2023 IEEE
SENSORS APPLICATIONS SYMPOSIUM

July 18-20, 2023 | OTTAWA, CANADA

SAS 2023 SYMPOSIUM PROGRAM

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Welcome Message

Welcome to the 18th IEEE Sensors Applications Symposium 2023 (SAS) in Ottawa, Canada!

On behalf of the entire Organizing Committee and of the IEEE SAS Steering Committee, we are delighted to welcome you to the 2023 IEEE Sensors Applications Symposium.

After difficult years where the Covid pandemic prohibited or strongly limited travels and thus physical interaction among researchers, finally this year we are pleased to finally offer a full in-person event, which is also a tangible sign that we are returning definitely going back to normality.

IEEE SAS is taking place in Canada for the first time, and it is coming back to the American continent after six years. Attracting new people and thus expanding the IEEE SAS community is one of the main goals of the IEEE SAS Steering Committee, and we are sure that IEEE SAS 2023 will comply succeed very well with in this task.

We are very greatly impressed by the outstanding quality of the papers and the superb international stature of the researchers presenting their findings at this year's symposium. The knowledge dissemination and discussions taking place in the symposium will help advance science, propose novel solutions, inform new policies, and initiate new research partnerships that will have a positive impact on our society.

New sensor technologies are being introduced at a high pace. Using If we use the right data analytics approaches, these sensors can make a significant positive impact on our lifelives. This year's IEEE SAS addresses applications ranging from energy, to health, robotics, transportation, smart agriculture, and smart cities.

The 2023 IEEE SAS has an exciting technical program with contributions from of 104 papers from by 350 authors, from 25 countries. The authors represent a broad range of stakeholders from academia, including researchers and students, and from industry, government, and NGOs. Three keynote speakers are giving interesting talks on cutting edge and interesting topics for the conference attendees. Finally, a wide range of side events such as tutorials, industry, young professional, and women in engineering panels enrich the conference program.

We would like to thank all authors and Special Sessions organizers for their contributions to the symposium, and as well as all reviewers for volunteering their time to ensure the high quality of our technical program. Finally, weWe appreciate the excellent work and dedication invested by that the entire Organizing Committee, the IEEE SAS Steering Committee, and the Conference Catalysts invested.

We are confident that you will enjoy IEEE SAS 2023 and we know that the symposium will inspire you to new ideas and will lead to innovative and exciting contributions and many future collaborations and contributions to knowledge.

Rafik Goubran, Honorary Chair
Sreeraman Rajan, IEEE SAS 2023 General Co-Chair
Alessandro Depari, IEEE SAS 2023 General Co-Chair and IEEE SAS Steering Committee Chairs

Symposium History

SAS 2022
August 1-3, 2022 | Sundsvall, Sweden

SAS 2021
August 23-25, 2021 | Virtual

SAS 2020
March 9-14, 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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Keynote Speakers

Sri Krishnan
Toronto Metropolitan University, Toronto, Canada

Topic: ***Wearables and Digital Healthcare***

Abstract:

Digital Healthcare harnesses the power of sensors, information and communications technology, signal and data processing, analytics, and machine learning for informed and better decision-making in healthcare. With the emergence of Internet of Things (IoT), wearable and wireless sensing, real-time machine learning algorithms digital healthcare is expected to make a significant impact in the day-to-day lives of many people. It also paves way for telemedicine and mobile health applications. Specific case studies related to mental health and wellness research will also be covered.

Speaker Biography:

Sri Krishnan joined Toronto Metropolitan University (formerly Ryerson University), Toronto, Canada in 1999, and he is now a Professor of Electrical, Computer Engineering, and Biomedical Engineering. Sri Krishnan's research interests are in biomedical signal analysis, audio signal analysis, and explainable machine learning. He is a Fellow of the Canadian Academy of Engineering. From 2007 to 2017 he was a Canada Research Chair in Biomedical Signal Analysis. Sri Krishnan is a recipient of the Outstanding Canadian Biomedical Engineer Award, Achievement in Innovation Award from Innovate Calgary, Sarwan Sahota Distinguished Scholar Award, Young Engineer Achievement Award from Engineers Canada, New Pioneers Award in Science and Technology, and Exemplary Service Award from the IEEE Toronto Section.

Abdulmotaleb El Saddik
University of Ottawa & MBZUAI

Topic: ***The Metaverse: AI-Powered Universe of Persistent Digital Twins***

Abstract:

A digital twin is a digital replication of a living or non-living physical entity. By bridging the physical and the virtual worlds, data is transmitted seamlessly allowing the virtual entity to exist simultaneously with the physical entity. A digital twin uses AI to facilitate the means to monitor, understand, and optimize the functions of the physical entity and provides continuous feedback to improve quality of life and wellbeing of citizens. A Metaverse is a universe of persistent Digital Twins In this research program, we explore the design and development of frameworks, methodologies, and methods regarding the convergence of multimedia technologies (AR/VR, AI, IoT, Big Data, Cybersecurity and 5G) towards the Metaverse. We will discuss metaverse sensory data fusion and streaming techniques and will explore open questions and possible R&D venues.

Speaker Biography:

Abdulmotaleb El Saddik is a Distinguished University Professor in the School of Electrical Engineering and Computer Science at the University of Ottawa and an Adjunct professor at MBZUAI, UAE. He is an internationally recognized scholar who has made strong contributions to the knowledge and understanding of intelligent multimedia computing, communications, and applications. He is Editor-in-Chief of the ACM Transactions on Multimedia Computing, Communications and Applications (ACM TOMM), Associate Editor & Guest Editor for several Transactions and Journals. He has co-authored 10 books and more than 600 publications and chaired more than 50 conferences and workshops and has supervised more than 150 researchers. He has received research grants and contracts totaling more than $20M. He is the author of the book Haptics Technologies: Bringing Touch to Multimedia.

