NEXT-AI 2026

NEUROMORPHIX TECHNOLOGIES FOR FUTURE AI

Loughborough University, 8-10 April 2026

www.next-ai.tech

List of Abstracts

Wednesday 8 April 2026

Opening Session & UK Landscape and Funding

11:00–11:10 | Welcome remarks and sponsor acknowledgement

Claudia Eberlein

Dean of Science, Loughborough University

11:10–11:25 | EPSRC Neuromorphic Strategy

Tomasz Kowalczyk

Portfolio Manager, Information and Communications Technologies (ICT) Theme, EPSRC

Biography

Dr Tomasz Kowalczyk is a Portfolio Manager in the Information and Communications Technologies (ICT) theme at EPSRC, where he leads the research portfolio in electronics and electronic devices, spanning architectures, operating systems, and microelectronics design and device technologies. He oversees key national investments, including EPSRC's Neuromorphic Computing portfolio, and serves as one of EPSRC's Subject Matter Experts for semiconductors. Tomasz is also the project officer for the National Ion Beam Facility and supports wider semiconductor delivery, international programmes, and cross-UKRI initiatives. His work focuses on advancing the UK's capability in next-generation computing technologies.

11:25–11:40 | NeuroSYNC-UK Multidisciplinary Centre for Neuromorphic Systems and Computing

Natalia Manuilovich

Manager, NeuroSYNC-UK Multidisciplinary Centre for Neuromorphic Systems and Computing, Aston University

Biography

Natalia Manuilovich is Manager of the UK Multidisciplinary Centre for Neuromorphic Systems and Computing (NeuroSYNC) at the Aston University, based within the Aston Institute of Photonic Technologies. She works at the intersection of artificial intelligence, photonics and next-generation computing systems, coordinating multidisciplinary research programmes that advance neuromorphic and post-digital technologies.

Her work focuses on building national and international collaborations across academia, industry and government to accelerate the development and adoption of emerging computing technologies. She is involved in several large research initiatives and contributes to shaping the UK neuromorphic computing ecosystem through community building, strategic partnerships and engagement with policymakers and industry.

Natalia also leads regional initiatives supporting AI adoption by businesses in the West Midlands, helping translate cutting-edge research into practical innovation and economic impact.

11:40–11:55 | NeuMat: Neuromorphic Materials and Devices for Future AI Hardware

Adnan Mehonic

Associate Professor in Electronic and Electrical Engineering; CTO & Co-founder, Intrinsic Semiconductor Technologies, University College London

Biography

Dr Adnan Mehonic is an Associate Professor in Electronic and Electrical Engineering at University College London and Chief Technology Officer and co-founder of Intrinsic Semiconductor Technologies. His research focuses on memristive devices, resistive switching materials, and neuromorphic hardware for energy-efficient computing. He is co-director of the EPSRC-funded Neuromorphic Materials and Devices for Future AI Hardware (NeuMat) network and a co-investigator on NeuroWare, the UK's Innovation and Knowledge Centre for neuromorphic computing. Dr Mehonic works closely with academic and industrial partners to translate emerging electronic materials into scalable semiconductor technologies. His work spans device physics, materials engineering, and hardware architectures for memory and efficient computing systems.

Abstract

NeuMat (Neuromorphic Materials and Devices for Future AI Hardware) is an EPSRC funded UK network that brings together researchers from materials science, device physics, electronics, and artificial intelligence to address the growing energy demands of modern computing. The network aims to accelerate the development of novel materials, nanoelectronic devices, circuits, and computing architectures for future AI hardware. By fostering collaboration between academia and industry, NeuMat creates a platform for interdisciplinary exchange, training, and community building across the UK. Its goal is to strengthen the national research ecosystem and support the development of energy efficient hardware technologies that will underpin the next generation of intelligent systems.

11:55–12:10 | Rewiring AI: Neuromorphic Computing, Capital Flows, and the Race to the 2030s

Paul Larcey

Innovation Lead, Innovate UK

Biography

Paul Larcey is with Innovate Uk Business Connect working on the defence and security portfolio with an interest in emerging technologies relevant to the sector and supporting start-ups and SMEs. Previous experience has been in Private Equity investment, Venture Capital and board level roles at global advanced manufacturing and critical infrastructure companies. He initially studied engineering and materials science before moving into business and is also a director of the Global Systemic Risk group at Princeton University.

Abstract

As the global AI industry faces growing energy and scalability challenges, neuromorphic computing has emerged as the leading paradigm for next-generation AI hardware. Technologies such as spiking neural networks and memristor-based architectures are driving this shift, offering improved energy efficiency and real-time learning compared to traditional silicon-based systems. The global neuromorphic computing market is projected to reach $20.27 billion by 2030, with a compound annual growth rate of 19.9% from 2024 (Grand View Research 2025). This momentum is evident in private-sector investment, including Unconventional AI's $475 million seed round in 2025, backed by Andreessen Horowitz, Lightspeed, and Jeff Bezos, which valued the company at $4.5 billion (Tech Crunch and Bloomberg 2025).

Research And Markets forecasts the global neuromorphic computing market will grow from $2.60 billion today to $61.48 billion by 2035, at a CAGR of 33.32% (2025). Research Nester (2025) and (Data Intelligence 2025) projects even higher growth, from $4.89 billion in 2025 to $76.18 billion by 2035. These projections consistently indicate that by 2035, neuromorphic computing will have evolved into a mature, multi-billion- dollar commercial industry.

In the UK, global competitiveness has been supported by initiatives by the UKRI-funded Multidisciplinary Centre for Neuromorphic Computing at Aston, UCL's Neuroware Innovation and Knowledge Centre, and Cambridge's NeuMat research group, as well as partnerships with companies including Arm, Microsoft, Intel, BT, Thales, and QinetiQ. However, public funding and early private investment are only the first steps. Bridging the gap between research and scalable commercial deployment will require coordinated efforts in semiconductor policy, skills development, and regulatory frameworks for safety-critical applications. As capital moves quickly and first-mover advantage grows, the UK's success will depend on focused innovation, strategic leadership, boldness and a clear understanding of market expectations and sector trends.

12:10–12:25 | Neuroware: Innovation and Knowledge Centre (IKC)

Adnan Mehonic

Associate Professor in Electronic and Electrical Engineering; CTO & Co-founder, Intrinsic Semiconductor Technologies, University College London

Biography

Dr Adnan Mehonic is an Associate Professor in Electronic and Electrical Engineering at University College London and Chief Technology Officer and co-founder of Intrinsic Semiconductor Technologies. His research focuses on memristive devices, resistive switching materials, and neuromorphic hardware for energy-efficient computing. He is co-director of the EPSRC-funded Neuromorphic Materials and Devices for Future AI Hardware (NeuMat) network and a co-investigator on NeuroWare, the UK's Innovation and Knowledge Centre for neuromorphic computing. Dr Mehonic works closely with academic and industrial partners to translate emerging electronic materials into scalable semiconductor technologies. His work spans device physics, materials engineering, and hardware architectures for memory and efficient computing systems.

Abstract

NeuroWare is a UK Innovation and Knowledge Centre focused on accelerating the development and commercialisation of neuromorphic computing hardware. The centre brings together leading universities, industry partners, start-ups, and investors to translate emerging research into practical technologies and high-impact applications. Covering the full innovation stack, from materials and devices to systems and algorithms, NeuroWare aims to advance next-generation computing platforms that offer major improvements in energy efficiency and performance. By fostering collaboration across academia, industry, and policy, the initiative seeks to strengthen the UK's leadership in neuromorphic technologies and support the growth of a vibrant national ecosystem for future AI hardware.

NEXT Optoelectronics and Photonics I

13:10–13:40 | Keynote: Advanced materials for practical implementations of optical neural networks

Andrea Di Falco

Professor of Physics, University of St Andrews

Biography

Prof. Andrea Di Falco leads the Synthetic Optics group in the School of Physics and Astronomy, in St Andrews. He leads the Fundamental Sciences activities of the UK Metamaterials Network and is co-director of the 3D Metamaterial Hub. His main research focus is the development of versatile multi-material platforms for the control of light behaviour at the nanoscale in time and space, for applications including biophotonics, imaging, augmented reality, and optical neural networks. With his EPSRC career acceleration fellowship, in 2010 he introduced the concept of flexible metasurfaces at optical frequencies. In 2019 he was awarded an ERC consolidator to introduce the metamaterials technology in microfluidics environments for biophotonics applications. Supported by a seed grant from ARIA, he is developing distributed photovoltaic neural networks for environmental monitoring.

