NSSN Smart Sensing and Climate Change Roundtable
Thursday 28 October – 10am-12pm
Virtual

With the world coming together once again to address climate change on 1-11 November, UNFCCC COP26 Glasgow holds the promise of a more ambitious global commitment to real action.

In the lead-up to Glasgow, the NSSN will host a roundtable elucidating the opportunities that lie at the nexus of smart sensing and climate change.

Smart sensing has a key role to play in reaching the goal of global net zero. From electric vehicles to energy efficiencies and low-emissions mining, smart sensing is vital to the technological innovation that will drive the global net zero agenda.

Similarly, climate resilient communities rely on smart sensing. Air and water quality monitoring, sustainable agriculture, natural disaster preparation and resilient infrastructure are all underpinned by smart sensing.

As a consortium of leading research universities, the NSW Smart Sensing Network (NSSN) is uniquely positioned to lend its voice to a global discourse on innovative technological solutions to monitoring and mitigating climate change.

Recognising the full breadth of expertise across the Network, the NSSN Smart Sensing and Climate Change Roundtable will bring together the thought leadership found in the NSSN Ambassadors Group together with leading climate change experts across the Network to explore smart sensing solutions across the following UN Sustainable Development Goals (SDGs):

- SDG 7 – Affordable & Clean Energy
- SDG 11 – Sustainable Cities & Communities
- SDG 12 – Responsible Consumption & Production
- SDG 13 – Climate Action
- SDG14 – Life Below Water
- SDG 15 – Life on Land

PROGRAM

1000 Welcome by Professor Ben Eggleton, NSSN Co-Director
1005 Welcome by Professor Julien Epps, NSSN Co-Director
1010 Professor John Close, ANU
1015 A/Professor Marta Yebra, ANU
1020 Dr Noushin Nasiri, Macquarie University
1025 Professor Michelle Leishman, Macquarie University
1030 Professor Subhas Mukhopadyay, Macquarie University
1035 Professor Paul Dastoor, University of Newcastle
1040 Dr Tomonori Hu, NSW Smart Sensing Network
1045 Dr Nathan Cooper, UNSW
1050 Professor Corrine Caillaud, The University of Sydney
1055 Professor Salah Sukkarieh, The University of Sydney
1100 Professor Sarath Kodagoda, UTS
1105 Professor Peter Ralph, UTS
1110 Professor Paul Hurley, WSU
1115 A/Professor Brendan Choat, WSU
1120 Moderated Roundtable Discussion
1155 Conclusion and next steps

Professor Ben Eggleton

NSSN Co-Director

The University of Sydney

Biography

Professor Benjamin Eggleton is the Director of The University of Sydney Nano Institute. He also serves as co-Director of the NSW Smart Sensing Network (NSSN). Eggleton was the founding Director of the Institute of Photonics and Optical Science (IPOS) at the University of Sydney and served as Director from 2009-2018. He was previously an ARC Laureate Fellow and an ARC Federation Fellow twice and was founding Director of the ARC Centre of Excellence for Ultrahigh bandwidth Devices for Optical Systems (CUDOS) from 2003-2017.

Eggleton is the author or coauthor of more than 510 journal publications, including Nature Photonics, Nature Physics, Nature Communications, Physical Review Letters and Optica and over 200 invited presentations. His journal papers have been cited 25,000 times according to webofscience with an h-number of 79 (109 in google scholar). Eggleton is a Fellow of the Australian Academy of Science (AAS), the Australian Academy of Technology and Engineering (ATSE), the Optical Society of America, SPIE and IEEE. He is Editor-in-Chief of APL Photonics.

Professor Julien Epps

NSSN Co-Director

UNSW Sydney

Biography

Professor Julien Epps is Head of the School of Electrical Engineering and Telecommunications at UNSW Sydney and was appointed Co-Director of the NSW Smart Sensing Network (NSSN) in July 2021. Professor Epps is also a Contributed Researcher at Data61, CSIRO, and a Scientific Advisor for Sonde Health. Prior to joining UNSW, Professor Epps held research appointments with the A*STAR Institute for Infocomm Research, National ICT Australia and Motorola Labs.

