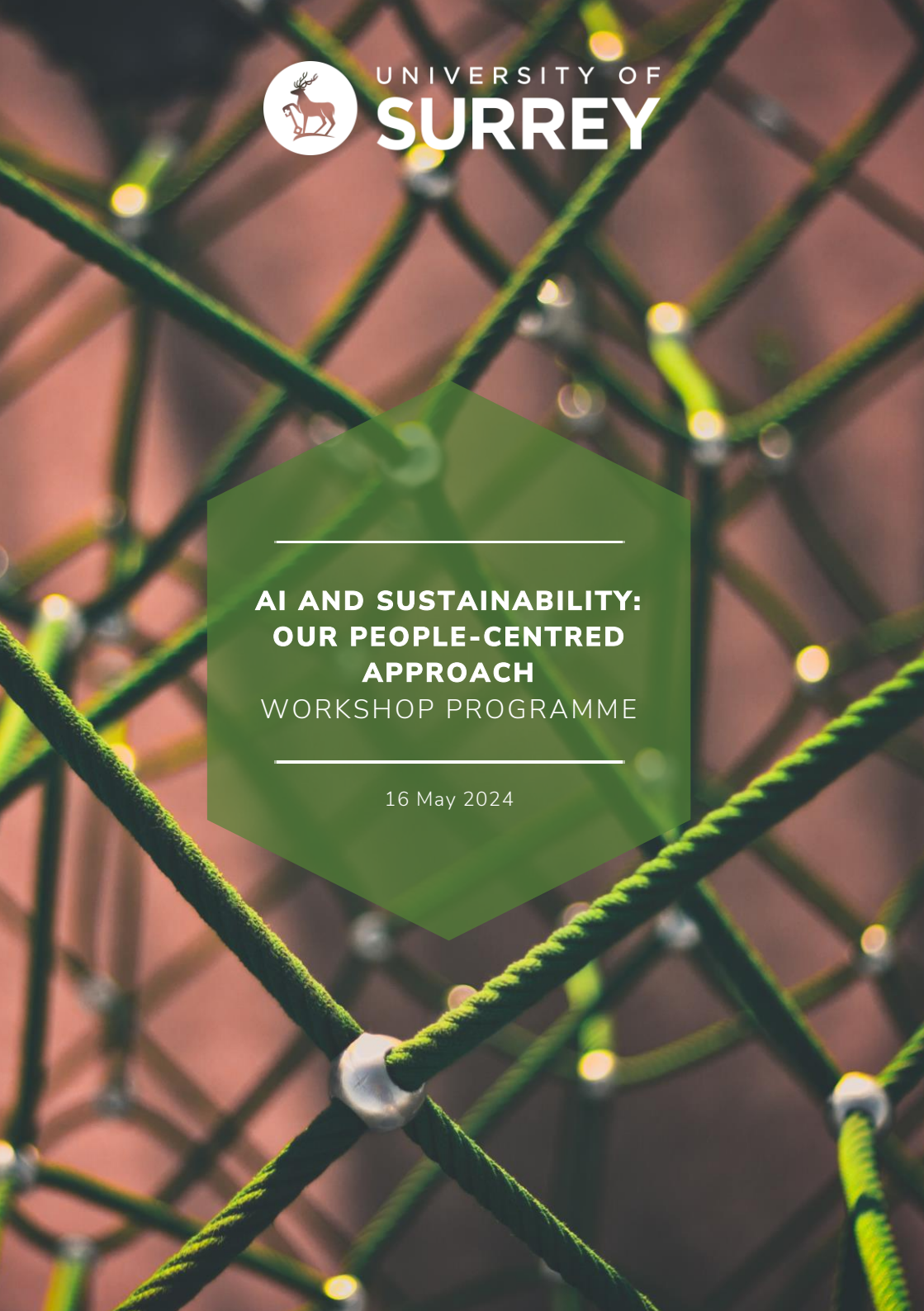


UNIVERSITY OF SURREY

AI AND SUSTAINABILITY: OUR PEOPLE-CENTRED APPROACH

WORKSHOP PROGRAMME

16 May 2024

OUR SPONSORS

IAS Institute of Advanced Studies

The Institute of Advanced Studies (IAS) at the University of Surrey sponsors workshops and Fellowships at the 'cutting edge' of science, engineering, social science and the humanities. Through this scheme the Institute fosters interdisciplinary collaborations and encourages a flow of international scholars to visit, enjoy their stay at Surrey and leave behind excellent ideas and innovations.

