}, Julia Floehr{2}, Danyil Azarkh{1}, Uwe Schnakenberg{1}  
{1}RWTH Aachen University, Germany; {2}Uniklinik RWTH Aachen University, Germany

## **10:30 – 12:00**

### **Pressure & Temperature Sensors**

Room: Cumberland H

Session Chair(s): Dong-Weon Lee & Siavash Pourkamali

**10:30**

2105: Ultrathin and Flexible Sensors for Pressure and Temperature Monitoring Inside Battery Cells

Vincent Dreher{1}, Daniel Joch{1}, Harald Kren{3}, Jannik Schwarberg{2}, Michael Jank{1}  
{1}Fraunhofer Institute for Integrated Systems and Device Technology IISB, Germany; {2}Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany; {3}VARTA Innovation GmbH, Austria

**10:45**

2458: Flexible Auxetic Structure as Substrates for Resistive Pressure Sensors

Hugo Oliveira, Annelot Nijkoops, Manuela Ciocca, Alejandro Carrasco-Peña, Luisa Petti, Giuseppe Cantarella, Niko Münzenrieder  
Free University of Bozen-Bolzano, Italy

**11:00**

2484: Thin Film PZT Multimode Resonant MEMS Temperature Sensor

Wen Sui, Tahmid Kaiser, Haoran Wang, Yihao Wu, Jaesung Lee, Huikai Xie, Philip Feng  
University of Florida, United States

**11:15**

2207: Flexible Thin-Film Temperature Sensors on Upcycled Polyethylene Terephthalate (PET) Substrates for the Circularity of Economy

Alejandro Carrasco-Peña, Federica Catania, Giuseppe Cantarella, Michael Haller, Michael Nippa, Niko Münzenrieder  
Free University of Bozen-Bolzano, Italy

**11:30**

2636: The Breakthrough in Electrical Artificial Skin Through Strain Control in ZnO/Si Films

Cheng-Ming Huang, Shao-Hui Hsu, Chun-Chi Chen, Mei-Yi Li, Yu-Sheng Lai

Taiwan Semiconductor Research Institute, Taiwan

**11:45**

2348: Flexible Resistive Pressure Sensors with High Sensitivity and Wide Detection Range

Huiyang Yu<sup>{1}</sup>, Zhentao Wang<sup>{1}</sup>, Chuanliang Li<sup>{1}</sup>, Xin Ye<sup>{1}</sup>, Zhe Wu<sup>{1}</sup>, Zefang Chen<sup>{1}</sup>, Jiacheng Tu<sup>{1}</sup>, Yifei Pan<sup>{1}</sup>, Qingying Ren<sup>{2}</sup>, Jianqiu Huang<sup>{3}</sup>, Yifeng Li<sup>{1}</sup>

<sup>{1}</sup>Nanjing Tech University, China; <sup>{2}</sup>Nanjing University of Posts and Telecommunications, China; <sup>{3}</sup>Southeast University, China

## **10:30 – 12:00**

### **Contactless Sensor Applications**

Room: Cumberland J

Session Chair(s): Darrin Young & Theerawit Wildaiprasitporn

**10:30**

2383: Ultra-Wideband Automatic Anchor's Localization for Indoor Path Tracking

Ahmed Mahmoud, Pedro Coser, Hamza Sadruddin, Mohamed Atia  
Carleton University, Canada

**10:45**

2568: Wireless Loose Bolt Detection with Multiple Battery-Free Backscatter Sensors

Tomoya Iwasaki, Osamu Tokumasu, Jin Mitsugi  
Keio University, Japan

**11:00**

2288: A Low Power Infrared Sensor for Direction, Speed, Distance Finding for Contextual Intelligence

Tiago Salzmann, Michele Magno  
ETH Zürich, Switzerland

**11:15**

2250: Passive 3D Time-of-Flight Imaging Leveraging VLC Infrastructure  
Faisal Ahmed<sup>{3}</sup>, Miguel Heredia Conde<sup>{3}</sup>, Paula López Martínez<sup>{1}</sup>, Thomas Kerstein<sup>{2}</sup>, Bernd Buxbaum<sup>{2}</sup>

<sup>{1}</sup>CiTIUS, University of Santiago de Compostela, Spain; <sup>{2}</sup>pmdtechnologies AG, Germany; <sup>{3}</sup>Universität Siegen, Germany

**11:30**

2505: Deep Learned Ground Penetrating Radar Subsurface Features for Robot Localization

Sathira Wickramanayake, Karthick Thiyagarajan, Sarath Kodagoda  
University of Technology Sydney, Australia

**11:45**

2541: Milliwear – A Short Range InSAR Approach for Surface Wear Inspection Using mm-Wave Radar

Amit Swain, Anwasha Khasnobish, Smriti Rani, Chirabrata Bhaumik, Tapas Chakravarty

Tata Consultancy Services Limited TCS Research, India

## **10:30 – 12:00**

### **Wearables II**

Room: Cumberland K

Session Chair(s): Omer Inan & Souvik Dubey

**10:30**

2675: INVITED: Digital Health for Medicine in the Wild

Roozbeh Jafari

Texas A&M University, United States

**11:00**

2342: Initial Validation of Multi-Frequency Patch-Based Impedance Pneumography in Hospital Settings

Jesus Antonio Sanchez-Perez{2}, Samer Mabrouk{2}, John Berkebile{2}, Annette Esper{1}, Philip Yang{1}, Rishikesan Kamaleswaran{1}, Omer T. Inan{2}

{1}Emory University, United States; {2}Georgia Institute of Technology, United States

**11:15**

2561: Kirigami-Patterned IoT-Enabled Smart Anklet to Aid Physiotherapy of Patients with Foot Injury

Tanzila Noushin, Shawana Tabassum

University of Texas at Tyler, United States

**11:30**

2255: Wearable Active Vibration Sensing for Mid-Activity Knee Health Assessment

Goktug Cihan Ozmen, Christopher Nichols, Lan Lan, Emily Moise, Christopher Sugino, Alper Erturk, Omer T. Inan

Georgia Institute of Technology, United States

**11:45**

2152: Wearable Scratching-Sound Sensing Device for Animal Healthcare

Shun Muramatsu, Emi Hira, Yasuyuki Momoi, Michitaka Yamamoto, Seiichi Takamatsu, Toshihiro Itoh

University of Tokyo, Japan



## 10:30 – 12:00

### Journal Presentations – New Devices & Systems

Room: Cumberland L

Session Chair(s): Sinisa Djurovic

#### 10:30

2702: Portable Sensing Devices for Detection of COVID-19: a Review

Deniz Sadighbayan, Ebrahim Ghafar-Zadeh

York University, Canada

#### 10:45

2709: Application of Physiological Sensors for Personalization in Semi-Autonomous Driving: a Review

Edric John Cruz Nacpil<sup>{1}</sup>, Zheng Wang<sup>{2}</sup>, Kimihiko Nakano<sup>{2}</sup>

<sup>{1}</sup>Corpy & Co. Inc., Japan; <sup>{2}</sup>University of Tokyo, Japan

#### 11:00

2763: Low-Cost, High-Performance Piezoelectric Nanocomposite for Mechanical Energy Harvesting

Nadeem Tariq Beigh, Dhiman Mallick

Indian Institute of Technology Delhi, India

#### 11:15

2779: Development of a Fiber Bragg Grating-Enabled Clamping Force Sensor Integrated on a Grasper for Laparoscopic Surgery

Chaoyang Shi<sup>{3}</sup>, Kai Sun<sup>{3}</sup>, Ming Li<sup>{3}</sup>, Shuxin Wang<sup>{2}</sup>, Guokai Zhang<sup>{1}</sup>, Hongbin Liu<sup>{1}</sup>

<sup>{1}</sup>King's College London, United Kingdom; <sup>{2}</sup>Tianjin Key Laboratory of Molecular Optoelectronic Sciences, Tianjin University, China; <sup>{3}</sup>Tianjin University, China

#### 11:30

2780: Direct on Chip Thermal Measurement in IGBT Modules Using FBG Technology – Sensing Head Interfacing

Siniša Djurović<sup>{2}</sup>, Shiyang Chen<sup>{2}</sup>, Damian Vilchis-Rodriguez<sup>{2}</sup>, Mike Barnes<sup>{2}</sup>, Paul McKeever<sup>{1}</sup>, Chunjiang Jia<sup>{1}</sup>

<sup>{1}</sup>Offshore Renewable Energy, United Kingdom; <sup>{2}</sup>University of Manchester, United Kingdom

#### 11:45

2692: Wide-Range Flexible Capacitive Pressure Sensors Based on Origami Structure

Huiyang Yu<sup>{1}</sup>, Xueyang Liu<sup>{1}</sup>, Chuanliang Li<sup>{1}</sup>, Zhentao Wang<sup>{1}</sup>, Yifeng Li<sup>{1}</sup>, Jianqiu Huang<sup>{2}</sup>

<sup>{1}</sup>Nanjing Tech University, China; <sup>{2}</sup>Southeast University, China

## 10:30 – 12:00

### Journal Presentations – Modeling & Phenomenology

Room: Cumberland B

Session Chair(s): Shawana Tabassum

**10:30**

2747: Subsurface Flow Path Modeling from Inertial Measurement Unit Sensor Data Using Infinite Hidden Markov Models

Laura Piho, Maarja Kruusmaa

Tallinn University of Technology, Estonia

**10:45**

2773: Lightweight Extended Kalman Filter for MARG Sensors Attitude Estimation

Zeyang Dai, Lei Jing

University of Aizu, Japan

**11:00**

2750: Modeling and Simulation of Ultrahigh Sensitive AlGa<sub>N</sub>/AlN/GaN HEMT-Based Hydrogen Gas Detector with Low Detection Limit

Arathy Varghese, Abdalla Eblabla, Khaled Elgaid

Cardiff University, United Kingdom

**11:15**

2783: AlGa<sub>N</sub>/Ga<sub>N</sub> HEMT Ph Sensor Simulation Model and its Maximum Transconductance Considerations for Improved Sensitivity

Chitrakant Sahu, Aasif Mohammad Bhat, Nawaz Shafi, Chinnamuthan Periasamy

Malaviya National Institute of Technology, India

**11:30**

2777: Modeling Cameras for Autonomous Vehicle and Robot Simulation: an Overview

Asher Elmquist, Dan Negrut

University of Wisconsin-Madison, United States

**11:45**

2761: Simulation of High-Efficiency Resonant-Cavity-Enhanced GeSn Single-Photon Avalanche Photodiodes for Sensing and Optical Quantum Applications

Qimiao Chen, Shaoteng Wu, Lin Zhang, Weijun Fan, Chuan Seng Tan

Nanyang Technological University, Singapore

## 12:00 – 13:30

### Lunch

Room: Marsalis B

## 13:30 – 15:30

### WiSe-YP Big Idea Pitch Competition

Room: Cumberland A

Session Chair(s): Shawana Tabassum & Ifana Mahbub

## 13:30 – 15:30

### Sensor Phenomenology, Modeling & Evaluation I

Room: Cumberland F

Session Chair(s): Azeemuddin Syed & Mustafa Beyaz

#### 13:30

2421: Real-Time Qualitative and Quantitative Analysis of Saccharides Using CSRR Based RF Sensor

Kunal Wadhvani<sup>{1}</sup>, Sheena Hussaini<sup>{2}</sup>, Azeemuddin Syed<sup>{1}</sup>  
<sup>{1}</sup>International Institute of Information Technology, Hyderabad, India;  
<sup>{2}</sup>Nokia of America Corporation, United States

#### 13:45

2454: Multiphysics Finite-Element Modeling of the Neuron/Electrode Electrodiffusive Interaction

Federico Leva<sup>{2}</sup>, Claudio Verardo<sup>{1}</sup>, Julian Mele<sup>{1}</sup>, Pierpaolo Palestri<sup>{1}</sup>, Luca Selmi<sup>{2}</sup>  
<sup>{1}</sup>Università degli Studi di Udine, Italy; <sup>{2}</sup>University of Modena and Reggio Emilia, Italy

#### 14:00

2441: Transfer-Learning-Aided Optimization for a Low-Frequency Wideband MEMS Energy Harvester

Aylar Abouzarkhanifard, Hamidreza Ehsani Chimeh, Mohammad Al Janaideh, Ting Zou, Lihong Zhang  
Memorial University of Newfoundland, Canada