Abstract

Realizing practical ONN systems requires advances in materials and device technologies that enable compact nonlinear operations together with efficient and scalable optical-to-electrical interfaces. Here, we present a materials-driven approach to ONN development, exploring how advanced functional materials can enhance both optical processing and signal detection within integrated architectures.

Hybrid photonic platforms that combine silicon with emerging functional thin films offer new opportunities to engineer optical responses tailored to the length scales of integrated photonic circuits, enabling compact and low-power nonlinear functionalities. At the same time, photovoltaic materials provide an attractive route for large-area, efficient signal acquisition while naturally generating electrical outputs, opening possibilities for simplified and potentially self-powered optical computing systems.

Together, these directions illustrate how the integration of advanced materials with photonic platforms can support the development of scalable and energy-efficient optical neural network technologies, contributing to the broader vision of photonic hardware for next-generation artificial intelligence and edge computing.

13:40–14:00 | From training readout to input encoding: leveraging telecom photonics for optical neuromorphic computing

Egor Manuylovich

Research Fellow, Aston Institute of Photonic Technologies, Aston University

Biography

Egor Manuylovich is Research Co-Lead of the UK Multidisciplinary Centre for Neuromorphic Computing and a researcher at Aston Institute of Photonic Technologies. He is a Royal Society Industry Fellow and Vice-Chancellor's Prize Fellow. His work focuses on neuromorphic photonics, nonlinear telecom devices, and energy-efficient optical computing architectures.

Abstract

This talk discusses physics-native optical neuromorphic computing using repurposed telecom photonic devices. Moving from linear readout training toward trainable input encoding, it shows how nonlinear elements such as SOAs, NOLMs, and microresonators enable high-dimensional mapping, memory, and efficient learning for time-series prediction and classification without auxiliary delay lines.

14:00–14:20 | Novel fibre systems for neuromorphic computing

Siddharth Sivankutty

CNRS Researcher, CNRS, University of Lille

Biography

Siddharth Sivankutty is a CNRS researcher at the University of Lille, France, where he leads a research team dedicated to harnessing mode-mixing in novel fiber-optic components. His group's work spans the development of next-generation fiber-based systems for optical computing, imaging, and spectroscopy. Before joining the CNRS in 2022, Siddharth served as a Product Architect at the deep-tech startup Cailabs, developing spatial mode conversion technologies for communication and industrial sectors.

Abstract

All-fiber photonic computing emerges as a high-bandwidth, low-latency alternative for neural network acceleration. We present a novel platform utilizing multicore fiber (MCF) architectures to perform complex data processing directly within the optical layer. By leveraging the spatio-temporal dynamics of in a photonic lantern configuration, this system transforms data streams in both linear and nonlinear optical regimes, and we demonstrate its use as an extreme learning machine.

14:20–14:40 | Principles and metrics of photonic learning machines

Mathilde Hary

Postdoctoral Researcher, FEMTO-ST Institute, CNRS FEMTO-ST, France

Biography

Mathilde Hary is currently a postdoctoral researcher on an ERC grant in the group of Daniel Brunner, FEMTO-ST, France, where she works on optical neural networks. She completed her PhD with distinctions in May 2025 at Tampere University, Finland, under the co-supervision of Prof. Goëry Genty and Prof. John Dudley. Her doctoral research focused on the optimisation-based control of fibre systems and their application to optical computing.

Abstract

Photonic systems have emerged as promising alternatives to electronic computing. Deep physical neural networks trained with physics-aware backpropagation show that nonlinear optical systems can function as neural networks, leveraging inherent parallelism, energy efficiency and speed. Unconventional platforms such as nonlinear chips, semiconductor lasers and a highly nonlinear fibre demonstrate computing capabilities. We characterise two such systems, a highly nonlinear fibre and a semiconductor laser, using two metrics: dimensionality, measuring effective degrees of freedom and consistency, assessing the response reproducibility. The HNLF reaches up to 100 principal components and 87% MNIST accuracy and >96% consistency, while VCSELs show similar parameter-dependent computational scaling.

14:40–15:00 | Learning Nonlinear Heterogeneity in Physical Kolmogorov-Arnold Networks

Jack C Gartside

Lecturer in Condensed Matter Physics, Imperial College London

Biography

Jack C. Gartside is a Lecturer/PI at Imperial College London, Physics, and leads the Neuromorphic Metamaterials group. Research interests include nanomagnetism, nonlinear nanophotonics, nonlinear SOI devices, development of neuromorphic computing architectures and algorithms, magnonics & optical magnetic switching. Jack is an ERC grantee & Royal Academy of Engineering Research Fellow.

Abstract

Physical neural networks typically train linear synaptic weights while treating device nonlinearities as fixed. We show the opposite - by training the synaptic nonlinearity itself, as in Kolmogorov-Arnold Network (KAN) architectures, we yield markedly higher task performance per physical resource and improved performance-parameter scaling than conventional linear weight-based networks, demonstrating ability of KAN topologies to exploit reconfigurable nonlinear physical dynamics.

We experimentally realise physical KANs in silicon-on-insulator devices we term 'Synaptic Nonlinear Elements' (SYNEs), operating at room temperature, 0.1-1 microampere currents, and 2 MHz speeds with no observed degradation over 10^13 measurements and months-long timescales.

We demonstrate nonlinear function regression, classification, and prediction of Li-Ion battery dynamics from noisy real-world multi-sensor data. Physical KANs outperform equivalently-parameterised software multilayer perceptron networks across all tasks, with up to two orders of magnitude fewer parameters, and two orders of magnitude fewer devices than linear weight based physical networks. These results establish learned physical nonlinearity as a hardware-native computational primitive for compact and efficient learning systems, and SYNE devices as effective substrates for heterogenous nonlinear computing.

NEXT-AI in the Real World I

15:30–16:00 | Keynote: Analog Optical Computer for Sustainable AI and Beyond

Francesca Parmigiani

Senior Principal Researcher, Microsoft Research Cambridge

Biography

Francesca Parmigiani is a member of the Future AI Infrastructure team at Microsoft Research Cambridge, UK, where she is leading the analog optical computing (AOC) project. She was elected as 2026 Optica Fellow.

Before joining Microsoft in July 2018, she was Principal Research Fellow at the ORC, which she had joined to carry out my PhD. At the ORC, she worked on all-optical sub-systems solutions, primarily based on a variety of nonlinear processes for optical communication, such as phase sensitive amplification and optical phase conjugation. She also worked on optical data transmission over engineered multi-mode optical fibres for short reach applications as well as investigated a variety of nonlinear processes in multi mode fibres and waveguides. In 2010 she won a five year Royal Academy of Engineering Research Fellowship to advance my work in the area of nonlinear processes for advanced modulation formats.

She is author/co-author of more than 200 publications in the highest prestigious optical communications technology journals and conferences and of 5 chapters in various different published books (e. g. Elsevier and Wiley). She was Topical Editor for Optics Letters, OSA, from January 2019 till January 2025, and an Associated Editor for the Journal of Quantum Electronics, IEEE, till January 2019. She is/has been ECOC TPC chair, and Technical Programme Committee member for various prestigious optical communications technology conferences.

Abstract

We present a low-cost, room-temperature Analog Optical Computer (AOC) and its applications. Through hardware–applications co-design, AOC leverages the unique speed and parallelism of optics to accelerate machine learning inference and complex optimization problems by up to 100× over conventional digital systems.

16:00–16:20 | Photonics: Enabling AI and Quantum Technologies

Jessica Steele

Applications Engineer, Hamamatsu Photonics UK

Biography

Jess is a Sales Engineer at Hamamatsu Photonics, with 5 years' experience supporting researchers and industry partners in applying advanced photonic and imaging technologies to AI, quantum, and other scientific applications. She specializes in translating complex optical device capabilities into practical, scalable solutions through close collaboration with customers and engineering teams.

