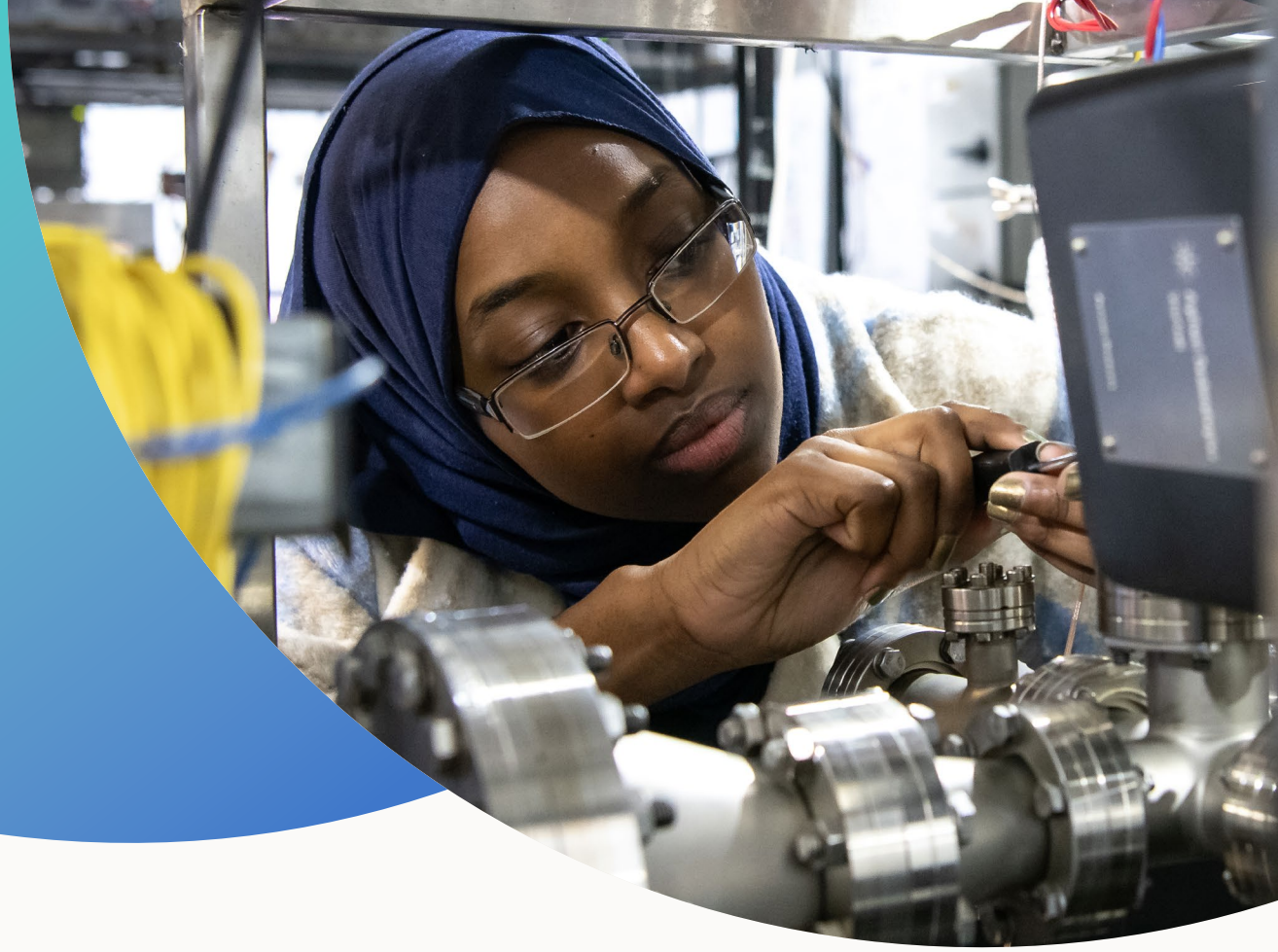


Sussex EPSRC Doctoral Landscape Projects and Themes for Autumn 2027

UNIVERSITY OF SUSSEX BRIGHTON

UKRI Engineering and Physical Sciences Research Council

Research Plus

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Chemistry

Sustainable chemistry for the synthesis of solar cells (EP27/1)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Barny Greenland
Department: Chemistry

Research outline:

This PhD project will develop sustainable organic electronic materials through solvent-free mechanochemical synthesis. Building on our pioneering work demonstrating Suzuki, Sonogashira and Buchwald-Hartwig coupling reactions in a ball mill, the research will investigate the green synthesis of functionalised naphthalene diimides (NDIs) for use in organic solar cells and other next-generation electronic devices. By eliminating solvent use and reducing energy consumption, the project aims to deliver more sustainable routes to high-performance semiconducting materials. The research aligns strongly with EPSRC priorities in Advanced Materials, Energy and Decarbonisation, and Manufacturing and the Circular Economy, supporting the development of sustainable technologies for a low-carbon future.

Key Publications:

Panther, L A.; Guest, D P.; McGown, A.; Emerit, H.; Khan Tareque, R.; Jose, A.; Dadswell, C M.; Coles, S J.; Tizzard, G J.; González-Méndez.; Goodall, C A I.; Bagley, M C.; Spencer, J. and Greenland, B W. (2022). Solvent-Free Synthesis of Core-Functionalised Naphthalene Diimides by Using a Vibratory Ball Mill: Suzuki, Sonogashira and Buchwald–Hartwig Reactions. Chem. Eur. J., 28, e202201444. (link)

New theranostic lanthanide complexes (EP27/2)

EPSRC Category: Interdisciplinary Research

Lead Supervisor: Deborah Sneddon
Department: Chemistry

Research outline:

Theranostics, combining therapy and diagnostics, is a rapidly growing field in precision medicine. Typically using radioactive isotopes, a single molecule can be delivered that can both image and treat disease. Using this concept, we want to exploit the unique properties of f-block lanthanides, harnessing their paramagnetism for MRI, luminescence for cellular imaging, and radioactive isotopes to create a new series of theranostic agent. The proposed PhD project will integrate coordination and organic chemistry in the design of new chelators and supramolecular scaffolds to optimise lanthanide binding and imaging performance, with the extension to new therapy regimes.

Key Publications:

Foster, C. A., Sneddon, D., Hacker, L., Sarson, E. T., Robertson, M., Sokolova, D., Martin, L. A. W., Allen, M. F., Khrapichev, A., Vincent, K. A., Hammond, E. M., Conway, S. J., & Faulkner, S. (2025). LnDOTA Releasing Probes for Luminescence and Magnetic Resonance Imaging. Inorganic Chemistry, 64(13), 6640-6647. (link)

Innovative DNA-Encoded Library (DEL) technologies for simultaneously identifying novel cancer targets and their ligands (EP27/3)

EPSRC Category: Interdisciplinary Research

Lead Supervisor: Haitham Hassan
Research Group Title: DNA Encoded Libraries Group
Department: Chemistry

Research outline:

The exciting PhD project at the forefront of chemical biology and oncology.
The project will develop innovative DNA-Encoded Library (DEL) technologies to simultaneously identify novel cancer targets and their ligands, transforming early-stage drug discovery. By integrating proteomics with engineered bifunctional DELs (STarDEL), you will screen millions of DNA-barcoded compounds directly in complex biological systems to uncover modulators of understudied kinases. The project offers

training in medicinal chemistry, chemical biology, proteomics, and drug discovery, with the potential to accelerate the development of new therapies for cancer and other diseases.