ias.surrey.ac.uk

UKRI Engineering and Physical Sciences Research Council

AI for Sound

AI for sound (AI4S) project is an Engineering and Physical Sciences Research Council (EPSRC) prestigious Fellowship awarded to the University of Surrey's Professor Mark Plumbley. AI4S project aims to design new AI for sound technology that has major potential applications in security, health & wellbeing, environmental sensing, urban living, and the creative sector.

ai4s.surrey.ac.uk

CVSSP Centre for Vision, Speech and Signal Processing

Centre for Vision, Speech and Signal Processing (CVSSP) Is a world-class research Centre for creating machines that can see and hear to understand the world around them. CVSSP is an internationally recognized leader in audio-visual machine perception research. With a diverse community of more than 150 researchers, with one of the largest audio and vision research groups in the UK. Research in the Centre has led to award-winning spin-out companies in the biometric, communication, medical and creative industries.

surrey.ac.uk/centre-vision-speech-signal-processing

INSTITUTE FOR SUSTAINABILITY UNIVERSITY OF SURREY

The creation of a pan-university Institute for Sustainability (IFS) demonstrates the University of Surrey's commitment to be at the forefront of transdisciplinary sustainability research. IFS will increase the scale and enhance the excellence of the University's research and innovation in priority areas of sustainability research. Through transdisciplinary collaborations across faculties, and business and external partner engagement, we will break new ground to produce world-class research and effecting significant change for the long-term wellbeing for all.

surrey.ac.uk/institute-sustainability

People-Centred AI UNIVERSITY OF SURREY

Surrey Institute for People-Centred AI (PAI) Institute brings together Surrey's core AI-related expertise in vision, speech and signal processing, computer science, and mathematics, with its domain expertise across engineering and the physical sciences, human and animal health, law and regulation, business, finance and the art and social sciences.
The pan-university institute will be spearheaded by a group of academics with a passion for collaboration and co-creation, and a strong vision for people-centred AI. With this distinctive approach, the academic team will build on Surrey's excellent track record of collaboration with industry, the public sector, government and other relevant institutions to develop innovative ideas and foster new research directions. AI and Sustainability is one of the six strategic research challenge areas at the core of PAI and supports PAI's ethos to deliver a step-change in AI research, training and innovation.

surrey.ac.uk/artificial-intelligence

INTRODUCTION

With the advent of technology and computation power in recent years, AI has become widely used by industry and academia across various applications, including natural language processing (NLP), and healthcare. However, the energy efficiency and impact of large-scale AI models like ChatGPTs and Chatbots on the environment have not yet been explored well. The workshop on "AI and Sustainability: Our People-Centred Approach" will look at how AI can be developed and deployed sustainably and investigate tools to measure the environmental impact of AI. AI and Sustainability is one of the six strategic research challenge areas at the core of the Surrey Institute for People-Centred AI (PAI) and supports our ethos to deliver a step-change in AI research, training and innovation.

The workshop brings together active researchers from academia with industrial experts who use AI to solve real-world problems and aim to make AI sustainable. It is a platform for exchanging new ideas and fostering future research collaborations on using AI technology responsibly and understanding its environmental impact.

The workshop on AI and Sustainability will focus on the following themes:

- What does the Sustainability of AI mean?
- Impact of AI on the environment.
- How do academic researchers and industry see the cruciality of sustainable AI from development to deployment cycle?
- Methods to make AI more energy-efficient and environmentally friendly.
- Tools to measure the environmental impact of AI.
- AI for Sustainability.