#### 14:15

2167: Dual-Band Metasurface Cross-Polarization Converter for Cancer Detection in Terahertz Band

Anirban Chaudhuri, Parama Pal, Beena Rai  
Tata Consultancy Services Limited TCS Research, India

#### 14:30

2368: Modeling the Anchor Effect for Estimating Performance Metrics of a MEMS Pirani Gauge

Manu Garg<sup>{1}</sup>, Sushil Kumar<sup>{1}</sup>, Dhairya Singh Arya<sup>{1}</sup>, Mujeeb Yousuf<sup>{1}</sup>, Yi Chiu<sup>{2}</sup>, Pushpapraj Singh<sup>{1}</sup>  
<sup>{1}</sup>Indian Institute of Technology Delhi, India; <sup>{2}</sup>National Yang Ming Chiao Tung University, Taiwan

**14:45**

2226: Design Optimization of CMOS-MEMS Staggered Vertical Comb Based Micro Scanners

Wenhao Chen{1}, Mingzheng Duan{1}, Hadi Tavakkoli{1}, Huahuang Luo{1}, Bin Zhao{1}, Wibool Piyawattanametha{2}, Yi-Kuen Lee{1}  
{1}Hong Kong University of Science and Technology, Hong Kong; {2} King Mongkut's Institute of Technology Ladkrabang, Thailand

**15:00**

2160: Dual-Band Tunable Terahertz Electromagnetic Stealth Metamaterial Based on Patterned Graphene

Jingyu Chen, Rui You, Xiaomeng Bian, Lianqing Zhu, Hong Wang  
Beijing Information Science and Technology University, China

**15:15**

2449: Vanadium Dioxide-Based High Sensitivity Dual-Heater Calorimetric Microfluidic Sensor

Yushan Zhou{1}, Xiaowei Wang{1}, Dibo Hou{1}, Hongjian Zhang{1}, Nelson Sepúlveda{2}, Yunqi Cao{1}  
{1}Control Science and Engineering, Zhejiang University, China; {2} Electrical and Computer Engineering, Michigan State University, United States

## **13:30 – 15:30**

### **Chemical, Electrochemical & Gas Sensors I**

Room: Cumberland G

Session Chair(s): Hamida Hallil & Xiaosan Zhu

**13:30**

2671: INVITED: Water and Air Quality Monitoring with Multi-Parameter Chemical Sensors: Managing Non-Idealities from Lab to Field

Bérengère Lebental{1}, Stephane Bila{4}, Eric Cloutet{2}, Corinne Dejous{3}, Hamida Hallil{3}, Stéphane Laporte{1}, Bernard Bobby Ngoune{3}, Guillaume Perrin{1}, Yan Ulanowski{1}

{1}COSYS-IMSE, Université Gustave Eiffel, France; {2}Université de Bordeaux, LCPO, UMR 5629, ENSCBP, IPB, France; {3}University of Bordeaux, Bordeaux INP, CNRS, IMS, UMR 5218, France; {4}University of Limoges, CNRS, XLIM UMR 7252, France

**14:00**

2220: Chemical Sensor Using Dielectrophoretically Assembled Carbon Nanotube on Micro-Trenches

Daniel Sim{2}, Steve Kim{1}

{1}Air Force Research Laboratory, United States; {2}Air Force Research Laboratory / UES, Inc., United States

**14:15**

2488: Extracting Selectivity from the Transient Responses of a Single Coated Gas Sensor to Analyte Mixtures Using Multivariate Analysis-Based Signal Processing

Sakin Satter<sup>{1}</sup>, Nicholas Post<sup>{1}</sup>, Florian Bender<sup>{1}</sup>, Fabien Josse<sup>{1}</sup>, Antonio J Ricco<sup>{2}</sup>

<sup>{1}</sup>Marquette University, United States; <sup>{2}</sup>Stanford University, United States

**14:30**

2462: Investigation of pH Sensing in Viscous Salt-Added Solution by Iridium Oxide Film

Khengdauliu Chawang, Sen Bing, Jungchih Chiao

Southern Methodist University, United States

**14:45**

2405: Encapsulation of Gas Sensors to Operate in the Gastrointestinal Tract for Continuous Monitoring

Hen-Wei Huang<sup>{1}</sup>, David de Gruijl<sup>{1}</sup>, Philip Fritz<sup>{1}</sup>, Abhijay Kemkar<sup>{1}</sup>, Ian Ballinger<sup>{1}</sup>, George Selsing<sup>{2}</sup>, Peter Chai<sup>{1}</sup>, Giovanni Traverso<sup>{2}</sup>

<sup>{1}</sup>Harvard Medical School, United States; <sup>{2}</sup>Massachusetts Institute of Technology, United States

**15:00**

2402: Highly Compact Multi-Spectral Non-Dispersive Infrared Gas Sensor for Large-Scale Deployment

Stephan Schröder, Benoit Wastine, Maksym Bryzgalov, Christine Hummelgård, Henrik Rødjegård, Hans Martin

SenseAir AB, Sweden

**15:15**

2427: Fast Vapor Detection by a Micropillar Array-Integrated Colorimetric Sensor

Timothy Palinski<sup>{1}</sup>, Bin Guan<sup>{2}</sup>, Bronwyn Bradshaw-Hajek<sup>{2}</sup>, Michael Lienhard<sup>{1}</sup>, Craig Priest<sup>{2}</sup>, Félix Miranda<sup>{1}</sup>

<sup>{1}</sup>NASA Glenn Research Center, United States; <sup>{2}</sup>University of South Australia, Australia

## **13:30 – 15:30**

### **IoT & Wireless Sensor Networks**

Room: Cumberland H

Session Chair(s): Elena Gaura

**13:30**

2669: INVITED: Edge AI-in-a-Box Framework That Bridges the Signal-to-Insight Gap

Daniel Wu

Dell Technologies, United States

**14:00**

2492: IoT-Based Meat Quality Monitoring System Using Computer Vision and Air Quality Sensor

Dong-Eon Kim, Ngoc-Dau Mai, Wan-Young Chung

Pukyong National University, Korea

**14:15**

2517: Energy Neutral Urban Noise Monitoring and Classification with LoRaWAN Based IoT

Huseyin Erdem{2}, Henry Leung{2}, Nan Xie{1}

{1}City of Calgary, University of Calgary, Canada; {2}University of Calgary, Canada

**14:30**

2651: Battery-Powered Wireless Sensor Network for Non-Invasive Monitoring of Water Usage Events in Premise Plumbing Systems

Chandrashekhar Choudhary, Gagan Batra, Tianshuo Wang, Toritseju Omaghomi, Steven Buchberger, Tao Li

University of Cincinnati, United States

**14:45**

2656: Frequency Compensated Crystal-Free 802.15.4 Wireless Radio

Alex Moreno, Kristofer Pister

University of California, Berkeley, United States

**15:00**

2096: Leakage Detection Using Low-Cost, Wireless Sensor Networks

Gabriel Rodriguez Gutierrez{1}, Leif Vogel{2}, Alvaro Ortiz Perez{1}, Stefan Palzer{1}

{1}Technische Universität Dortmund, Germany; {2}WoePal GmbH, Germany

**15:15**

2523: A 5.8 GHz Array Antenna Based on 4×4 Butler Matrix for Beamforming in 5G Network

Maryam Eshaghi, Rashid Rashidzadeh

University of Windsor, Canada

**13:30 – 15:30**

**Energy Harvesters & Actuators Session**

Room: Cumberland J

Session Chair(s): Shahrazad Towfighian & Smitha Rao

**13:30**

2259: INVITED: Toward CMOS-Compatible Triboelectric Generator to Operate MEMS

Mohammad Alzgoool{1}, Mohammad Mousavi{1}, Benyamin Davaji{2}, Shahrazad Towfighian{1}

{1}Binghamton University, United States; {2}Northeastern University, United States

**14:00**

2597: An Asymmetric Adaptive Approach to Enhance Output Power in Kinetic-Based Microgenerators

Masoud Roudneshin<sup>{1}</sup>, Kamran Sayrafian<sup>{2}</sup>, Amir G. Aghdam<sup>{1}</sup>  
<sup>{1}</sup>Concordia University, Canada; <sup>{2}</sup>National Institute of Standards & Technology, United States

**14:15**

2111: Wireless Power Transfer Closed-Loop Control for Low-Power Active Implantable Medical Devices

Fabiana Del Bono<sup>{2}</sup>, Andrea Bontempi<sup>{2}</sup>, Nicola Di Trani<sup>{1}</sup>, Danilo Demarchi<sup>{2}</sup>, Alessandro Grattoni<sup>{1}</sup>, Paolo Motto Ros<sup>{2}</sup>  
<sup>{1}</sup>Houston Methodist, United States; <sup>{2}</sup>Politecnico di Torino, Italy

**14:30**

2577: 3D Architectures of a Thick Graphite Anode Enabled by Laser Patterning Process to Improve Capacity Density and Cycling Performance of Libs

Soma Ahmadi, Dinesh Maddipatla, Valliammai Palaniappan, Himanaga Rama Krishn Emani, Sajjad Hajian, Qingliu Wu, Massood Atashbar

Western Michigan University, United States

**14:45**

2214: Simultaneous Step Counting and Energy Harvesting from Piezoelectric Discs Embedded in a Shoe

Niharika Gogoi, Yuanjia Zhu, Jens Kirchner, Georg Fischer  
Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

**15:00**

2591: Theoretical Modeling and Experimental Validation of Reverse Electrowetting on Dielectric (REWOD) Through Flexible Electrodes for Self-Powered Sensor Applications

Karthik Kakaraparty<sup>{1}</sup>, Gretchen Hyer<sup>{2}</sup>, Erik Pineda<sup>{1}</sup>, Russel Reid<sup>{2}</sup>, Ifana Mahbub<sup>{1}</sup>  
<sup>{1}</sup>University of North Texas, United States; <sup>{2}</sup>Utah Tech University, United States

**15:15**

2483: Vertical Electrostatic MEMS Aligner with Integrated Silicon Nitride Optical Waveguides

Seyedfakhreddin Nabavi, Michaël Ménard, Frederic Nabki  
École de technologie supérieure, Canada

**13:30 – 15:30**

**Sensor Systems & Applications**

Room: Cumberland K

Session Chair(s): Weidong Zhou & Massood Atashbar

**13:30**

2616: A Gas Sensor Based on Electrically Coupled Quartz Crystal Microbalances Coated with ZIF-8

Bernardo Madeira{2}, Benzhenq Xia{2}, Yuan Wang{1}, Rob Ameloot{2}, Michael Kraft{2}, Chen Wang{2}  
{1}Huazhong University of Science and Technology, China; {2} Katholieke Universiteit Leuven, Belgium

**13:45**

2318: Identifying Benign and Malignant Breast Tumor Using Vibro-Acoustic Tactile Imaging Sensor

Nazia Rahman, Chang-Hee Won  
Temple University, United States

**14:00**

2239: Measurement of Magnetic Particle Concentrations in Wildfire Ash via Compact NMR

Jacob Martin, Austin Downey, Mohammed Baalousha, Sang Hee Won  
University of South Carolina, United States

**14:15**

2379: Machine Learning In-Sensors: Computation-Enabled Intelligent Sensors for Next Generation of IoT

Andrea Ronco, Lukas Schulthess, David Zehnder, Michele Magno  
ETH Zürich, Switzerland

**14:30**

2245: A Scalable, Low-Maintenance, Smart Water Quality Monitoring System

Anastasios Malissovass{1}, Nitin Narayan{2}, Thijs Boonen{1}, Shrishail Patki{1}  
{1}Imec, Holst Centre, Netherlands; {2}Imec, OnePlanet Research Center, Netherlands

**14:45**

2333: Phaseless FMCW Multistatic Radar

Aditi K{2}, Achanna Anil Kumar{2}, Angshul Majumdar{1}, Rokkam Krishna Kanth{2}, Tapas Chakravarty{2}, Kriti Kumar{2}, Arpan Pal{2}  
{1}Indraprastha Institute of Information Technology, Delhi, India; {2} Tata Consultancy Services Limited TCS Research, India

**15:00**

2463: Real Time Light-Independent Slope-Failure Monitoring Using LiDAR and 2D-3D Semantic Segmentation

