2021 IEEE

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Welcome Message from the General Chair

Welcome to the 16th IEEE Sensors Applications Symposium 2021!

Dear Attendee,

It is my great pleasure to welcome you to the 2021 IEEE Sensors Applications Symposium. This symposium gathers international researchers and developers to share and discuss ideas and results on sensor technologies, methods, applications, standardization and commercialization. With no doubt, these topics are only increasing in importance in our daily lives, and SAS reflects this growing interest and research activity.

Our call for papers has resulted in submissions from 30 countries and over 350 co-authors, representing academia, industry, NGOs and government. Each submission was carefully peer-reviewed by a set of international experts, resulting in 68 accepted papers to be presented in regular and special sessions.

I am excited that this technical program is complemented by keynote presentations of three highly regarded experts, namely Brendan O'Flynn from the Tyndall National Institute in Ireland, Alexander Bergmann from the Graz University of Technology in Austria, and Henrik Rödjegård from Senseair in Sweden.

Organizing a conference is a significant effort and could not have been achieved without the help of many people. First and foremost, I would like to thank all authors for their contributions to the symposium. Without your submissions, this event would not have been possible. I would also like to thank all reviewers for volunteering their time to ensure a high quality of the technical program. Last but not least, I want to thank the entire organizing committee for their excellent work and their support in shaping this year's symposium.

By now, many of you will have experienced COVID-adjusted conferences. Organizing a fully virtual conference comes with challenges and opportunities. I hope that you thoroughly enjoy this year's conference and that you will leave it with new ideas, knowledge and connections. I also hope to welcome you again to SAS in future years.

Enjoy IEEE SAS 2021!

Sebastian Bader
IEEE SAS'21 General Chair
Mid Sweden University, Sweden

Symposium History

SAS 2020
March 9-11, 2020 | Virtual

SAS 2019
March 11-13, 2019 | Sophia Antipolis, France

SAS 2018
March 12-14, 2018 | Seoul, Korea

SAS 2017
March 13-15, 2017 | Glassboro, New Jersey

SAS 2016
April 20-22, 2016 | Catania, Italy

SAS 2015
April 13-15, 2015 | Zadar, Croatia

SAS 2014
February 18-20, 2014 | Queenstown, New Zealand

SAS 2013
February 19-21, 2013 | Galveston, Texas

SAS 2012
February 7-9, 2012 | Brescia, Italy

SAS 2011
February 22-24, 2011 | San Antonio, Texas

SAS 2010
February 23-25, 2010 | Limerick, Ireland

SAS 2009
February 17-19, 2009 | New Orleans, Louisiana

SAS 2008
February 12-14, 2008 | Atlanta, Georgia

SAS 2007
February 6-8, 2007 | San Diego, California

SAS 2006
February 7-9, 2006 | Houston, Texas

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Donghan Kim, Kyung Hee University, Korea (South)
Yongho Kim, Argonne National Laboratory, USA
Spyros Lalis, University of Thesally, Greece
Aime' Lay-Ekuakille, University of Salento, Italy
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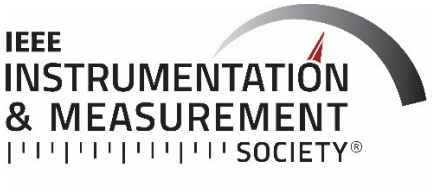


Keynote Speakers

Brendan O'Flynn (Tyndall National Institute, University College Cork, Ireland)

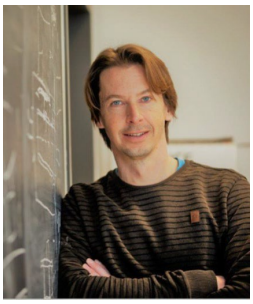
Topic: ***Smart Sensing Systems For Living and Working***

Speaker Biography:
Brendan O'Flynn is a Senior Staff Researcher at the Tyndall National Institute, University College Cork where he has been defining and leading the research activities of Wireless Sensor Networks Group (WSN) since 2004. His multidisciplinary group consists of over 20 researchers, comprising postdoctoral researchers, postgraduate students, engineers and scientists. Brendan's key contribution to Tyndall Institute's strategic objectives lies in his work developing, managing & coordinating a world-class, multidisciplinary research group who have successfully focussed on delivering smart sensors, circuits and systems in the application domains of Healthcare, Smart Manufacturing and Smart Agriculture.