Workshop Chairs:
Dr Arshdeep Singh, Professor Mark Plumbley and Dr Erick Giovani Sperandio Nascimento, University of Surrey

Organising Committee:
Dr Arshdeep Singh, Dr Erick Giovani Sperandio Nascimento and Professor Mark Plumbley

Administrative Support:
Louise Jones, Institute of Advanced Studies, Sophie Maxwell, CVSSP and Arshdeep Singh, University of Surrey

Publicity:
Surrey PAI and CVSSP

Event Set-Up:
Dr Thomas Deacon, Gabriel Bibbó, Haohe Liu and James King, University of Surrey

PROGRAMME

THURSDAY 16 MAY

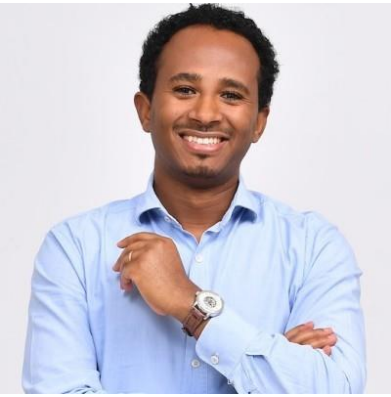
Rik Medlik Building, 32 MS 01

(BST)

09.00 – 09.30	Registration & Morning Coffee/Tea
09.30 – 09.40	Welcome Address – Dr Arshdeep Singh, University of Surrey
09.40 – 10.20	Key AI-for-Good Practices to Enhance Sustainability of AI - Dr Girmaw Abebe Tadesse, Microsoft
10.20 – 10.55	AI for Sustainable Energy Use - Professor Alex Rogers, University of Oxford
10.55 – 11.15	Coffee Break
11.15 – 11.55	How AI is Making Our Climate Change Predictions More Sustainable - Jeff Adie, NVIDIA Corporation
11.55 – 12.25	How is the University of Surrey Contributing Towards AI & Sustainability? - Dr Erick Sperandio, University of Surrey
12.25 – 12.55	Business as Usual" or "Brave New World"? Unlocking the Power of AI for Sustainability - Dr Jill Juergensen, University of Surrey
12.55 – 13.50	Lunch Break (Photo) & Networking (Poster Presentations)
13.50 – 14.20	Bigger isn't Always Better: A Sociotechnical Perspective on AI for Health - Dr Hannah Mary Thomas T, CMC Vellore, India
14.20 – 15.00	Monitoring Environmental Impact of Machine Listening Systems: why and how? - Professor Romain Serziel, University of Lorraine, France
15.00 – 15.20	Coffee Break & Networking (Poster presentations)
15.20 – 16.00	Dimensions of Efficiency in Machine Learning - Dr Nitish Mital and Dr Daniel Mannion, The Alan Turing Institute
16.00 – 16.35	AI & Sustainability Research Priorities/Challenges/Opportunities Panel discussion Chair – Professor Mark Plumbley, University of Surrey
16.35	Closing Remarks – Dr Arshdeep Singh, University of Surrey

ABSTRACTS AND PARTICIPANTS

Dr Girmaw Abebe Tadesse



Girmaw is a Principal Research Scientist and Manager at Microsoft AI for Good Research Lab. He leads the Africa team in developing AI solutions for critical challenges in agriculture, healthcare, biodiversity, and more. His research focuses on developing impactful and trustworthy AI solutions with active collaboration with domain experts across non-profits, governmental and academic institutions. Girmaw has filed over 20 patents at the US patent office. He is an Executive Member for IEEE Kenya Section and an active contributor to the AI scientific community (Keynote speaker at ICLR 2023, Workshop Chair at ICLR 2024, Program Committee of Deep Learning Indaba, etc.) He also serves in the Advisory Group for Global System for Mobile Communications (GSMA). He has previously worked as a Staff Research Scientist at IBM Research Africa, as Postdoctoral ML Researcher for Healthcare at the University of Oxford and interned in various research groups across Europe. He received his PhD at Queen Mary University of London, under the Erasmus Mundus Double Doctorate Program in Interactive and Cognitive Environments.

Key AI-for-Good Practices to Enhance Sustainability of AI

Dr Girmaw Abebe Tadesse, Principal Research Scientist and Manager at Microsoft AI for Good Research Lab

Sustainable AI investigates how AI can contribute to sustainability, e.g., by supporting Sustainable Development Goals (SDGs) and how AI can be sustainable in itself, e.g., by reducing the environmental impact. In this talk, I will present some of our recent works that use AI to address various of the most urgent and vital problems of our time with a clear connection with SDGs. More importantly, I will share our main practices in the AI development cycle that aimed to enhance the sustainability of the technology.