Dr. El Saddik is a Fellow of the Royal Society of Canada, Fellow of IEEE, Fellow of the Canadian Academy of Engineering and Fellow of the

Engineering Institute of Canada. He is an ACM Distinguished Scientist and has received several awards, including the Friedrich Wilhelm Bessel Award from the German Humboldt Foundation, the IEEE Instrumentation and Measurement Society Technical Achievement Award. He also received IEEE Canada C.C. Gotlieb (Computer) Medal and A.G.L. McNaughton Gold Medal for important contributions to the field of computer engineering and science and the IEEE TCSC Achievement Award for Excellence in Scalable Computing.

John Schmalzel
Rowan University, USA

Topic: ***Sensors at the Edge***

Abstract:
The proliferation of low-cost sensors means that they find their way into more and more applications. Their role in industrial, medical, military, aerospace, and transportation are all areas that continue to see dramatic expansion. In some of our work for the Department of Defense, we have merged sensing with the associated processing of those signals in artificial intelligence (AI) driven applications. This evolution of sensors combined with edge computing has created a new normal, which will drive significant efforts to harness the power of AI as close to the point of sensing as possible. This architecture paves the way for further advances in autonomous systems with greater potential for independence.

The rapid progression of high-bandwidth, high-resolution data acquisition methods such as LIDAR and high-definition video streaming, in combination with the advent of ubiquitous AI, has placed significant demands on existing edge hardware. The problem here has three contributing factors – the high volume of data being acquired, the performance demands of AI workloads, and resource constraints of the edge computers. In the past, AI tasks were often offloaded to the cloud or the server away from the edge, to be executed on computing platforms with more resources. However, the latency of data transmission and the volume of data traffic makes it essential for the sensor data to be processed at the edge. Given this landscape, there is a strong motivation to design and develop domain-specific computing accelerators at the edge. Customized accelerators accomplish two objectives – a) they execute AI workloads at the edge, resulting in improved performance since data no longer must be transmitted to a non-edge infrastructure and b) they operate within the design constraints of the edge environment. Existing research indicates that performance to power consumption ratio improves by at least an order of magnitude when customized accelerators are tightly integrated with data acquisition systems. Our preliminary efforts explored the efficacy of commercial off-the-shelf edge devices such as the Nvidia Jetson AGX Orin; ongoing work involves the design of accelerated computing structures targeted at AI models suitable for edge deployment.

Speaker Biography:
Dr. Schmalzel (Ph.D. ’80) is the Founding Chair of the Electrical and Computer Engineering program at Rowan University. He is committed to project-based and laboratory-complemented curricula; the 4-year Engineering Clinic is one of the hallmarks of the Rowan Engineering experience. His interests include intelligent sensors, which he has worked on in collaboration with NASA-Stennis, NIST, and others. He serves as Vice-Chair of the IEEE P21451.0 Working Group (IEEE IMS Society, TC-9) that is completing balloting of an overhaul to the original IEEE 1451.0. This standard development promises to be a key contributor to smart networked transducers that address emerging needs in the Internet-of-Things (IoT), Smart Grid, and Industry 4.0 domains. In prior work with NASA-Stennis Space Center, he developed a framework for intelligent systems incorporating smart sensors to provide what is now termed edge intelligence to support rapid detection and diagnosis of faults in complex systems. Another application area is Smart Grid including sensors and training. In one of his latest research projects, he works with a team focused on providing advanced AI-supported threat detection with Edge intelligence. Dr. Schmalzel is a registered Professional Engineer (TX) and a Fellow of the IEEE.

Technical Program: Tuesday, July 18

9:00 - 10:30
Tutorial: Quantifying Uncertainty in Machine Learning-Assisted Sensing
Tutorial Speaker: Shervin Shirmohammadi
Room: Theater

9:00 - 10:30
Tutorial: Tensor Decompositions for Multidimensional Signal Processing
Tutorial Speaker: Sherif S. Sherif
Room: Room 2224

9:00 - 10:30
Tutorial: Brief Introduction to Quantum Radar
Tutorial Speaker: David Luong
Room: 3224

10:30 - 11:00
Coffee Break
Room: Atrium

11:00 - 12:30
Tutorial: Quantifying Uncertainty in Machine Learning-Assisted Sensing
Tutorial Speaker: Shervin Shirmohammadi
Room: Theater

11:00 - 12:30
Tutorial: Tensor Decompositions for Multidimensional Signal Processing
Tutorial Speaker: Sherif S. Sherif
Room: 2224

11:00 - 12:30
Tutorial: Using the Stone Soup Open-Source Tracking Library to Simulate and perform Multi-Target Tracking with a Radar
Tutorial Speakers: Peter Carniglia and Jagrit Rai
Room: 3228

12:30 - 13:30
Lunch
Room: Atrium

13:30 - 14:00
Opening Ceremony
Room: Theater

14:00 - 15:40
Special Session: Machine Learning for Sensing Systems
Session Chairs: Sebastian Bader and Bruno Andò
Room: Theater

14:00
Driving Behaviour Detection using Smart Steering Wheel: Supervised and Unsupervised Classification
Arash Abarghooei and Mojtaba Ahmadi (Carleton University, Canada)

14:15
A Robust Low-Latency Transformer-based Hyper-Spectral Image Fusion Model for Concrete Crack Segmentation on Autonomous Robots
Matthias Steiner (ETH, Switzerland); Nicolas Baumann (ETH Zürich, Switzerland); Luzian Lebovitz (ETH, Switzerland); Michele Magno (ETH Zurich, Switzerland)