Professor Epps is the author or co-author of around 250 journal articles, conference publications and patents related to sensor signal processing. His work has been cited more than 9,000 times (Google Scholar). He has given multiple keynote and invited tutorial presentations to several major international conferences. He is currently serving as an Associate Editor for the IEEE Transactions on Affective Computing.

Professor Corinne Caillaud

NSSN Ambassador

University of Sydney

Biography

Corinne Caillaud is a Professor of digital health at the University of Sydney. She is co-chair of the "Nano Sensors & Diagnostics" cluster within the university Nano Health initiative and co-lead for the "Adolescents Health and wellbeing in the Pacific" group at the Charles Perkins Centre which brings collaborators from across the pacific region.

Prof Caillaud brings to nano her strong expertise in health, sport and metabolism. She aims for effective innovation and creates new technology-supported solutions that help adolescents self-monitor their health. Her approach includes implementing co-design frameworks with both consumers and health professionals to identify key levers for effective solutions in health. She is passionate about bringing technology into the health space through a human-centred approach, with a particular interest for accessibility and equity in digital health.

Abstract

We will discuss the role that smart sensing technologies can contribute to sustainable agriculture and livestock practices, in particular the development of affordable technologies. Agriculture is both contributing and vulnerable to climate change. Food production and transport are major contributors to greenhouse gas (GHG) emissions while climate variability and land degradation are threats.

Australia is uniquely positioned to lead change toward a more sustainable and responsible agriculture not only in Australia but in the Pacific through innovation and sustainable practices ensuring food security in the region. The challenge we propose to discuss is the contribution to innovation in smart sensing to support agriculture resilience and food security not only through the contribution to large food production entreprises but also to small and medium size farms including urban and periurban community gardens and family farming. We challenge the notion that technology and smart sensing can be accessible to only large food production industries and that the benefit will be enormous for smaller size productions, particularly for remote Australia and the Pacific nations. This is an opportunity to tackle climate change in the region by reducing food transport GHG emissions through more locally produced food. At local level it may enhance agriculture resilience to climate variability while increasing access to a larger choice of healthy foods.

A/Professor Brendan Choat

Hawkesbury Institute for the Environment

Western Sydney University

Biography

A/Professor Choat is an ARC Future Fellow (2014-2018) at the Hawkesbury Institute for the Environment, Western Sydney University. He studies plant physiology and ecology with a focus on the impacts of climate change on native vegetation, forestry, and horticultural plants.

Brendan has more than 100 peer-reviewed publications and is listed in the top 1% of Highly Cited Researchers in his field according to the international ranking of publication output by Clarivate. His research has been published in top-ranked journals including Nature, Science, PNAS, Plant Physiology and New Phytologist. He obtained his PhD in the field of plant physiology from James Cook University in 2003.

From 2003-2005 he worked as a postdoctoral Fellow at Harvard University in the Department of Organismic and Evolutionary Biology. He held a second postdoctoral fellowship in the Department of Viticulture and Enology at the University of California, Davis from 2005-2008. He returned to Australia in 2008 to work as a Research Fellow at the Australian National University, before moving to the Hawkesbury Institute for the Environment in 2011. He is editor in chief for Prometheus Protocols and on the editorial board of the journal Plant Biology. He was awarded an Alexander von Humboldt Fellowship for Experienced Researchers in 2010 and an ARC Future Fellowship in 2013 for his work on mapping drought response in trees.

Abstract

Measurement of plant performance using plant-based sensors

Plant-based sensors have the potential to improve remote measurement of plant performance across a large range of applications, including horticulture, urban forestry, and ecosystem science. Current methods generally rely on sensors located adjacent to the plant (e.g. soil sensors), or on remote sensing approaches (satellite or airborne platforms). Measurements obtained by plant-based sensors are superior because they provide direct information on the stress levels, growth rates, water use, etc., experienced by the plant. Wireless plant-based sensor systems would provide more accurate data streams for applications such as precision irrigation, early warning of plant stress in urban environments, and long term ecological monitoring at remote sites. These sensors also offer the potential to improve calibration and training of remote sensing metrics derived from airborne and satellite methods, allowing for improved measurement of plant performance at broader scales.