Key Publications:

Staikopoulou, S.; Hassan, H. (2026). Targeting Kinases with DNA-Encoded Libraries: Current Landscape and Future Directions. Drug Discovery Today, 31, 104658. (link)

New quantum methods for the many-particle Schrödinger equation in chemical physics (EP27/4)

EPSRC Category: Mathematics and Theoretical Foundations

Lead Supervisor: Hazel Cox
Research Group Title: Theoretical and Computational Quantum chemistry
Department: Chemistry

Research outline:

The solution of the Schrödinger equation, without the conventional separation of electronic and nuclear motion, makes it possible to approach the non-relativistic limit arbitrarily close. However, due to the exponential growth of dimension with number of degrees of freedom, all-particle treatments are limited to few particle systems. Therefore, a key challenge is the development of more efficient computational methods. Recently we demonstrated the power of numerical tensor methods in collapsing computational costs without compromising accuracy. This project will build on these initial findings to derive new quantum methods capable of solving the many particle Schrödinger equation for quantum chemical physics systems.

Key Publications:

Brice, K. T., Murdoch, F., Fitzgerald, Kyle. M. P., & Cox, H. (2026). Ground and excited S states of three-body systems using a numerical tensor method. Molecular Physics, 124 (9–10), e2561867. (link)

Electro-active Molecular Main-group Organometallic Compounds (EP27/5)

EPSRC Category: Experimental approaches to Understanding

Lead Supervisor: Ian Crossley
Department: Chemistry

Research outline:

Our research is focussed on organo-element compounds of the transition metals and main group elements, incorporating low-coordinate phosphorus-based fragments. Work is directed toward the development of novel electronically and/or opto-electronically active molecular species, seeking to develop and exploit new and unusual reactivity patterns and/or establish model systems for molecular materials (e.g. conductors, 'molecular wires', photo-emitters). Potential project areas include: Poly-conjugated phosphorus-doped organometallics (extending our work with phosphaalkynes, cyaphide and related fragments); Redox-responsive diketophosphanyl-derived macrocycles (extending our studies of phosphametacyclophanes and associated ligands); Heteroatom modified cyclopentadienyl analogues (building on our boroledíide work).

Key Publications:

Levis, M.C.; Helm, M.H.; Turner, J.F.C.; Crossley, I.R. (2024). A monometallic bis(cyaphido)complex. Chem. Eur. J., 30, e202303370. (link)

Small-Molecule Activation with Low-Valent Lanthanide Synthons (EP27/6)

EPSRC Category: Experimental approaches to Understanding

Lead Supervisor: Richard Layfield
Department: Chemistry

Research outline:

Our research uses rare-earth metals to unlock new reactions of small molecules, creating unusual compounds through controlled bond breaking and bond formation. Recent discoveries include coupling five carbon monoxide molecules into a carbon ring and transforming white phosphorus into smaller phosphorus fragments and a phosphorus-centred radical. PhD projects starting in September 2027 will build on these advances, designing reactive rare-earth complexes and exploring their ability to transform simple chemical feedstocks. You will gain expertise in air-

sensitive synthesis, crystallography and spectroscopy, supported by computational collaborations. We welcome ambitious, curious applicants keen to discover new chemical reactivity and understand how it works.

Key Publications:

Mondal, A., Rajeshkumar, T., Steiner, A., Tang, J., Maron, L., & Layfield, R. A. (2026). Reductive Cyclopentamerization of Carbon Monoxide to the Elusive Croconate Radical Trianion. Journal of the American Chemical Society, 148(12), 12507-12512. (link)

Modular Synthesis and Properties of Previously Inaccessible Sulfur-Substituted Medicinally Relevant Heterocycles (EP27/7)

EPSRC Category: Interdisciplinary Research

Lead Supervisor: Storm Hassell-Hart
Department: Chemistry

Research outline:

Introduction of sulfur substituents to heterocyclic cores is highly desirable, offering key benefits including improved pharmacokinetic properties. Unfortunately, synthetic methods to access these species remain restricted and their properties remain underexplored. We recently developed the first general method to prepare sulfur substituted thiazoles, utilising a Pummerer-type reaction. By conducting the first matched-pair analysis of these cores, with the billion-dollar drug Mirabegron, we demonstrated they offer improvements to biological properties while retaining potency. This project aims to expand our research to synthesis and evaluate other key heterocycles, combining organic and medicinal chemistry to develop new key motifs for drug discovery.

Key Publications:

Smy, J. L., Webb, T. C., Greenland, B. W., Roe, S. M., Spencer, J., & Hassell-Hart, S. (2026). A Modular Synthesis of C5-Sulfenyl Thiazoles via an Intermolecular Pummerer Rearrangement: An Underexplored Scaffold for Medicinal Chemistry. Angewandte Chemie International Edition, 65(41), e8444671. (link)

Grosjean, H., Aimon, A., Hassell-Hart, S., Thompson, W., Koekemoer, L., Bennett, J., Bradley, A., Anderson, C., Wild, C., Bradshaw, W. J., FitzGerald, E. A., Krojer, T., Fedorov, O., Biggin, P. C., Spencer, J., & von Delft, F. (2025). Binding-Site Purification of Actives (B-SPA) Enables Efficient Large-Scale Progression of Fragment Hits by Combining Multi-Step Array Synthesis With HT Crystallography. Angewandte Chemie International Edition, 64(16), e202424373. (link)



Engineering

Bio-Inspired Adaptive Anomaly Detection for Resilient Autonomous Systems (EP27/8)

EPSRC Category: Mathematics and Theoretical Foundations

Lead Supervisor: Zhengguo Sheng
Department: Engineering

Research outline:

Resilient autonomous systems are increasingly deployed in transportation, manufacturing, and critical infrastructure, where they must operate safely and securely in dynamic and potentially adversarial environments. As autonomy increases, conventional cybersecurity approaches struggle to detect novel attacks, adapt to changing operational conditions, and maintain system resilience. The UK's industrial strategy identifies cybersecurity and artificial intelligence as key frontier technologies, highlighting the need for trustworthy, adaptive autonomous systems. This project will investigate a bio-inspired, adaptive anomaly-detection framework for autonomous systems. Drawing on principles from Artificial Immune Systems (AIS), the project will develop adaptive algorithms that continuously learn normal system behaviour and identify previously unseen threats. AIS offer a promising basis for adaptive cyber defence and operational resilience.