Yi Zhao{1}, Shaocong Wang{1}, Shiyi Liu{1}, Jiacheng Yang{2}  
{1}Chang'an University, China; {2}Southeast University, China



**15:15**

2223: Direct Digital Frequency Synthesizer Modeling with a Re-Configurable DAC Evaluation for Electrochemical Impedance Spectroscopy

Amr Farouk{1}, Ahmed Naguib{2}, Islam Mostafa{3}, Mohamed Dessouky{1}

{1}Ain Shams University, Egypt; {2}Military Technical College, Egypt;

{3}Technische Universität München, Germany

## **13:30 – 15:30**

**Focused Session: Microwave & Hot Carrier Based Sensors I**

Room: Cumberland L

Session Chair(s): Mohammad Zarifi

**13:30**

2667: INVITED: Record Enhancement in LiDAR SNR Using Non-Classical Light

Han Liu, Phillip Blakey, Amr S Helmy

University of Toronto, Canada

**14:00**

2013: Nitrogen Dioxide Detection by the Utilization of MoO<sub>3</sub>-Based Gas Sensing Layer and Eight-Port Reflectometer in the Microwave Frequency Range

Dominik Grochala, Anna Paleczek, Kamil Staszek, Sławomir Gruszczyński, Artur Rydysz

AGH University of Science and Technology, Poland

**14:15**

2033: Spoof Plasmon Sensing for NDE Applications

William Wilson{2}, Katelyn Brinker{1}

{1}Iowa State University, United States; {2}NASA Langley Research Center, United States

**14:30**

2254: Phase Variation Microfluidic Permittivity Sensor Using a Dispersive Transmission Line

Amir Ebrahimi{2}, Jonathan Muñoz-Enano{1}, Paris Vélez{1}, James Scott{2}, Kamran Ghorbani{2}, Ferran Martín{1}

{1}GEMMA/CIMATEC, Universitat Autònoma de Barcelona, Spain; {2}Royal Melbourne Institute of Technology, Australia

**14:45**

2277: Non-Visual and Contactless Wellness Monitoring for Long Term Care Facilities Using mm-Wave Radar Sensors

Hajar Abedi{2}, Ahmad Ansariyan{2}, Christopher Lehman{1}, Plinio Morita{2}, Jennifer Boger{2}, Alexander Wong{2}, George Shaker{2}

{1}GoldSentintel Inc, Canada; {2}University of Waterloo, Canada

**15:00**

2419: Raman Thermometry for Sensing of Hot Carriers in Gold Nanoparticle-Based Bimetallic Photocatalysts

Harshitha Rajashekhar, Navneet Kumar, Ajay Manuel, Mustafa Supur, Richard McCreery, Karthik Shankar

University of Alberta, Canada

**15:15**

2281: Bacteria Sensing Based on Multi-Mode Resonance at Microwave Regime

Hee-Jo Lee, Sun Chul Kang

Daegu University, Korea

**13:30 – 15:30**

**Journal Presentations – Chemical & Gas Sensors**

Room: Cumberland B

Session Chair(s): Tao Li

**13:30**

2781: Magneto-Semiconductor Resistor for Hydrogen Detection

Thomas Daniel{2}, S. Raveesh{1}, Koushik Saikia{1}, Roy P. Paily{1}  
{1}Indian Institute of Technology Guwahati, India; {2}K-fab Tech Private Limited, India

**13:45**

2712: Cytochrome P450 2B6 Amperometric Biosensor for Continuous Monitoring of Propofol

David Ferrier, Janice Kiely, Richard Luxton

University of the West of England, United Kingdom

**14:00**

2749: Fabrication of a Molecular Imprinted Polyacrylonitrile Engraved Graphite Electrode for Detection of Formalin in Food Extracts

Shreya Nag, Susmita Pradhan, Debangana Das, Bipan Tudu, Rajib Bandyopadhyay, Runu Banerjee Roy

Jadavpur University, India

**14:15**

2755: Copper Complex-Coated Nanopatterned Fiber-Tip Guided Mode Resonance Device for Selective Detection of Ethylene

Ratnesh Kumar{1}, Shawana Tabassum{2}, Divyesh P. Kumar{1}  
{1}Iowa State University, United States; {2}University of Texas at Tyler, United States

**14:30**

2776: Non-Enzymatic Urea Sensing Based on MWCNT Nanocomposite

Nirmal Roy, Shirsendu Mitra, Harshal B. Nemade, Tapas K. Mandal  
Indian Institute of Technology Guwahati, India

**14:45**

2698: MEMS Gas Sensors: a Review

Mohamed Sultan Mohamed Ali, Muhammad Izzudin Ahmad Asri,  
Mohammed Nazibul Hasan, Mariatul Rawdhah Ahmad Fuaad, Yusri  
Md Yunos

Universiti Teknologi Malaysia, Malaysia

**15:00**

2701: Non-Dispersive Infrared Gas Sensing Technology: a Review

Ravindra Jha

Indian Institute of Technology Guwahati, India

**15:15**

2700: Ammonia Sensing Performance of RGO-Based Chemiresistive  
Gas Sensor Decorated with Exfoliated MoSe<sub>2</sub> Nanosheets

Ravindra Jha<sup>{2}</sup>, Aman Nanda<sup>{1}</sup>, Navakanta Bhat<sup>{1}</sup>

<sup>{1}</sup>CeNSE, Indian Institute of Science, Bangalore, India; <sup>{2}</sup>Indian  
Institute of Technology Guwahati, India

**15:30 – 16:00**

Coffee Break

Room: Marsalis A

**16:00 – 17:30**

Industry Session

Room: Moreno AB

Session Chair(s): Srikanth Chandrasekaran

**16:00 – 17:30**

Optical Sensors I

Room: Cumberland F

Session Chair(s): Cedric Tubert

**16:00**

2631: INVITED: Lossy Mode Resonances Based Sensors in Planar  
Configuration

Ignacio Raúl Matías<sup>{1}</sup>, Jesús M. Corres<sup>{2}</sup>, Ignacio del Villar<sup>{2}</sup>

<sup>{1}</sup>Public University of Navarre, Spain; <sup>{2}</sup>Universidad Pública de  
Navarra, Spain

**16:30**

2388: A Reconfigurable Sensing Structure for Fast Optical Modulation  
by Graphene in Critically Coupled Photonic Crystal Cavities

Aaron Liu, Mingsen Pan, Zhonghe Liu, Weidong Zhou

University of Texas at Arlington, United States

**16:45**

2495: A Compact Active Quenching and Recharge Pixel Circuit for Single Photon Imaging Sensors

Soumya Shatakshi Panda, Bhaskar Choubey

Universität Siegen, Germany

**17:00**

2390: Non-Uniform Sampling Theory Applied to FM Channel Optical Feedback Interferometry for Displacement Sensors

Olivier Bernal<sup>{2}</sup>, Han Cheng Seat<sup>{2}</sup>, Frédéric Surre<sup>{1}</sup>, Usman Zabiti<sup>{3}</sup>, Clément Deleau<sup>{2}</sup>, Thierry Bosch<sup>{2}</sup>

<sup>{1}</sup>James Watt School of Engineering, University of Glasgow, United Kingdom; <sup>{2}</sup>LAAS-CNRS, University of Toulouse, Toulouse INP, France; <sup>{3}</sup>National University of Sciences and Technology, Islamabad, Pakistan

**17:15**

2218: A Compact-Size and Ultrasensitive Optical Biosensor Using a Double-Spiral Microresonator

Anh Igarashi<sup>{1}</sup>, Yugang Shang<sup>{1}</sup>, Shigeki Kuroiwa<sup>{2}</sup>, Keishi Ohashi<sup>{2}</sup>, Hirohito Yamada<sup>{1}</sup>

<sup>{1}</sup>Tohoku University, Japan; <sup>{2}</sup>Waseda University, Japan

## **16:00 – 17:30**

### **Sensors in Industrial Practices I**

Room: Cumberland G

Session Chair(s): James Brusey & Stephen Bart

**16:00**

2676: INVITED: A Future Enabled by Sensors: Focus on Gas Sensors

Nishit Goel

TDK InvenSense Inc., United States

**16:30**

2032: Software-Based Rotation Sensor Using High-Speed Video Analysis

Feiyue Wang<sup>{1}</sup>, Fujian Ding<sup>{1}</sup>, Shaopeng Hu<sup>{1}</sup>, Kohei Shimasaki<sup>{2}</sup>, Idaku Ishii<sup>{1}</sup>

<sup>{1}</sup>Hiroshima University, Japan; <sup>{2}</sup>Hiroshima University Digital Monozukuri (Manufacturing) Education and Research Center, Japan

**16:45**

2208: An Acoustical Machine Learning Approach to Determine Abrasive Belt Wear of Wide Belt Sanders

Maximilian Bundscherer<sup>{2}</sup>, Thomas Schmitt<sup>{2}</sup>, Sebastian Bayerl<sup>{2}</sup>, Thomas Auerbach<sup>{1}</sup>, Tobias Bocklet<sup>{2}</sup>

<sup>{1}</sup>Hans Weber Maschinenfabrik GmbH, Germany; <sup>{2}</sup>Technische Hochschule Nürnberg Georg Simon Ohm, Germany

**17:00**

2381: Boosting Stability of Photonic Multi-Gas Sensors

Radislav Potyrailo, Brian Scherer, Joleyn Brewer, Renner Ruffalo

GE Research, United States

**17:15**

2060: UAS Navigation in the Real World Using Visual Observation

Yuci Han, Jianli Wei, Alper Yilmaz

Ohio State University, United States

## **16:00 – 17:30**

### **Sensor Data Processing I**

Room: Cumberland H

Session Chair(s): Marco Da Silva & Krikor Ozanyan

**16:00**

2581: INVITED: Exploring a Modular Architecture for Sensor Validation in Digital Twins

Hossein Darvishi{1}, Domenico Ciuonzo{2}, Pierluigi Salvo Rossi{1}

{1}Norwegian University of Science and Technology, Norway; {2}

University of Naples Federico II, Italy

**16:30**

2163: Explainable AI for Gas Sensors

Sanghamitra Chakraborty{1}, Simon Mittermaier{1}, Cecilia

Carbonelli{1}, Lorenzo Servadei{2}

{1}Infineon Technologies AG, Germany; {2}Infineon Technologies AG, Technical University of Munich, Germany

**16:45**

2183: Deep-Learned Air-Coupled Ultrasonic Sonar Image Enhancement and Object Localization

Stefan Schulte, Gianni Allevato, Christoph Haugwitz, Mario Kupnik

Technische Universität Darmstadt, Germany

**17:00**

2359: Object Depth Estimation from Line-Scan EMI Data Using Machine Learning

Marko Šimić, Davorin Ambruš, Vedran Bilas

University of Zagreb, Croatia

**17:15**

2469: DENSE-DEFENSE: Diversity Promoting Ensemble Adversarial Training Towards Effective Defense

Onat Gungor{2}, Tajana Rosing{2}, Baris Aksanli{1}

{1}San Diego State University, United States; {2}University of California, San Diego, United States

**16:00 – 17:30**

## Journal Presentations – Physical Sensing I

Room: Cumberland J

Session Chair(s): Hamida Hallil

**16:00**

2717: Biomedical Catheters with Integrated Miniature Piezoresistive Pressure Sensors: a Review

Krishna Vasu Meena, A. Ravi Sankar

Vellore Institute of Technology, India

**16:15**

2726: Design and Optimization of a Joint Torque Sensor for Lightweight Robots

Dai-Dong Nguyen<sup>{2}</sup>, Chung-Hsien Kuo<sup>{1}</sup>

<sup>{1}</sup>National Taiwan University, Taiwan; <sup>{2}</sup>National Taiwan University of Science and Technology, Taiwan

**16:30**

2727: Stretchable and Compliant Textile Strain Sensors

Johannes Mersch, Carlos A. Gómez Cuaran, Aleksandr Vasilev, Andreas Nocke, Chokri Cherif, Gerald Gerlach

Technische Universität Dresden, Germany

**16:45**

2765: Passive Resonant Sensors: Trends and Future Prospects

Hamida Hallil<sup>{5}</sup>, Corinne Dejous<sup>{5}</sup>, Sami Hage-Ali<sup>{3}</sup>, Omar Elmazria<sup>{3}</sup>, Jerome Rossignol<sup>{2}</sup>, Didier Stuergea<sup>{2}</sup>, Abdelkrim Talbi<sup>{1}</sup>, Aurélien Mazzamurro<sup>{1}</sup>, Pierre-Yves Joubert<sup>{4}</sup>, Elie Lefeuvre<sup>{4}</sup>