Although significant progress has recently been made in the development of plant-based sensors, a number of barriers still exist to adoption of this technology. These barries include cost effectiveness, durability of sensors, data transmission and processing, and accessibility to practitioners in the field. I will focus on evaluation of sensor types currently available and the potential for development of improved sensor technology.

Professor John Close

Professor of Physics and NSSN Ambassador

Australian National University

Biography

John completed his PhD in physics at the University of California at Berkeley in 1991. He was a postdoctoral fellow at the University of Washington in Seattle from 1992 to 1995 and an Alexander von Humboldt Fellow at the Max Planck Institute in Göttingen, Germany from 1995 to 1998. John returned to Australia and took up a position as Queen Elizabeth II Fellow at the ANU in 2000. John was promoted to Professor of Physics in 2008. He was Deputy Director of the Research School of Physics from 2012-2016, elected member of ANU council from 2012 to 2014, member of the ARC Panel of Experts from 2014-2016, and is currently Head of ANU Defence Engagement and Head of the Quantum Sensors Group in the Department of Quantum Science.

John was the 2020 recipient of the Australian Defence Industry Award for Academic of the Year, and the recipient of the 2020 Australian Defence Industry Award for Excellence for his work on quantum sensors and more generally for driving collaboration between defence and academia.

Abstract

Water is a critical resource for Australia. Climate change appears likely to put increased strain on our surface and ground water resources. Our environmental health, economic health, food security and national security rely on decisions made on land and water use. In turn, those decisions must be informed by reliable data. There is a great deal of uncertainty around our ground water resources, how much we have, how it is connected, recharge and depletion. This uncertainty is problematic for decision makers who allocate water for agriculture, for the environment, for residential use and for industry. These decisions have long-term and far reaching impact environmentally and economically for Australia, and it is essential that we provide decision makers with the best data possible on our ground and surface water resources.

I will discuss a new tool, terrestrial measurements of local gravity and gravity gradients with quantum gravimeters, and their application to the mapping, monitoring and understanding of ground water. I will discuss how we are approaching this problem and how terrestrial measurements of gravity and its gradients may provide high spatial resolution data on ground water resources to complement the long-length scale data from the GRACE satellite mission.

Dr Nathan Cooper

Climate Change Research Centre

UNSW Sydney

Biography

Nathan is a postdoctoral researcher with the Centre for Air pollution, energy and health Research (CAR) and the Climate Change Research Centre at UNSW.

Nathan has a background in air pollution, environmental health, data analysis, GIS and human geography. He completed his PhD in 2019, which examined disparities in exposure to air pollution in Australia, illustrating the health risk air pollution poses to vulnerable subpopulations including Indigenous communities, the elderly, the young, and communities of low socio-economic status.

Nathan's current research expands on his PhD by analysing air quality in early learning environments, such as schools, and the risk that air pollution poses to children. His research focuses particular attention on the threat that is posed by bushfire smoke to school children, which is especially important as bushfire events becoming increasingly severe due to the influence of climate change.

To better understand the children's exposure to air pollution, he has broadened his research into methods of low-cost sensor technology and how they can be used to measure air quality in various environments. With this research, Nathan plans to increase the reliability of air quality measurements from low-cost sensors and improve our understanding of children's exposure to air pollution, both in the present and in the future. Nathan also plans to use this research to develop sensor systems that can measure and mitigate other atmospheric factors affecting children's health in learning environments, such as temperature, humidity and ventilation.

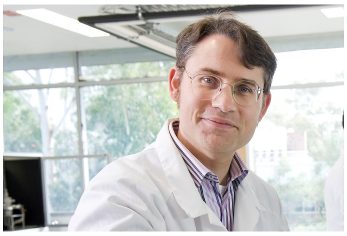
Abstract

Air pollution is a major health threat to Australian communities, especially from bushfire smoke which is predicted to become more severe in the future due to our changing climate. Children are especially vulnerable to air pollution due to their developing physiology and levels of activity. As children spend up to a third of their day in school, almost entirely indoors, it is imperative that children are protected from bushfire smoke while in schools.