Abstract

Hamamatsu Photonics develops advanced photonic devices that enable emerging AI and quantum technologies. This talk highlights high-speed photodetectors, silicon photomultipliers, and advanced imaging solutions that support optical interconnects and energy-efficient AI hardware. In the quantum domain, single-photon detectors, spatial light modulators, and high-power single frequency lasers provide the precision and control required for quantum communication, sensing, and computing. We will discuss device performance metrics, system integration, and collaboration opportunities. Our hardware forms critical building blocks for next-generation quantum technologies and data centres.

16:20–16:40 | Simulation-Driven Design of Photonic Platforms for High-Performance AI Hardware

Shin-Sung Kim

R&D Engineer, Synopsys

Biography

Shin Sung Kim is a Sr. Architect of Application Engineering at Ansys, part of Synopsys. He leads the development of photonics-centric multi-physics simulation workflows across optical, electrical, thermal, and mechanical domains. He holds a PhD in Electrical and Electronics Engineering from the University of Glasgow, with research spanning high-power semiconductor lasers, quantum well intermixing, photonic wires, e-beam lithography, ultrasonic sensors, and piezoelectric actuators.

Abstract

As photonic integration advances to meet the demands of AI hardware, accurate multi-physics modelling becomes essential. This talk examines how combined optical, thermal, and electrical simulation provides reliable insight into PIC behaviour under realistic operating conditions. We highlight how AI-enabled optimisation accelerates design exploration, improves device performance, and reduces the need for physical iterations. The presentation demonstrates how these simulation-driven workflows support scalable development of next-generation photonic platforms that enable high-bandwidth, energy-efficient AI systems.

16:40–17:20 | Discussion Panel: Optica × NEXT-AI Startups

Discussion panel chair: Jon Pugh

Senior Director, Industry & Entrepreneurship, Optica

Biography

Dr. Jon Pugh is a leading expert in Photonic Integration and Quantum Engineering, currently serving as the Director of PIC and Quantum Technologies at Optica, a position he assumed in October 2024. In this role, he manages corporate members involved in photonic integrated circuits (PICs) and quantum technologies. His responsibilities include connecting members with potential partners, suppliers, customers, and investment opportunities, as well as providing market insights and facilitating opportunities for members to showcase their technologies to key stakeholders. Before joining Optica, Dr. Pugh was a Lecturer in Quantum Engineering at the University of Bristol, where he played a crucial role in the Quantum Engineering Centre for Doctoral Training. With over a decade of research experience, his work focused on quantum enabling technologies including advancing PICs and exploring the potential for scaling single-photon sources using cutting-edge fabrication technologies. He has been instrumental in bridging the gap between academia and industry, particularly in the commercialization of quantum technologies and lowering the barrier to entry into PIC and quantum by facilitating training to upskill the current workforce.

Panel Member: **Phillip Burr**

Co-founder & CEO, Lumai

Biography

Phil Burr is Head of Product at Lumai, the optical computing company developing highly energy-efficient AI acceleration for the inference era. With more than 25 years of experience in global product management, go-to-market strategy, and leadership, Phil has held senior roles at leading semiconductor and technology companies including Arm, Indie Semiconductor, and Mentor Graphics (now Siemens). He has a strong track record of building and scaling innovative products and services.

Panel Member: **Gregoire Bonnat**

Founder & CEO, LightSpring

Biography

Grégoire Bonnat graduated from École Polytechnique, specialized in Electrical Engineering and Entrepreneurship at UC Berkeley. In 2014, he co-founded Padam Mobility, a software company dedicated to real-time optimization of on-demand public transportation, acquired by Siemens in 2021. As CEO until the end of 2023, he grew the company to 90 employees and deployed its solutions across 12 countries. With a track record of building and scaling companies from the ground up—and a passion for solving high-impact challenges—he is now the co-founder and CEO of Lightspring. This Femto-ST (CNRS, UMLP) spinoff aims to set the standard for photonic integration through advanced 3D lithography.

Panel Member: **Richard Taylor**

CEO, Vector Photonics

Biography

Dr Richard Taylor is a founder, director and CTO of Vector Photonics, a company based on technology he developed during his PhD. Having completed the original engineering development work within UK universities, he began the process of commercialising the technology with Vector Photonics, which spun-out of the University of Glasgow in March of 2020. Since incorporation, Vector has raised more than £4 million in equity investment leveraged by more than £5 million in grant funding and has expanded the team to 21 staff. During his PhD, Dr Taylor developed photonic crystal surface emitting lasers (PCSELs), a new class of laser which is set to revolutionise the semiconductor laser market.

Panel Member: **Matthias Sagerer**

Founder's Associate, Akhetonics

Biography

Akhetonics is a Munich-based startup developing the world's first all-optical digital processor (XPU) for high-performance computing. The architecture is designed for deterministic computation, ultra-efficient processing, and ultra-low latency memory access, fabricated on European semiconductor nodes.

Matthias Sagerer is a member of the company's management team. He has a background in Physics (B.Sc.) and Robotics, Cognition & Intelligence (M.Sc.) from the Technical University of Munich, with research and development experience in medical AI and multi-sensor deep learning in academia (TUM, TUM Klinikum, Helmholtz Munich) and industry (Infineon Technologies). He is also a co-organiser of the TUM.ai E-Lab startup incubator

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Panel Member: **Giulia Marcucci**

CEO, LumiAIres Ltd.

Biography

Dr Giulia Marcucci is a physicist, deep-tech entrepreneur, and leading expert in photonic neuromorphic computing who has been advancing sustainable AI long before it became a global priority. She holds a PhD in nonlinear optics and spent nine years conducting international research in optical computing and neuromorphic systems before founding LumiAIres. As CEO, she leads LumiAIres in pioneering ultra-low-energy photonic AI processors through deep hardware–software co-design, aligning technological progress with responsibility toward the planet.

Thursday 9 April 2026

NEXT-Generation Platforms: Biological Systems

09:00–09:30 | Keynote: Engineering living brain circuits

Paul Roach

Professor of Bionanotechnology, Loughborough University

Biography

Professor Paul Roach, PhD, FRSC, FHEA, is Professor of Biomaterials and Interface Science at Loughborough University. His research focuses on neural engineering, biomaterials, and surface science, with a particular emphasis on microfabrication and chemical surface design for brain-on-a-chip technologies. He has led pioneering work on biomaterials, neural guidance, and advanced biointerfaces, bridging chemistry, biology, and engineering to develop next-generation neurotechnologies. Professor Roach leads biological integration within the UKRI-funded UK Centre for Neuromorphic Computing and has held leadership roles in the UK Society for Biomaterials and the Royal Society of Chemistry's Biomaterials Chemistry Group.

Abstract

Using principles from biomaterials, microfabrication, and cell–surface interactions, neuronal growth can be precisely guided through tailored chemistry and topographical cues. This talk explores strategies for creating brain-on-a-chip platforms for disease modelling, drug discovery, and neuromorphic computing. Advances in fabricating cellular architectures that mimic brain circuitry will be highlighted, forming the basis for biological neuromorphic systems. By merging materials science, neurobiology, and AI-driven approaches, these innovations promise transformative impacts on neurotechnology, accelerating therapeutic development and deepening our understanding of neural processes. Ultimately, harnessing the inherent computational power of biological systems could redefine the future of intelligent technologies.

09:30–09:50 | Engineering Neural Circuitry to model biological neuronal networks

Eric Hill

Senior Lecturer in Cell Engineering, Loughborough University

Biography

My main research interests include the development of tissue engineering strategies to model stem cell behaviour in the development of neuronal networks and also during neurodegeneration. I undertake a multi-disciplinary, approach to enable us to understand the functional properties of neuronal network including optogenetics, fluorescent calcium imaging and multielectrode arrays. These developments are currently being utilised develop biological computers. Using patient derived stem cells we are able to utilise these methods to accelerate the development of methods to produce and characterise human neuronal networks for medicines development.

Abstract

Biological neurons are emerging as attractive computing alternatives over silicon-based systems because they self-organise and develop into systems capable of learning, information storage, processing and pattern recognition, whilst using a fraction of the energy of silicon-based systems to execute similar computations. In 2018 computers consumed 1-2% of global electricity with projected increase to 8-21% by 2030 , driven by the AI/ML revolution. Human neurons could potentially enable the harnessing of the computational power of the human brain for ML applications.