<sup>{1}</sup>Centrale Lille, University Polytechnique Hauts-de-France, UMR 8520,CNRS, IEMN, France; <sup>{2}</sup>Laboratoire Interdisciplinaire Carnot de Bourgogne, GERM, France; <sup>{3}</sup>Université de Lorraine, CNRS, IJL, France; <sup>{4}</sup>Université Paris-Saclay, C2N, CNRS, France; <sup>{5}</sup>

**17:00**

2772: Multi-Threshold Inertial Switch for Quantitative Acceleration Measurements

Mohammad I. Younis<sup>{2}</sup>, Qiu Xu<sup>{1}</sup>, Fahimullah Khan<sup>{1}</sup>

<sup>{1}</sup>King Abdullah University of Science and Technology, Saudi Arabia;

<sup>{2}</sup>King Abdullah University of Science and Technology, and State University of New York, Saudi Arabia

**17:15**

2768: High Resolution Frequency Measurement Techniques for Relaxation Oscillator Based Capacitive Sensors

Laxmeesha Somappa<sup>{1}</sup>, Shahid Malik<sup>{2}</sup>, Shuchin Aeron<sup>{4}</sup>, Sameer Sonkusale<sup>{4}</sup>, Maryam Shojaei Baghini<sup>{3}</sup>

<sup>{1}</sup>École Polytechnique Fédérale de Lausanne, India; <sup>{2}</sup>Imperial College London, United Kingdom; <sup>{3}</sup>Indian Institute of Technology Bombay, India; <sup>{4}</sup>Tufts University, United States

## 16:00 – 17:30

### Wearables III

Room: Cumberland K

Session Chair(s): Rahim Esfandyarpour & Shawana Tabassum

**16:00**

2546: Evaluating 3D Printed sEMG Electrodes with Silver Ink Traces Using In-Situ Impedance Measurements

Martijn Schouten, Philip van de Maat, Kostas Nizamis, Gijs Krijnen  
University of Twente, Netherlands

**16:15**

2497: A Radio-Frequency Planar Resonant Loop for Noninvasive Monitoring of Water Content

Sen Bing, Khengdauliu Chawang, Jungchih Chiao  
Southern Methodist University, United States

**16:30**

2629: Atomized Liquid Metal Droplet-Enabled Enhancement of Sensing Range and Stability for Ultrasensitive Crack-Based Sensor

Jinwon Jeong, Arkadeep Mitra, Jeong Bong Lee  
University of Texas at Dallas, United States

**16:45**

2055: Proof-of-Principle Validation of a Novel Intraluminal Optical Sensor for Dynamic Monitoring of Intestinal Anastomosis: An In Vivo Animal Model Case Study

Karthik Budidha<sup>{1}</sup>, Mohamed Thaha<sup>{3}</sup>, Matthew Eschbach<sup>{2}</sup>, Elisa Mejía-Mejía<sup>{1}</sup>, Panicos Kyriacou<sup>{1}</sup>

<sup>{1}</sup>City, University of London, United Kingdom; <sup>{2}</sup>Medtronic PLC, United States; <sup>{3}</sup>Queen Mary University of London, United Kingdom

**17:00**

2351: Design of a Hands-Free Braille Display Using a Pneumatically Controlled Wristband

Gonzalo Tello, Kanghoon Choi, Jungkyu Kim, Haohan Zhang  
University of Utah, United States

**17:15**

2338: SLAM-ING: A Wearable SLAM Inertial Navigation System

Renjie Wu<sup>{2}</sup>, Matthew Pike<sup>{2}</sup>, Xiaoqing Chai<sup>{2}</sup>, Boon Giin Lee<sup>{2}</sup>, Xian Wu<sup>{1}</sup>

<sup>{1}</sup>Tianjin Fire Science and Technology Research Institute of MEM, China; <sup>{2}</sup>University of Nottingham Ningbo China, China

## 16:00 – 17:30

### Journal Presentations – Wireless & Networking

Room: Cumberland L

Session Chair(s): Ifana Mahbub

**16:00**

2720: Machine Learning for Anomaly Assessment in Sensor Networks for NDT in Aerospace

Ivan Kraljevski{2}, Frank Duckhorn{2}, Constanze Tschöpe{2}, Matthias Wolff{1}

{1}Brandenburg University of Technology Cottbus–Senftenberg, Germany; {2}Fraunhofer Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Germany

**16:15**

2740: DEKCS: a Dynamic Clustering Protocol to Prolong Underwater Sensor Networks

Kenechi Omeke{3}, Michael S. Mollel{2}, Metin Ozturk{1}, Shuja Ansari{3}, Lei Zhang{3}, Qammer H. Abbasi{3}, Muhammad Ali Imran{3}

{1}Ankara Yıldırım Beyazıt University, Turkey; {2}Nelson Mandela African Institution of Science and Technology, South Africa; {3}University of Glasgow, United Kingdom

**16:30**

2745: Data-Driven Sparse Sensor Selection Based on A-Optimal Design of Experiment with ADMM

Takayuki Nagata{1}, Taku Nonomura{1}, Kumi Nakai{1}, Keigo Yamada{1}, Yuji Saito{1}, Shunsuke Ono{2}

{1}Tohoku University, Japan; {2}Tokyo Institute of Technology, Japan

**16:45**

2767: Medical Sensors and Their Integration in Wireless Body Area Networks for Pervasive Healthcare Delivery: a Review

Hamza Fahim{1}, Shumaila Javaid{1}, Sherali Zeadally{2}, Bin He{1}

{1}Tongji University, China; {2}University of Kentucky, United States

**17:00**

2786: Dual-Attention Generative Adversarial Networks for Fault Diagnosis Under the Class-Imbalanced Conditions

Weihua Li{3}, Rugen Wang{2}, Zhuyun Chen{2}, Shaohui Zhang{1}

{1}Dongguan University of Technology, China; {2}South China University of Technology, China; {3}South China University of Technology Pazhou Lab, China

**17:15**

2728: A TDMA-Based Data Gathering Protocol for Molecular Communication via Diffusion-Based Nano-Sensor Networks

Ethungshan Shitiri, Ho-Shin Cho

Kyungpook National University, Korea

**16:00 – 17:30**

**Journal Presentations – Wireless & Noninvasive Sensing**

Room: Cumberland B

Session Chair(s): Chonggang Wang



**16:00**

2764: Wireless Ice Detection and Monitoring Using Flexible UHF RFID Tags

Mahmoud Wagih{1}, Junjie Shi{2}

{1}University of Glasgow, United Kingdom; {2}University of Southampton, United Kingdom

**16:15**

2756: An Automatic Lane Marking Detection Method with Low-Density Roadside Lidar Data

Jason Dayong Wu{2}, Ciyun Lin{1}, Yingzhi Guo{1}, Wenjun Li{1}, Hui Liu{1}

{1}Jilin University, China; {2}Texas A&M University, United States

**16:30**

2729: AgriSegNet: Deep Aerial Semantic Segmentation Framework for IoT-Assisted Precision Agriculture

Tanmay Anand{2}, Soumendu Sinha{3}, Murari Mandal{4}, Vinay Chamola{1}, F. Richard Yu{5}

{1}ARTPARK, India; {2}Birla Institute of Technology and Science, India; {3}CSIR-Central Electronics Engineering Research Institute, India; {4}Indian Institute of Information Technology Kota, India; {5}Shenzhen University, China

**16:45**

2766: Distance Estimation in Thermal Cameras Using Multi-Task Cascaded Convolutional Neural Network

Wansu Lim{1}, Ej Miguel Francisco Caliwag{3}, Angela C. Caliwag{3}, Bong-Ki Baek{2}, Yongrae Jo{2}, Hae Chung{3}

{1}FCSL, Kumoh National Institute of Technology, Korea; {2}i3system Inc., Korea; {3}Kumoh National Institute of Technology, Korea

**17:00**

2746: Genetic Algorithm for Path Loss Model Selection in Signal Strength-Based Indoor Localization

Byeong-Ho Lee{3}, Doyoung Ham{3}, Jeongsik Choi{2}, Seong-Cheol Kim{3}, Yong-Hwa Kim{1}

{1}Korea National University of Transportation, Korea; {2}Kyungpook National University, Korea; {3}Seoul National University, Korea

**17:15**

2743: Missing Data Imputation on IoT Sensor Networks: Implications for on-Site Sensor Calibration

Nwamaka Okafor, Declan T. Delaney  
University College Dublin, Ireland

**18:30 – 21:00**

Gala Dinner

Room: Reunion Ballroom

## TECHNICAL PROGRAM: WEDNESDAY, 2 NOVEMBER 2022

### 8:00 – 9:00

#### Registration

Room: Reunion Foyer

### 9:00 – 10:00

Microwaving Cells for Molecular, Cellular and Tissue Sensing: Which Status, Challenges and Prospects for Health and Medicine

Katia Grenier

Room: Reunion Ballroom

Session Chair(s): J.-C. Chiao & Zeynep Celik

### 10:00 – 10:30

#### Coffee Break

Room: Marsalis A

### 10:30 – 12:00

#### Journal Presentations – Silicon & CMOS

Room: Cumberland K

Session Chair(s): Christoforos Panteli

#### 10:30

2694: An All-Silicon Process Platform for Wafer-Level Vacuum Packaged MEMS Devices

Mustafa Mert Torunbalci<sup>{1}</sup>, Hasan Dogan Gavcar<sup>{2}</sup>, Ferhat Yesil<sup>{2}</sup>, Said Emre Alper<sup>{2}</sup>, Tayfun Akin<sup>{1}</sup>

<sup>{1}</sup>Middle East Technical University, Turkey; <sup>{2}</sup>MikroSistemler, Turkey

#### 10:45

2707: CMOS-Based Tactile Force Sensor: a Review

Meng-Lin Hsieh, Sheng-Kai Yeh, Weileun Fang

National Tsing Hua University, Taiwan

#### 11:00

2736: Reduced Drift of CMOS ISFET Ph Sensors Using Graphene Sheets

Christoforos Panteli, Pantelis Georgiou, Kristel Fobelets

Imperial College London, United Kingdom

#### 11:15

2751: CMOS Compatible MEMS Air Velocity Sensor with Improved Sensitivity and Linearity for Human Thermal Comfort Sensing Applications

Izhar Izhar<sup>{2}</sup>, Wei Xu<sup>{3}</sup>, Lung-Jieh Yang<sup>{4}</sup>, Yi-Kuen Lee<sup>{1}</sup>

<sup>{1}</sup>Hong Kong University of Science and Technology, Hong Kong;

<sup>{2}</sup>Hong Kong University of Science and Technology / University of Pennsylvania, Hong Kong; <sup>{3}</sup>Huazhong University of Science and

Technology, China; <sup>{4}</sup>Tamkang University, Taiwan

**11:30**

2722: Sensing Characteristic Enhancement of CMOS-Based ISFETs with Three-Dimensional Extended- Gate Architecture

Chih-Ting Lin, Nan-Yuan Teng, Yi-Ting Wu, Rui-Xing Wang

National Taiwan University, Taiwan

**11:45**

2733: An Ultra Low Current Measurement Mixed-Signal ASIC for Radiation Monitoring Using Ionisation Chambers

Sarath Kundumattathil Mohanan{1}, Hamza Boukabache{1}, Vassili Cruchet{1}, Daniel Perrin{1}, Stefan Roesler{1}, Ullrich R. Pfeiffer{2}

{1}CERN Radiation Protection, Switzerland; {2}University of Wuppertal, Germany

## **10:30 – 12:00**

### **Chemical, Electrochemical & Gas Sensors II**

Room: Cumberland F

Session Chair(s): Preethi Preethichandra & Bérengère Lebental

**10:30**

2385: Boosting Stability of Electronic Multi-Gas Sensors

Radislav Potyrailo, Richard St-Pierre, Janell Crowder, Brian Scherer, Baokai Cheng

GE Research, United States

**10:45**

2325: Selective Gas Detection Using Conductivity-Based MEMS Resonator and Machine Learning

Wagner Barth Lenz{1}, Usman Yaqoob{1}, Rodrigo Tumolin Rocha{1}, Mohammad I. Younis{2}