The problem is there is no monitoring of indoor air pollution in Australia, so we do not know how well indoor learning environments protect children from outdoor air pollution such as bushfire smoke. As

bushfires are predicted to grow in intensity and frequency in the future, it is important to understand children's exposure to air pollution in schools and to develop measures to effectively protect them from exposure.

To address this, we established the 'CleanAir Schools' project, which is aimed at setting up a network of low-cost indoor and outdoor air quality monitors in schools across NSW. Using the readings from these monitors, this project aims to understand children's exposure to air pollution in schools. By surveying the characteristics of the schools and classrooms that readings are collected from, this project also aims to understand how well school environments protect children from bushfire smoke and other sources of outdoor air pollution, and to develop measures that will effectively minimise exposure.



Professor Paul Dastoor

Professor of Physics and NSSN Ambassador

The University of Newcastle

Biography

Professor Paul Dastoor is Professor of Physics at the University of Newcastle in Australia. He received his B.A. degree in Natural Sciences and his PhD in Surface Physics from the University of Cambridge. He has been Visiting Research Fellow at Fitzwilliam College, Cambridge, UK, at the Daresbury Laboratory, Cheshire, UK at Nanyang Technological University and Leverhulme Visiting Professor at the University of Cambridge. He is Director of the Centre for Organic Electronics, which he established in 2007. His research interests encompass the growth and properties of thin films, surface coatings and organic electronic devices based on semi-conducting polymers. These exciting materials offer the tantalising prospect of paints that generate electricity directly from sunlight and sensors that can be printed as flexible arrays.

Abstract

Expert judgement indicates that climate change has reached a crisis point and scientific and public opinion is agreed that CO_2 emission and fossil fuel usage must immediately be curtailed. In light of this paradigm shift in beliefs, governmental policy must and will follow suit. Indeed, most western countries have already committed to expansive renewable energy growth and rapid transitioning of energy production away from fossil fuels. While conventional (silicon-based) solar energy will continue to play a significant role in the new energy generation mix, a suite of renewable technologies is urgently required to transition the global energy profile.

Printed solar is a photovoltaic technology comprising carbon-based inks printed at high speeds across large areas using roll-to-roll (R2R) processing techniques, enabling every roof and other suitable building surface to be coated with photovoltaic materials at extremely low cost. Economic modelling of the balance of materials (BOM) and balance of system (BOS) costs have validated the long-term commercial viability of OPV-based technology in today's energy marketplace. Unlike conventional solar, the all-organic nature of printed solar means that the technology is 100 % recyclable; resulting in a fully sustainable renewable energy technology.

The Centre for Organic Electronics (COE) at the University of Newcastle has pioneered printed solar in Australia, successfully completing multiple large-scale installations. Having successfully listed its printed biosensor technology on the NASDAQ in 2020, the COE is currently capital raising to build the first printed solar manufacturing factory in Newcastle. This facility will provide Australia a sovereign renewable energy manufacturing capability.

Dr Tomonori Hu

Environment & AgTech Theme Leader

NSW Smart Sensing Network

Biography

Dr Tomonori Hu has a background in physics - developing mid-infrared fiber lasers for applications in spectroscopy. His interests lie in the translation of academic technologies to industry.

Since graduating from a PhD at the University of Sydney in 2015, Tom has been involved with commercialisation of his research to form a start-up company - developing mid-infrared spectrometers.

Tom has completed accelerator programs such as INCUBATE, and subsequently operated the company from various locations in Sydney. At the same time, he leads a group at the University of Sydney on optical sensor technologies related to air quality, wildlife detection and defence.

Abstract

Tracing Black Carbon using Optical Spectroscopy

Smart sensing plays a critical role for handling climate change. As new strategies are implemented, their impacts need to be measured and interpreted using the latest sensors and signal processing to ensure their efficacy. Among the numerous parameters to measure, we highlight one that poses a unique challenge to Australia – black carbon.