14:30
Radar based Fall Detection with Imbalance Data Handling and Data Augmentation
Hamidreza Sadreazami (McGill University, Canada); Abhishek Khoyani, Marzieh Amini and Sreeraman Rajan (Carleton University, Canada); Miodrag Bolic (University of Ottawa, Canada)

14:45
ADASS: Anti-Drone Audio Surveillance Sentinel via Embedded Machine Learning
Alessandro Brighente, Mauro Conti, Giacomo Peruzzi and Alessandro Pozzebon (University of Padova, Italy)

15:00
Comparison of COVID-19 Classification via Imagenet-based and RadImagenet-based Transfer Learning Models with Random Frame Selection
Ebrahim Nehary, Sreeraman Rajan and Carlos Rossa (Carleton University, Canada)

15:15
Real-time acoustic monitoring of foraging behavior of grazing cattle using low-power embedded devices
Luciano Sebastian Martinez Rau and Veysi Adin (Mid Sweden University, Sweden); Leonardo Giovanini (Universidad Nacional del Litoral, Argentina); Bengt Oelmann and Sebastian Bader (Mid Sweden University, Sweden)

14:00 - 15:40
Special Session: Sensors / Sensing Applications for Uninhabited Aircraft Systems (UAS) and Advanced Air Mobility
Session Chairs: Jeremy Laliberté and Sreeraman Rajan
Room: 2224

14:00
Establishing Wireless Intranet Network using UAVs and Web Application for Emergency Communications
Jihoon Yang and Juhyun Kim (Jeju National University, Korea (South)); Sion Kang (Chungnam National University, Korea (South)); Haeeun Ok, Yijun Yoo, Hyewon Koh and Pilkyo Kim (Jeju National University, Korea (South)); Alexander Lawrence Head (Purdue University, Korea (South)); Anthony Smith (Purdue University, USA)

14:15
Depth Sensor Application in Ground Unevenness Estimation for UAV Emergency Landing
Tatsunori Matsumoto (Shibaura Institute of Tehnology, Japan); Chinthaka Premachandra (Shibaura Institute of Technology, Japan)

14:30
Combined Radar and Camera Drone Detection in Urban Environment: A Simulation-based Approach
Marc-Antoine Drouin, Frank Billy Djupkep Dizeu and Terrence C Stewart (National Research Council Canada, Canada); Guillaume Gagné (Defence Research and Development Canada, Canada); Hilda Azimi (National Research Council Canada, Canada)

14:45
Acoustic-Based Detection of UAVs using Machine Learning: Analysis of Distance and Environmental Effects
Diana Tejera-Berengue (University of Alcalá, Spain); Fangfang Zhu-Zhou (University of Alcala, Spain); Manuel Utrilla (University of Alcalá, Spain); Roberto Gil-Pita (University of Alcala, Spain); Manuel Rosa-Zurera (University of Alcalá, Spain)

15:00
Radar-based Drone Detection using Complex-Valued Convolutional Neural Network
Ankita Dey (Carleton University, Canada); Yann Cabanes (Carleton University); Sreeraman Rajan (Carleton University, Canada); Bhashyam Balaji (Defence R&D Canada, Ottawa Research Center, Canada); Anthony Damini (DRDC Ottawa, Canada); Rajkumar Chanchlani (General Dynamics Mission Systems, Canada)

15:15
Studying the Effects of Clutter using V-band Radar for Drone Classification
Ian WK Lam (Carleton University, Canada); Shashank Pant (National Research Council Canada, Canada); Max Manning, Michael Kubanski and Peter Fox (AiRadar Inc., Canada); Sreeraman Rajan (Carleton University, Canada); Prakash Patnaik (NRC, Canada); Bhashyam Balaji (Defence R&D Canada, Ottawa Research Center, Canada)

15:40 - 16:10
Coffee Break
Room: Atrium

16:10 - 17:20
Keynote: Wearables and Digital Healthcare
Sri Krishnan, Toronto Metropolitan University
Room: Theater

17:20 - 19:00
Special Session: Machine Learning for Sensing Systems
Session Chairs: Sebastian Bader and Bruno Andò
Room: Theater

17:20
Machine Learning-Based Real-Time Metasurface Reconfiguration
Feng Su, David Luong, Ian WK Lam, Sreeraman Rajan and Shulabh Gupta (Carleton University, Canada)

17:35
Tiny Machine Learning for Real-time Postural Stability Analysis
Veysi Adin, Yuxuan Zhang and Bengt Oelmann (Mid Sweden University, Sweden); Bruno Ando (University of Catania, Italy); Sebastian Bader (Mid Sweden University, Sweden)

17:50
Gait Recognition Using EigenfeetNet
Robyn Larracy, Angkoon Phinyomark and Erik Scheme (University of New Brunswick, Canada)

18:05
Denoising Induction Motor Sounds Using an Autoencoder
Thanh Tran (Assa Abloy, Stockholm, Sweden & Mid Sweden University, Sweden); Jan Lundgren and Sebastian Bader (Mid Sweden University, Sweden)

18:20
Gait Representation: From Vision-based to Floor Sensor-based Gait Recognition
Robyn Larracy, Angkoon Phinyomark and Erik Scheme (University of New Brunswick, Canada)

18:35
Grayscale and Event-Based Sensor Fusion for Robust Steering Prediction for Self-Driving Cars
Luca Pascarella and Michele Magno (ETH Zurich, Switzerland)

17:20 - 19:00
Special Session: Supportive Smart Homes
Session Chairs: Bruce Wallace and Frank Knoefel
Room: 2224

17:20
Identification of Cooking ADL Actions through Analysis of Thermal Camera Video
Emma J Boulay, Abeer Rafiq, Christian Ratsamany and Jonathan Mack (Carleton University, Canada); Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada); Frank Knoefel (Bruyere Continuing Care, Canada)