Professor Alex Rogers

Prof Alex is a Professor of Computer Science at the University of Oxford and a Tutorial Fellow at St. Anne's College. His research applies artificial intelligence and machine learning within physical sensor systems to address real-world problems focusing on sustainability. His recent work addressed future energy systems, such as the smart grid, citizen science platforms, and environmental monitoring, and typically involves the real-world deployment of novel approaches in devices, smartphones or the cloud. His current work addresses smart building energy management and the development of low-cost conservation technology.

AI for Sustainable Energy Use

Professor Alex Rogers, Professor of Computer Science at the University of Oxford and a Tutorial Fellow at St. Anne's College

Energy used to implement AI systems may generate high levels of CO2 and adversely affect the environment. However, AI also holds the promise of automating the optimisation of energy use within a wide range of applications. This talk will describe an ongoing project, called GridCarbon, that tracks the changing carbon intensity of the UK electricity grid. It will then describe a number of projects that have used AI to better monitor and optimise energy use within UK homes and businesses.

Jeff Adie

Jeff is a HPC specialist with over 30 years of experience in developing and optimizing scientific codes and architecture HPC solutions. Jeff leads the Earth Systems Science research team for the NVIDIA AI technology centre's joint laboratory established at Nanyang Technology University (NTU) in Singapore. There he works on collaborations with industry partners and academia in the fields of accelerated Climate/Weather research and in application of AI to Earth system modelling. Prior to joining NVIDIA, Jeff spent 16 years working at SGI on designing and deploying several operational weather centres across the Asia Pacific region. Jeff holds a postgraduate Diploma in Computer Science from the University of Auckland and is currently a PhD candidate at the University of Newcastle on Tyne.

How AI is Making Our Climate Change Predictions More Sustainable

Jeff Adie, Principal Solutions Architect, NVIDIA Corporation

The effects of our changing climate are occurring faster and more intensely than our present models are predicting, largely due to limitations in the models which are constrained by computational and energy consumption. Indeed, these large model runs have been the target of "climate shaming" due to the large carbon footprint of the runs themselves. New AI techniques for fully data-driven AI prediction models offer a more sustainable approach, with models showing up to 4 orders of magnitude reductions in Carbon footprint and energy consumption for comparable predictive skill. This opens the door to better predictions of our future climate in a sustainable manner. This talk will explore the latest developments in sustainable models for climate change.

Dr Erick Sperandio

Dr Erick Giovani Sperandio Nascimento is Associate Professor (Reader) in AI for Clean Air at the Surrey Institute for People-Centred AI, member of the Global Centre for Clean Air Research (GCARE) and Sustainability Fellow at the Institute for Sustainability (IfS), both at University of Surrey, UK, where he is the Programme Lead of AI and Sustainability. He is also Associate Professor at SENAI CIMATEC, Brazil. He is University Ambassador of the NVIDIA Deep Learning Institute, PI of the NVIDIA/CIMATEC AI Joint Lab and was the co-PI of one of the Brazilian National Applied Research Centers in AI. He has published >90 research papers and filed four patents. He attracted, led and participated in R&D projects totalling >£18M.

How is the University of Surrey Contributing Towards AI & Sustainability?

Dr Erick Giovani Sperandio Nascimento, Associate Professor (Reader) in AI for Clean Air Systems, Programme Lead of the AI and Sustainability Programme, University of Surrey

In this talk, we will present the AI and Sustainability Programme at the University of Surrey, bridging its two world-leading pan-University Institutes - the Surrey Institute for People-Centred AI and the Institute for Sustainability. This programme aims to create and establish a lead in AI and sustainability, by researching and developing AI solutions with a human- and environment-centric approach. It aims to underpin AI-based research that deals with the challenges of the sustainability of AI, which relates to making AI development and usage more sustainable, and AI for sustainability, which is responsible for researching and applying AI techniques to foster sustainable development. Through a transdisciplinary team of sustainability fellows within our Institutes, the programme aims to provide the means to connect different and complementary expertise across all faculties in the University of Surrey, as well as expertise beyond the University, to better explore opportunities to deliver outstanding quality research projects through this initiative.,