Recent progress in the field of human induced pluripotent stem cells (iPSCs) has led to the efficient production of human neuronal cell models for in vitro study. A major challenge is the generation of reproducible neural networks together with the ability to interrogate and record at the single cell level. Biomaterial scaffolds that would enable the development and guidance of neuronal networks in physiologically relevant architectures and dimensionality. We have identified a number of approaches that can support the growth and differentiation of human iPSC-derived neural progenitors to produce defined functional neuronal networks that can be applied to pioneer brain-inspired, energy-efficient computing technologies.

09:50–10:10 | Brain-inspired complexity metrics for photonic neuromorphic computing

Oliver Neill

Postdoctoral Research Associate in Neurophotonics, Extreme Light Group, University of Glasgow

Biography

Oliver Neill is a Research Associate at the University of Glasgow, working at the intersection of photonics, AI and neuroscience. He obtained his PhD in 2025, developing new approaches for training unconventional physical and neuromorphic computing systems. His current research focuses on applying photonic technologies to better understand both artificial and biological intelligence. This includes recent work developing new approaches to measuring and decoding human brain activity via non-invasive photonic sensing. Oliver is also cofounder and CEO of Brain Dynamics, a spinout company developing wearable medical-grade brain sensing to improve accessibility and outcomes in brain health.

Abstract

Neuromorphic computing systems take inspiration from the brain to build novel, efficient forms of artificial intelligence. However, as these systems become more complex, particularly when implemented in unconventional physical substrates such as photonics, they become harder to analyse using existing tools. We explore the application of complexity metrics originally developed in neuroscience, including measures based on Integrated Information Theory (IIT), to photonic neuromorphic platforms. These offer a principled way to quantify integration, dynamical richness, and emergent behaviour in high-dimensional systems. By adapting such approaches to artificial systems, we aim to develop new techniques for evaluating and designing neuromorphic architectures.

10:10–10:30 | Protobrain from thermal proteins

Panagiotis Mougkogiannis

Research Fellow, Unconventional Computing Laboratory, University of the West of England (UWE Bristol)

Co-author: Prof. Andrew Adamatzky

Biography

Dr. Panagiotis Mougkogiannis is a Senior Research Fellow in the Unconventional Computing Laboratory at UWE Bristol, UK, working under the supervision of Prof. Andrew Adamatzky. Born in Patras, Greece, Dr. Mougkogiannis earned both his BSc and MSc degrees from the University of Patras. He completed his PhD in Chemical Engineering at the University of Manchester, UK, where his research focused on organic electronics and conducting polymers. His earlier work involved developing solution-based techniques to optimize organic field-effect transistors, thin films, and chemical sensors. Additionally, he gained experience in x-ray absorption spectroscopy (investigating calcium carbonate lubricant additives) and the preparation of titania nanotubes for water-splitting applications. Currently, his research centers on the electrical properties of proteinoid microspheres, the development of analog and neuromorphic circuits, and the study of proteinoid anesthesia.

Abstract

This talk explores how heat-treated proteins form proto-neural structures, potentially giving rise to rudimentary cognition. We examine how thermal protein clumping and folding create self-organizing networks capable of information processing. Our research demonstrates basic signal propagation and memory-like persistence within these assemblies, alongside their ability to adapt to environmental shifts. These "protobrains" exhibit collective behaviors mirroring early neural systems, suggesting thermal protein chemistry was a vital precursor to prebiotic nervous systems. This work bridges materials science, abiogenesis, and neuroscience to map the evolutionary transition toward biological intelligence.

NEXT Algorithms and Co-Design I

11:00–11:30 | Keynote: Timing-Native Address Selection for Spiking and Neuromorphic Hardware

Natalia Berloff

Professor of Applied Mathematics, University of Cambridge

Biography

Professor Natalia Berloff leads the Physics-Inspired Computing group at University of Cambridge and is a Fellow of Jesus College. Her research exploits coherence in driven-dissipative classical and quantum systems for unconventional computing. She pioneered gain-based computing and the polaritonic XY–Ising machine using exciton-polariton condensates for optimization. Previously, she was an Assistant Professor at University of California, Los Angeles, a Visiting Professor at Microsoft (2021–2023), and a Fellow of the Alan Turing Institute. She is the Chair of the APS Committee for the International Freedom of Scientists.

Abstract

Spike timing provides a factorial "address space," so spiking inference can be framed as lookup and routing rather than dense MAC. We introduce Polychronous Wave Computing (PWC), a timing-native address selector that maps relative spike latencies to phases, scores K temporal templates in parallel with a programmable multiport interferometer, and digitizes the winner via driven–dissipative winner-take-all to emit a one-hot route without timestamping. A unified phase-noise budget (jitter, mismatch, dephasing) reveals wrap and coherence limits and boundary-first errors. Simulations show that gain competition improves routing fidelity and can be recovered via intensity-only hardware-in-the-loop calibration under strong static mismatch.

11:30–11:50 | Hardware Fault Detection and Tolerance using Spike-based Approaches

Jim Harkin

Professor of Computer Science; Head of the School of Computing, Engineering and Intelligent Systems, Ulster University

Biography

Prof. Jim Harkin is Head of the School of Computing, Engineering and Intelligent Systems and a member of the Computational Neuroscience and Neuromorphic Engineering team in the Intelligent Systems Research Centre (ISRC) at Ulster University. He leads research on the design of intelligent embedded systems, focusing on developing electronic computing systems that can self-repair under the presence of errors. His work explores how computer models of neural networks can be mapped to hardware to build highly efficient and reliable embedded computers, with innovations in Networks-on-Chip strategies and the hardware implementation of self-repairing Spiking Neural Networks. He is co-founder of the medical analytics start-up Respiratory Analytics and has secured grant funding of over £3.5 million from EPSRC, MRC, Innovate UK, and other sources.

Abstract

As computing systems scale in complexity and operate under increasingly constrained power and reliability budgets, traditional fault detection and mitigation techniques face significant limitations. This talk presents emerging approaches that leverage spike-based, event-driven principles inspired by neuromorphic computing to address these challenges. These approaches enable systems not only to recognise the presence of errors but also to infer their underlying characteristics, supporting more adaptive and context-aware fault tolerance strategies.

11:50–12:10 | Co-designing programmable accelerators for event-based training and inference

James Knight

Research Fellow in Neuroinformatics, University of Sussex

Biography

James Knight received a PhD in Computer Science from the University of Manchester in 2016. He has worked at the University of Sussex since 2017 where he is now a Research Software Engineering Fellow. His research interests include AI accelerator design and bio-inspired AI.

Abstract

Spiking Neural Networks (SNNs) are a promising, energy-efficient alternative to standard Artificial Neural Networks (ANNs) for spatio-temporal tasks. Neuromorphic systems for SNN inference at the edge are already commercially available but the design of accelerators for training and deploying larger SNNs remains an open question. Due to the low arithmetic intensity of these workloads, Field Programmable Gate Arrays (FPGAs) are potentially a good fit. Here, we describe FeNN-DMA, a fully-programmable FPGA accelerator, designed for SNN

acceleration. We show that FeNN-DMA has comparable resource and energy requirements to fixed-function FPGA accelerators, but supports more complex models, enabling state-of-the-art accuracy on SNN benchmarks.

12:10–12:30 | Tackling Reliability and Scalability in Neuromorphic Computing via Noise-aware Learning

Eleni Vasilaki

Professor of Computational Neuroscience, University of Sheffield

Biography

Eleni Vasilaki is Professor of Bioinspired Machine Learning at the University of Sheffield, where her research spans computational neuroscience, artificial intelligence, and neuromorphic computing. Her work explores how principles of biological learning can inspire both machine learning and next-generation hardware. She has published in journals including Nature Neuroscience, PNAS, Nature Communications, and Nature Reviews Physics, and leads the Computational Neuroscience strand of the UK's Neuroware Innovation and Knowledge Centre.

Abstract

Neuromorphic computing has become a broad umbrella term encompassing technologies ranging from biologically inspired systems to machine-learning-based architectures. Computing with materials is often presented as a potentially energy-efficient alternative to conventional hardware, although some of these claims still lack robust empirical support.

In this talk, I will outline key challenges in the field, focusing in particular on variability and scalability. I will present examples from my recent work showing how noise-aware learning in systems with stochastic device-level behaviour can mitigate variability and improve robustness. These results suggest that, while variability imposes real constraints, appropriate learning strategies can help address them.