Commonly known as soot, these are produced from industrial emissions, diesel engines, and biomass burning. Its optical properties cause it to be the second major human generated contributions to arctic warming (up to 25%), after carbon-dioxide. Although air pollution monitoring is done quite routinely, black carbon-specific measurements are still needing further development and understanding. The challenge is identifying the source of black carbon in Australia – being able to separate the human-caused emissions from those that are naturally produced, such as bushfires.

The MABI Sensor, developed by ANSTO, uses optical spectroscopy to measure black carbon. The unique combination of high accuracy and compactness has enabled the technology to be adopted in over 40 countries – with every unit been manufactured in NSW. There is an opportunity to utilise this sensor in the context of climate change by adding new functionality such as source identification and the potential to use these devices in a sensor-network to map black carbon emissions in specific regions. This requires collaboration across climate scientists, sensor network engineers, and the industry manufacturing the units to develop a world-leading technology.

Professor Paul Hurley

Professor of Data Science and NSSN Ambassador

Western Sydney University

Biography

Paul is Professor of Data Science and the Director of the Centre for Research in Mathematics and Data Science at Western Sydney University (WSU). Paul is also an active member of WSU's International Centre for Neuromorphic Computing.

Before coming to Australia, Paul was a technical lead and senior research scientist at IBM Research in Zurich, Switzerland. He holds a PhD from EPFL in Lausanne, Switzerland, and is a graduate of the National University of Ireland in Galway. His research interests range from signal processing and algorithms (especially as applied to ultrasound, other modes of medical imaging, radio astronomy and other sensors, and sensor arrays) to data science, machine learning, information theory and abstract algebra. Paul enjoys listening to podcasts, in particular, “Hidden Brain”.

Professor Sarath Kodagoda

Director, UTS Robotics Institute and NSSN Ambassador

University of Technology Sydney

Biography

Professor Sarath Kodagoda is the Director (Acting) of the UTS Robotics institute (formerly Centre for Autonomous Systems) which is the world leader in infrastructure robotics. He is the UTS ambassador to the NSW Smart Sensing Network (NSSN) and President of the Australian Robotics & Automation Association (ARAA). His broad research interest is to develop sensing and robotic solutions for humans to safely and efficiently carry out dirty, dull and dangerous tasks. Robotics, sensor technology, sensor networks, data processing and decision making through machine learning are his research directions with application areas, Infrastructure robotics, Autonomous cars and Human robot interaction. He has over 20 years of experience in sensing and robotics, published over 180 papers, received multi million dollar industry grants inwhich outcomes are recognized through 8 research awards including international, national, state and university awards.

He is a co-chair of the first Robotic Roadmap for Australia, which was launched in 2018 and the second edition is in preperation. He supervised 12 PhD students for successful completions. He has been a keynote speaker, conference general chair, session chair, editorial board member, associated editor, member of program committees and reviewer of prestigious robotic conferences and journals. He is instrumental in the development of the Mechatronics courses at UTS and received 3 teaching awards including the prestegious UTS Medal for Teaching & Research Integration and Australian OLT awards.

Abstract

Global urban population is growing and it is expected that by 2050, two-thirds of the world population will be living in urban areas. It is estimated that 70 percent of the gross domestic product is generated in urban areas. The cities are essential part of human advancement and survival. Water, sanitation, transport, waste management, disaster risk reduction are crucial aspects to manage. State of the art infrastructures need to be commissioned and maintained efficiently, effectively and cost effectively to keep up with the demands forced by the growing urban population. Maintenance of infrastructure becomes crucial for safe, resilient and sustainable cities. Sensors can capture critical information about the infrastructures for timely fit for purpose decision making. The sensor measurements those require frequent updates can be infrastructure mounted and others can be integrated with mobile robotic platforms to access dangerous and dirty environments through planned deployments. My contribution will focus on how the high-end sensors and robotic solutions can contribute to safe, resilient and sustainable cities. Some examples from our own backyard will be presented.