{1}King Abdullah University of Science and Technology, Saudi Arabia;

{2}King Abdullah University of Science and Technology, and State University of New York, Saudi Arabia

**11:00**

2389: Humidity Monitoring Using a Flexible Polymer-Based Microwave Sensor and Machine Learning

Bernard Bobby Ngoune{3}, Hamida Hallil{3}, Julien George{4}, Corinne Dejous{3}, Eric Cloutet{2}, Benoit Bondu{1}, Stephane Bila{4}, Dominique Baillargeat{4}

{1}ISORG, France; {2}Université de Bordeaux, LCPO, UMR 5629, ENSCBP, IPB, France; {3}University of Bordeaux, Bordeaux INP, CNRS, IMS, UMR 5218, France; {4}University of Limoges, CNRS, XLIM UMR 7252, France

**11:15**

2227: A 20 ppb Resolution Readout Circuit Dedicated to Optomechanical Mass Sensors

Houssein Elmi Dawale, Sebastien Regord, Thomas Furcatte, Marc Sansa, Patrick Villard, Guillaume Jourdan, Franck Badets

CEA-Leti, France

**11:30**

2219: ATR Microreactor: A Tool for In-Situ and Spatial Reaction Monitoring

Ketki Srivastava{2}, Nicole Boyle{1}, Koen Jorissen{2}, Ian Burgess{1}, Ward van der Stam{3}, Albert van Den Berg{2}, Mathieu Odijk{2}  
{1}University of Saskatchewan, Canada; {2}University of Twente, Netherlands; {3}University of Utrecht, Netherlands

**11:45**

2050: Oxygen and Humidity Sensing Property of a Limiting Current-Type Thin-Film YSZ-Based Sensor on a Micro-Hotplate

Shunsuke Akasaka{2}, Isaku Kanno{1}  
{1}Kobe university, Japan; {2}Rohm Co. Ltd, Japan

## **10:30 – 12:00**

### **Sensor Data Processing II**

Room: Cumberland G

Session Chair(s): Pierluigi Salvo Rossi

**10:30**

2249: Perception System Based on Cooperative Fusion of Lidar and Cameras

Martin Dimitrievski, David Van Hamme, Wilfried Philips  
Ghent University, imec-IPI, Belgium

**10:45**

2085: Feature Importance Methods Unveiling the Cross-Sensitive Response of an Integrated Sensor Array to Quantify Major Cations in Drinking Water

Gianmarco Gabrieli, Michal Muszynski, Patrick Ruch  
IBM Research Europe, Switzerland

**11:00**

2501: Incipient Slip Detection for Rectilinear Movements Using the PapillArray Tactile Sensor

Pablo Martinez Ulloa{1}, David Cordova Bulens{1}, Stephen Redmond{2}

{1}University College Dublin, Ireland; {2}University of New South Wales, Ireland

**11:15**

2198: A Study for Laser Additive Manufacturing Quality and Material Classification Using Machine Learning

Ralph Rudi Schmidt{1}, Jörg Hildebrand{2}, Ivan Kraljevski{1}, Frank Duckhorn{1}, Constanze Tschöpe{1}

{1}Fraunhofer Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Germany; {2}Technische Universität Ilmenau, Germany

**11:30**

2625: Fall Event Detection Using Vision Transformer

Ankita Dey{1}, Sreeraman Rajan{1}, George Xiao{2}, Jianping Lu{2}  
{1}Carleton University, Canada; {2}National Research Council of  
Canada, Canada

**11:45**

2195: A Joint Perception Scheme for Connected Vehicles

Ahmed N. Ahmed{3}, Ian Ravijts{1}, Jens de Hoog{3}, Ali Anwar{3},  
Siegfried Mercelis{2}, Peter Hellinckx{3}  
{1}AP University of Applied Sciences, Belgium; {2}Cosys-Lab,  
University of Antwerp, Belgium; {3}IDLab, University of Antwerp, imec,  
Belgium

## **10:30 – 12:00**

### **Journal Presentations – Wearable Sensing**

Room: Cumberland L

Session Chair(s): Sue Gong

**10:30**

2710: A Nanometer Resolution Wearable Wireless Medical Device for  
Non Invasive Intracranial Pressure Monitoring

Rodrigo Andrade{1}, Helder Eiki Oshiro{1}, Caio Kioshi Miyazaki{1},  
Cintya Yukie Hayashi{1}, Marcos Antonio de Moraes{1}, Rodrigo  
Brunelli{1}, João Paulo Carmo{2}  
{1}Braincare Desenvolvimento e Inovacao Tecnologica S.A., Brazil; {2}  
University of São Paulo, Brazil

**10:45**

2725: Influence of Armband Form Factors on Wearable ECG  
Monitoring Performance

Braden Li{3}, Amanda C. Mills{3}, Tashana J. Flewwellin{3}, Jacklyn  
L. Herzberg{2}, Azin Saberi Bosari{1}, Michael Lim{3}, Yaoyao Jia{4},  
Jesse S. Jur{3}  
{1}Athens Drive Magnet High School, United States; {2}Holly Springs  
High School, United States; {3}North Carolina State University, United  
States; {4}University of Texas at Austin, United States

**11:00**

2739: Fusion of Multi-Sensor-Based Biomechanical Gait Analysis  
Using Vision and Wearable Sensor

Vishwanath Bijalwan{2}, Vijay Bhaskar Semwal{3}, Tapas K. Mandal{1}  
{1}Indian Institute of Technology Guwahati, India; {2}Institute of  
Technology Gopeshwar, India; {3}Maulana Azad National Institute of  
Technology, India

**11:15**

2753: Fully-Conformable Porous Polyethylene Nanofilm Sweat Sensor for Sports Fatigue

Andreas Kenny Oktavius{1}, Qiao Gu{2}, Nathaniel Wihardjo{1}, Olivia Winata{1}, Stefanus William Sunanto{1}, Jin Li{1}, Ping Gao{1}

{1}Hong Kong University of Science and Technology, Hong Kong; {2}University of Toronto, Canada

**11:30**

2770: PPG-Based Smart Wearable Device with Energy-Efficient Computing for Mobile Health-Care Applications

Eugene Lee{1}, Chen-Yi Lee{2}

{1}National Chiao Tung University, Taiwan; {2}National Yang Ming Chiao Tung University, Taiwan

## **10:30 – 12:00**

### **Journal Presentations – Device Technologies I**

Room: Cumberland B

Session Chair(s): Ferran Martin

**10:30**

2721: Phase-Variation Microwave Sensor for Permittivity Measurements Based on a High-Impedance Half-Wavelength Transmission Line

Ferran Martín{1}, Lijuan Su{1}, Jonathan Muñoz-Enano{1}, Paris Vélez{1}, Pau Casacuberta{1}, Marta Gil{2}

{1}GEMMA/CIMITEC, Universitat Autònoma de Barcelona, Spain; {2}Universidad Politécnica de Madrid, Spain

**10:45**

2719: Plasmonic Fiberoptic Absorbance Biosensor (P-FAB) for Rapid Detection of SARS-CoV-2 Nucleocapsid Protein

Himanshu Bhatia{2}, M. Divagar{1}, R. Gayathri{1}, J. Kuzhandai Shamlee{1}, Himanshu Bhatia{2}, Jitendra Satija{3}, V. V. R. Sai{1}

{1}Indian Institute of Technology Madras, India; {2}Ricovr Healthcare Inc., United States; {3}Vellore Institute of Technology, India

**11:00**

2784: Single-Frequency Amplitude-Modulation Sensor for Dielectric Characterization of Solids and Microfluidics

Ferran Martín{2}, Paris Vélez{2}, Jonathan Muñoz-Enano{2}, Amir Ebrahimi{3}, Cristian Herrojo{1}, Ferran Paredes{1}, James Scott{3}, Kamran Ghorbani{3}

{1}CIMITEC, Universitat Autònoma de Barcelona, Spain; {2}GEMMA/CIMITEC, Universitat Autònoma de Barcelona, Spain; {3}Royal Melbourne Institute of Technology, Australia

11:15

2754: A Novel Noninvasive Hemoglobin Sensing Device for Anemia Screening

S. Guruprasad{3}, R. Dinesh Kumar{1}, Krity Kansara{2}, K. N. Raghavendra Rao{2}, Murali Mohan{2}, Manjunath Ramakrishna Reddy{2}, Uday Haleangadi Prabhu{2}, P. Prakash{2}, Sushovan Chakraborty{2}, Sreetama Das{2}, K. N. Madhusoodanan{1}  
{1}Cochin University of Science and Technology, India; {2}Robert Bosch, India; {3}Robert Bosch RBEI, Germany

11:30

2703: Nonanal Sensor Fabrication Using Aldol Condensation Reaction Inside Alkali-Resistant Porous Glass

Masato Tsujiguchi{1}, Takashi Aitoku{1}, Hironori Takase{1}, Yasuko Yamada Maruo{2}

{1}Nippon Electric Glass Company Ltd., Japan; {2}Tohoku Institute of Technology, Japan

11:45

2782: Effect of Oxygen on the Electrical Conductivity of Pt-Contacted  $\alpha$ -Ga<sub>2</sub>O<sub>3</sub>/ε(κ)-Ga<sub>2</sub>O<sub>3</sub> MSM Structures on Patterned Sapphire Substrates

Nikita Yakovlev{1}, Vladimir I. Nikolaev{2}, Sergey I. Stepanov{2}, Aleksei V. Almaev{1}, Aleksei I. Pechnikov{2}, Evgeny V. Chernikov{1}, Bogdan O. Kushnarev{1}

{1}National Research Tomsk State University, Russia; {2}Perfect Crystals LLC, Russia

## 10:30 – 12:00

### Journal Presentations – Smart & Bio-Inspired Systems

Room: Cumberland J

Session Chair(s): Theerawit Wilaiprasitporn

10:30

2752: An Autonomous Environmental Logging Microsystem (ELM) for Harsh Environments

Yu Sui, Alexander C. Benken, Yushu Ma, Andrew Trickey-Glassman, Tao Li, Yogesh B. Gianchandani  
University of Michigan, United States

10:45

2704: Tutorial: a Versatile Bio-Inspired System for Processing and Transmission of Muscular Information

Fabio Rossi, Andrea Mongardi, Paolo Motto Ros, Massimo Ruo Roch, Maurizio Martina, Danilo Demarchi  
Politecnico di Torino, Italy

**11:00**

2759: Towards Development of an ISFET-Based Smart Ph Sensor: Enabling Machine Learning for Drift Compensation in IoT Applications

Nishad Sahu{1}, Rishabh Bhardwaj{3}, Het Shah{1}, Ravindra Mukhiya{2}, Rishi Sharma{2}, Soumendu Sinha{2}

{1}Birla Institute of Technology and Science, India; {2}CSIR-Central Electronics Engineering Research Institute, India; {3}Singapore University of Technology and Design, Singapore

**11:15**

2744: Revealing Preference in Popular Music Through Familiarity and Brain Response

Theerawit Wilaiprasitporn{4}, Soravitt Sangnark{4}, Phairot Autthasan{4}, Puntawat Ponglertnapakorn{4}, Phudit Chalekarn{4}, Thapanun Sudhawiyangkul{4}, Manatsanan Trakulruangroj{2}, Sarita Songsermsawad{4}, Rawin Assabumrungrat{3}, Supalak Amplod{4}, Kaj

{1}King Mongkut's University of Technology Thonburi, Thailand; {2} Thammasat University, Thailand; {3}Tohoku University, Japan; {4} Vidyasirimedhi Institute of Science and Technology, Thailand

**11:30**

2711: False-Alarm-Controllable Radar Detection for Marine Target Based on Multi Features Fusion via CNNs

Xiaolong Chen, Ningyuan Su, Yong Huang, Jian Guan  
Naval Aviation University, China

## **10:30 – 12:00**

### **Journal Presentations – Physical Sensing II**

Room: Cumberland H

Session Chair(s): Brent Lunceford

**10:30**

2760: A MEMS Pressure Sensor Using Electrostatic Levitation

Mohammad Mousavi, Mohammad Alzgoool, Shahrzad Towfighian  
Binghamton University, United States

**10:45**

2716: Textile-Based Pressure Sensors for Monitoring Prosthetic-Socket Interfaces

Jordan Tabor{2}, Talha Agcayazi{2}, Aaron Fleming{2}, Brendan Thompson{2}, Ashish Kapoor{2}, Ming Liu{2}, Michael Y. Lee{1}, He Helen Huang{2}, Alper Bozkurt{2}, Tushar K. Ghosh{2}