Dr Jill Juergensen

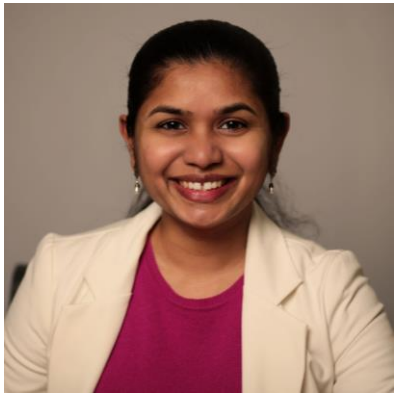
Dr Jill Juergensen is Lecturer in International Business and Strategy at Surrey Business School. She was previously at Henley Business School and the London School of Economics (LSE). Her research primarily focuses on the cross-border generation and dissemination of innovations, including new technologies and management practices. Beyond her academic contributions, Jill's research has fed into multiple policy documents from the European Parliament, European Commission and OECD. Increasingly, Jill combines her knowledge on innovation and international business to tackle sustainability-related questions; for instance, her recent teaching case on Beyond Meat examines the dynamics of the global plant-based alternative meat industry.

"Business as Usual" or "Brave New World"? Unlocking the power of AI for sustainability"

Dr Jill Juergensen, Lecturer in International Business and Strategy, University of Surrey

Since the industrial evolution, new and improving technologies have significantly contributed to human welfare around the world. However, today, the associated impact on the environment is hard to deny, whether in the context of climate change, biodiversity loss, deforestation or air pollution. Artificial intelligence (AI) may help us, going forward, to plan and conduct economic activities in a more efficient manner, thereby potentially aiding economic growth without causing greater greenhouse gas emissions and resource consumption. In fact, research conducted by PWC estimates that using AI for environmental applications may boost global GDP by 3-4%, whilst also reducing global greenhouse gas emissions by 1.5-4.0% by 2030. These are impressive numbers!
But, what does this mean for firms and their managers around the world? What, if any, differences are there across countries and which regions can capture the economic benefits? These are some of the questions we will consider in this talk. Whilst the rise of AI for sustainability offers immense opportunities for start-ups and incumbent firms – leading to entirely new business models –, there will, at least in the short- and medium-term, be important challenges which require attention by researchers, managers and policy makers alike. Both, opportunities and challenges, will be considered throughout this talk.

Dr Hannah Mary Thomas T



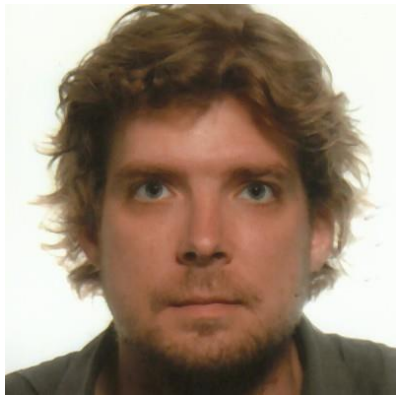
Hannah Mary Thomas T, PhD (2016) is an Imaging Scientist in the Department of Radiation Oncology at the Christian Medical College, Vellore, India. She is supported by the DBT/Wellcome Trust(UK) India Alliance Early career fellowship. She co-founded the Quantitative Imaging and Artificial Intelligence (AI) research Lab (https://qirail.cmcvellore.edu.in) that currently focuses on 1) Quantitative Imaging of Cancer and Normal Tissue 2) AI for health outcome prediction models and 3) Making AI accessible and inclusive. She has been the recipient of many fellowships and awards including the Fulbright-Nehru Doctoral and Professional Fellowship at the University of Washington, Seattle and the Institute of Advanced Sciences External Academic Fellow (2021-22) at the Centre for Vision Speech and Signal Processing , University of Surrey. Dr Thomas has authored over 30 publications.