Professor Michelle Leishman

Distinguished Professor in Climate Change Impacts,

Macquarie University

Biography

Distinguished Professor Michelle Leishman has a wealth of experience and expertise in climate change impacts on plants across a wide range of contexts and the fundamental effects of rising temperatures and carbon dioxide on native and managed ecosystems. Her research focuses on climate change impacts and adaptation for plants, invasion success of exotic plants and pathogens, and urban greening. She leads the Green Cities Which Plant Where project at Macquarie University in collaboration with Western Sydney University and the Department of Planning, Industry and Environment and serves on several Boards and Councils including Royal Botanic Gardens and Domain Trust, Bush Heritage and the Australian Flora Foundation. In 2020, she was awarded the NSW Royal Society Clarke Medal in recognition of her distinguished research in the natural sciences conducted in Australia and its territories.

Abstract

Cities are dynamic and complex by their very nature. By 2050, it is estimated that 70% of the world's population will live in cities. The future liveability, vibrancy and sustainability of our cities is challenged by multiple factors including population growth, natural resource constraints and climate change.

At the same time, established and emerging areas of research are converging. This together with broad technology adoption and sophisticated analysis and prediction tools create exceptional opportunities to achieve huge advances for our cities and our communities.

Smart sustainable cities can be seen as a resolution to the growing urban population and its challenges. United Nations has chosen to focus specifically on sustainable cities and communities in their Sustainable Development Goal number 11 (SDG 11). However, the potential to apply smart technology to manage green and blue infrastructure in our urban areas is largely overlooked.

Professor Subhas Mukhopadyay

Professor of Mechanical/Electronics Engineering

Macquarie University

Biography

Subhas holds a B.E.E. (gold medallist), M.E.E., Ph.D. (India) and Doctor of Engineering (Japan). He has over 31 years of teaching, industrial and research experience.

Currently he is working as a Professor of Mechanical/Electronics Engineering, Macquarie University, Australia and is the Discipline Leader of the Mechatronics Engineering Degree Programme. His fields of interest include Smart Sensors and sensing technology, instrumentation techniques, wireless sensors and network (WSN), Internet of Things (IoT), Healthcare, Mechatronics, Robotics, Environmental monitoring etc. He has supervised over 40 postgraduate students and over 100 Honours students.

He has published over 400 papers in different international journals and conference proceedings, written ten books and fifty two book chapters and edited eighteen conference proceedings. He has also edited thirty five books with Springer-Verlag and thirty two journal special issues. He has organized over 20 international conferences as either General Chairs/co-chairs or Technical Programme Chair. He has delivered 390 presentations including keynote, invited, tutorial and special lectures.

He is a Fellow of IEEE (USA), a Fellow of IET (UK), a Fellow of IETE (India). He is a Topical Editor of IEEE Sensors journal. He is also associate editor of IEEE Transactions on Instrumentation and Measurements and IEEE Transactions on Review of Biomedical Engineering. He is a Distinguished Lecturer of the IEEE Sensors Council from 2017 to 2022. He is the Founding chair of the IEEE Sensors Council NSW chapter.

Abstract

Design and development of low-cost, low-power sensors and sensing systems are active research areas in building the effortless smart city.

Firstly, a human counting and environmental monitoring sensor node will be developed to count the number of pedestrians and their travel direction and provide ambient parameters (temperature, humidity, pressure, CO2, and TVOC). The importance of developing selective sensors to monitor air quality has been realised while working with commercial sensors. The novelty of this work lies in compensating the temperature and humidity effect to make it applicable in actual environmental conditions and measure CO_2 concentrations with more than 95% accuracy. The sensors detect and differentiate acetone and ethylene concentrations from 10 ppb to 300 ppb. The significant contributions of this research are improving the response and recovery time, detection limit, and developing an intelligent sensing system to monitor air quality using these sensors.

Water is another essential aspect of a smart city and smart agriculture. Hence, a flexible Multi-Walled Carbon Nanotubes based sensor will be fabricated for nitrate, phosphate, calcium, magnesium, and pH detection in water. A novelty of this work will be utilising a machine-learning algorithm to classify the data and predict the amount of water quality parameters using only one sensor and without utilising selective coating. A smart autonomous and portable system will be designed for real-time water quality monitoring from any remote location.