The WSN group's research focus is in developing next generation embedded systems. Solutions are designed around low-power consumption, meeting requirements such as the indefinite, lifetime deployment of sensing systems that are low maintenance while creating information to inform real time, autonomous decision making.

Alexander Bergmann (Graz University of Technology, Graz, Austria)

Topic: ***Optical Aerosol Sensors From Photoacoustics to Evanescent Field Sensing***



Speaker Biography:
Alexander Bergmann received his Ph.D. degree in natural sciences from Karl-Franzens University, Graz, Austria, in 2000. From 2001 to 2016, he worked in different industrial R&D positions in the field of sensors and sensor systems. Since 2016, he has been a Professor and the Head of the Institute of Electronic Sensor Systems with the Faculty of Electrical and Information Engineering, Graz University of Technology, Austria. Since 2020 he is Head of the newly founded Institute of Electrical Measurement and Sensor Systems at the Graz University of Technology. He has co-authored two books, more than 95 articles, and filed more than 20 patents. His main research areas include modelling, simulation and design of electronic sensor systems; aerosol sensors and ambient air sensors; photo- and thermoacoustic sensors; sound, ultrasound and vibration sensors; distributed and multi-model sensors and sensor networks; highly integrated sensors, and sensor systems.

Henrik Rödjegård (Senseair, Sweden)

Topic: ***Bringing chip-integrated NDIR gas sensors into IoT applications***

Speaker Biography:
Henrik Rödjegård is the CTO of the Swedish NDIR gas sensor producer Senseair. He is also an adjunct professor in electronics design at Mid Sweden University. Henrik started his professional career with a Ph.D degree in solid state electronics from Chalmers University of Technology, Göteborg, Sweden in 2005. His thesis focused on MEMS technology and analogue electronics for inertial sensors such as accelerometers and gyroscopes. The technology developed during that period is still used for navigation of new satellites. Since 2006 Henrik has been part of the research team at Senseair improving gas sensing technology. This includes low-cost carbon dioxide sensors, greenhouse gas mapping and alcohol breathalyzers without mouthpiece for vehicle integration.

Special Sessions

SPS-1 Recent trends in factory communications in the IIoT and Industry 4.0 era
Organizers: Prof. Emiliano Sisinni, University of Brescia, Brescia, Italy
Prof. Mikael Gidlund, Mid Sweden University, Sundsvall, Sweden
Assistant Prof. Aamir Mahmood, Mid Sweden University, Sundsvall, Sweden
Dr. Luca Beltramelli, Mid Sweden University, Sundsvall, Sweden

SPS-2 Sensors, instrumentation and artificial intelligence technologies: Development and applications
Organizers: Prof. Olfa Kanoun, Professorship of Measurement and Sensors Technology, 09126 Chemnitz, Germany
Dr. Sonia Bradai, Professorship of Measurement and Sensors Technology, 09126, Chemnitz, Germany
Dr. Jose Roberto Bautista-Quijano, Professorship of Measurement and Sensors Technology, 09126 Chemnitz, Germany

SPS-3: Edge Computing for Medical IoT: From Sensors, Algorithms and Applications for Wearables and Implantable HMIs
Organizers: Dr. Simone Benatti, University of Bologna, Bologna, Italy
Dr. Victor J. Kartsch Morinigo, University of Trento, Trento, Italy

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Yasmina Souley Dosso and Roger Selzler (Carleton University, Canada); Kim Greenwood (Children's Hospital of Eastern Ontario, Canada); JoAnn Harrold (The Children's Hospital of Eastern Ontario, CHEO, Ottawa, Canada); James R Green (Carleton University, Canada)