Key Publications:

Liu, C. K., Zhang, Y. K., Xue, Z., Sheng, Z., Kang, J., & Han, G. (2026). CATwin-IDS: Context-Aware Intrusion Detection System for Both In-Vehicle and External-Vehicle Networks via Digital Twin. IEEE Transactions on Intelligent Transportation Systems, 27(7), 8795-8809. (link)
Sousa, B.; Magaia, N.; Silva, S. (2023). An Intelligent Intrusion Detection System for 5G-Enabled Internet of Vehicles. Electronics, 12, 1757. (link)

Autonomous Robot Navigation in Pasture-based Farm Environments (EP27/9)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Bao Kha Nguyen
Research Group Title: Centre for Robotics and Sensing Technologies
Department: Engineering

Research outline:

Precision and smart farming techniques that utilise robotic systems have significantly transformed a wide range of agricultural applications by reducing human labour and enhancing operational safety. However, deploying robotic systems in pasture-based farms presents unique challenges due to varying terrain, changing weather conditions, and the presence of dynamic obstacles. This research aims to develop new methods that enable autonomous robots to navigate around moving obstacles while traversing uneven terrain in unstructured and dynamic pasture-based farming environments.

Key Publications:

Liu, CX; Lin, ZW; Ying, RH; Wang, Jj; Li, YN; Nguyen, BK. (2026) DynaSeedFusion: a Real-Time Object-Level Dynamic Obstacle Detection System for Agricultural Robots. Smart Agricultural Technology, Vol. 15,102496 (link)

Modular Robotics for First Responders in Harsh Environments (EP27/10)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Carlo Tiseo
Department: Engineering

Research outline:

Remote search-and-rescue operations face severe logistical barriers where harsh terrain and resource scarcity critically impede rapid medical relief. This PhD project addresses these challenges by developing a versatile, modular robotic system tailored to austere interventions. Working alongside emergency experts, the researcher will establish functional specifications, bridging hardware modularity, physical robustness, and clinical integration. The work culminates in fabricating a physical prototype and validating its capabilities under realistic, stress-tested conditions. We seek a motivated candidate with an understanding of biomedical engineering or disaster medicine, equipped to integrate frontline clinical protocols into resilient robotic systems for life-saving emergency support.

Key Publications:

Tiseo, C., Rouxel, Q., Asenov, M., Babarahmati, K. K., Ramamoorthy, S., Li, Z., & Mistry, M. (2024). Achieving Dexterous Bidirectional Interaction in Uncertain Conditions for Medical Robotics. IEEE Transactions on Medical Robotics and Bionics. (link)

Cryogenic sprays at the edge of supercriticality: Optical investigation of transcritical phase change at high pressure (EP27/11)

EPSRC Category: Experimental approaches to Understanding

Lead Supervisor: Cyril Crua
Department: Engineering

Research outline:

My group investigates multiphase thermofluids for low-carbon energy and propulsion. Current themes include cryogenic injections for heavy-duty transport, advanced laser diagnostics (rainbow refractometry, PIV, shadowgraphy), and deep learning for fluid diagnostics, including neural-network surrogate models for optical measurements. Students join a well-equipped experimental laboratory and an active international network of industrial and academic partners. I welcome applications from engineering and physics graduates with strong analytical skills and an interest in experimental fluid mechanics.

Key Publications:

Murphy-Hunt, F., Marlow-Eastwood, C. and Crua, C., (2026). Optical investigation of effect of L/D ratio on transcritical cryogenic sprays. ILASS Europe 2026, 34th Conference on Liquid Atomization & Spray Systems, Lisbon, Portugal. (link)

Multimodal AI for Automated Tissue Characterisation and Digital Pathology (EP27/12)

EPSRC Category: Interdisciplinary Research

Lead Supervisor: Elizabeth Rendon-Morales
Research Group Title: Centre for Robotics and Sensing Technologies
Department: Engineering

Research outline:

Histopathology remains the clinical gold standard for cancer diagnosis; however, conventional workflows rely on tissue sectioning, staining, slide scanning, and expert review, resulting in significant delays and limiting their use during surgery. The inability to provide rapid intraoperative assessment of tumour margins can lead to incomplete resections, repeat surgical procedures, and increased healthcare costs. There is therefore a growing need for real-time, label-free technologies capable of delivering objective tissue characterisation at the point of care. This PhD project aims to develop a multimodal imaging and artificial intelligence framework for automated tissue characterisation and digital pathology.

The research will combine label-free UV imaging, which provides high-resolution structural and morphological information, with laser speckle micro-rheology (LSM), a non-contact optical technique capable of quantifying tissue mechanical properties. By integrating these complementary imaging modalities, the project will investigate how structural, functional, and biomechanical tissue signatures can be fused to improve diagnostic accuracy and robustness. The project will focus on three research objectives: (1) developing a multimodal imaging platform capable of acquiring co-registered optical and mechanical tissue information; (2) designing advanced AI algorithms to fuse UV and LSM data for tissue classification, segmentation, and uncertainty-aware decision support; and (3) implementing real-time deployment on embedded hardware to enable intraoperative use within robotic surgical and microscopy platforms.

The expected outcome is to research on the next-generation digital pathology system capable of providing rapid, label-free tissue assessment directly at the point of intervention. By combining multimodal sensing, artificial intelligence, and high-precision robotics, this research will establish new methodologies for image-guided diagnosis and surgical decision-making. The project will contribute towards future autonomous medical systems capable of real-time tissue interrogation, assessment, and intervention, ultimately improving clinical outcomes and enabling more precise and personalised healthcare.

Key Publications:

Tang, J; Huang, X; Williams, T; Hildick-Smith, D; Aviles-Espinosa, R; Rendon-Morales, E. (2025). Assessing the characteristics of modern valvuloplasty balloons using a robotic non-contact optical approach. MDPI Hearts Journal University of Sussex. Journal contribution. (link)

Huang, X; Rendon-Morales, E; Aviles-Espinosa, R (2023). ROMI: design and experimental evaluation of a linear delta robotic system for high-precision applications. MDPI Machines Journal University of Sussex. Journal contribution. (link)

Renewable Hydrogen Systems for Net-Zero Energy Integration (EP27/13)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Fan Zhang
Research Group Title: Energy and Materials Engineering Research Centre
Department: Engineering

Research outline:

Green hydrogen is emerging as a key decarbonisation technology. However, efficiently integrating renewable electricity generation with hydrogen production, storage, and utilisation remains a major challenge. This PhD project will develop advanced modelling, control and optimisation methods for integrated renewable hydrogen energy systems. The research will investigate how electrolysers, hydrogen storage facilities and fuel cells can be coordinated with renewable energy sources to maximise efficiency, reliability and economic performance. The successful candidate will employ state-of-the-art techniques including dynamic system modelling, energy management optimisation, AI technology and techno-economic analysis. Opportunities may also exist to explore digital-twin and data-driven approaches for real-time decision-making.

Key Publications:

Basnet, S., Deschinkel, K., Le Moyne, L. and Péra, M.C., (2023). A review on recent standalone and grid integrated hybrid renewable energy systems: System optimization and energy management strategies. Renewable Energy Focus, 46, pp.103-125. (link)

High-efficiency Oil-free Flexible Gifford-McMahon cryocooler for quantum future (HOF-GM) (EP27/14)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Kun Liang
Research Group Title: Energy and Materials Engineering Research Centre (EMERC)
Department: Engineering

Research outline:

Conventional Gifford-McMahon (GM) cryocoolers rely on oil-lubricated scroll compressors with rotary motor, which introduce efficiency and maintenance bottlenecks. By integrating an oil-free linear compressors designed at the University of Sussex (UoS) and coupling linear compressors with Oxford Cryosystems (OCS)

cold head, this project between UoS and OCS aims to develop next-generation oil-free flexible GM cryocoolers that eliminate oil lubricants and significantly improve thermal efficiency by varying compressor stroke. This disruptive solution will enhance the efficiency, flexibility and compactness of GM coolers and expand the applicability of GM coolers in quantum devices and medical, where high-efficiency and contamination-free operation is critical.