Bigger isn't Always Better: A Sociotechnical Perspective on AI for Health

Dr Hannah Mary Thomas T, Imaging Scientist in the Department of Radiation Oncology at the Christian Medical College, Vellore, India

When we founded the first lab on artificial intelligence (AI) for Radiation Oncology in India in 2020, we set ourselves against the narrative for larger and more complex models. However, we as a group have been advocating for a sociotechnical perspective that prioritizes simplicity and efficiency realizing it was the only way to keep the efforts sustainable.
These efforts broadly included encouraging hypothesis driven AI models and experiments on quantifying the performance benefits of models with larger datasets. We have also been focusing on model localization along with clinical champions who invest their time in the implementation and building trust. We have been integrating the concept of stewardship into AI model development; particularly technical and clinical stakeholders, take responsibility for preparing data for analysis. This involves integrating, ensuring quality and currency, and placing it in the institutional repository. While we could establish these efforts for a large group and are working towards build communities, we still face challenges when we have to scale up because not everyone understands the sustainability issues of AI in healthcare. We are often limited not only by the cost of implementing a vendor driven solution but the lack of infrastructure to deploy it at an institutional level. While AI as a technology promises many things, it is still an expensive toy many cannot afford to buy.

Professor Romain Serziel



Romain Serziel is an Associate Professor with Université de Lorraine (Nancy, France) doing research on robust speech communications and ambient sound analysis. He has been co-organizing DCASE tasks since 2018, including task 4 which includes the evaluation of the submissions energy consumption since 2022. Since 2019 he is general co-chair of the DCASE challenge together with Annamaria Mesaros. He was DCASE workshop general co-chair in 2022. Since 2023 is the chair of the DCASE steering group.

Monitoring Environmental Impact of Machine Listening Systems: why and how?

Professor Romain Serziel, Associate Professor with Université de Lorraine, Nancy, France

With the increasingly complex models used in machine learning and the large amount of data needed to train these models, machine learning based solutions can have a large environmental impact. Even if a few hundred experiments are sometimes needed to train a working model, the cost of the training phase represents only 10% to 20% of the total CO2 emissions of the related machine learning usage (the rest lying in the inference phase). Yet, as machine listening researchers the largest part of our energy consumption lays in the training phase. Even though models used in machine listening are smaller than those used in natural language processing or image generation, they still present similar problems. Comparing the energy consumption of system trained on different site can be a complex task and the relation between the system performance and its energy footprint can be uneasy to interpret. In this presentation we will study the energy consumption measurement under various configurations to assess the aspects that can potentially affect the measure of the energy consumption.

Dr Nitish Mital

Nitish received his B.Tech. and M.Tech. degrees in electrical engineering, specialising in communications and signal processing, from the Indian Institute of Technology, Bombay in 2015 and his Ph.D. in electrical and electronics engineering from Imperial College London in 2021. He moved to Alan Turing Institute from Imperial College where he was a Research Associate with the Intelligent Systems and Networks Group. In 2018, he was a Visiting Researcher with the NYU Tandon School of Engineering. His research interests include areas of communication and information theory, synthetic data generation for machine learning, and machine-learning aided data compression and wireless communication. He received the Best Student Paper Award at the 2018 IEEE Wireless Communications and Networking Conference (WCNC), and he held the H2020 Marie-Sklodowska-Curie Fellowship from 2016 to 2019.

Dr Daniel Mannion

Daniel is currently a senior research associate at The Alan Turing Institute in London. He researches the application of machine learning techniques in the electromagnetic domain specifically radar signal processing. In addition to radio frequency research, he is also developing hardware architectures inspired by biological specimens to reduce the power consumption of today's ML hardware. This has included developing novel circuits to imitate biological dendrites as well as the development of memristor based synapses and neurons - all of which contribute to the field of neuromorphic computing. He is currently working to combine these two interests of radio frequency signal processing and neuromorphic computing to bring low-powered edge ML to the radio frequency domain.