NEXT Optoelectronics and Memristors I

13:30–14:00 | Keynote: Edge of Chaos and Entropy Production Minimization as Keys to Neuromorphic Computing (online)

Stan Williams

Professor of Electrical and Computer Engineering, Texas A&M University, USA

Biography

R. Stanley Williams research during the past fifty years has been in the fields of solid-state chemistry, applied physics and materials, and their applications to technology. In 2008, a team of researchers he led announced they had demonstrated the first intentional memristor, predicted theoretically by Prof. Leon Chua 37 years earlier. Williams has received awards for business, scientific and academic achievement, including the 2021 Diels-Planck Medal for Nanotechnology, the 2019 Sir Neville Mott Lecturer, the 2007 Glenn T. Seaborg Medal and the 2000 Feynman Prize. He has over 230 granted US patents and 500 papers published in reviewed scientific journals, which have an h-index of 133 according to Google Scholar. He is presently the director of the US DOE Energy Frontier Research Center reMIND.

Abstract

Biological systems acquire and process information far more efficiently than any existing digital hardware, which is attributed to the possibility that neurons operate in the 'edge of chaos' (EOC), a critical regime between order and disorder where systems achieve maximal computational capability and adaptability. The nonequilibrium thermodynamics of systems with negative differential resistance (NDR) has revealed that entropy production minimization (EPM) in such systems would naturally drive them to a state of optimum thermodynamic efficiency. These two lines of research are now converging to reveal that the same aspect of nonlinear dynamical systems, a local non-monotonic relationship between current and voltage, simultaneously optimizes both the ability to perform and the thermodynamic cost of the computation. This has important implications for understanding how brains compute so efficiently and for the design of neuromorphic systems for Artificial Intelligence.

14:00–14:20 | Materials design for multi-level resistive switching devices

Markus Hellenbrand

Research Associate, Department of Materials Science and Metallurgy, University of Cambridge

Biography

Dr Markus Hellenbrand is an Assistant Research Professor at the University of Cambridge, Department of Materials Science. He has been working on the characterisation and engineering of CMOS-compatible oxides for over a decade, first during his PhD on oxide defects in transistor gate oxides at Lund University, Sweden, and then, since joining Cambridge, for resistive and ferroelectric switching for future memory devices. He holds a licensed patent application on his work, and will co- develop this technology as a part-time Senior Device Engineer with the licensing company.

Abstract

As AI strongly pushes into our lives, the transfer of data between memory and processing cores is becoming a severe bottleneck, and new forms of memory devices are needed to address this. Remedies could lie in new computing paradigms such as in-memory computing, where data storage and processing are carried out by the same devices, or by combining favourable features of fast, but volatile, random-access-memory-level devices with non-volatile, but slow, main-memory-level devices. Here, I will present materials design approaches to semi-non-volatile multi-level memory devices with potential for both applications.

14:20–14:40 | Model free end-to-end training and performance predictors for computing with physical systems

Daniel Brunner

CNRS Researcher, FEMTO-ST Institute, CNRS FEMTO-ST, France

Biography

Daniel Brunner is a CNRS researcher with the FEMTO-ST, France. His interests include novel computing using quantum or nonlinear substrates with a focus on photonic neural networks. He received several University and the IOP's 2010 Roy's prize, the IOP Journal Of Physics: Photonics emerging leader 2021 prize, as well as the CNRS Bronze medal in 2022. He edited one Book and three special issues, has presented his results 60+ times upon invitation, has published 70+ scientific articles, has been awarded a prestigious ERC Consolidator grant and is a pilot of the French PEPR Electronique project of the France 2030 initiative.

Abstract

Neural network concepts revolutionize computing by solving challenges previously thought to be reserved to the abstract intelligence of humans. For maximal efficiency, the largest fraction of a NN's hardware should be dedicated to the core computational task, while computations carried out on auxiliary infrastructure should be minimized. We demonstrated a high performance and high-dimensional semiconductor laser photonic NN fully in parallel that we train end-to-end using model free algorithm. Finally, we experimentally obtain the scaling laws for computing performance predictors of such system.

NEXT-AI in the Real World II

15:10–15:40 | Keynote: Neuromorphic technology for low power edge AI inference

Laurent Hili

Neuromorphic Computing Engineer, European Space Agency (ESA)

Biography

Laurent Hili started his career in 1995 in TAS (formerly Alcatel Espace) as a digital ASIC designer and signal processing engineer. In 2000, he moved to Motorola and worked on hardware/software SoC design methodologies. In 2002, Laurent joined ESA as micro-electronics engineer and was in charge for Rad-Hard ASIC technologies developments with ST Grenoble, Rad-Hard high-speed links developments still with ST, broadband ADC and DAC developments with Teledyne. Since 2021 Laurent moved from micro-electronics section (TEC-EDM) to data handling section (TEC-EDD) where he is now in charge for onboard processing technologies in general, with a focus on edge AI, and neuromorphic in particular.

Beside technology development, Laurent also gave extensive support to various ESA programs:

- Thales telecom payloads from 1st … 5th generation
- Airbus AlphaSat telecom payload
- Metop 2nd gen Earth Observation payload
- Galileo 2nd generation, signal generator
- Sentinel 3 next generation

Abstract

Recent AI developments have primarily relied on large-scale GPU-based cloud infrastructures, but this approach faces challenges with latency, power consumption, and data privacy. To address these issues, there is an increasing shift toward edge AI. Upcoming ESA missions will require greater onboard autonomy, utilizing smart sensors AI powered. However, SWaP constraints may require energy efficient solutions, particularly when deployed on rovers, probes, or landers. This presentation will highlight how event-based processing, neuromorphic technology, can effectively address these limitations, enabling efficient object detection, classification, and tracking.

15:40–16:00 | Co-Design Across the Stack for Efficient ML Inference

Alessandro Pierro

Researcher, LMU Munich

Biography

Alessandro Pierro is an R&D Engineer at Axelera AI, working on system architecture, and a Ph.D. candidate in Computer Science at LMU Munich. Previously, he was a researcher at Intel Labs, where he worked on hardware-algorithm co-design for efficient inference on the Loihi 2 neuromorphic processor. His research focuses on model compression, novel recurrent architectures, and performance modeling for spatially-mapped hardware.

Abstract

Novel compute approaches offer great potential for lower latency and better energy efficiency of machine learning systems. However, realizing concrete gains in the real-world requires optimization across many levels of the compute stack, spanning neural architectures, model compression, compiler design, and hardware platforms. Based on work conducted at Intel Labs, we present how applying this co-design thinking across the Intel Loihi 2 stack enables power and performance improvements across different machine learning workloads.

16:00–16:40 | Discussion Panel: Chips, Clusters & Capital | Building Europe's NEXT-AI Ecosystems

Ofer Shayo

Founder, London Ignite

Biography

Ofer Shayo is the Managing Director of Ignite London, an equity-free, founder-first AI and deep tech hub based at Fora, The Jellicoe in King’s Cross. The programme builds on the experience of Intel Ignite London, where Ofer helped support deep tech founders scaling globally.

Previously, Ofer co-founded Tvinci and served as CEO for seven years, leading the company to a successful acquisition by Kaltura. After the acquisition he helped scale Kaltura’s global business as it grew to a valuation above $1 billion and later listed on NASDAQ. Ofer also worked with the AWS Startup Program, supporting early-stage companies building cloud-native and AI-first products.

Panel Member: **Jon Pugh**

Senior Director, Industry & Entrepreneurship, Optica

Biography

Dr. Jon Pugh is a leading expert in Photonic Integration and Quantum Engineering, currently serving as the Director of PIC and Quantum Technologies at Optica, a position he assumed in October 2024. In this role, he manages corporate members involved in photonic integrated circuits (PICs) and quantum technologies. His responsibilities include connecting members with potential partners, suppliers, customers, and investment opportunities, as well as providing market insights and facilitating opportunities for members to showcase their technologies to key stakeholders. Before joining Optica, Dr. Pugh was a Lecturer in Quantum Engineering at the University of Bristol, where he played a crucial role in the Quantum Engineering Centre for Doctoral Training. With over a decade of research experience, his work focused on quantum enabling technologies including advancing PICs and exploring the potential for scaling single-photon sources using cutting-edge fabrication technologies. He has been instrumental in bridging the gap between academia and industry, particularly in the commercialization of quantum technologies and lowering the barrier to entry into PIC and quantum by facilitating training to upskill the current workforce.