Reconfigurable Optical Neural Networks for Next Generation AI Systems (EP27/15)

EPSRC Category: Mathematics and Theoretical Foundations

Lead Supervisor: Leila Yousefi
Department: Engineering

Research outline:

Artificial intelligence (AI) has made significant strides across various fields, often surpassing human capabilities. Neural networks are central to these advancements, but traditional electronic computing systems face limitations such as high power consumption, limited bandwidth, and high costs. These challenges have led to growing interest in optical neural networks (ONNs), which offer ultra-low power usage, high-speed parallel processing, and exceptional bandwidth. ONNs present a promising alternative for next-generation AI systems. This project aims to design and develop reconfigurable optical neural networks that can support more efficient, scalable, and high performance AI applications, addressing the limitations of conventional electronic architectures.

Key Publications:

Abed, O, Yousefi, L, (2020). Tunable metasurfaces using phase change materials and transparent graphene heaters. Optics Express, Vol. 28, pp. 33876-33889. (link)

Next generation energy-conversion systems for low-temperature heat (EP27/16)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Martin White
Department: Engineering

Research outline:

My research focuses on advanced power cycles and heat pumps that convert low-temperature heat into electricity or upgraded thermal energy. Key application areas include geothermal energy, industrial waste-heat recovery, and broader decarbonisation technologies. Research opportunities span system-level modelling, optimisation and techno-economic assessment, as well as the design of key components such as turbines and compressors. A particular area of expertise is multiphase turbomachinery, including wet-to-dry expansion processes. Projects may involve the development of bespoke multiphase CFD models and their validation using Sussex's unique blowdown test facility, which enables detailed investigation of rapidly expanding multiphase flows.

Key Publications:

White, M. (2021). Cycle and turbine optimisation for an ORC operating with two-phase expansion. Applied Thermal Engineering, 192, 116852. (link)

AI-Native and Intent-Driven Advanced Connectivity for Future Mobility and Connected Robotics (EP27/17)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Maziar Nekovee
Research Group Title: Advanced Communications and Signal Processing (ACMI)
Department: Engineering

Research outline:

This PhD builds on the successful DSIT-funded BEACON project with Honda R&D with further collaboration with Quanser on connected robotics. It will investigate secure, adaptive 6G connectivity and edge computing for connected mobility and robotics. Research will combine large language models, policy constraints and feedback control to translate human objectives and machine requirements into coordinated network and computing actions, adapting to changing mobility and network conditions. Evaluation will combine simulation with vehicle, robot and network testbed experiments, in collaboration with industry. Expected outcomes include an automation framework improving latency, reliability and resource efficiency while maintaining security and accountability.

Key Publications:

Speranza, A., Giardina, P., Bernini, G., & Nekovee, M. (2025). Intent-Based Networking for Vehicular Service Deployment. In Proceedings of the 2025 IEEE Vehicular Networking Conference (VNC). IEEE. (link)

Programmable Diffractive Neural Networks Based on SpaceTime Coding for Next-Generation Terahertz Communications (EP27/18)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Mohammad Neshat
Department: Engineering

Research outline:

My research focuses on terahertz technology, using the 0.1–10 THz band that future wireless networks will exploit to achieve unprecedented data rates and capacity. This project builds on our previous research on space–time-coded (STC) arrays, which enable dynamic manipulation of electromagnetic waves across space and time. Its novelty lies in developing a programmable diffractive deep neural network based on STC principles, enabling analog processing with exceptional speed and energy efficiency - addressing the key bottlenecks of conventional digital processing. The proposed approach will be tested in ultra-high-speed THz communication and sensing scenarios, addressing many of the current challenges.

Key Publications:

Gholami M., Khajavi S., Neshat M., Tewes S. and Sezgin A., (2025) Wireless localization with space–time-coded reconfigurable intelligent surfaces. IEEE Transactions on Antennas and Propagation, vol. 73, no. 8, pp. 5650-5657. (link)

Energy-efficient pneumatic actuation and control for robot locomotion (EP27/19)

EPSRC Category: Experimental approaches to Understanding

Lead Supervisor: Nicolas Herzig
Department: Engineering

Research outline:

Pneumatic actuators offer high power-to-weight ratios and inherent compliance, making them attractive for legged robots. However, their reliance on compressed air and associated energy consumption remains a major limitation for autonomous locomotion. This PhD will explore how novel pneumatic actuation, system architectures and advanced control can substantially improve the energy efficiency and autonomy of walking robots. The student will have the opportunity to develop

new modelling and control approaches, investigate how actuation and locomotion strategies can be co-designed for efficiency, and experimentally validate their ideas on robotic legs and quadruped platforms.

Key Publications:

Herzig, N., Moreau, R., Redarce, T., Abry, F. & Brun, X. (2018). Nonlinear position and stiffness backstepping controller for a two degrees of freedom pneumatic robot. Control Engineering Practice, 73, 26–39. (link)

Computer Vision for Subgroup Activity Recognition (EP27/20)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Phil Birch
Department: Engineering

Research outline:

You will explore Computer Vision and Human Activity Recognition (HAR) to pioneer cutting-edge deep learning models capable of detecting and analysing distinct subgroup activities embedded within larger, crowded environments. The project will use a mixture of cameras and passive or active radar. Passive radar uses the reflections caused by people moving through an existing electromagnetic field, such as a Wi-Fi network. You will tackle fine-grained spatial-temporal challenges, advancing multi-person action detection and interaction modelling to untangle complex group dynamics. This project's research has applications spanning smart environments, crime and public safety, social behaviour analysis, and human-robot interaction.

Key Publications:

Bayik, K; Ajayi, O; Roggen, R; Birch, P. (2026) From user recognition to activity counting: an identity-agnostic approach to multi-user WiFi sensing. arXiv. (link)

Accelerating Discovery at the Interface of Nanomaterials, AI and Automation (EP27/21)

EPSRC Category: Interdisciplinary Research

Lead Supervisor: Philip Howes
Research Group Title: Energy and Materials Engineering Research Centre (EMERC)
Department: Engineering

Research outline:

This cutting-edge multidisciplinary project sits at the interface of nanomaterials chemistry, automation and AI. You will develop/use automated systems for nanomaterials synthesis, allowing for rapid and data-rich experimentation. You will use AI to analyse gathered data and to drive experiments in search of specific research outcomes. You will discover new nanomaterials synthesis and processing approaches, and optimise these for target applications. This project is ideal for students inspired by interdisciplinary and high impact research. Candidates from a broad variety of academic backgrounds are welcome, and you will join a group where interdisciplinary and diverse thinking are embraced.