POSTER PRESENTATIONS

Dimensions of Efficiency in Machine Learning

Dr Nitish Mital, Research Associate with the Intelligent Systems and Networks Group, The Alan Turing Institute, London and Dr Daniel Mannion, Senior research associate, The Alan Turing Institute, London

We investigate four dimensions of challenges for AI sustainability, data, computation, communication and hardware. Firstly, scarcity of clean and well annotated real data, secondly, high power consumption of AI computations, thirdly, high communication costs of machine learning models deployed in distributed systems and finally, the limitations of today's hardware. To solve the problem of scarce data, particularly for computer vision tasks like object detection, we generate synthetic data using Unity, a 3D gaming engine, which allows one to build a fully annotated dataset, and augment the training dataset with it. We establish through experiments that synthetic data provides significant gains in unseen scenarios, scarce data, and imbalanced class distributions. To solve the problem of communication costs in distributed systems using AI, we present an overview of two works, one using deep neural networks (DNN) for the distributed source compression problem from information theory, and the other using DNNs for the joint source-channel coding problem in single and multi-user distributed wireless communication. In the former, we consider the problem of compressing an information source when a correlated one is available as side information only at the decoder side. In the latter, we study the collaborative image retrieval problem at the wireless edge. Finally, we explore the issue of large power consumptions observed during the training and inference of neural networks. We will introduce the field of neuromorphic computing, an attempt to imitate the biological neurons of the brain in a bid to match our own ability to compute with low power consumptions, and survey the key concepts in this field and published benchmarking results., will be considered throughout this talk.

The Critical Role- of AI in Detecting Offende-rs: Exploring Customs Law Enforcement

Abhishek Kumar Singh, Directorate of Revenue Intelligence, India and Navdha Bhardwaj, IIT MANDI, India

International commerce is a sphere where well-built customs rules are crucial. Nevertheless, due to the existence of illegal acts and fraudulent undertakings, there is an urge for safety and economic soundness in customs controls. India's customs service and related organizations employ artificial intelligence-based technologies that aid in combating illegal trade globally. The paper examines how AI can be used to identify people who misuse technology for illicit imports or exports. These evaluations also demonstrate how border control has become more dependent on AI, identify major concerns, and predict future trends. AI may provide an opportunity to strengthen border security as well as expedite legal business relations.

Making AI Model Efficient via Pruning

James King, Arshdeep Singh, Haohe Liu and Mark D Plumbley, University of Surrey

Convolutional neural networks (CNNs) are popular in high-performing solutions to many real-world problems, such as audio classification. CNNs have many parameters and filters, with some having a larger impact on the performance than others. This means that networks may contain many unnecessary filters, increasing a CNN's computation and memory requirements while providing limited performance benefits. To make CNNs more efficient, we propose a pruning framework that eliminates filters with the highest "commonality". We measure this commonality using the graph-theoretic concept of centrality. We hypothesise that a filter with a high centrality should be eliminated as it represents commonality and can be replaced by other filters without affecting the performance of a network much. An experimental evaluation of the proposed framework is performed on acoustic scene classification and audio tagging. On the DCASE 2021 Task 1A baseline network, our proposed method reduces computations per inference by 71% with 50% fewer parameters with less than a two-percentage point drop in accuracy compared to the original network. For large-scale CNNs such as PANNs designed for audio tagging, our method reduces computations per inference by 24% with 41% fewer parameters at a slight improvement in performance.

Recognize and Notify Sound Events Using a Raspberry Pi Based Standalone Device

Gabriel Bibbó, Arshdeep Singh and Mark D Plumbley, University of Surrey

Convolutional neural networks (CNNs) have exhibited state-of-the-art performance in various audio classification tasks. However, their real-time deployment remains a challenge on resource-constrained devices such as embedded systems. In this paper, we analyse how the performance of large-scale pre-trained audio neural networks designed for audio pattern recognition changes when deployed on a hardware such as a Raspberry Pi. We empirically study the role of CPU temperature, microphone quality and audio signal volume on performance. Our

Continued ►

experiments reveal that the continuous CPU usage results in an increased temperature that can trigger an automated slowdown mechanism in the Raspberry Pi, impacting inference latency. The quality of a microphone, specifically with affordable devices such as the Google AIY Voice Kit, and audio signal volume, all affect the system performance. In the course of our investigation, we encounter substantial complications linked to library compatibility and the unique processor architecture requirements of the Raspberry Pi, making the process less straightforward compared to conventional computers (PCs). Our observations, while presenting challenges, pave the way for future researchers to develop more compact machine learning models, design heat-dissipative hardware, and select appropriate microphones when AI models are deployed for real-time applications on edge devices.