Panel Member: **Prof. Varuna De Silva**

Loughborough University London

Biography

Varuna De Silva is a Professor of Machine Intelligence and the UK Parliament's inaugural Thematic Research Lead in AI and Digital. After earning his Ph.D. from the University of Surrey, he developed imaging algorithms at ARM PLC now utilized in millions of global devices. At Loughborough University, he leads a research portfolio exceeding £2M, collaborating with partners like Chelsea FC, Babcock International and Toyota. His expertise spans multi-agent learning and multimodal data fusion and neuromorphic algorithms. He routinely provides deep technical counsel to parliamentary select committees on critical policy issues and technological innovation.

Panel Member: **Jane Choi**

Investment Manager, Cloudberry Ventures

Biography

Jane Choi is an investment manager at Cloudberry Ventures with a focus in Deep Tech, including AI infrastructure, semiconductor technologies, and quantum. Previously a Spacecraft Operations Engineer at Eutelsat OneWeb, and Cloud Engineering Lead at a Pan-European exchange, with a focus on hybrid and cloud infrastructure.

Panel Member: **Benjamin Wolba**

Analyst, European Defense Tech Hub (EDTH)

Biography

Benjamin Wolba did his Ph.D. in theoretical condensed matter physics, writes a blog about startups shaping the future of computing, and co-founded the European Defense Tech Hub, a pan-European network for defense innovation.

Panel Member: **Caroline O'Brien**

CEO, CSA Catapult

Biography

Caroline was appointed Chief Executive Officer in September 2025, setting the strategic direction and delivering the organisation's purpose and is a member of the board of directors. Caroline joins the Catapult from Kubos Semiconductors, where she was CEO for more than 6 years. She brings over 30 years of experience in the technology sector, where she has developed a broad knowledge of working with VC-backed businesses and blue-chip multinationals. She has held senior commercial and executive positions in several companies, focusing on developing and commercialising new technologies and products. Caroline holds a B.Eng in Electronic and Electrical Engineering and an MBA from the University of Bath.

Sir Nevill Mott Lecture 2026 (Sponsored by IOP)

18:30–19:30 | Keynote: Precision Materials Science of Functional Oxide Thin Films

Judith MacManus-Driscoll FREng FRS

Professor of Materials Science; Fellow of the Royal Academy of Engineering and Fellow of the Royal Society, University of Cambridge

Biography

Judith MacManus-Driscoll is Professor in Materials Science at the University of Cambridge and Fellow of Trinity College. She is Royal Academy of Engineering Chair in Emerging Technologies and has been visiting faculty/staff member at Los Alamos National Lab. for 22 years. She is fellow of the Royal Society of London, the Royal Academy of Engineering, APS, AAAS, MRS, RSC, IOP, IOM3, WES. Her research covers wide ranging oxide thin film engineering for electronic applications. She has many licensed patents, consults widely with industry worldwide, and has two start-ups. She is a strong supporter of women in science/engineering and has numerous prizes for her work from Materials, Physics, Chemistry and EE societies.

Abstract

Strongly correlated functional oxides exhibit fascinating physics. However, it is a hard task to take exciting discoveries of oxides (simple or complex) to high performance devices. The problems stem from both intrinsic and extrinsic materials problems, e.g. composition, defect and interface control. Also, for electronics applications where thin films are needed, current thin film deposition routes mostly cannot deliver the performance of bulk materials. This talk looks at examples of exciting physical phenomena of complex oxides and explains routes that we have devised to ensure their complexity is a positive attribute and not a negative one. Recent examples from my group are given, highlighting unrivalled device properties across a diverse set of applications, from superconductors to non-volatile memory.

Friday 10 April 2026

NEXT-Generation Platforms: Quantum AI

09:00–09:30 | Keynote: Applications of photonic quantum computers in AI

William Clements

Co-founder & CTO, ORCA Computing

Biography

William Clements is Head of Applications and Software at ORCA Computing, where he develops novel AI models that can be accelerated by photonic quantum computers. He has co-authored over 25 publications in top journals and conferences in machine learning and quantum computing. Before joining ORCA in 2021, he worked in roles spanning basic research to engineering in leading AI deeptech startups. He received a PhD in physics from the University of Oxford in 2018, where he pioneered novel methods for computation with photonics.

Abstract

Photonic quantum computers, though not universal for quantum computation in the near-term, have evolved to the point where they can solve some classes of hard sampling problems. This talk will introduce the basics of photonic quantum computing, then present ongoing research on how these computers can be used in hybrid quantum/classical generative models to improve performance on a range of datasets. We will discuss the potential and the limitations of these hybrid approaches, as well as opportunities for further research.

09:30–09:50 | Dynamics as Computation

Gerard McCaul

Lecturer in Theoretical Physics, Loughborough University

Biography

I am a theoretical physicist working at the interface of quantum dynamics and computation. My work develops operator-based frameworks for treating physical evolution itself as a computational primitive, with applications ranging from minimal quantum reservoirs to photonic platforms and dynamical emulation.

Abstract

Modern computing architectures increasingly blur the boundary between physics and information processing. In reservoir computing, we exploit complex physical dynamics as high-dimensional feature maps, training only a

simple readout layer. But this raises a deeper question: what is the relationship between dynamical evolution and computation itself? In this talk, I argue that computation can be understood as structured evolution in state space. By moving to operator and observable-based representations | including Koopman and quantum Liouvillian frameworks | physical systems naturally generate rich feature spaces suitable for learning and regression. The central message is that high-dimensionality and separability do not require large architectures | they can emerge from dynamics itself. This perspective suggests that next-generation AI hardware may not require more layers, but better use of physical evolution.

09:50–10:10 | Beyond Classical: Quantum Hardware Manufacturing in the UK

Jack Brennan

Research Associate, University of Glasgow / Quantcore

Biography

Jack Brennan is the CEO of Quantcore, a superconducting hardware manufacturing company based in Glasgow, Scotland. With a background in physics, Jack has long been a passionate quantum physics researcher, with a focus on superconducting systems. With extensive experience in developing cutting-edge quantum computing solutions, Jack is dedicated to advancing the field through innovative research and collaboration. He holds a strong academic background in physics and engineering, complemented by hands-on expertise in quantum algorithms and hardware implementation.

Abstract

This talk explores the intersection of next-generation quantum and classical computing through superconducting technology. As the demand for enhanced computational power escalates, superconducting qubits and circuits emerge as exciting opportunities in advancing computing capabilities. We will discuss the challenges of manufacturing and operating superconducting circuits, and the implications for classical, quantum, and hybrid computing architectures for a huge range of applications.

10:10–10:30 | Quantum reservoir computing with linear photonic networks

Oliver Neill

Postdoctoral Research Associate in Neurophotonics, Extreme Light Group, University of Glasgow

Biography

Dr Oliver Neill is a Postdoctoral Research Associate in Neurophotonics within the Extreme Light group at the University of Glasgow. His research sits at the intersection of neuromorphics and brain sensing, combining EEG, fNIRS, and modern AI methods. His PhD developed new hardware and optimisation processes for photonic neuromorphic computing, tackling the problem of efficiently scaling compute for AI. He is interested in the brain, photonic computing, and meta-learning.

Abstract

Neuromorphic processors can improve the efficiency of certain computing tasks by reducing overheads inherent to conventional general-purpose computing architectures. While efficient classical neuromorphic processors have been demonstrated in various forms, practical quantum neuromorphic platforms are still in their early stages of development. We propose a fixed, random optical network for photonic quantum machine learning, enabled by photon number-resolved detection (PNRD). By leveraging the dynamics of PNRD we can solve application-specific tasks efficiently with minimal quantum resources and commercially available hardware.

NEXT Algorithms and Co-Design II

11:00–11:30 | Keynote: Perspectives on and beyond Reservoir Computing (w/ Andrea Ceni)

Claudio Gallicchio

Associate Professor of Computer Science, University of Pisa

Biography

Claudio Gallicchio is an Associate Professor of Computer Science at the University of Pisa. His research focuses on reservoir computing, recurrent neural networks, and dynamical systems for deep learning, with particular emphasis on hardware-aware and energy-efficient models. He is involved in several research projects on merging concepts from deep learning and neuromorphic hardware for sustainable artificial intelligence.