Key Publications:

Munyebvu, N; Dunn, S; Howes, P. D. (2025). Multiobjective platform for autonomous property targeting and optimization of colloidal lead halide perovskite quantum dots. Chemistry of Materials, 37, 6629–6641. (link)

AI-based Multimodal Imaging Guided Optical Tissue Soldering for Robotic Minimally Invasive Surgery (EP27/22)

EPSRC Category: Interdisciplinary Research

Lead Supervisor: Rodrigo Aviles-Espinosa and Elizabeth Rendon-Morales
Research Group Title: Centre for Robotics and Sensing Technologies
Department: Engineering

Research outline:

Despite significant advances in robotic-assisted minimally invasive surgery (MIS), tissue suturing remains one of the most technically demanding surgical tasks. Current robotic systems enhance precision and dexterity; however, surgeons still rely heavily on visual assessment and manual techniques to evaluate tissue quality and perform wound closure. The lack of real-time quantitative information about tissue composition and viability limits the development of intelligent and autonomous

surgical systems. This PhD project aims to establish the foundations for a multimodal AI-imaging guided optical tissue-soldering platform based on infrared (IR) laser technology.

The central hypothesis is that combining complementary optical imaging modalities with AI can be trained to provide quantitative information about tissue composition, hydration, structure, and mechanical properties, enabling the optimisation of laser-based tissue-soldering. Particular emphasis will be placed on characterising tissue water content, as water is the dominant absorber in soft tissues and plays a critical role in light-tissue interactions and tissue-welding performance. The research will focus on three key objectives: a) Multimodal tissue characterisation: Develop and integrate optical sensing and AI-imaging techniques capable of assessing tissue hydration, composition, and structural characteristics in real time during surgical procedures. b) Imaging-guided tissue soldering: Establish predictive models of light-tissue interaction by combining multimodal imaging data with photon absorption analysis, enabling optimisation and control of broadband laser tissue soldering. c) Optical assessment of tissue repair: Develop imaging-based methods for non-destructive evaluation of tissue weld quality, stiffness, and mechanical integrity following soldering.

By integrating multimodal AI-imaging, optical sensing, and laser tissue repair within a single platform, this project will deliver the foundations for a next-generation surgical tool capable of tissue interrogation, image-guided soldering, and real-time quality assessment. The outcomes will advance robotic surgery towards data-driven decision-making and provide a pathway for the future integration of artificial intelligence and autonomous surgical control systems.

Key Publications:

Huang, X; Rendon-Morales, E; Aviles-Espinosa, R (2023). ROMI: design and experimental evaluation of a linear delta robotic system for high-precision applications. MDPI Machines Journal University of Sussex. Journal contribution. (link)

Tang, J; Huang, X; Williams, T; Hildick-Smith, D; Aviles-Espinosa, R; Rendon-Morales, E. (2025). Assessing the characteristics of modern valvuloplasty balloons using a robotic non-contact optical approach. MDPI Hearts Journal University of Sussex. Journal contribution. (link)

Research on Hybrid Model of Optimal Vehicle Control and Macroscopic Dynamic Traffic Assignment for Mixed Traffic Network Capacity Maximization (EP27/23)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Shangbo Wang
Department: Engineering

Research outline:

Dr. Wang's research interest mainly includes intelligent transportation systems, wireless communications, radar signal processing, wireless localization techniques, machine learning, deep reinforcement learning and its applications in transportation systems

How can we leverage artificial intelligence to tackle modern serious threats to energy infrastructure that leave millions without power? (EP27/24)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Spyros Skarvelis-Kazakos
Research Group Title: Energy and Materials Engineering Research Centre (EMERC)
Department: Engineering

Research outline:

This PhD project aims to investigate the use of Artificial Intelligence (AI) tools, including machine learning (ML) and agent-based control, for predicting, managing and improving the resilience of energy networks to disruption. AI tools will be used to predict the likelihood and impact of cascading failures. Cascading failures can lead to widespread electrical blackouts, typically characterised as High-Impact Low Probability (HILP) events, potentially leaving millions of people without energy, water or communications, risking lives, and costing £ billions. Prior knowledge of the occurrence of such HILP events can enhance the response of infrastructure operators, thus limiting their impact. You will build on prior research that has been done by the supervisor's team on leveraging machine learning to predict large-scale blackouts, including the Network Theory Resilience Metric (NTRM) toolkit.

Key Publications:

Skarvelis-Kazakos, S., Van Harte, M., Panteli, M., Ciapessoni, E., Cirio, D., Pitto, A., Moreno, R., Kumar, C., Mak, C., Dobson, I., Challen, C., Papic, M., & Rieger, C. (2022). Resilience of electric utilities during the COVID-19 pandemic in the framework of the CIGRE definition of Power System Resilience. International Journal of Electrical Power & Energy Systems, 136, 107703. (link)

Effect of flow unsteadiness on compressor blade aerodynamics (EP27/25)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Vasudevan Kanjirakkad
Research Group Title: Energy and Materials Engineering Research Centre (EMERC)
Department: Engineering

Research outline:

Axial compressors used in gas turbines and aero-engines are characterised by complex aerodynamic phenomena, including wake-induced unsteady flows and flow instabilities that can arise at low mass flow operating conditions, such as rotating stall and surge. A detailed understanding of these mechanisms is essential for improving compressor performance, stability, and operational flexibility. This PhD project will investigate the nature of unsteady flow within axial compressors and assess its impact on compressor performance and operating range.

The research will build upon knowledge generated through previous doctoral studies on wake-induced boundary layer transition in compressor blade rows, extending the understanding of unsteady aerodynamic processes in turbomachinery. The project is expected to involve a combination of experimental investigations and computational fluid dynamics (CFD) simulations. Candidates should possess a strong background in fluid mechanics, turbomachinery, or a related engineering discipline. Preference will be given to applicants who can demonstrate Master's-level experience in conducting experimental laboratory research in aerodynamics and who have familiarity with unsteady numerical simulation techniques, including the use of high-performance computing (HPC) resources.

Key Publications:

Irps, T., & Kanjirakkad, V. (2025). Wake–Separation Bubble Interaction Over an Experimentally Simulated Axial Compressor Blade Under Low Reynolds Number Flow. Journal of Turbomachinery, 147(8), 081018. (link)

Learning Human Motor Control for Personalised Robotic Assistance (EP27/26)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Yanan Li
Department: Engineering

Research outline:

Rehabilitation and assistive robots for upper-limb movement and hand grasping have advanced considerably. However, providing personalised assistance during complex daily activities and within established rehabilitation protocols remains challenging. Two key barriers are the limited range of tasks supported by existing systems and the difficulty of continuously estimating users' movement intentions and motor control strategies. This project will combine insights from neurological motor control with advanced machine learning to learn both task requirements and individual motor control models. The aim is to develop robotic systems that deliver personalised, adaptive assistance during meaningful activities tailored to individual needs.