17:35
A Confidence Framework through Temporal Averaging for Heart Rate Estimation in Video Magnification
Diane Geena Elhajjar (Carleton University, Canada); Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada); Andrew Law (National Research Council, Canada); Rafik Goubran (Carleton University, Canada); Frank Knoefel (Bruyere Continuing Care, Canada)

17:50
Comparison of Spatial Coverage of LiDAR Systems for In Home Activity of Daily Living Applications
Philippe Masson (Carleton University, Canada); Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada); James R Green and Rafik Goubran (Carleton University, Canada)

18:05
Sample Size in Floor Sensor-based Gait Recognition for Smart Home and Access Control Scenarios
Saeed Kazemi, Angkoon Phinyomark and Erik Scheme (University of New Brunswick, Canada)

18:20
New Approach for Stress Assessment based on Healthcare Ecosystems
Gonçalo T Ribeiro (ISCTE - Instituto Universitário de Lisboa, Portugal & Instituto de Telecomunicações, Portugal); Octavian Adrian Postolache (Instituto de Telecomunicações, Lisboa/IT & Instituto Universitario de Lisboa, ISCTE-IUL, Portugal)

18:35
Wearable Smart Sensing and UWB System for Fall Detection in AAL Environments
Mariana Catela Jacob Rodrigues (ISCTE-IUL & Instituto de Telecomunicações, Portugal); Octavian Adrian Postolache (Instituto de Telecomunicações, Lisboa/IT & Instituto Universitario de Lisboa, ISCTE-IUL, Portugal); Francisco Cercas (ISCTE-IUL & Instituto de Telecomunicações, Portugal)

19:00 - 21:00
Welcome Reception
Room: Atrium

Technical Program: Wednesday, July 19

8:30 - 10:10
Assisted Living
Session Chairs: Salvatore Tedesco and Manuela Kunz
Room: Theater

8:30
Hearing Aid Accelerometer Based Pedometry Assessment for Older Adults
Will Sloan (Carleton University, Canada); Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada); Andrea Pepe and Heidi Sveistrup (Bruyère Research Institute, Canada); Frank Knoefel (Bruyere Continuing Care, Canada); Amy Fraser and Matthew Bromwich (Shoebox, Canada)

8:45
Design and Validation of a System to Synchronize Speech Recognition and Eye-Tracking Measurements
Emma J Boulay (Carleton University, Canada); Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada); Kathleen C Fraser and Manuela Kunz (National Research Council Canada, Canada); Frank Knoefel (Bruyere Continuing Care, Canada); Rafik Goubran (Carleton University, Canada); Neil Thomas (Bruyère Research Institute, Canada)

9:00
Cuff-less Blood Pressure Monitoring in a Cohort of People with Parkinson's Disease
Colum Crowe and Marco Sica (Tyndall National Institute, Ireland); Lorna Kenny (University College Cork, Ireland); Brendan O'Flynn (Tyndall National Institude, Ireland); David Scott Mueller (AbbVie Inc., USA); Suzanne Timmons (University College Cork, Ireland); John Barton and Salvatore Tedesco (Tyndall National Institute, Ireland)

9:15
Reducing Fixation Error Due to Natural Head Movement in a Webcam-based Eye-tracking Method
Manuela Kunz (National Research Council Canada, Canada); Arsalan Syed (Carleton University, Canada); Kathleen C Fraser (National Research Council Canada, Canada); Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada); Rafik Goubran (Carleton University, Canada); Frank Knoefel (Bruyere Continuing Care, Canada); Neil Thomas (Bruyère Research Institute, Canada)

9:30
Deep Learning Ensemble for Recognising Lower Limb Activity
Ganesha H S (Amity University Uttar Pradesh, Noida, India); Rinki Gupta (Amity University Noida, India); Sindhu Hak Gupta (Amity University, India); Sreeraman Rajan (Carleton University, Canada)

9:45
Designing and Developing a Mobile Application for Monitoring & Visualizing Blood Pressure Data
Mahsa Sinaei Hamed, Laura Reid, Alice Olorunnife, David Casciano and Fateme Rajabiyazdi (Carleton University, Canada)

8:30 - 10:10
Remote Sensing
Session Chairs: Xin Qiao and Bruno Andò
Room: 2224

8:30
Automated Stride Detection from OpenPose Keypoints Using Handheld Smartphone Video
Shri Harini Ramesh (University of Ottawa, Canada)

8:45
An Attention based Complex-valued Convolutional Autoencoder for GEO SA-Bi SAR Ship Target Refocusing
Meng Lian (University of Ottawa, China); Miodrag Bolic (University of Ottawa, Canada)

9:00
Spectral-Spatial-Frequency Transformer Network for Hyperspectral Image Classification
Xin Qiao (Memorial University of Newfoundland, Canada); Weimin Huang (Memorial University, Canada)

9:15
Assessment of Displacement Measurements by a mmWave Radar
Gianluca Ciattaglia and Grazia Iadarola (Polytechnic University of Marche, Italy); Gianmarco Battista (Università Degli Studi di Parma, Italy); Linda Senigagliesi and Ennio Gambi (Università Politecnica delle Marche, Italy); Paolo Castellini (Polytechnic University of Marche, Italy); Susanna Spinsante (Università Politecnica Delle Marche, Italy)

9:30
Synthetic Aperture Radar-based Ship Classification using CNN and Traditional Handcrafted Features
Ebrahim Nehary, Ankita Dey and Sreeraman Rajan (Carleton University, Canada); Bhashyam Balaji (Defence R&D Canada, Ottawa Research Center, Canada); Anthony Damini (DRDC Ottawa, Canada); Rajkumar Chanchlani (General Dynamics Mission Systems, Canada)