Abstract

This talk revisits reservoir computing as an alternative paradigm for sequence modeling, motivated by the well-known difficulties of training recurrent neural networks and the growing demand for efficient, hardware-compatible learning systems. After introducing the core principles of reservoir computing and its natural suitability for neuromorphic and physical implementations, the limitations of conventional echo state networks in terms of long-range information propagation are discussed. The second part of the talk presents recent research directions focusing on non-dissipative reservoir dynamics and novel reservoir architectures that extend reservoir computing toward the deep learning regime while preserving fast training and hardware amenability.

11:30–11:50 | SteganoSNN: SNN-Based Audio-in-Image Steganography with Encryption

Pedro Machado

Senior Lecturer in Computer Science; Course Leader, MSc Artificial Intelligence, Nottingham Trent University

Biography

Dr Pedro Machado is a Senior Lecturer in Computer Science and Course Leader for MSc Artificial Intelligence at Nottingham Trent University. He holds an MSc in Electrical and Computer Engineering from the University of Coimbra (2012) and a PhD in Computer Science from Nottingham Trent University (2022). He combines expertise in neuromorphic engineering, edge computer vision, and bio-inspired computing. He is an IEEE CertifAIEd lead assessor, AdvanceHE Fellow, and first secretary for the IEEE Systematic Innovation Special Interest Group (SISIG). He is a member of the Computational Intelligence and Applications research group.

Abstract

Secure data hiding remains a critical challenge in digital communication, where protecting sensitive information must balance computational efficiency and perceptual transparency | a task made more urgent by generative Artificial Intelligence (AI) systems capable of automating advanced cryptanalysis and steganalysis routines.

This article proposes the SteganoSNN, a neuromorphic framework that employs Spiking Neural Networks (SNNs) for secure, low-power steganography. Digitised audio samples are transformed into spike trains using Leaky Integrate-and-Fire (LIF) neurons, encrypted via a modulo-based mapping scheme, and embedded into the least significant bits of red, green, blue, alpha (RGBA) image channels with dithering to preserve image quality. Implemented in Python using NEST and deployed on a PYNQ-Z2 field-programmable gate array (FPGA), SteganoSNN achieves real-time performance and high embedding capacity (8 bits per pixel (bpp)). Experiments on the DIV2K 2018 dataset demonstrate fidelity exceeding 46 dB peak signal-to-noise ratio (PSNR) and 0.99 structural similarity index (SSIM), outperforming SteganoGAN in efficiency and robustness. SteganoSNN pioneers neuromorphic steganography for secure, energy-efficient communication in EDGE-AI, internet of things (IoT), and biomedical systems

11:50–12:10 | Scalable architectures for neuromorphic AI

Anand Subramoney

Lecturer in Machine Learning, Royal Holloway, University of London

Biography

Dr Anand Subramoney is a Lecturer (Assistant Professor) in the Department of Computer Science at Royal Holloway, University of London. He is broadly interested in learning and intelligence, both algorithmic and biological. His current research focusses on understanding intelligence both through the engineering lens of neuromorphic computing and the biological lens of neuroscience. His research draws inspiration from both in his quest to build a better and more general artificial intelligence.

Abstract

Neuromorphic computing provides the potential to scale up AI models while remaining as energy efficient as the human brain. But what are the building blocks we need for scalable neuromorphic AI? I will discuss how to design

architectures for neuromorphic machine learning from first principles, taking inspiration from biology without being constrained by biological details. I will present our recent work on using sparsity and distributed learning to improve the scalability and efficiency of neuromorphic deep learning models.

12:10–12:30 | Neuromorphic multimodal sensor fusion

Luca Peres

Research Associate, University of Manchester

Biography

Luca obtained his PhD in computer science in 2022 at the University of Manchester exploring real-time simulations of large scale biologically-representative spiking neural networks on neuromorphic hardware. He then continued for a postdoctoral position in the same institution, working on event-driven sensing and processing for computer vision in the scope of edge applications. Luca's main interests are in low-power sensing and processing, with focus on event-based sensor fusion applications and in-sensor and near-sensor computing. In addition, Luca is interested in exploring novel biologically-inspired architectures with the intent of producing more reliable and low-power systems aiming to overcome the von Neumann bottleneck.

Abstract

The number of deployed artificial intelligence (AI) models is growing rapidly. Large language models (LLMs) are both compute and memory intensive in training and inference, regularly having billions of parameters and requiring petabytes of training data. Neuromorphic computing seeks to improve scaling in machine learning by bypassing the memory bandwidth limitations inherent in hardware that LLMs are currently run on, by designing biologically-inspired systems. Neuromorphic algorithm-hardware co-design requires reproducible low-level, hardware-optimised training and testing inputs. In this talk, I will present a framework to generate the first high-resolution, multimodal, phonetically-rich neuromorphic eventset, including a novel synchronisation signal. This overcomes the limitations of traditional datasets by encoding information in the form of events, a low-level representation that capture the underlying physical phenomenon with high fidelity while remaining sparse, compressed and digital. I will show that events are highly compressible, and that datasets recorded with traditional methods would require more than 100x more memory to capture the same level of temporal granularity.

NEXT Optoelectronics and Memristors II

14:00–14:30 | Keynote: Oxide-Based Resistive Switching for Energy-Efficient Memory and Computing

Adnan Mehonic

Associate Professor in Electronic and Electrical Engineering; CTO & Co-founder, Intrinsic Semiconductor Technologies, University College London

Biography

Dr Adnan Mehonic is an Associate Professor in Electronic and Electrical Engineering at University College London and Chief Technology Officer and co-founder of Intrinsic Semiconductor Technologies. His research focuses on memristive devices, resistive switching materials, and neuromorphic hardware for energy-efficient computing. He is co-director of the EPSRC-funded Neuromorphic Materials and Devices for Future AI Hardware (NeuMat) network and a co-investigator on NeuroWare, the UK's Innovation and Knowledge Centre for neuromorphic computing. Dr Mehonic works closely with academic and industrial partners to translate emerging electronic materials into scalable semiconductor technologies. His work spans device physics, materials engineering, and hardware architectures for memory and efficient computing systems.

Abstract

The increasing demand for computing power has led to unsustainable energy consumption. By 2035, the energy required for computing systems is projected to exceed realistic supply, constraining the development of transformative applications. Memory is the cornerstone of computing efficiency; memory access and data transfer account for most of the energy consumed in advanced systems. Beyond the largest and most complex energy-hungry systems, there is a pressing need to embed intelligence in devices that must operate on low-power

budgets, an advance that would transform numerous applications. In this talk, I will present the study and development of resistive switching in amorphous oxides that is maturing into a resistive RAM (RRAM) technology that addresses the requirements for future non-volatile memory and novel energy-efficient computing hardware. I will outline contributions to understanding resistive switching physics, tuning performance through materials engineering and device design, and developing reliable, manufacturable technology. The presentation concludes with a roadmap defining RRAM's role in future memory-centric and novel computing systems.

14:30–14:50 | Nanoporous oxide memristors for time series prediction via physical reservoir computing

Pavel Borisov

Senior Lecturer in Physics, Loughborough University

Biography

Pavel Borisov is a Senior Lecturer in Physics working on thin-film oxide memristor devices and physical neuromorphic computing. Before joining Loughborough University in 2016, he completed his PhD in Applied Physics in 2009 at the University of Duisburg-Essen, Germany, followed by research positions at the University of Liverpool, UK, and West Virginia University, USA.

Abstract

All-oxide devices for on-chip processing of time-based signals are promising for the realisation of neural networks in many applications that require local and energy-efficient execution. A random network of nanoporous niobium oxide channels was prepared as a physical memristor reservoir with built-in parallel processing and short-term, fading memory. It was then used within the approach of in-materia reservoir computing to predict and reconstruct the three-dimensional chaotic Lorenz-63 time series by applying time-varying voltage signals and training the readout layer on the device's electrical currents (3 physical nodes). We obtained a NRMSE error value as low as 10-2, demonstrated scalability, and achieved up to a x2000 improvement in energy consumption compared with a standard Echo State Network. J. Donald et al., Adv. Intell. Syst. 0, e202500833 (2026)

14:50–15:10 | Optical Memristors for Neuromorphic Computing: From Light-Sensitive Materials to Ultrafast Photonic Chips

Neil Kemp

Professor of Physics, University of Nottingham

Biography

Dr Neil Kemp is an Associate Professor in the School of Physics and Astronomy at the University of Nottingham, UK. He completed his PhD in Physics at Victoria University of Wellington, New Zealand, followed by postdoctoral research at the University of New South Wales, Australia, and the Université de Strasbourg, France. In 2009, he established a research group in Nanophysics at the University of Hull, before moving his group to Nottingham in 2021 to focus on nanoelectronic devices for neuromorphic computing (kempnanogroup.com). His current research centres on optical memristors for neuromorphic computing and artificial intelligence applications. He has published over 70 peer-reviewed papers and currently holds research funding from the Leverhulme Trust, EPSRC, and AFOSR-EOARD.