Key Publications:

Y. Li, A. Sena, Z. Wang, X. Xing, J. Babic, E.H.F. van Asseldonk and E. Burdet. (2022). A review on interaction control for contact robots through intent detection. Progress in Biomedical Engineering, vol. 4, 032004. (link)



Informatics

Active embodied AI for rapid robust learning (EP27/27)

EPSRC Category: Interdisciplinary Research

Lead Supervisor: Andrew Philippides
Department: Informatics

Research outline:

Perception is not passive. Animals actively explore their environments to acquire the information they need to guide future behaviour and evolution has shaped the animal movements to shape incoming information to make it easier to learn/recall. This is seen across animals, from choreographed learning flights of bees to eye movements of humans, but has yet to be exploited by AI and robotics. You will explore this question by either developing novel active AI algorithms for robotics (using visual or tactile perception), or analysing insect behaviour to develop a better understanding of natural intelligence.

Key Publications:

Philippides, A., de Ibarra, N. H., Riabinina, O., & Collett, T. S. (2013). Bumblebee calligraphy: the design and control of flight motifs in the learning and return flights of Bombus terrestris. Journal of Experimental Biology, 216(6), 1093-1104. (link)

Leveraging Machine Learning for Verification Problems in Timed Logics (EP27/28)

EPSRC Category: Mathematics and Theoretical Foundations

Lead Supervisor: Hsi-Ming Ho
Department: Informatics

Research outline:

This project explores leveraging machine learning (ML) to address verification and synthesis challenges in timed logics, which model systems with temporal constraints. It aims to enhance scalability and efficiency in verifying system behaviours, generating counterexamples, and providing explanations. Key steps include developing data representations, feature engineering, training ML models, and integrating them with existing tools. The research promises novel ML methodologies tailored to formal verification, improved verification performance, and automated synthesis capabilities. Over three years, the project will progress from data collection and experimentation to methodology development, integration, and evaluation, contributing insights to both formal methods and ML.

Key Publications:

Brihaye, T., Geeraerts, G., Ho, H.-M., & Monmege, B. (2017). MightyL: A Compositional Translation from MITL to Timed Automata. In Computer Aided Verification (CAV 2017), Lecture Notes in Computer Science, 10426, 421-440. (link)

Neurobiology-inspired adaptive reinforcement learning in changing and uncertain environments (EP27/29)

EPSRC Category: Interdisciplinary Research

Lead Supervisor: James Bennett
Research Group Title: Sussex AI
Department: Informatics

Research outline:

This project explores how animals and artificial agents learn continuously in changing and uncertain environments, with the goal of connecting reinforcement learning frameworks to dopaminergic circuits in the brain, as well as integrating neurobiological phenomena into reinforcement learning algorithms to support adaptive behaviour in continual learning problems. A major part of this project will entail relating models to, and drawing inspiration from, experimental findings in model organisms

such as Drosophila melanogaster. This project is ideal for applicants interested in reinforcement learning, computational neuroscience, and biologically grounded adaptive learning.

Key Publications:

Bennett, J.E.M., Philippides, A. & Nowotny, T. (2021). Learning with reinforcement prediction errors in a model of the Drosophila mushroom body. Nat Commun 12, 2569. (link)

Understanding and Improving Language Models (EP27/30)

EPSRC Category: Experimental approaches to Understanding

Lead Supervisor: Jeff Mitchell
Research Group Title: AI Research Group
Department: Informatics

Research outline:

The standard transformer architecture has been extremely successful in driving recent advances in Natural Language Processing, resulting in tools such as ChatGPT, Gemini, Grok and others. However, these models consume several orders of magnitude more data than a human language learner and yet continue to have problems with correctness and reliability. Which aspects of the transformer are responsible for these weaknesses? What benefits would other architectures bring? How could we best incorporate human-like learning biases?

Key Publications:

Mitchell, J & Bowers, J. (2020) Priorless recurrent networks learn curiously. Proceedings of the 28th International Conference on Computational Linguistics. 5147-5158. (link)

AI for Assessing Lesion Transmurality and Durability After Cardiac Pulsed Field Ablation (EP27/31)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Luc Berthouze
Department: Informatics

Research outline:

Pulsed field ablation (PFA) is an emerging treatment for cardiac arrhythmias, but establishing whether lesions extend through the entire heart wall (transmurality) and remain effective over time (durability) remains challenging. This project will exploit a novel CO_2 insufflation technique developed by our clinical collaborators at University Hospitals Sussex, enabling simultaneous recordings of electrical activity from the inner (endocardial) and outer (epicardial) heart surfaces. Using time-series analysis, machine learning and physics-informed neural networks (PINNs), the student will investigate changes in electrical activity following ablation, identify markers of lesion transmurality and durability, and develop predictive models. No prior cardiac electrophysiology knowledge is required.

Key Publications:

West TO, Berthouze L, Halliday DM, et al. (2018). Propagation of beta/gamma rhythms in the cortico-basal ganglia circuits of the parkinsonian rat. J Neurophysiol 119: 1608-1628. (link)

Intent-Based Networking for Resilient Autonomous Systems (EP27/32)

EPSRC Category: Mathematics and Theoretical Foundations

Lead Supervisor: Naercio Magaia
Department: Informatics

Research outline:

Future autonomous systems require networks that can automatically translate high-level operational goals into secure, adaptive, and resilient network behaviour. Intent-Based Networking (IBN) enables users and applications to specify desired outcomes, while the network autonomously configures, monitors, and optimises resources to achieve them. Emerging AI-native networking paradigms identify intent-driven automation as a key capability for next-generation communication infrastructures. This project will develop an AI-powered IBN architecture for resilient autonomous systems operating across edge-cloud environments. The framework will integrate intent translation, federated learning, autonomous orchestration, and network digital twins to continuously align network behaviour with operational objectives. AI-driven analytics will support proactive anomaly detection, automated fault recovery, and adaptive resource management under dynamic and adversarial conditions. Network digital twins will enable safe validation of intent fulfilment before deployment.

Key Publications:

You, H., Galkandage, C., Magaia, N., Nekovee, M. M., & Davies, S. (2026). IntentNEF: LLM-Driven Natural Language Automation of 5G Network Exposure. In 2026 IEEE 12th International Conference on Network Softwarization (NetSoft), 435-441. (link)

Next-Gen Disease Progression Modelling: Integrating cellular and brain imaging across scales to reveal neurodegenerative disease mechanisms (EP27/33)

EPSRC Category: Interdisciplinary Research

Lead Supervisor: Peter Wijeratne
Research Group Title: Learners of Interpretable Latent Information (LILI) Lab
Department: Informatics

Research outline:

This PhD project will develop a multi-scale framework for modelling disease progression by integrating multi-modal neuroimaging data (e.g., MRI, PET and other biomarkers) with cell-scale and transcriptomic data. Building on our proof-of-concept publication [1], this project will create next-gen data-driven disease progression models that capture interactions across biological scales. Optimal transport and pre-trained biological foundation models will be used to align trajectories and representations between imaging and cellular domains, enabling coherent modelling of disease evolution. Bayesian inference will provide principled parameter estimation, uncertainty quantification and model comparison, supporting robust, interpretable predictions of progression pathways and individual patient trajectories for precision medicine.