9:45
Robustness investigation of a particle analyzer for the analysis of volcanic ash
Bruno Ando, Salvatore Baglio, Salvatore Castorina, Salvatore Graziani, Vincenzo Marletta and Alberto Campisi (University of Catania, Italy)

10:10 - 11:30
Coffee Break
Room: Atrium

10:10 - 11:30
Poster Session
Session Chairs: Carlos Rossa and Sebastian Bader
Room: Atrium

#1 Domestic Sound Classification with Deep Learning
Zhenyu Zhang (McMaster University, Canada); Yichun Shen (National Research Council Canada & University of Waterloo, Canada); Julio Valdes (Researcher at the National Research Council of Canada, Canada); Saiful Huq (Carleton University, Canada); Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada); James R Green (Carleton University, Canada); Pengcheng Xi (National Research Council Canada, Canada); Rafik Goubran (Carleton University, Canada)

#2 Big Data Analysis of Canadian Drivers using OBDII Sensor Data: The impact of the Pandemic
Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada); Abigael Schonewille, Kathleen Van Benthem and Chris Herdman (Carleton University, Canada); Jocelyn Keillor (National Research Council of Canada, Canada); Rafik Goubran (Carleton University, Canada); Frank Knoefel (Bruyere Continuing Care, Canada); Shawn Marshall (University of Ottawa, Canada)

#3 Automated and Interference-Free Inventory Solution using Energy-Neutral BLE Tags
Jona Cappelle, Bert Cox and Liesbet Van der Perre (KU Leuven, Belgium)

#4 A High-Speed Stereo Monitoring System for Remote One-Man Operation
Jiahua Wang, Qing Li, Shaopeng Hu, Kohei Shimasaki and Idaku Ishii (Hiroshima University, Japan)

#5 Automating safety critical ultrasonic data analysis with a variational auto-encoder
Nick Torenvliet (University of Waterloo & Bruce Power, Canada); John Zelek and Yizhe Liu (University of Waterloo, Canada)

#6 Development of a Neural Network for Automatic Classification of Post-Consumer Wood Using Rapid-FLIM
Nina Leiter and Maximilian Wohlschläger (Technical University of Applied Sciences Rosenheim, Germany); Maximilian Dietlmeier (University of Applied Science Rosenheim, Germany); Martin Versen (Technical University of Applied Sciences Rosenheim, Germany); Martin G.J. Löder and Christian Laforsch (University Bayreuth, Germany)

#7 Data Augmentation based on Inverse Transform Sampling for Improved Tissue Classification via Electrical Impedance Spectroscopy
Conor McDermott and Carlos Rossa (Carleton University, Canada)

#8 Machine Learning Based Listener Classification and Authentication Using Frequency Following Responses to English Vowels for Biometric Applications
Martin Bouchard, Hilmi R Dajani and Bijan Borzou (University of Ottawa, Canada)

#9 An Initial Study of Ingrown Toenail Removal Simulation in Virtual Reality with Bimanual Haptic Feedback for Podiatric Surgical Training
Jason Abounader, Kwangtaek Kim, Bryan D. Caldwell and Mark A. Hardy (Kent State University, USA)

#10 Lung Ultrasound Image Classification Using Deep Learning and Histogram of Oriented Gradients Features for COVID-19 Detection
Ebrahim Nehary, Sreeraman Rajan and Carlos Rossa (Carleton University, Canada)

#11 Characterizing surface charge density of solid-state nanopore sensors for improved biosensing applications
Mohamed Yassine Bouhamidi, Dmytro Lomovtsev, Gengyang Mu, Matthew Waugh, Martin Charron and Vincent Tabard-Cossa (University of Ottawa, Canada)

#12 Identification and Closed-Loop Control of High-Performance Accelerometers
Zayed Ahmad, Charles Duruaku and Behraad Bahreyni (Simon Fraser University, Canada)

#13 A Novel Approach for IMU Denoising using Machine Learning
Rohan Kumar Reddy Damagatla (Carleton University, Canada); Mohamed Atia (Carleton University & Queen's University, Canada)

#14 Optimizing the IoT Performance: A Case Study on Pruning a Distributed CNN
Eiraj Saqib, Isaac Sánchez Leal and Irida Shallari (Mid Sweden University, Sweden); Axel Jantsch (TU Wien, Austria); Silvia Krug (Mid Sweden University, Sweden & IMMS GmbH, Germany); Mattias O'Nils (Mid Sweden University, Sweden)

#15 A Simplified Measurement Procedure for Dielectric Measurement of Liquids, Including Calibration Via the Cut-off Circular Waveguide Reflection Method
Kouji Shibata (Hachinohe Institute of Technology, Japan)

#16 Receiver Operator Characteristic Enhancement by Overcoming the Hardware Temporal Resolution Limit Using Nonlocal Effects in LiDAR
Georgios Papangelakis and Han Liu (University of Toronto, Canada); Bhashyam Balaji (Defence R&D Canada, Ottawa Research Center, Canada); Phillip Blakey and Amr Helmy (University of Toronto, Canada)

#17 The "Serpentine" RTD Fluxgate Magnetometer
Claudia Ferro, Antonio Manuli, Carlo Trigona and Salvatore Baglio (University of Catania, Italy)

#18 Device-free Fine-grained Dining Activity Sensing
Majid G Moghaddam (University of Ottawa, Canada); Ali Asghar Nazari Shirehjini (D!fintech AG, Switzerland); Shervin Shirmohammadi (University of Ottawa, Canada)