Abstract

Optical memristors are emerging devices that combine memory-resistive (memristive) behavior with optical functionality, leveraging light either to modulate resistive states or as an electronically controllable memristive medium through which optical data transmission can be modulated1. This additional optical degree of freedom enhances neuromorphic capabilities, enabling ultrafast, energy-efficient, and high-bandwidth computing that is particularly promising for applications in computer vision and neuromorphic photonic systems.

However, realizing industry-ready optical memristors requires significant advancements, particularly in improving optical responsivity and wavelength selectivity. To address these challenges, our group is developing novel light-sensitive materials and memristor device architectures, including quantum dots, phase-change materials, functionalized metal-oxide thin-films and hybrid polymer-nano material composites2.

Among these, zinc oxide (ZnO) has recently demonstrated significant potential. Thin-film devices, fabricated by RF magnetron sputtering, yielded highly reliable memristor switching across a wide voltage range (Fig.1), as well as stable multi-level switching under varying UV light intensities (Fig.2). These devices exhibited diverse synaptic behaviours, such as excitatory postsynaptic current (EPSC), paired-pulse facilitation (PPF), tunable potentiation/depression and enhanced learning-forgetting characteristics. Interestingly, after light exposure ceased, short-term memory was retained due to a persistent photoconductance (PPC) effect, which we later enhanced by embedding the ZnO within an insulating layer3.

Phase-change materials (PCM) represent another promising candidate. These materials reversibly switch between amorphous and crystalline phases under optical or electronic excitation, leading to pronounced changes in their optical and electronic properties. Using our unique multilayer thin-film and cluster-source deposition platform, we fabricated PCM–nanoparticle memristors that demonstrated optical switching on the microsecond scale, highlighting their potential for ultrafast neuromorphic and photonic applications.

Finally, I will present our recent progress toward developing an ultrafast optical memristor chip for image processing and how the integration of memristors within waveguides could be used to manipulate light in photonic crystals for neuromorphic computing applications.

NEXT Optoelectronics and Photonics II

15:30–16:00 | Keynote: Novel Materials and Nanoarchitectures for Neuromorphic Computing

Dimitra Georgiadou

Associate Professor in Electronic Materials and Devices, University of Southampton

Biography

Dimitra Georgiadou is Professor of Flexible Nanoelectronics in the School of Electronics and Computer Science at the University of Southampton, UK. Dimitra earned her PhD in Chemical Engineering/Organic Electronics in 2013 from the National Technical University of Athens, Greece. She then moved to Imperial College London, first as Marie Skłodowska-Curie Fellow in the Physics Department and then as Industrial Fellow in the Materials Department. Dimitra holds a UKRI Future Leaders Fellowship and is Head of the Flexible Nanoelectronics Lab, Director of the ECS Centre for Neuromorphic Technologies and co-Director of the UK Multidisciplinary Centre for Neuromorphic Computing. Her research interests are the fabrication and optimisation of nanoscale opto/electronic devices by applying novel materials concepts and alternative patterning techniques. Her group focuses on creating efficient, sustainable, and intelligent systems for neuromorphic computing and the Internet of Things.

Abstract

In this work, I will present the work performed in my group in the field of opto/electronic neuromorphic hardware based on nanomaterials and nanodevices. We fabricate 2-terminal nanodevices with a 10-nm nanogap-separated coplanar large aspect ratio metal electrode architecture. This geometry resembles the actual dimensionality of the biological neuron and synaptic cleft. Furthermore, the coplanar architecture allows facile integration with light sources for optical -in addition to electrical- excitation. Next, we apply material engineering to create functional devices that are able to perform certain basic (paired-pulse facilitation, post-synaptic excitation/depression) and more specialised (reservoir computing, in-memory sensing) functionalities. We exploit the unique characteristics of certain material classes, for instance, the redox activity of polyoxometalates, the optical activity of perovskites and the low dimensionality of transition metal dichalcogenides.

16:00–16:20 | Artificial Photonic Spiking Neurons for SNN platforms

Joshua Robertson

Research Associate, Institute of Photonics, University of Strathclyde

Biography

Dr Joshua Robertson is a research associate within the Neuromorphic and Nanophotonic group at the Institute of Photonics (IoP), University of Strathclyde, Glasgow. He received his MPhys degree in Physics with specialization in Photonics from the University of Strathclyde, Glasgow in 2017, where he also completed his PhD in 2022. His work focuses on the investigation of neuromorphic photonic devices and systems, experimentally deploying excitability and spiking to create artificial neurons for photonic-based computing.

Abstract

Photonics is rapidly emerging as an exciting platform for future neuromorphic technologies. Beside optical accelerators for fast, parallel computing, bio-realistic optical devices are realising fast and efficient hardware neurons for neural network implementations. Neuron-like spiking models, such as those present in vertical cavity surface emitting lasers (VCSELs), resonant tunnelling diodes (RTDs), and micro-ring resonators (MRRs), offer an interesting pathway to the sparse, energy efficient, non-linear spiking mechanisms wielded by the brain. Here, we discuss the operation of these photonic devices and demonstrate photonic spiking neural network (SNN) schemes that enable functionality and processing with high speed, brain-inspired, light-powered spiking signals.

16:20–16:40 | Neuromorphic Computing with Integrated Opto-Electronic Devices

Nikolaos Farmakidis

Departmental Lecturer, Department of Materials, University of Oxford

Biography

Dr Nikolaos Farmakidis is a Departmental Lecturer in the Department of Materials at the University of Oxford. His research sits at the interface between optics, electronics, and materials, focusing on the development of nanoscale opto-electronic devices integrated with active materials. He designs, fabricates, and experimentally demonstrates systems with improved performance in applications including neuromorphic computing, data storage, and sensing. He has published in Nature Reviews Electrical Engineering, Nature Communications, and Advanced Science.

16:40–17:00 | Optical Human Action Recognition leveraging free-space optics and basic arithmetic

Maximilian Zier

Researcher, Theoretical Physics, Technische Universität Ilmenau, Germany

Biography

Maximilian is a PhD candidate in the group of Theoretical Physics 2 led by Kathy Lüdge at Technische Universität Ilmenau. As part of the Ilmenau School of Green Electronics, he focuses on opto-electronic reservoir computing, exploring how optical systems can enhance the efficiency and performance of neuromorphic computing architectures.

Abstract

In this contribution, we present a hybrid opto-electronic Reservoir computing system, that is able to reduce the computational demand to classify human action videos by multiple orders of magnitude for the used dataset. In contrast to previous works, we forgo common preprocessing and feature extraction methods and use raw video data as input to the reservoir. Additionally, we are able to reduce the length of video sequences to one second, thereby using less input data and reducing the runtime by a factor of 4.

ORGANISERS

Central Organisation Team

Dr Juan Totero Gongora	Emergent Photonics Research Centre, Loughborough University
Natalia Manuilovich	Aston University, NeuroSYNC-UK Multidisciplinary Centre for Neuromorphic Systems and Computing
Dr Xavier Porte-Parera	University of Strathclyde, NeuroSYNC-UK Multidisciplinary Centre for Neuromorphic Systems and Computing
Dr Shirin Dora	Loughborough University
Dr Giulia Marcucci	LumiAIres Ltd (CEO)
Dr Robin Rainier (Coordinator)	Emergent Photonics Research Centre, Loughborough University

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Prof. Alexander Balanov	Dept. of Physics, Loughborough University
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Phil Whitby	Partnership Development Associate, Loughborough University

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Loughgorough University
Epinal Way
Loughborough, LE11 3TU
United Kingdom

https://next-ai.tech
info@next-ai.tech