Key Publications:

Pinnawala, S., Hartanto, A., Jairamani, M., Simpson, I. J. A., & Wijeratne, P. A. (2026). Revealing trajectories of multi-modal voxel-level changes in neurodegenerative diseases using latent event mapping. bioRxiv. (link)

Category-theoretic methods for semantics of programming language (EP27/34)

EPSRC Category: Mathematics and Theoretical Foundations

Lead Supervisor: Philip Saville
Department: Informatics

Research outline:

Research areas: information and communication technologies; mathematical sciences. My work uses ideas from logic to study the structure of programming languages, and uses ideas from algebra to study the relationships between denotational models, and hence better understand common techniques in semantics. I'm happy to supervise projects in category theory and semantics of programming languages. Possible projects include: Exploring connections versions of between combinatory logic and closed categories; Using 2-dimensional structures (e.g. 2-categories, bicategories) to build semantic models, or to reason about collections of semantic models; Exploring the use of enriched multi-ary models (e.g. multicategories, abstract clones) as refined semantics for programming languages.

Key Publications:

Azevedo de Amorim, P. H., Kura, S., & Saville, P. (2025). Logical relations for call-by-push-value models, via internal fibrations in a 2-category. arXiv. (link)

AI for assessment of pain and fear of falling with Parkinson's disease (EP27/35)

EPSRC Category: Applied Research for a Better World

Lead Supervisor: Temitayo Olugbade
Department: Informatics

Research outline:

This project will investigate automatic assessment of levels of pain and fear of falling in daily life with Parkinson's, toward facilitating personalized management. While there are a large number of studies on motor symptoms of Parkinson's, pain and fear of falling have received much less attention despite their significance. The project will contribute novel machine learning methods that advance the area. The project will also involve creation of new datasets and engagement with people with lived experience.

Key Publications:

Olugbade, T., Buono, R. A., Potapov, K., Bujorianu, A., Williams, A. C. de C., & de Ossorno Garcia, S. (2024). The EmoPain@Home Dataset: Capturing Pain Level and Protective Behaviour Through Everyday Movements in Chronic Pain. In IEEE. (link)

Event-based machine learning and neuromorphic computing (EP27/36)

EPSRC Category: Mathematics and Theoretical Foundations

Lead Supervisor: Thomas Nowotny
Department: Informatics

Research outline:

Event-based Spiking Neural Networks (SNNs) are inspired by the efficiency of biological neurons, and with recent advances such as Eventprop (Wunderlich & Pehle (2021), Nowotny et al. (2024), Mészáros et al. (2025)), we can train them using supervised learning. However, there are technical difficulties, and the methods have thus far only been applied to a few benchmark problems. Equally important, like in ML more generally, lack of labelled data is becoming a problem. Self-supervised approaches are an exciting and competitive alternative (Chen et al. (2020), Illinger et al. (2020), Halvagal & Zenke (2023)). We are looking for PhD students interested in working on these challenges using our GPU-accelerated SNN simulation framework (Knight et al. (2021), Knight & Nowotny (2023) to: further improve methods for gradient descent in SNNs extend gradient descent methods towards real-world problems combine SNNs and self-supervised learning to solve real-world tasks train SNNs for deployment on neuromorphic hardware like Loihi 2 or our own FPGA-based FeNN accelerator (Aizaz et al. 2026).

Key Publications:

Nowotny T, Turner JP, Knight JC (2025). Loss shaping enhances exact gradient learning with eventprop in spiking neural networks. Neuromorphic Computing and Engineering, 5(1), 014001. (link)

Mészáros B, Knight JC, Nowotny T (2025). Efficient event-based delay learning in spiking neural networks. Nature Communications 16(1), 10422. (link)

Explainable AI as a Source of Creative Reflection (EP27/37)

EPSRC Category: Interdisciplinary Research

Lead Supervisor: Maria Teresa Llano
Department: Informatics

Research outline:

Explainable AI (XAI) typically aims to make AI systems transparent and to build trust, helping users accept outputs efficiently. In creative practice, explanations could play

a different role, acting as provocations that make practitioners pause, reconsider and reflect on their work. This PhD project will investigate how explanations of what a generative system did, ignored, or found likely or unlikely can introduce productive friction into co-creative AI. The project will design, implement and evaluate explanation mechanisms with practising artists, contributing new models of explanation for reflective human-AI creativity.

Key Publications:

Llano, M. T., d'Inverno, M., Yee-King, M., McCormack, J., Ilsar, A., Pease, A., & Colton, S. (2022). Explainable Computational Creativity. In International Conference on Computational Creativity, 334-341. arXiv. (link)





Mathematics

Mathematical modelling and inference of infectious disease dynamics in heterogeneous populations (EP27/38)

EPSRC Category: Mathematics and Theoretical Foundation

Lead Supervisor: Chris Hadjichrysanthou
Department: Mathematics

Research outline:

Understanding how population heterogeneity and patterns of interaction influence infectious disease transmission is a fundamental challenge in mathematical epidemiology. This project will develop and analyse mathematical models to investigate how contact-network structure, individual heterogeneity and different transmission mechanisms affect epidemic dynamics. Particular attention will be given to understanding how these factors influence key epidemiological outcomes, such as outbreak probability, epidemic peak and final epidemic size, and to determining what can be inferred about underlying transmission processes from incomplete epidemiological observations.

An important question is how much information a single epidemic trajectory contains, and what additional observations would make otherwise indistinguishable transmission mechanisms identifiable. Potential research directions include the development and analysis of novel stochastic models of infectious disease transmission on networks, the derivation of tractable approximations to stochastic epidemic processes in heterogeneous populations, and the investigation of statistical inference and parameter identifiability. Computational investigations will involve high-performance computing for large-scale stochastic simulations on a range of empirical networks.

Key Publications:

Lalovic, M., Georgiou, N., Kiss, I. Z. (2026). Likelihood-based inference for birth-death processes with composite birth mechanisms. arXiv:2604.20422. (link)

Avraam, D., Hadjichrysanthou, C. (2025). The impact of contact-network structure on important epidemiological quantities of infectious disease transmission and the identification of the extremes. Journal of Theoretical Biology, 599, 112010. (link)

Optimal transport for physical phenomena (EP27/39)

EPSRC Category: Mathematics and Theoretical Foundations

Lead Supervisor: Lukas Koch
Department: Mathematics

Research outline:

Optimal transport has been a very active area of research in the recent past driven by applications in machine learning and theoretical advances. In particular, a number of variants have been explored which contain additional penalty terms. These variants have been introduced in order to facilitate numerical computation of optimal transport maps, as well as to better model physical phenomena, such as congestion. I am interested in studying regularity properties of these models, possibly with numerical applications depending on applicant's interest.

Key Publications:

Gvalani, R. and Koch, L. (2025) Uniform large-scale ε-regularity for entropic optimal transport. arXiv. (link)

Spatial structure and microbial ecosystem dynamics: a mathematical modelling approach (EP27/40)

EPSRC Category: Interdisciplinary Research

Lead Supervisor: Marianna Cerasuolo
Research Group Title: Mathematics Applied to Biology
Department: Mathematics

Research outline:

Microbial communities play a fundamental role in ecosystem functioning, yet the mechanisms linking environmental structure, microbial interactions and community

dynamics remain poorly understood. This PhD project will develop mathematical frameworks to investigate how spatial organisation, resource transport and ecological interactions shape microbial growth, diversity and resilience. Combining dynamical systems, stochastic modelling and network-based approaches, the research will explore how different spatial configurations influence community assembly, coexistence and stability. Particular emphasis will be placed on identifying general mathematical principles connecting environmental structure to emergent ecological behaviour, with potential applications to soil health, sustainable agriculture and environmental resilience.