A Capacitive Readout Strategy for Ammonia Detection: Design Flow, Modeling and Simulation
Bruno Ando, Salvatore Baglio, Salvatore Castorina and Salvatore Graziani (University of Catania, Italy); Marianna Messina (AOU Policlinico Rodolico - San Marco, Italy); Salvatore Petralia and Sri Viswanadh Tondepu (University of Catania, Italy)

Quantifying the glucose concentration in urine test strip with a color-calibrated imaging system
Cheng-Ru Li, Chih-Chung Yang, Hsin-Yi Tsai and Chun-Han Chou (Taiwan Instrument Research Institute, National Applied Research Laboratories, Taiwan); Kuo-Cheng Huang (Taiwan Instrument Research Institute National Applied Research Laboratories, Taiwan); Yu-Hsuan Lin (Taiwan Instrument Research Institute, National Applied Research Laboratories, Taiwan)

Dual Pyroelectric Sensor for Thermal Characterization of Cell Lines
Salvatore Andrea Pullano, Marta Greco, Daniela P. Foti and Antonio Brunetti (University Magna Graecia of Catanzaro, Italy); Antonino S. Fiorillo (University of Magna Græcia, Italy)

Detection of False Alarms in the NICU Using Pressure Sensitive Mat
Daniel G Kyrollos (Carleton University, Canada); Kim Greenwood (Children's Hospital of Eastern Ontario, Canada); JoAnn Harrold (The Children's Hospital of Eastern Ontario, CHEO, Ottawa, Canada); James R Green (Carleton University, Canada)

Virtual Medical Instruments for Orthopedic Surgery Training: A Hip Arthroplasty Application
Alexander W Wiese, George D. Lecakes, Jr. and Shreekanth Mandayam (Rowan University, USA)

Non-Destructive Evaluation

Non-Destructive Evaluation of Food and Beverage (F&B) Fast Moving Consumer Goods (FMCG) Using Capacitive Proximity Sensor
Hari Krishna Salila Vijayalal Mohan and Andrew Alexander Malcolm (Advanced Remanufacturing and Technology Centre (ARTC), Singapore)

Comparison of sensors for contactless detection of void behind concrete using stress waves
Hengameh Noshahri, Ysbrand Wijnant, Catalin Cernat, Edwin Dertien and Léon olde Scholtenhuis (University of Twente, The Netherlands)

Non-destructive evaluation of treated polyethylene terephthalate films by fluorescence lifetime imaging
Maximilian Wohlschläger (Technical University of Applied Sciences Rosenheim, Germany); Martin Versen (Technical University of Applied Sciences, Rosenheim, Germany); Christian Laforsch (University Bayreuth, Germany)

S11 Calibration of a Coaxial-loaded-type Stepped Cut-off Circular Waveguide with SOM Termination
Kouji Shibata (Hachinohe Institute of Technology, Japan)

A Semi-Analytical Method for Modelling of EC Probes for Detection of Thin Defects in Metals
Shourya Mukherjee and Tapabrata Sen (Indian Institute of Technology Kharagpur, India); Chandrika Sreekantan Anoop (Indian Institute of Space Science and Technology, India); Siddhartha Sen (IIT Kharagpur, India)

Next Generation Geophysical Assessment System
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Novel Sensing Technologies - 1

Novel Method of Temperature Modulation for Enhancing Catalytic Gas Sensor Selectivity
Denis Spirjakin (Moscow Aviation Institute, Russia); Alexander Baranov (MATI–Russian State Technological University, Russia); Saba Akbari (Uppsala University, Sweden); Thanhphong Cu (MATI– Russian State Technological University, Russia); Ngoc Tuan Nguyen (Air Defence - Airforce Academy, Vietnam)