{1}Baylor College of Medicine, United States; {2}North Carolina State University, United States



**11:00**

2731: Highly Stretchable Strain Sensor with Spiral Fiber for Curvature Sensing of a Soft Pneumatic Gripper

Chaoyang Shi{3}, Rui Liu{1}, Shuxin Wang{2}, Hui Yang{2}  
{1}Key Laboratory of Mechanism Theory and Equipment Design, Tianjin University, China; {2}Tianjin Key Laboratory of Molecular Optoelectronic Sciences, Tianjin University, China; {3}Tianjin University, China

**11:15**

2734: A Novel Trapezoidal ScAlN/AlN-Based MEMS Piezoelectric Accelerometer

Wenjuan Liu, Bohao Hu, Yan Liu, Binghui Lin, Guoqiang Wu, Chengliang Sun  
Wuhan University, China

**11:30**

2758: In-Run Mode-Matching of MEMS Gyroscopes Based on Power Symmetry of Readout Signal in Sense Mode

Xukai Ding{2}, Zhihu Ruan{2}, Jia Jia{1}, Libin Huang{2}, Hongsheng Li{2}, Liye Zhao{2}  
{1}Jiangsu University of Science and Technology, China; {2}Southeast University, China

**11:45**

2774: A Micromachined Resonant Micro-Pressure Sensor

Yu Zheng{2}, Sen Zhang{1}, Yulan Lu{1}, Bo Xie{1}, Deyong Chen{1}, Junbo Wang{1}, Jian Chen{1}  
{1}Aerospace Information Research Institute, Chinese Academy of Sciences, China; {2}Chinese Academy of Sciences, China

**12:00 – 13:30**

Lunch

Marsalis B

**13:30 – 15:00**

Editors Forum

Room: Cumberland A

Session Chair(s): Zeynep Celik & Krikor Ozanyan

**13:30 – 15:00**

Interactive Forum: Sensor Phenomenology, Modeling & Evaluation II

Room: Marsalis A

Session Chair(s): Azeemuddin Syed

2159: Reflective-Mode Phase-Variation Permittivity Sensors Based on Coupled Resonators

Pau Casacuberta{1}, Paris Vélez{1}, Jonathan Muñoz-Enano{1}, Lijuan Su{1}, Marta Gil{2}, Ferran Martín{1}

{1}GEMMA/CIMITEC, Universitat Autònoma de Barcelona, Spain; {2} Universidad Politécnica de Madrid, Spain

2192: MEMS Microphone for Acoustic Sensing on Overhead Power Lines: Analysis of Electric and Magnetic Field Interference

Jeremias Sattlegger, Markus Neumayer, Thomas Bretterklieber  
Graz University of Technology, Austria

2229: Genetic Algorithm Application to Enlarge Travel Range for Multi-Electrode MEMS Resonators

Yu Tian, Ronald Miles, Shahrzad Towfighian  
Binghamton University, United States

2248: Multivariate Analysis of Optoelectronic Detection Units for the Maximization of Photon Interaction with Implanted Sensing Material

Briley James, Amir Zavareh, Michael McShane  
Texas A&M University, United States

2280: Silicon Electrothermal Microactuators as Zero Standby Power Local Temperature Switches

Han Xuan Wong, Yul Koh, Duan Jian Goh, Jaibir Sharma, Srinivas Merugu, Joshua En-Yuan Lee

IME, Agency for Science, Technology and Research, Singapore

2404: A Resistor Network Optimization Algorithm Enabling Synthetic Bioimpedance Generation for Validating Wearable Sensing Systems

Harrison Crane, Samer Mabrouk, Omer T. Inan  
Georgia Institute of Technology, United States

2466: An Implantable Sensor for Arterial Pressure Monitoring with Minimal Loading: Design and Finite Element Validation

Mustafa Beyaz  
Antalya Bilim University, Turkey

2481: Estimating the Angular Error of Magnetic Positions Sensors Under the Influence of External Stray Fields

Phil Meier, Kris Rohrmann, Marvin Sandner, Marcus Prochaska  
Ostfalia University of Applied Sciences, Germany

2504: Magnetic Signature Sensor Model for Accurate Short-Distance Localization

Steffen Kastner{1}, Markus Ebner{1}, Markus Bullmann{1}, Toni Fetzter{1}, Frank Deinzer{1}, Marcin Grzegorzec{2}

{1}University of Applied Sciences Würzburg-Schweinfurt, Germany;  
{2}University of Lübeck, Germany

## 13:30 – 15:00

### Interactive Forum: Chemical, Electrochemical & Gas Sensors III

Room: Marsalis A

Session Chair(s): Hamida Hallil & Xiaosan Zhu

#### 2031: Cleaning Procedure for the Screen-Printed RuO<sub>2</sub> pH Electrodes

Maryna Lazouskaya<sup>{3}</sup>, Iuliia Vetik<sup>{3}</sup>, Kiranmai Uppuluri<sup>{2}</sup>, Nasrin Razmi<sup>{1}</sup>, Ott Scheler<sup>{3}</sup>

<sup>{1}</sup>Linköping University, Sweden; <sup>{2}</sup>Łukasiewicz Research Network–Institute of Microelectronics and Photonics, Poland; <sup>{3}</sup>Tallinn University of Technology, Estonia

#### 2063: Facile Use of In-Situ Doped Onion-Like Carbon Nanoparticles for Detecting Toluene at Room Temperature

Manoko Maubane-Nkadimeng<sup>{3}</sup>, Thomas Mongwe<sup>{3}</sup>, Themba Ntuli<sup>{3}</sup>, Ludwe Sikeyi<sup>{3}</sup>, Neil Coville<sup>{3}</sup>, Jose Serbena<sup>{1}</sup>, Messai Mamo<sup>{2}</sup>

<sup>{1}</sup>Universidade Federal do Paraná, Brazil; <sup>{2}</sup>University of Johannesburg, South Africa; <sup>{3}</sup>University of the Witwatersrand, South Africa

#### 2122: Work Function Modification of Borophene by Barium Decoration Towards Room Temperature NO<sub>2</sub> Gas Sensor

Naveen Kumar Arkoti, Kaushik Pal

Indian Institute of Technology Roorkee, India

#### 2143: Ingestible pH Sensing Capsule with Thread-Based Electrochemical Sensors

Cihan Asci, Ruben Del-Rio-Ruiz, Atul Sharma, Sameer Sonkusale  
Tufts University, United States

#### 2154: Rapid SARS-CoV-2 S-Protein Detection Using Nanostructured Electrochemical Biosensor

Špela Trafela, Anja Korent, Kristina Žagar Soderžnik, Kristina Žužek, Sašo Šturm

Jožef Stefan Institute, Slovenia

#### 2190: A Hydrophilic Fe<sub>3</sub>O<sub>4</sub>/CNTs Nanoenzyme Sensor for Ultra-Low Concentration H<sub>2</sub>O<sub>2</sub> Sensing

Zhiqiang Zhai, Xiaosong Du, Rui Liao, Yang Wang, Yin Long  
University of Electronic Science and Technology of China, China

#### 2276: Odor Recorder Based on an Array of QCM Sensors Using Frequency Shifts and Resistance Changes of Multiple Harmonics

Nanxin Gong, Manuel Aleixandre, Takamichi Nakamoto  
Tokyo Institute of Technology, Japan

2400: RFID Gas Sensor for In-Field Detection of Chemical Threats: Evaluation of Batteryless Discontinuous Operation

Ailyn Estevez{1}, Noemi Perez{1}, Juan Casanova-Chafer{2}, Eduard Llobet{2}, Andoni Beriain{1}

{1}TECNUN, Universidad Pública de Navarra, Spain; {2}Universitat Rovira i Virgili, Spain

2445: Engineering Plasmonic Nanostructures for Label-Free SERS Detection of Neurotoxic Gases

Kissia Batista, Marta Lafuente, Sergio G Rodrigo, Reyes Mallada, Maria Pilar Pina

Universidad de Zaragoza, Spain

2457: Development of a Micro Gas Sensor with a Suspended Micro Heater for Hydrogen Sulfide Gas Detection

Chia-Hsu Hsieh{2}, Chuan-Chun Liu{3}, An-Ting Li{3}, Chun-Hsun Lin{1}, Wei-Chieh Sun{3}, Yao-Ching Fang{3}, I-Yu Huang{3}

{1}China Steel Corporation, Taiwan; {2}Metal Industries Research & Development Centre, Taiwan; {3}National Sun Yat-sen University, Taiwan

2551: Novel Gate Electrode Design for Flexible Planar Electrolyte-Gated Field-Effect Transistor-Based Sensors for Real-Time Ammonium Detection

Mattia Petrelli{1}, Bajramshahe Shkodra{1}, Martina Aurora Costa Angeli{1}, Alessandra Scarton{2}, Silvia Pogliaghi{3}, Roberto Biasi{2}, Paolo Lugli{1}, Luisa Petti{1}

{1}Free University of Bozen-Bolzano, Italy; {2}Microgate Srl, Italy; {3}University of Verona, Italy

2068: EC Sensor to Improve Sea Turtle Nesting Research

Rebecca Dean, Robert Dean

Auburn University, United States

2093: Fano Resonance-Based Terahertz Metamaterial Uric Acid Sensor with Asymmetric Design

Yuke Han, Xiaomeng Bian, Rui You, Tianshu Li, Lianqing Zhu, Fei Luo  
Beijing Information Science and Technology University, China

2199: Chronoamperometric Detection of Heavy Metal Ions for Multi-Analyte Water Analysis with Microsensors

Besnik Uka, Jochen Kieninger, Stefan Rupitsch, Gerald Urban, Andreas Weltin

IMTEK, Albert-Ludwigs-Universität Freiburg, Germany

2315: Triple Oleylamine Capped WS<sub>2</sub> Sensor Array for Room Temperature Discrimination of Chemical Vapours

Siziwe Gqoba{2}, Tshegofatso Mabilane{2}, Mildred Airo{2}, Lerato Machogo-Phao{2}, Rudo Sithole{2}, Nosipho Moloto{2}, Rafael Rodrigues{1}, Ivo Hümmelgen{1}

{1}Universidade Federal do Paraná, Brazil; {2}University of the Witwatersrand, South Africa

**13:30 – 15:00**

## Interactive Forum: Optical Sensors III

Room: Marsalis A

Session Chair(s): Iganacio R. Matias

### 2072: An Optical Grasping Force Sensor for Minimally Invasive Surgical Robotic Forceps

Kazutaka Sato, Shuichi Morizane, Atsushi Takenaka, Masaru Ueki, Tadao Matsunaga, Sang-Seok Lee

Tottori University, Japan

### 2089: Environmental Monitoring of Methane Utilizing Multispectral NDIR Gas Sensing for Compensation of Spectral Impact from Water Vapor in Air

Bakhran Gaynullin{3}, Christine Hummelgård{2}, Henrik Rödjegård{2}, Claes Mattsson{1}, Goran Thungström{1}  
{1}Mid Sweden University, Sweden; {2}SenseAir AB, Sweden; {3}SenseAir AB, Mid Sweden University, Sweden

### 2123: Novelty Sensor Using Integrated Fluorescence and Dielectric Spectroscopy to Improve Food Quality Identification

Euclides Chuma, Yuzo Iano

Universidade Estadual de Campinas, Brazil

### 2178: Alfalfa Quality Detection by Means of VIS-NIR Optical Fiber Reflection Spectroscopy

Carlos Ruiz Zamarreño{1}, Ander Gracia-Moises{2}, Ignacio Vitoria{1}, José Javier Imas{1}, Lorena Castaño{1}, Amaia Avedillo{1}, Ignacio Raúl Matías{1}

{1}Public University of Navarre, Spain; {2}Pyroistech S.L., Spain

### 2289: Low-Cost Colorimetric Alternative of qPCR for DNA Sensing Based on Intercalation with Methylene Blue

Ruchira Nandeshwar, Avani Kulkarni, Shruti Ahuja, M.Santhosh Kumar, Kiran Kondabagil, Siddharth Tallur

Indian Institute of Technology Bombay, India

### 2394: Towards Integrated Optical Feedback FM-to-Am Conversion in Silicon Nitride for Displacement Sensing Applications