11:30 - 12:40
Keynote: The Metaverse: AI-Powered Universe of Persistent Digital Twins
Abdulmotaleb El Saddik, University of Ottawa & MBZUAI
Room: Theater

12:40 - 13:00
SAS 2024 Presentation
Room: Theater

13:00 - 14:00
Lunch
Room: Atrium

14:00 - 15:30
Industry Panel
Room: Theater

15:30 - 16:00
Coffee Break
Room: Atrium

16:00 - 17:40
Special Session: Smart Sensing and IoT for Precision Agriculture
Session Chairs: Alessandro Depari and Juan Campo Rodriguez
Room: Theater

16:00
Assessment of Leaf Phosphorus for Multiple Crop Species using an Electrical Impedance Spectroscopy Sensor
Rinku Basak and Khan A Wahid (University of Saskatchewan, Canada)

16:15
LoRaVine: using LoRaWAN for smart vineyards microclimate monitoring
Davide Botturi, Alessandro Depari, Paolo Ferrari, Alessandra Flammini and Simone Pasinetti (University of Brescia, Italy); Matteo Soprani (Prospecto, Italy); Emiliano Sisinni (University of Brescia, Italy)

16:30
A Performance Comparison of Two Portable NIRS Technologies for Olive Oil Adulteration
Ana Soldado Cabezuelo, Jose Manuel Costa Fernandez, Candela Melendras García, Patricia Lozano Fernández, Juan C Campo Rodriguez, Marta Valledor, Alberto López Martínez and Francisco Ferrero Martín (University of Oviedo, Spain)

16:45
Wireless sensing in the woodlands: preliminary tests for LoRaWAN transmission in vegetated areas
Irene Cappelli (University of Siena, Italy); Giacomo Peruzzi, Alessandro Pozzebon and Edoardo Scarpel (University of Padova, Italy)

17:00
Vineyard Thermal Stress Assessment through the Combination of In-Situ and Remote Sensing Technology
Teresa Felício (ISCTE-IUL & Instituto de Telecomunicações, Portugal); Octavian Adrian Postolache (Instituto de Telecomunicações, Lisboa/IT & Instituto Universitario de Lisboa, ISCTE-IUL, Portugal); Mariana Catela Jacob Rodrigues (ISCTE-IUL & Instituto de Telecomunicações, Portugal); Pedro Sebastião (Instituto de Telecomunicações/Instituto Superior Técnico, Portugal)

16:00 - 17:40
Optical Sensing
Session Chairs: Nunzio Cennamo and Oliver Pitts
Room: 2224

16:00
Optical Chemical Sensors based on waveguides with a core of Molecularly Imprinted Polymer
Francesco Arcadio, Domenico Del Prete and Luigi Zeni (University of Campania Luigi Vanvitelli, Italy); Maria Pesavento and Giancarla Alberti (University of Pavia, Italy); Vincenzo Marletta, Salvatore Castorina and Bruno Ando (University of Catania, Italy); Nunzio Cennamo (University of Campania Luigi Vanvitelli, Italy)

16:15
Modular implementation of a dual-band imager: visible and SWIR with compressed sensing
Costel Flueraru (National Research Council of Canada, Canada); Oliver J Pitts (National Research Council Canada, Canada); Alexandre W Walker (National Research Council of Canada, Canada); Alexandre Levesque (University of Ottawa, Canada)

16:30
High resolution interferometric temperature compensation using optical fibers with different temperature coefficients
Meng Tian and Huicong Li (Institute of Semiconductors CAS, China); Bing Lv (North China Electric Power University, China); Wenzhu Huang, Wentao Zhang and Fang Li (Institute of Semiconductors, Chinese Academy of Sciences, China)

16:45
Measurements of four-component fiber strainmeters orientation using seismic coda cross correlation
Guoheng Qi (Institute of Semiconductors, Chinese Academy of Sciences & Central South University, China); Wenzhu Huang, Wentao Zhang and Fang Li (Institute of Semiconductors, Chinese Academy of Sciences, China)

17:00
System Evaluation of a Pyrometer Combined with an Optical Fiber
Anna Poms (University of Technology Graz, Austria); Hannes Wegleiter and Bernhard Schweighofer (Graz University of Technology, Austria)

17:40 - 18:20
Young Professional Event
Room: Theater

19:30 - 22:30
Gala Dinner and Awards Banquet
Location: Lord Elgin Hotel

Technical Program: Thursday, July 20

9:00 - 10:40
Sensors for Medical and Biomedical Applications
Session Chairs: Bruce Wallace and Kwangtaek Samuel Kim
Room: Theater

9:00
DNA Nucleotides Detection via C2N Sensor: First-Principles Modeling
Asma Wasfi (United Arab Emirates University, United Arab Emirates); Falah Awwad (UAE University, United Arab Emirates)

9:15
Comparison of Deep Learning and Signal Processing Methods for Removing a Ringing Artifact from Ultrasound Signals
Yana Sosnovskaya, Eli Shlizerman, Blake Hannaford and Mika N Sinanan (University of Washington, USA)

9:30
Automatic Real-time Fever Screening in a Thermal Video Surveillance System
Ghazal Rouhafzay and Angel J. Valencia (University of Ottawa, Canada); Stephen Rowlands (Spectronix Inc., Canada); Shengsong Yang and Pierre Payeur (University of Ottawa, Canada)

9:45
Integrating Medical and Wearable Devices with E-Health Systems using Horizontal IoT Platforms
Mohannad Abu Issa, AbdelRahman Eldosouky, Mohamed Ibnkahla, Jason Jaskolka and Ashraf Matrawy (Carleton University, Canada)