Towards Fault Injection Modules for Functionality Checks in MEMS-based LiDAR Systems
Philipp Stelzer, Andreas Strasser and Christian Steger (Graz University of Technology, Austria); Simon Waldhuber, Johannes Wiesmeier, Leonhard Christian Niedermueller and Norbert Druml (Infineon Technologies Austria AG, Austria)

Cryogenic Temperature characteristics of Thermosetting Epoxy Resins coated FBG Sensors
Zijian Cai, Han Song, Zhiyong Zhang and Xingyu Yao (Wuhan University of Technology, China)

Self-Compensation of Cross Influences using Spectral Transmission Ratios for Optical Fiber Sensors in Lithium-Ion Batteries
Florian Rittweger (Hamburg University of Applied Sciences, Germany); Christian Modrzynski (DECHEMA Forschungsinstitut Frankfurt, Germany); Philipp Schiepel (Hamburg University of Applied Sciences, Germany); Karl-Ragmar Riemschneider (Hochschule für Angewandte Wissenschaften, University of Applied Sciences, Germany)

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Peter Mark Jansson (Bucknell University & Center for Sustainability & the Environment, USA); John L Schmalzel (Rowan University, USA); Neal Graneau (Eliquigen); Peter Kaladius (Bucknell University, USA); Eric Jansson and William McGrath (Integrated Systems, USA); Luka Baramidze, Ifunanya Maduka and Julian Medina (Bucknell University, USA)

A Non-intrusive Ultrasonic Sensor System for Water Flow Rate Measurement
Sergey Mileiko (Newcastle University, United Kingdom (Great Britain)); Oktay Cetinkaya (The University of Sheffield, United Kingdom (Great Britain)); Alex Yakovlev and Domenico Balsamo (Newcastle University, United Kingdom (Great Britain))

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Universal tool for surface plasmon resonance sensors realized in waveguides
Fiore Capasso (University of Campania L. Vanvitelli, Italy); Francesco Arcadio, Luigi Zeni and Chiara Perri (University of Campania Luigi Vanvitelli, Italy); Girolamo D'Agostino, Giovanni Porto and Guido Chiaretti (Moresense srl, Italy); Nunzio Cennamo (University of Campania Luigi Vanvitelli, Italy)

An Embedded Vision Tool for Volcanic Ash Analysis
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Partial Discharge Detection Using Distributed Acoustic Sensing at the Oil-Pressboard interface
Laurie Kirkcaldy (University of Southampton, United Kingdom (Great Britain)); Gareth Lees (AP Sensing, United Kingdom (Great Britain)); Rosalie Rogers (AP Sensing UK, United Kingdom (Great Britain)); Paul Lewin (University of Southampton, United Kingdom (Great Britain))

Broadband Ultra-sensitive Adiabatic Magnetometer
Igor Savukov and Young Jin Kim (Los Alamos National Laboraoty, USA)

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Sawan Kumar Ambedkar and Elangovan K (Indian Institute of Space Science and Technology, India); Kishor Bhaskarrao Nandapurkar (Indian Institute of Technology Kaharagpur, India); Chandrika Sreekantan Anoop (Indian Institute of Space Science and Technology, India)

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Versatile and low-cost sensor interface for IoT-ready odor monitoring in wastewater management
Alessandro Depari, Paolo Bellagente, Paolo Ferrari, Alessandra Flammini, Marco Pasetti, Stefano Rinaldi and Emiliano Sisinni (University of Brescia, Italy)

SCPI: IoT and The Deja Vu of Instrument Control
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Robotics, Automation, and Data Fusion

Characterizing the Heated Oils Degradation
Chih-Chung Yang (Taiwan Instrument Research Institute, National Applied Research Laboratories, Taiwan); Yu-Ting Li (National Applied Research Laboratories, Taiwan); Donyau Chiang (Taiwan Instrument Research Institute, Taiwan); Po-kai Chiu (National Applied Research Laboratories, Taiwan); Yi-Cheng Lin (ITRC, Narlabs, Taiwan); Wen-Tse Hsiao (Taiwan Instrument Research Institute, Taiwan)