Clément Deleau{3}, Thidsanu Apiphatnaphakul{3}, Han Cheng Seat{3}, Frédéric Surre{1}, Usman Zabit{4}, Franck Carcenac{2}, Pierre-François Calmon{2}, Thierry Bosch{3}, Olivier Bernal{3}  
{1}James Watt School of Engineering, University of Glasgow, United Kingdom; {2}LAAS-CNRS, France; {3}LAAS-CNRS, University of Toulouse, Toulouse INP, France; {4}National University of Sciences and Technology, Islamabad, Pakistan

### 2039: Design of Optical Inclinator Composed of a Ball Lens and Viscosity Fluid to Improve Focusing

Iwao Matsuya, Osamu Furuya

Tokyo Denki University, Japan

2174: Physical LiDAR Simulation in Real-Time Engine

Wouter Jansen, Nico Huebel, Jan Steckel

Cosys-Lab, University of Antwerp, Belgium

**13:30 – 15:00**

### Interactive Forum: Sensor Networks & IOT

Room: Marsalis A

Session Chair(s): Elena Gaura & Yacine Ghamri-Doudane

2047: Federated Learning for Masked Psoriasis Severity Classification

Cho-I Moon{2}, Jiwon Lee{2}, Seula Kye{2}, Yoo Sang Baek{1}, Onseok Lee{2}

{1}Korea University College of Medicine, Korea; {2}Soonchunhyang University, Korea

2078: Design and Evaluation of a Mobile Sensing Platform for Water Conductivity

Chamod Weerasinghe{2}, Lokesh Padhye{2}, Suranga Nanayakkara{1}

{1}National University of Singapore, Singapore; {2}University of Auckland, New Zealand

2117: Multi-Modal Sensor Selection with Genetic Algorithms

Sergei Chuprov{1}, Leon Reznik{1}, Igor Khokhlov{2}, Karan Manghi{1}

{1}Rochester Institute of Technology, United States; {2}Sacred Heart University, United States

2127: An Open-Source IoT Remote Monitoring System for High-Hazard Dams

Corinne Smith{2}, John McCain{1}, Austin Downey{2}, Jasim Imran{2}

{1}South Carolina Department of Health and Environmental Control, United States; {2}University of South Carolina, United States

2130: Cryptographic Data Security for IoT Healthcare in 5G and Beyond Networks

Sabrina Ahmed, Zareen Subah, Mohammed Zamshed Ali

University of Texas at Dallas, United States

2145: Electro-Mechanical Design of Sensor-Hub for Indoor Smart Irrigation

Jagan P, Sasirekha Gvk, Madhav Rao, Jyotsna Bapat, Debabrata Das

International Institute of Information Technology, Bangalore, India

2272: An Indirect Method of Brushing Force Detection with Five Force Sensors and RF Algorithm

Haicui Li, Lei Jing

University of Aizu, Japan

2291: A LoRaWAN-Based Smart Sensor Tag for Cow Behavior Monitoring

Thai-Ha Dang{1}, Ngoc-Hai Dang{1}, Viet-Thang Tran{2}, Wan-Young Chung{1}

{1}Pukyong National University, Korea; {2}Vietnam Research Institute of Electronics, Informatics and Automation, Vietnam

2370: High-Accuracy and Long-Range Energy Harvesting Beat Sensor with LoRa

Tuan Anh Tran, Koichiro Ishibashi

University of Electro-Communications, Japan

2560: A Photodetector-Based Automated Light Intensity Controlling System Using IoT

Pranjali Shrivastava, Manpreet Singh, Vandana Chalka, Nikhil Vadera, Saakshi Dhanekar, Kamaljit Rangra

Indian Institute of Technology Jodhpur, India

## 13:30 – 15:00

### Interactive Forum: Actuators & Powering Sensors

Room: Marsalis A

Session Chair(s): Djilali Kourtiche & Souvik Dubey

2141: Twisted and Coiled Carbon Nanotube Yarn Muscle Embedding Ferritin

Jong Woo Park, Dong Yeop Lee, Seon Jeong Kim

Hanyang University, Korea

2263: Thermally Driven Phase Transition for Reversible Diving/Surfacing Hydrogel Devices

Jung Gi Choi{1}, Jae Sang Hyeon{1}, Seon Jeong Kim{2}

{1}Center for Self-Powered Actuation, Hanyang University, Korea; {2} Hanyang University, Korea

2285: Non Intrusive Current and Power Factor Sensor with Energy Harvesting for Maintenance-Free Operation

Takaya Yoshitake{2}, Akashi Satoh{2}, Shinichiro Mito{1}

{1}National Institute of Technology, Tokyo College, Japan; {2} University of Electro-Communications, Japan

2527: Self-Sensing Piezoelectric Micro-Lens Actuator

Syed Mamun R Rasid, Aron Michael, Hemanshu Roy Pota, Ssu-Han Chen

University of New South Wales, Australia

2544: Non-Intrusive Water Flow Rate Measurement: A TEG-Powered Ultrasonic Sensing Approach

Domenico Balsamo{1}, Oktay Cetinkaya{2}, Sergey Mileiko{1}

{1}Newcastle University, United Kingdom; {2}University of Oxford, United Kingdom

2595: Investigating the Impact of Thickness and Porosity on Energy Density of Screen Printed Graphite/NMC LIBs with 3D Structures Under Fast Charging Condition

Soma Ahmadi, Dinesh Maddipatla, Qingliu Wu, Massood Atashbar

Western Michigan University, United States

### 2601: Capillary Suspension Based Ink Formulation for Stable Graphite Anode in Lithium-Ion Batteries

Valliammai Palaniappan, Dinesh Maddipatla, Soma Ahmadi, Himanaga Rama Krishn Emani, Binu Narakathu, Bradley Bazuin, Qingliu Wu, Massood Atashbar

Western Michigan University, United States

### 2647: State of the Art Supercapacitor Families for Environmental Friendly Battery-Less Energy Storage for Environmental Sensor Networks

Dulsha Kularatna–Abeywardana{1}, Nihal Kularatna{2}

{1}University of Auckland, New Zealand; {2}University of Waikato, New Zealand

### 2515: Novel Laser Patterned MXene Based Anodes for High Capacity Fast Charging Li-Ion Batteries

Himanaga Rama Krishn Emani, Valliammai Palaniappan, Dinesh Maddipatla, Bradley Bazuin, Qingliu Wu, Massood Atashbar

Western Michigan University, United States

### 2574: Energy-Efficient Adhesion Controlled Microelectromechanical Volatile Memory (MVM)

Khanjan Joshi, Manu Garg, Dhairya Singh Arya, Sushil Kumar, Mujeeb Yousuf, Pushpapraj Singh

Indian Institute of Technology Delhi, India

## 13:30 – 15:00

### Interactive Forum: Sensor Data Processing V

Room: Marsalis A

Session Chair(s): Marco Da Silva

### 2059: Encoded Image-Based Time Series Classification for Improving Colorimetric Detection of Hydrogen Sulfide (H<sub>2</sub>S)

Chang-Hyun Kim{1}, Junyeop Lee{1}, Junkyu Park{1}, Seung-Hwan Choi{1}, Daewoong Jung{1}, Chang-Woo Nam{1}, Yuntae Ha{1}, Kwan Woo Kim{1}, Sang Hyeok Park{1}, Su Ji Choi{1}, Sanghun Choi{2}, Suwoong Lee{1}

{1}Korea Institute of Industrial Technology, Korea; {2}Kyungpook National University, Korea

### 2140: Detection of Antibodies for COVID-19 from Reflectance Spectrum Using Supervised Machine Learning

Ciao-Ming Tsai{2}, Chitsung Hong{3}, Wei-Yi Kong{1}, Wei-Huai Chiu{1}, Cheng-Hao Ko{1}, Weileun Fang{2}

{1}National Taiwan University of Science and Technology, Taiwan; {2}National Tsing Hua University, Taiwan; {3}Spectrochip Inc., Taiwan

### 2238: A Stray Field Compensation Method for Stacked Angular Sensors Based on a Neuronal Network

Phil Meier, Kris Rohrmann, Marvin Sandner, Marcus Prochaska  
Ostfalia University of Applied Sciences, Germany



2240: Time-Series Forecasting: Extreme Gradient Boosting Implementation in Smartphone Photoplethysmography Signals for Biometric Authentication Processes

Bengie L. Ortiz, Evan Miller, Tim Dallas, Jo Woon Chong

Texas Tech University, United States

2331: A Distance Based Freshness Evaluation Method for Oyster Monitoring by Electronic Nose

Ru Yin<sup>{2}</sup>, Guangfen Wei<sup>{2}</sup>, Guishuai Zhang<sup>{2}</sup>, Zhiqiang Zou<sup>{2}</sup>, Zhilin Zhu<sup>{2}</sup>, Jun Yu<sup>{1}</sup>

<sup>{1}</sup>Dalian University of Technology, China; <sup>{2}</sup>Shandong Technology and Business University, China

2414: SVM-Based Motion Classification Using Foot-Mounted IMU for ZUPT-Aided Ins

Eudald Sangenis, Chi-Shih Jao, Andrei Shkel

University of California, Irvine, United States

2653: Machine Learning-Based Severity Classification of Spinal Cord Injury Patients Using Straight Leg Raising Test

Ryoto Yoshikura, Shintaro Izumi, Tatsuya Sugimoto, Hiroshi Kawaguchi

Kobe University, Japan

## 13:30 – 15:00

### Interactive Forum: Sensor Data Processing IV

Room: Marsalis A

Session Chair(s): Carlos Ruiz

2054: Robust Time-of-Flight-Based Material Imaging Using Three-Dimensional Deep Neural Networks on Spatial Neighborhoods of Pixels

Rajababu Udainarayan Singh, Miguel Heredia Conde

Universität Siegen, Germany

2090: Machine Learning Based Optimization of a Ceramic Bushing Manufacturing Process

Thomas Schmitt<sup>{2}</sup>, Maximilian Bundscherer<sup>{2}</sup>, Ralf Drechsel<sup>{1}</sup>, Tobias Bocklet<sup>{2}</sup>

<sup>{1}</sup>Paul Rauschert Steinbach GmbH, Germany; <sup>{2}</sup>Technische Hochschule Nürnberg Georg Simon Ohm, Germany

2116: Performance Evaluation of Spatial Modulation Patterns in Compressive Sensing Terahertz Imaging

Adolphe Ndagijimana<sup>{1}</sup>, Miguel Heredia Conde<sup>{2}</sup>, Iñigo Ederra Urzainqui<sup>{1}</sup>

<sup>{1}</sup>Public University of Navarre, Spain; <sup>{2}</sup>Universität Siegen, Germany

2118: Integrating Security with Accuracy Evaluation in Sensors Fusion

Igor Khokhlov<sup>{2}</sup>, Sergei Chuprov<sup>{1}</sup>, Leon Reznik<sup>{1}</sup>

<sup>{1}</sup>Rochester Institute of Technology, United States; <sup>{2}</sup>Sacred Heart University, United States

## 2411: Fault Size Estimation of Ball Bearings: A Machine Learning Approach for Noisy Data

Matthias Kahr, Gabor Kovács, Hubert Brückl

University for Continuing Education Krems, Austria

## 2017: A GIS Aided Approach for Geolocalizing an Unmanned Aerial System Using Deep Learning

Jianli Wei<sup>{2}</sup>, Deniz Karakay<sup>{1}</sup>, Alper Yilmaz<sup>{2}</sup>

<sup>{1}</sup>Middle East Technical University, Turkey; <sup>{2}</sup>Ohio State University, United States

## 2557: A 3D CNN Based People Counting System Using Auto-Correlation Functions from Frequency Modulated Continuous Wave Radar Signals

Yura Seo, Miseon Han, Jeongtae Kim

Ewha Womans University, Korea

## 2034: Texture Classification Model Based on Temporal Changes in Vibration Using Wavelet Transform

Momoko Sagara, Kenjiro Takemura

Keio University, Japan

## 13:30 – 15:00

### Interactive Forum: Sensors in Industrial Practices II

Room: Marsalis A

Session Chair(s): Stephen Bart & James Brusey

## 2094: Vibration Anomaly Detection Using Deep Autoencoders for Smart Factory

Mark Waters<sup>{1}</sup>, Pawel Waszczuk<sup>{1}</sup>, Rodney Ayre<sup>{2}</sup>, Alain Dreze<sup>{2}</sup>, Don McGlinchey<sup>{1}</sup>, Babakalli Alkali<sup>{1}</sup>, Gordon Morison<sup>{1}</sup>