Key Publications:

Cerasuolo, M., Vanino, S., Piccini, C., & Farina, R. (2026). Estimated effect of crop diversification on soil organic carbon under present and future climate conditions. Science of the Total Environment, 1012, 181173. (link)

Characteristic polynomials of random matrices and the Riemann zeta function (EP27/41)

EPSRC Category: Mathematics and Theoretical Foundations

Lead Supervisor: Nicholas Simm
Department: Mathematics

Research outline:

I am offering PhD projects in probability and statistics, specifically on topics related to random matrix theory and its interactions with other fields of mathematics and physics. One of the projects is to understand the relationship between random matrix theory and the Riemann zeta function, the latter being of central importance in number theory. The main focus of the project will be about statistical properties of characteristic polynomials of random matrices. The aim will be to use these properties to make precise number theoretical predictions about the behaviour of the Riemann zeta function close to the critical line.

Key Publications:

Najnudel, J. and Paquette, E. and Simm, N. (2023). Secular coefficients and the holomorphic multiplicative chaos. Annals of Probability, Vol 51, No. 4, 1193-1248. (link)

Machine learning for adaptive methods for the wave equation (EP27/42)

EPSRC Category: Mathematics and Theoretical Foundations

Lead Supervisor: Omar Lakkis
Research Group Title: Numerical Analysis and Scientific Computing
Department: Mathematics

Research outline:

Computational Mathematics and Partial Differential Equations. I can host a project on (1) AI-driven adaptive methods for the wave equation, (2) Computational methods for flood-risk assessment and mitigation modelling, (3) Numerical optimal mass transportation.

Key Publications:

Grote, M. J., Lakkis, O., & Santos, C. S. (2026). Adaptive FEM with explicit time integration for the wave equation. Journal of Computational and Applied Mathematics, 481, 117272. (link)

Numerical methods for delay differential equations (EP27/43)

EPSRC Category: Mathematics and Theoretical Foundations

Lead Supervisor: Peter Giesl
Department: Mathematics

Research outline:

The PhD project (together with Prof. Yuliya Kyrychko who is an expert in delay differential equations in the Mathematics applied to Biology research group in Mathematics at Sussex) is to develop numerical methods for delay differential equations, in particular to compute Razumikhin- and Krasovskii-Lyapunov functions. The project will adapt existing methods to compute Lyapunov functions for ODEs (partly developed by Peter Giesl) to delay differential equations; the numerical methods will involve meshfree collocation and optimisation methods.

Key Publications:

Giesl, P., Hafstein, S., Suhr, S., Wendland, H. (2025). Minimization with differential inequality and equality constraints applied to complete Lyapunov functions. Discrete Contin. Dyn. Syst. Ser. B 30 No. 2, 449-473. (link)

PDE constrained shape optimisation: numerical methods and functional analysis (EP27/44)

EPSRC Category: Mathematics and Theoretical Foundations

Lead Supervisor: Philip Herbert
Department: Mathematics

Research outline:

Optimal design is key to many industrial applications, ranging from hydro and wind energy harvesting to space travel and telecommunication. Finding optimal designs is notoriously challenging, especially when this requires determining optimal component shapes (e.g., of wind turbine blades). Numerical methods to solve shape optimisation problems are available, but their approximation qualities (and hence reliability) are not well understood. This project aims to address this issue by building on functional analysis, PDE-theory, and numerical methods to develop novel mathematical concepts and scientific software to assess and improve the performance of numerical shape optimisation.

Key Publications:

Deckelnick, K., Herbert, P. J., & Hinze, M. (2025). PDE-constrained shape optimization with first-order and Newton-type methods in the W1,∞ topology. Optimization Methods and Software. (link)

Geometric properties of random convex hulls (EP27/45)

EPSRC Category: Mathematics and Theoretical Foundations

Lead Supervisor: Vladislav Vysotsky
Research Group Title: Probability and Statistics
Department: Mathematics

Research outline:

Convex hulls provide a tractable yet reasonably accurate approximation for sets of more complicated structure. Selecting the sets at random, for example taking a finite number of points in the space according to some probability distribution, produces a random convex hull. The most popular models assume that these points are sampled independently or represent the steps of a random walk. This PhD project in theoretical probability aims to study geometric properties of the random convex hulls of such type, e.g. when the number of points is large. Some of the problems arising require additional use of convex geometry and combinatorics.

Key Publications:

Z. Kabluchko, V. Vysotsky, D. Zaporozhets (2017) Convex hulls of random walks, hyperplane arrangements, and Weyl chambers. Geometric and Functional Analysis, v. 27, pp. 880-918. (link)





Physics

Nanomaterials including graphene and 2D materials, for a diverse range of nanotechnologies and device applications (EP27/46)

EPSRC Category:

Lead Supervisor: Sean Ogilvie, Alan Dalton and Alice King
Research Group Title: Materials Physics Group
Department: Physics

Research outline:

In Materials Physics, we process and study nanomaterials with emergent functional properties, including graphene and 2D materials, which have the potential to enable a diverse range of nanotechnologies and device applications. We work primarily with scalable solution processing techniques, allowing us to develop functional inks, coatings, composites, and free-standing hierarchical structures. Our work ranges from nanoscale characterisation of optoelectronic and nanomechanical properties of materials for quantum technologies to the assembly of nanomaterials into macroscopic structures and devices.

Our current research streams include the understanding and enhancement of electrical transport in nanomaterial networks, which has supported the development of conductive inks for radiofrequency applications such as printed RFID tags and absorbing panels for NASA's Europa Clipper mission. We are also investigating nanomaterial-based electromechanical sensors for strain monitoring, including applications in electric vehicle batteries and, in collaboration with clinicians at St Thomas' Hospital London, wearable devices for health monitoring. Additionally, we explore the use of nanostructures for tissue engineering to understand cellular interactions, and we are developing nanomaterial functionalities for energy devices such as electrochemical energy storage, solar infrared smart windows, and thermoelectric heat capture.

Our team is a diverse and dynamic group of interdisciplinary researchers with backgrounds across physics, chemistry, engineering, and materials science, and we have a wide network of external and industrial partners. Contact us to discuss how your experience and research interests align with ours to develop an exciting new project in one of these areas.

Key Publications:

King, A.A.K., et al (2022). Tuneable synthetic reduced graphene oxide scaffolds elicit high levels of three-dimensional glioblastoma interconnectivity in vitro. Journal Materials Chemistry B. (link)

Dalton. A.B., et al (2023). Explosive percolation yields highly-conductive polymer nanocomposites. Nature Communications. (link)

Ogilvie S.P., et al (2024). Emergent high conductivity in size-selected graphene networks. Carbon, 218. (link)



Sussex EPSRC Doctoral Landscape Projects and Themes for Autumn 2027