10:00
A Portable Electrochemical Measurement Platform for Wearable-Flexible Sweat Sensors
Mahdi Saleh and Zixin Wang (University of Manchester, United Kingdom (Great Britain)); John Batchelor (University of Kent, United Kingdom (Great Britain)); Alexander J Casson (The University of Manchester, United Kingdom (Great Britain))

10:15
Continuous Surface Electromyography and Bioimpedance Sensing from the Same Electrodes
Soumyajyoti Maji, Sebastian Roubert Martinez and Robert D. Howe (Harvard University, USA)

9:00 - 10:40
Sensor Data Fusion
Session Chairs: Salvatore Graziani and John Schmalzel
Room: 2224

9:00
LiDAR and Camera Raw Data Sensor Fusion in Real-Time for Obstacle Detection
Abhishek Thakur and P Rajalakshmi (Indian Institute of Technology Hyderabad, India)

9:15
A deep learning approach for classification and measurement of hazardous gases using multi-sensor data fusion
Mazhar Hussain, Mattias O'Nils, Jan Lundgren, Mehdi Akbari Saatlu, Rikard Hamrin and Claes Mattsson (Mid Sweden University, Sweden)

9:30
Improved Radar Data Clustering using Camera Data for Extended Target Tracking
Jing Zeng (McMaster University, Canada); Dipayan Mitra (McMaster University, Hamilton, ON, Canada); Erping Zhang, Ming Chen and Ratnasingham Tharmarasa (McMaster University, Canada); Sunil Chomal (Uhnder Inc, Canada)

9:45
Decision Fusion in Automated Sleep Apnea Classification Using Multiple Polysomnography Sensors and Convolutional Neural Networks
Matthew R Stewart (Carleton University, Canada); Caitlin Higginson (University of Ottawa, Canada); Julien Larivière-Chartier (Bruyère Research Institute, Canada); Rebecca Robillard (University of Ottawa, Canada); James R Green and Rafik Goubran (Carleton University, Canada); Frank Knoefel (Bruyere Continuing Care, Canada)

10:00
Low Power Sensor Fusion Targeted for AI Applications at The Edge
Scott P Wood, John L Schmalzel and Dwaipayan Chakraborty (Rowan University, USA)

10:40 - 12:00
Coffee Break
Room: Atrium

10:40 - 12:00
Poster Session
Session Chairs: Carlos Rossa and Sebastian Bader
Room: Atrium

#1 Surface Imprinted Electroimpedance Biosensor for Detecting α-Synuclein for Parkinson's Disease
Roslyn Massey and Yu Han Li (Carleton University, Canada); Ravi Prakash (Carleton University, Ottawa, Canada)

#2 Flame-Millimeter-Wave-Interactions: A Radar-based Sensor Concept
Francesca Schenkel (Ruhr Univerity Bochum, Germany); Christoph Baer (Ruhr-Universität Bochum & Institute of Electronic Circuits, Germany); Ilona Rolfes and Christian Schulz (Ruhr-Universität Bochum, Germany)

#3 Quantum Enhanced Sensing using Gaussian Quantum States
Neel Kanth Kundu and R. McKay Matthew (University of Melbourne, Australia); Bhashyam Balaji (Carleton University, Canada)

#4 Phase Estimation for an Experimental Noise Radar
Ian WK Lam and David Luong (Carleton University, Canada); Bhashyam Balaji (Defence R&D Canada, Ottawa Research Center, Canada); Sreeraman Rajan (Carleton University, Canada)

#5 Matching Pursuit based Joint Angle and Delay Estimation for Bluetooth Direction Finding
Gerrit Maus and Dieter Brückmann (University of Wuppertal, Germany)

#6 Improving Data-Scarce Image Classification Through Multimodal Synthetic Data Pretraining
Carl Laurenz Amadeus Brander, Cristian Cioflan and Vlad Niculescu (ETH Zurich, Switzerland); Hanna Müller (ETH Zürich, Switzerland); Tommaso Polonelli, Michele Magno and Luca Benini (ETH Zurich, Switzerland)

#7 Energy and Time-Effective Computation Offloading for Edge Computing-Enabled IoT Networks
Othman Al Aidaros (Carleton University, Canada); Youcef Kardjadja (La Rochelle University, France); Zied Bouida and Mohamed Ibnkahla (Carleton University, Canada)

#8 Traffic Level Monitoring in Urban Scenarios with Virtual Sensing Techniques Enabled by Embedded Machine Learning
Francesco Maccantelli (University of Siena, Italy); Giacomo Peruzzi and Alessandro Pozzebon (University of Padova, Italy)

#9 Detection Level and Target Level Road User Classification with Radar Point Cloud
Yizi Lu, Aranee Balachandran and Ratnasingham Tharmarasa (McMaster University, Canada); Sunil Chomal (Uhnder Inc, Canada)

#10 Benchmarking UWB-Based Infrastructure-Free Positioning and Multi-Robot Relative Localization: Dataset and Characterization
Paola Torrico Morón (University of Turku, Finland); Sahar Salimpour (University of Turku & None, Finland); Lei Fu, Xianjia Yu, Jorge Peña Queralta and Tomi Westerlund (University of Turku, Finland)

#11 An embedded Multi-Sensor architecture for applications in Structural Health Monitoring
Bruno Ando, Salvatore Castorina, Salvatore Graziani, Danilo Greco and Mattia Manenti (University of Catania, Italy); Antonio Pistorio (STMicroelectronics Srl Catania, Italy)

#12 Critical Electrical Infrastructure Segmentation in Arctic Conditions
Arka Singh, Sreeraman Rajan, Marzieh Amini, James R Green and Kevin Dick (Carleton University, Canada)