<sup>{1}</sup>Glasgow Caledonian University, United Kingdom; <sup>{2}</sup>Mitsubishi Electric Air-Conditioning Systems Europe LTD, United Kingdom

## 2112: Photoluminescence Imaging for Industrial Quality Control During Manufacturing of Thin-Film Solar Cells

Johanna Zikulnig<sup>{1}</sup>, Wolfgang Mühleisen<sup>{1}</sup>, Marcel Simor<sup>{2}</sup>, Veronique Gevaerts<sup>{2}</sup>, Martin De Biasio<sup>{1}</sup>

<sup>{1}</sup>Silicon Austria Labs GmbH, Austria; <sup>{2}</sup>TNO, Netherlands

## 2514: An Approach for Smart and Cost-Efficient Automated E-Waste Recycling for Small to Medium-Sized Devices Using Multi-Sensors

Nermeen Abou Baker, Uwe Handmann

Ruhr West University of Applied Sciences, Germany

## 2607: Template Matching Technique for Unobstrusive Leak Event Detection in Oil and Gas Pipelines

Raj Rakshit, Supriya Gain, Arijit Sinharay, Chirabrata Bhaumik, Tapas Chakravarty, Arpan Pal

Tata Consultancy Services Limited TCS Research, India

## 13:30 – 15:00

### Interactive Forum: Focused Session: Microwave & Hot Carrier Based Sensors II

Room: Marsalis A

Session Chair(s): Karthik Shankar

2494: Identifying Plasmon-Exciton Coupling in Au Nanoislands Coated with Thin Films of J-Aggregates

John Garcia, Ethan Wilson, Dipesh Aggarwal, Harshitha Rajashekhar, Navneet Kumar, Karthik Shankar

University of Alberta, Canada

## 13:30 – 15:00

### Interactive Forum: Focused Session: Nanomaterials Based Sensors II

Room: Marsalis A

Session Chair(s): Shideh Ameri & Sameer Sonkusale

2409: Low-Modulus, Low-Motion-Artifact Sensor for Biological Signal Recording

Anan Zhang, Shideh Kabiri Ameri

Queen's University, Canada

## 15:00 – 16:00

### Optical Sensors II

Room: Cumberland F

Session Chair(s): Ignacio Matías

15:00

2158: Integration of Carboxymethyl Cellulose Waveguides for Smart Textile Optical Sensors

Sofía Guridi<sup>{1}</sup>, Ari Hokkanen<sup>{3}</sup>, Aayush Jaiswal<sup>{3}</sup>, Nonappa Nonappa<sup>{2}</sup>, Pirjo Kääriäinen<sup>{1}</sup>

<sup>{1}</sup>Aalto University, Finland; <sup>{2}</sup>Tampere University, Finland; <sup>{3}</sup>VTT Technical Research Centre of Finland, Finland

15:15

2044: 1.4kDots Consumer LiDAR Up to 10m Based on Indirect Time-of-Flight Sensor

Cedric Tubert, Pascal Mellot, Jose Sanches, Jeremie Teyssier, Valentin Rebière, Thibault Augey, Thomas Bouchet, Valerie Pena-Laroche, Adrien Bonnat, Marc Sanchez, Franck Hingant, Jean-Raphael Bezal, Patrick Laurent, Maxime Mellier, Jeannie Chinal, Matteo

STMicroelectronics, United States; STMicroelectronics, China; STMicroelectronics, France; STMicroelectronics, United Kingdom

**15:30**

2234: Optomechanical Holographic Sensors – COMSOL Modelling & Experimental Studies

Faolan Radford McGovern, Catherine Grogan, George Amarendei, Izabela Naydenova

Technological University Dublin, Ireland

**15:45**

2387: Gas Sensor Based on Silicon Nitride Integrated Long Period Grating

Clément Deleau{3}, Han Cheng Seat{3}, Frédéric Surre{1}, Franck Carcenac{2}, Pierre-François Calmon{2}, Olivier Bernal{3}

{1}James Watt School of Engineering, University of Glasgow, United Kingdom; {2}LAAS-CNRS, France; {3}LAAS-CNRS, University of Toulouse, Toulouse INP, France

**15:00 – 16:00**

## Sensor Network Applications

Room: Cumberland G

Session Chair(s): Yacine Ghamri-Doudane

**15:00**

2081: Leakage Sensor Placement Optimization Using Acoustic Attenuation Features in Water Mains

Akihiro Koyama{2}, Yusuke Sugita{2}, Atsushi Isobe{2}, Yudai Kamada{1}, Munenori Degawa{2}, Toshiyuki Mine{2}, Takashi Kawamoto{2}

{1}Hitachi America, Ltd., United States; {2}Hitachi, Ltd., Japan

**15:15**

2135: The Gecko Sensor: An Ultra-Compact, Low-Cost, Solar-Powered Environment Monitoring Device

Hongwei Li, Mingde Zheng, Michael Eggleston

Nokia Bell Labs, United Kingdom; Nokia Bell Labs, United States

**15:30**

2182: An Innovative Sensor for the Simultaneous Measurement of Photosynthetic Active Radiation (PAR) and Leaf Area Index (LAI)

Laura Maria Comella{1}, Frank Goldschmidtboeing{2}, Johannes Klüppel{1}, Eiko Hager{1}, Peter Woias{2}

{1}IMTEK, Albert-Ludwigs-Universität Freiburg, Germany; {2}Laboratory for Design of Microsystems, IMTEK, Albert-Ludwigs-Universität Freiburg, Germany

**15:45**

2429: Structured Isosurface Mapping of 3D Scalar Fields with Mobile Sensor Networks

Robert Lee, Christopher Kitts, Michael Neumann

Santa Clara University, United States

## 15:00 – 16:00

### Sensor Data Processing III

Room: Cumberland H

Session Chair(s): Vedran Bilas & Marco Da Silva

#### 15:00

2630: Commercial MAV Velocity Estimation Using Gaussian Process Regression for Drift Reduction

Kenny Anderson Queiroz Caldas<sup>{2}</sup>, Roberto Santos Inoue<sup>{1}</sup>, Marco Henrique Terra<sup>{2}</sup>

<sup>{1}</sup>Federal University of São Carlos, Brazil; <sup>{2}</sup>University of São Paulo, Brazil

#### 15:15

2536: Digital Dose Rate Equivalent Meter for Neutron-Gamma Mixed Field

Jiří Čulen<sup>{3}</sup>, Jan Král<sup>{1}</sup>, Aleš Jančář<sup>{3}</sup>, Zdeněk Kopecký<sup>{3}</sup>, Filip Mravec<sup>{3}</sup>, Zdeněk Matěj<sup>{2}</sup>

<sup>{1}</sup>Brno University of Technology, Czech Rep.; <sup>{2}</sup>Masaryk University, Czech Rep.; <sup>{3}</sup>VF, a.s., Czech Rep.

#### 15:30

2399: FootstepNet: A Convolutional Neural Network for Footstep-Based Person Identification

Sahil Anchal, Bodhibrata Mukhopadhyay, Subrat Kar

Indian Institute of Technology Delhi, India

#### 15:45

2350: Sensor Management Based on Convex Optimization via PCRLB and Joint Interception Probability

Yue Liu, Lin Zhou, Qian Wei, Benhui Zhao

Henan University, China

## 15:00 – 16:00

### Focused Session: Nanomaterials Based Sensors I

Room: Cumberland J

Session Chair(s): Shideh Ameri & Sameer Sonkusale

#### 15:00

2062: INVITED: Skin-Interfaced Wearable Sweat Biosensors

Wei Gao

California Institute of Technology, United States

#### 15:30

2602: Nanoplasmonic Sensing Technologies for Molecular Analysis of Extracellular Vesicles

Hyungsoon Im, Mi Ho Jeong, Taehwang Son, Jouha Min, Ralph Weissleder, Hakho Lee

Massachusetts General Hospital, United States

**15:45**

2637: Photonic Crystal Enhanced Quantum Dot Biosensor for Cancer-Associated miRNA Detection

Yanyu Xiong{3}, Qinglan Huang{3}, Taylor D. Canady{3}, Priyash Barya{3}, Shengyan Liu{3}, Opeyemi Arogundade{4}, Caitlin M. Race{3}, Congnyu Che{3}, Xiaojing Wang{3}, Lifeng Zhou{3}, Anh Igarashi{2}, Xing Wang{3}, Manish Kohli{1}, Andrew Smith{3}, Brian C {1}Huntsman Cancer Institute, United States; {2}Tohoku University / University of Illinois at Urbana-Champaign, Japan; {3}University of Illinois at Urbana-Champaign, United States; {4}University of Illinois Urbana-Champaign, United States

## **15:00 – 16:00**

### **Focused Session: Bio-Remote Sensing & Integrated Artificial Intelligence Systems**

Room: Cumberland K

Session Chair(s): Kianoush Rassels & Paddy French

**15:00**

2398: INVITED: Cost-Effective Solution of Remote Photoplethysmography Capable of Real-Time, Multi-Subject Monitoring with Social Distancing

Hen-Wei Huang{1}, Philip Rupp{1}, Jack Chen{1}, Abhijay Kemkar{1}, Naitik Khandelwal{1}, Ian Ballinger{1}, Peter Chai{1}, Giovanni Traverso{2}

{1}Harvard Medical School, United States; {2}Massachusetts Institute of Technology, United States

**15:30**

2613: Non-Contact Atrial Fibrillation Detection Using a 24-GHz Microwave Doppler Radar

Shintaro Izumi{1}, Sho Murase{2}, Itsumi Fukuda{3}, Kenta Taki{3}, Kazunori Toyama{3}, Tadashi Inuzuka{3}, Hideki Mochizuki{2}, Hiroshi Kawaguchi{1}

{1}Kobe University, Japan; {2}Osaka University, Japan; {3}Toyota Systems Corporation, Japan

**15:45**

2633: Motor Imagery Brain Activity Recognition Through Data Augmentation Using DC-GANs and Mu-Sigma

Abhishek Khoyani{1}, Harshdeep Kaur{1}, Marzieh Amini{1}, Hamidreza Sadreazami{2}

{1}Carleton University, Canada; {2}McGill University, Canada

## **15:00 – 16:00**

### **Journal Presentations – Device Technologies II**

Room: Cumberland L

Session Chair(s): Danling Wang

**15:00**

2742: Development of MEMS Sensor for Detection of Creatinine Using MIP Based Approach – a Tutorial Paper

Sumedha Nitin Prabhu{2}, Chinthaka Pasan Chinthaka Pasan{1}, Subhas Chandra Mukhopadhyay{2}

{1}EXPEC Advanced Research Center, Saudi Arabia; {2}Macquarie University, Australia

**15:15**

2741: Enhanced Graphene Sensors via Multi-Lasing Fabrication

Altynay Kaidarova{1}, Mani Teja Vijjapu{1}, Kuat Telegenov{1}, Alexander Przybysz{1}, Khaled Nabil Salama{1}, Jürgen Kosel{2}

{1}King Abdullah University of Science and Technology, Saudi Arabia; {2}Silicon Austria Labs GmbH, Austria

**15:30**

2769: Reduced Graphene Oxide Based Electronic Sensors for Rapid and Label-Free Detection of CEA and CYFRA 21-1

Sowmya Joshi, Gorthala Guruprasad, Saraswati Kulkarni, Ruma Ghosh

Indian Institute of Technology Dharwad, India

**15:45**

2714: Recent Advances in Electrochemical Sensors for Wearable Sweat Monitoring: a Review

Zhaoli Gao{1}, Kan Kan Yeung{1}, Ting Huang{1}, Yunzhi Hua{4}, Kai Zhang{2}, Matthew M. F. Yuen{3}

{1}Chinese University of Hong Kong, Hong Kong; {2}Guangdong University of Technology, China; {3}Hong Kong University of Science and Technology, Hong Kong; {4}Shenzhen Institute of Information Technology, China

**16:00 – 17:00**

**Award Ceremony**

Room: Reunion Ballroom

**17:00 – 17:30**

**Closing Ceremoy**

Room: Reunion Ballroom

## Notes:

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