Resource-Efficient and Explainable Anomaly Detection in Sensor-Based Remote Healthcare Monitoring Using Adaptive Temporal Contrast

Nivedita Bijlani, Gustavo Carneiro, and Samaneh Kouchaki, University of Surrey

Sensor-based remote healthcare monitoring offers a sustainable solution for detecting adverse health events in individuals with long-term conditions, directly in their homes. Traditional anomaly detection methods in noisy, multivariate real-world data often require large labelled datasets, complex AI models, extensive hyperparameter tuning, and frequent retraining to address data drift, limiting their scalability and explainability. Inspired by the simplicity and success of negative sample-free contrastive learning in computer vision, we propose a resource-efficient, self-supervised model that adapts to noise to improve anomaly detection. Our model has outperformed similar algorithms in detecting agitation and fall events in a real-world study of dementia patients. We enhanced model transparency through a 'spatiotemporal attention map' that pinpoints anomalies, fostering user trust and encouraging broader adoption. Our scalable, domain-agnostic solution can be applied across diverse healthcare, industrial, and urban environments, aligning with sustainable development goals, particularly in low-resource settings.

An Intelligent Optimized Deep Network-Based Predictive System for Sustainable Wind Power Plant Application

Abdul Baseer, Yasaman Mohammadi, Prashant Kumar and Erick Giovani Sperandio Nascimento, University of Surrey

As the world transitions towards sustainable energy sources to combat climate change, wind power has emerged as a promising renewable alternative. The growing demand for wind energy generation has significant interest in developing accurate wind speed and energy forecasting models. Reliable forecasting is crucial for optimizing the planning and operation of wind power plants, enabling the seamless integration of this clean and sustainable energy source into the grid. While numerous models have been proposed in the past to predict wind speed and energy, their performance has been hindered by the inherent non-linearity and irregularity of wind patterns. To address this challenge and facilitate the widespread

Continued ►

research introduces a Novel Modular Red Deer Neural System (MRDNS) designed to effectively forecast wind speed and energy. The MRDNS harnesses data from wind turbine SCADA databases, which undergoes pre-processing to eliminate training flaws. Relevant features are then extracted, reducing the complexity of the prediction process. By analysing these features, the MRDNS employs a fitness function to predict wind speed and energy with enhanced accuracy, supporting the efficient utilization of this renewable resource. The model achieved remarkable performance, boasting a prediction accuracy of 99.99% for wind power forecasting, with an MSE of 0.0017 and an RMSE of 0.0422. For wind speed forecasting, the model yielded an MSE of 0.0003 and an RMSE of 0.0174.

Efficient Representation Learning of Bird Sounds

Ilyass Moummad, IMT Atlantique, France; Emmanouil Benetos, Queen Mary University of London; Romain Serizel, University of Lorraine, France; and Nicolas Farrugia, IMT Atlantique, France

In the pursuit of environmental sustainability, the development of energy-efficient artificial intelligence (AI) models becomes imperative. This work presents a novel approach to bioacoustic monitoring using self-supervised learning (SSL) of bird sound representations. We employ MobileNetV3, a lightweight deep learning model designed to focus on low computational cost while maintaining high performance. Our method leverages the capability of SSL to exploit unlabeled data, significantly reducing the dependency on extensive labelled datasets that is costly. By choosing appropriate data augmentation techniques to train MobileNetV3 in a self-supervised manner, we extract informative features from the data. These features achieve robust few-shot learning capabilities, enabling accurate bird species recognition with one labeled example per class. The application of such a lightweight model not only mitigates the environmental impact associated with the training of large-scale AI models but also enhances the feasibility of deploying AI solutions in resource-constrained environments. In future work, we aim to extend the application of our method to the large bird sound collection Xeno-Canto, which contains recordings from over 10,000 species. This scalability will allow us to learn more robust features, potentially enhancing the generalizability and effectiveness of our model across a broader spectrum of bioacoustic challenges. Additionally, by employing model compression techniques such as distillation, we can further reduce the model size, enabling the development of an ultra-compact model that is well-suited for deployment on small devices.

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