#13 Systematic Sensor Data-driven Analysis Pipeline for Anomaly Monitoring of Bridges and Rails
Ling Bai and Rakiba Rayhana (The University of British Columbia, Canada); Zheng Liu (University of British Columbia Okanagan, Canada); Chunsheng Yang, Min Liao and Gaozhi (George) Xiao (National Research Council Canada, Canada)

#14 Wireless Sensors Measure the Neural Effects of Sleep Debt on Prospective Memory for Pilots
Michael Guirguis, Kathleen Van Benthem and Chris Herdman (Carleton University, Canada)

#15 Assessing Driver Task Engagement Through Machine Learning Classification of Physiological Response,
idan Lochbihler (Carleton University, Canada); Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada); Kathleen Van Benthem, Chris Herdman, Will Sloan, Kirsten Brightman and Josh Goheen (Carleton University, Canada); Frank Knoefel (Bruyere Continuing Care, Canada); Shawn Marshall (Ottawa Hospital, Canada)

#16 Pipeline for Automation of LiDAR Data Annotation
Bhaskar Anand (Indian Institute of Technology Hyderabad, India); Rajalakshmi P (IIT Hyderabad, India)

#17 Fog-Aware Adaptive YOLO for Object Detection in Adverse Weather
Hasan Abbasi, Marzieh Amini and Richard Yu (Carleton University, Canada)

#18 Optimizing Building Heating Efficiency: A Data-driven Approach for Cost and Energy Savings
Reyhaneh Banihabib (University of Stavanger, Norway); Fredrik Skaug Fadnes (Norconsult AS, Norway); Mohsen Assadi (University of Stavanger, Norway)

#19 Room Acoustic Characterization with Smartphone-based Automated Speech Recognition
Brady Laska (Carleton University, Canada); Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada); Abagael Hudak and Rafik Goubran (Carleton University, Canada)

12:00 - 13:10
Keynote: Sensors at the Edge
John Schmalzel, Rowan University, USA
Room: Theater

13:10 - 14:00
Lunch
Room: Atrium

14:00 - 15:40
Sensors for Aerospace
Session Chairs: Yazan Al-Rawashdeh
Room: Theater

14:00
Monitored Versus Non-monitored stimuli in Brain-Computer-Interface Methods for Classifying Workload States during Piloting Tasks
Kathleen Van Benthem, Stefanie Gard and Chris Herdman (Carleton University, Canada)

14:15
A Deep Learning Approach for Drone Detection and Classification using Radar and Camera Sensor Fusion
Varun Mehta (National Research Council Canada & University of Ottawa, Canada); Fardad Dadboud and Miodrag Bolic (University of Ottawa, Canada); Iraj Mantegh (National Research Council Canada, Canada)

14:30
Experimental Point Spread Function Imaging of Turbulent Wavefronts using Compressive Sensing
Robert F. H. Hunter (University of Ottawa, Canada); Mohamadreza Pashazanoosi and Steve Hranilovic (McMaster University, Canada); Costel Flueraru (National Research Council of Canada, Canada); Antony Orth and Oliver J Pitts (National Research Council Canada, Canada)

14:45
Mass and Inertia Estimation using all-accelerometer
Yazan Al-Rawashdeh (Memorial University of Newfoundland, Canada); Moustafa Elshafei (Zewail City of Science and Technology, Egypt); Hassen M. Ouakad (Mediterranean Institute of Technology, Oman & South Mediterranean University, Tunisia)

15:00
Simulated Dataset for the Loaded vs. Unloaded UAV Classification Problem Using Deep Learning
Hamid Azad (University of Ottawa, Canada); Varun Mehta (National Research Council Canada & University of Ottawa, Canada); Miodrag Bolic (University of Ottawa, Canada); Iraj Mantegh (National Research Council Canada, Canada)

14:00 - 15:40
Sensors for Environmental Monitoring
Session Chairs: Nina Leiter and Martin Versen
Room: 2224

14:00
Zero-Power MEMS Resonant Mass Sensor Inspired by Piezoelectric Vibration Energy Harvesting
Aylar Abouzarkhanifard (Memorial University of Newfoundland & Memorial University, Canada); Hamidreza Ehsani Chimeh (Memorial University of Newfoundland, Canada); Seyedfakhreddin Nabavi (McGill University, Canada); Mohammad Al Janaideh (Memorial University, Canada); Lihong Zhang (Memorial University of Newfoundland, Canada)

14:15
Comparative Analysis of Fluorescence Properties of Post-consumer Wood Using FD-FLIM
Nina Leiter and Maximilian Wohlschläger (Technical University of Applied Sciences Rosenheim, Germany); Maximilian Dietlmeier (University of Applied Science Rosenheim, Germany); Martin Versen (Technical University of Applied Sciences Rosenheim, Germany); Martin G.J. Löder and Christian Laforsch (University Bayreuth, Germany)

14:30
Combining BLOB-detection and MLP to detect and identify plastics in an environmental matrix
Maximilian Wohlschläger, Yamna Khan, Nina Leiter and Martin Versen (Technical University of Applied Sciences Rosenheim, Germany); Martin G.J. Löder and Christian Laforsch (University Bayreuth, Germany)

14:45
Attention-based Sound Classification Pipeline with Sound Spectrum
Ki In Tan, Seanglidet Yean and Bu Sung Lee (Nanyang Technological University, Singapore)

15:00
Enhanced Hybrid Energy-Efficient Distributed Clustering Protocol for IoT-based WSNs with Multiple Sinks
Dick Mugerwa (Chungbuk National University, Korea (South) & Kyambogo University, Uganda); Hyunseok Choi and Youngju Nam (Chungbuk National University, Korea (South)); Youngmi Kwon (Chungnam National University, Korea (South)); Euisin Lee (Chungbuk National University, Korea (South))

15:40 - 16:00
Conference Closing
Room: Atrium