Robust Precision Landing for Autonomous Drones Combining Vision-based and Infrared Sensors
Giannis Badakis and Manos Koutsoubelias (University of Thessaly, Greece); Spyros Lalis (University of Thesally, Greece)

Parallel Delta-Sigma ADC modulation for performance increase of position sensors in industrial applications
Stefan Hoeltl, Matthias Kneissl and Martin Versen (Technical University of Applied Sciences Rosenheim, Germany)

Leader-Follower System in Convoys: An Experimental Design Focusing on Computer Vision
Yaqin Wang, Miloš Stanković, Eric Matson and Anthony Smith (Purdue University, USA)

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A Fusion Model for Cross-Subject Stress Level Detection Based on Transfer Learning
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A low-power embedded system for fire monitoring and detection using a multilayer perceptron
Alexios Papaioannou, Panagiotis Verikios and Charalampos S Kouzinopoulos (Information Technologies Institute / Centre of Research and Technology Hellas, Greece); Dimosthenis Ioannidis (Information Technologies Institute, Greece); Dimitrios Tzovaras (Centre for Research and Technology Hellas, Greece)

Sensors, Instrumentation and Artificial Intelligence Technologies: Development and Applications - 2

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3D printed capacitive shear and normal force sensor using a highly flexible dielectric
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Marco Giordano and Raphael Fischer (ETH Zurich, Switzerland); Michele Crabolu (HIlti, Switzerland); Giovanni Bellusci (Hilti, Switzerland); Michele Magno (ETH Zurich, Switzerland)

Smart Agriculture, Smart Buildings and Smart Mobility

Design of a Soil Moisture Sensor for Application in a Smart Watering System
Tran Anh Khoa (Modeling Evolutionary Algorithms Simulation & Artificial Intelligence, Vietnam); Nguyen Minh Trong, Le Mai Bao Nhu and Cao Hoang Phuc (Faculty of Electrical & Electronics Engineering, Ton Duc Thang Unviersity, Vietnam); VanDung Nguyen (Faculty of Electrical & Electronics Engineering Ton Duc Thang University, Vietnam); Duc Ngoc Minh Dang (Faculty of Electrical & Electronics Engineering, Ton Duc Thang Unviersity, Vietnam)

Method to determine the suitability of non-dispersive infrared carbon dioxide sensors for the application in Heating, Ventilation and Air Conditioning systems
Simon Nutsch and Michael Sauer (Hochschule für Technik und Wirtschaft des Saarlandes, Germany)

Metrological Analysis of an Ion Current Measurement System
Gabriel Gruber, Markus Neumayer, Thomas Bretterklieber and Hannes Wegleiter (Graz University of Technology, Austria)

A temperature compensated soil specific calibration approach for frequency domain soil moisture sensors for in-situ agricultural applications
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Investigating Heater Resistance Tolerance of the Heat-Pulse Sensor for Accurate Soil Moisture Measurements on Vadose Zone Soil
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An Oscillator-Based Wake-Up Receiver for Wireless Sensor Networks
Arian Nowbahari, Luca Marchetti and Mehdi Azadmehr (University of South-Eastern Norway, Norway)

Bridging the Last Mile: Utilizing QR codes, e-Paper and Smartphones to Link Low-Power IoT Data Collection Devices to the Internet
Scott Fazackerley (Okanagan College & University of British Columbia, Canada); Craig Nichol (University of British Columbia, Canada); Ramon Lawrence (University of British Columbia Okanagan, Canada)

Passive Methane Gas Sensor Node
Denis Spirjakin (Moscow Aviation Institute, Russia); Alexander Baranov (MATI–Russian State Technological University, Russia); Saba Akbari (Uppsala University, Sweden)

A novel energy harvesting actuator for self-powered environmental sensors
Joshua Curry, Nick Harris and Neil M White (University of Southampton, United Kingdom (Great Britain))

Polycrystalline silicon photovoltaic harvesting for indoor IoT systems under red-far red artificial light
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