These systems and sensors provide an opportunity for decision-makers to test assumptions and strategies and provide a healthy and safe environment for all of us.

Dr Noushin Nasiri

Senior Lecturer in Nanomaterials and NSSN Ambassador

Macquarie University

Biography

Dr Noushin Nasiri is the NSSN ambassador, and the Head of the NanoTech Laboratory at the School of Engineering. Her research is focused on design and fabrication of nanostructured materials, miniaturized sensor technologies and wearable electronics for health, energy and environment application. She serves on the editorial board of Nanotechnology and Nanomanufacturing journals. She is one of Australia's 2021-2022 Superstars of STEM, 40 under 40 most influential Asian-Australians in 2021 and the recipient of NSW 2019 Young Tall Poppy Science Award. She is a passionate science communicator who has received considerable outside recognition for her research including TEDx Sydney Salon 2017, TEDx Macquarie University 2019 and TEDx Bligh Street 2020 and ABC Ockham's Razor 2018.

Abstract

From smog hanging over cities to smoke inside the home, air pollution poses a major threat to climate and health. Among gases that cause the most air pollution, volatile organic compound (VOC) emissions are one of the biggest environmental problems today. When exposed to sunlight, VOCs react with other gases to form ground-level smog compounds, which stimulate diseases in plants, inhibit seed production and hinder fertilization. Prolonged exposure to VOCs can cause severe health issues in humans including chronic obstructive pulmonary disease, lung cancer and strokes. According to World Health Organisation (WHO), the combined effects of indoor and outdoor air pollution cause about 7 million premature deaths every year, and it is estimated that the number of deaths will double by 2050. In Australia, the estimated financial cost of premature deaths due to air pollution ranges from roughly $11 billion to $24 billion per year. This economic burden is expected to

increase exponentially without an improvement in air pollution monitoring technologies, particularly gas sensing devices for VOCs detection.

While the conventional gas sensing techniques such as Gas chromatography–mass spectrometry (GC–MS) are gold standard, they are expensive and time-consuming, greatly limiting the potential for real-time measurements. The use of advanced nano-sensing technologies, particularly metal oxide semiconductors, is one of the most promising detection techniques for monitoring low concentrations of VOCs in a complex gas mixture.

Professor Peter Ralph

Executive Director, Climate Change Cluster (C3)

University of Technology Sydney

Biography

Peter Ralph is an expert in photosynthesis and pigments biosynthesis in algae. Peter has over 20 years of experience in aquatic photosynthesis research, making significant advances in the understanding of photosynthesis and biomass production in algae. In 2013, he created a new research program that applies his knowledge in photobiology, biophysics and cellular biochemistry to develop sustainable raw algae materials to grow the emerging algal biotechnology sector in Australia. He works with a wide range of start-ups, SMEs, not-for-profits, NGOs and multi-nations to deliver a sustainable circular bioeconomy.

Abstract

To achieve net zero, we need smart sensors to verify that we are actually reducing emitted carbon as well as legacy carbon from the atmosphere. Decarbonisation will also require accurate monitoring of carbon use and storage. These types of novel sensors will support two important processes of decarbonisation; carbon trading schemes and circular bioeconomy.

Carbon trading schemes will need to be able to verify when carbon is removed from a source and placed into a new sink. Sensor will need to be able to accurately and remotely assess this across a wide range of natural and industrial settings. For carbon stores, we will need sensors to verify that the carbon remains in place (forest, geo-sequestration and industrial use of captured carbon). Specifically, these sensors will be required for terrestrial and aquatic sinks, as well as industrial transformation of captured carbon into products used across society (building products, bioplastics).

Secondly, to understand the efficiency of the circular bioeconomy, carbon sensors (and other waste product sensors such as nutrients) will also be required. These sensors will need to be integrated with industrial processing systems and should be based on industry 4.0 principles.

Professor Salah Sukkarieh

Professor of Robotics and Intelligent Systems

University of Sydney

Biography

Salah Sukkarieh is the Professor of Robotics and Intelligent Systems at the University of Sydney, and is the CEO of Agerris, a new Agtech startup company from the ACFR developing autonomous robotic solutions to improve agricultural productivity and environmental sustainability. He was the Director Research and Innovation at the Australian Centre for Field Robotics from 2007-2018, where he led the strategic research and industry engagement program in the world's largest field robotics institute. He is an international expert in the research, development and commercialisation of field robotic systems and has led a number of robotics and intelligent systems R&D projects in logistics, commercial aviation, aerospace, education, environment monitoring, agriculture and mining. Salah was awarded the NSW Science and Engineering Award for Excellence in Engineering and Information and Communications Technologies in 2014, the 2017 CSIRO Eureka Prize for Leadership in Innovation and Science, and the 2019 NSW Australian of the Year nominee. Salah is a Fellow of Australian Academy of Technological Sciences and Engineering (ATSE), and has over 500 academic and industry publications in robotics and intelligent systems.

Abstract

Australia is uniquely positioned to lead change toward a more sustainable and responsible agriculture not only in Australia but in the Pacific through innovation and sustainable practices ensuring food security in the region. The challenge we propose to discuss is the contribution to innovation in smart sensing to support agriculture resilience and food security not only through the contribution to large food production entreprises but also to small and medium size farms including urban and periurban community gardens and family farming. We challenge the notion that technology and smart sensing can be accessible to only large food production industries and that the benefit will be enormous for smaller size productions, particularly for remote Australia and the Pacific nations. This is an opportunity to tackle climate change in the region by reducing food transport GHG emissions through more locally produced food. At local level it may enhance agriculture resilience to climate variability while increasing access to a larger choice of healthy foods.

Salah will discuss from the perspective of his expertise in robotics and intelligent systems.

Associate Professor Marta Yebra

Director, ANU National Bushfire Initiative

Australian National University

Biography

Dr Yebra is an Associate Professor in Environmental Engineering at the School of Engineering and the Fenner School of Environment & Society and the Director of the ANU Bushfire Initiative which aims to use technology to protect Australia from catastrophic bushfires.

Her research focuses on developing applications of remote sensing to the management of fire risk and impact. Dr Yebra led the development of the Australian Flammability Monitoring System, and it is now working with a multidisciplinary team to design Australia's first satellite mission (Ozfuel) to help forecast vulnerable areas where bushfires are at the highest risk of starting or burning out of control.

She has served on several advisory government bodies including the Australian Space Agency's Bushfire Earth Observation Taskforce (Feb-May 2020), Australian Space Agency's Earth Observation Technical Advisory Group (Since 2019), the Victorian Department of Environment, Land, Water and Planning's Scientific Reference Panel (Since 2019) and the ACT Bushfire Council (since 2021). Her research and contributions to bushfire management have been recognised through numerous awards, including the Max Day Environmental Science Award by the Australian Academy of Science and the Bushfire and Natural Hazards CRC's Outstanding Achievement in Research Utilization award.

Abstract

Australia has experienced catastrophic bushfire conditions that exceed known firefighting technologies, leading to significant ecological, economic, health and social costs. During the 19/20 bushfire season, numerous fires were ignited by lightning strikes and burnt extensive areas largely because of an inability to detect and extinguish ignitions in remote areas before the fires spread and became uncontrollable under extreme weather and fuel and soil dryness conditions. The most recent IPCC report warns that the frequency and severity of bushfires is likely to increase because of more frequent coincidences of heatwaves, droughts, and fire weather. Therefore, we urgently need to accelerate the development and implementation of modern technologies to prevent, detect and rapidly extinguish bushfires before they become hazardous and widespread, well ahead of future catastrophic bushfire seasons.

Sensing technologies have huge potential to address those challenges. I will briefly present the advanced interdisciplinary research the Australian National University is undertaking to develop an innovative and integrated national system to protect Australia from future catastrophic bushfires using a combination of sensing technologies. The comprehensive research program covers aspects from fire prevention to suppression and is running in close collaboration and support by industry, government and philanthropic partners.