FoSE PhD research areas

Department/School

Department of Civil Engineering

Head of Department: Dr Yung-Tsang Chen

Department PGR Director: Professor Juan Wang

Staff profile page: People - University of Nottingham Ningbo China

Research areas:

- Structural and Earthquake Engineering,
- Geotechnical Engineering,
- Hydraulic and Ocean Engineering,
- Construction Engineering and Management,
- Transportation Engineering,
- Pavement engineering,
- Engineering Survey and Remote Sensing,
- Construction and Building Materials,
- Infrastructure Engineering,
- Digital twins and smart construction.

Department of Architecture and Built Environment

Head of Department: Dr Edward Cooper

Department PGR Director: Dr Tongyu Zhou

Staff profile page: People - University of Nottingham Ningbo China

Research areas:

- Building performance, energy, and systems: low-carbon and smart buildings, AI-driven high performance buildings, simulation, HVAC, ventilation, adaptive façades, and energy storage materials
- Human-centred built environment: thermal comfort, occupant behaviour, and human–building interaction
- Digital design and computational methods: AI-enabled analysis, building prototyping, and emerging digital techniques
- Urban sustainability: sustainable urban development, regeneration, and urban resilience

- Architecture and digital heritage: architectural history, modernism, and digital architecture and heritage preservation

School of Computer Science

Head of School: Professor Dave Towey

School PGR Director: Dr Kian Ming Lim

Staff profile page: People - University of Nottingham Ningbo China

Research areas:

- AI for Science
- Autonomous Agents and Multi-agent Systems
- Computational Intelligence and Optimization
- Computer Vision
- Data Mining & Machine Learning
- Embedded AI and Edge Computing
- Circuits and Systems
- Fintech
- Fuzzy Logic
- Human-Computer Interaction and Extended Reality
- Knowledge Representation and Reasoning
- Medical Image Analysis
- Natural Language Processing
- Parallel Computing
- Security and Privacy
- Smart Home/City and Internet of Things
- Smart Hospital & Health Informatics
- Smart Sensing and Embedded Systems
- Smart Transportation & Logistics
- Software Engineering and Software Testing
- Theoretical Computing and Reasoning
- Trustworthy Artificial Intelligence
- Precision Agriculture

These research areas enable a diverse set of interdisciplinary applications spanning healthcare, finance, logistics, transportation, intelligent systems, and emerging AI-driven technologies. Further information on individual research interests and supervisory areas can be found via staff profile pages on the School of Computer Science website.

Department of Electrical and Electronic Engineering

Head of Department: Dr Chiew-Foong Kwong

Department PGR Director: Dr Shuo Wang

Staff profile page: People - University of Nottingham Ningbo China

Research areas:

1. PEMC – Power Electronics, Machines, and Control

Key Research areas:

- High-efficiency power converters and inverters
- Motor drive systems and control strategies
- Renewable energy integration and grid applications
- Electric and hybrid vehicle powertrains
- High-performance machine design

Key Members:

Dr. Weiduo Zhao (Group Leader)

Chris Gerada, Chunyang Gu, Giampaolo Buticchi, He Zhang, Jiajun Yang, Jing Li, John Xu, Liang Huang, Salman Ijaz, Shuo Wang, Yuli Bao, Yury Mikhaylov, Ahmed Nasr Abdelwahed, David Gerada, Hailin Huang, Jianwei Zhang

2. NGIoE – Next Generation Internet of Everything

Key Research areas:

- Smart transportation, smart health, applications of AI in IoT
- Industrial IoT (IIoT), V2X, Internet of Health (IoH), Internet of Waste Things I (IoWT)
- Edge computing, resource allocation and optimization, real-time embedded systems
- 5/6G wireless communications, Integrated Sensing and Communication (ISAC), Reconfigurable Intelligent Surfaces (RIS), Multiple Input Multiple Output (MIMO) and antenna design
- Wearable, non-intrusive biomedical sensors, contactless wireless-based human activity sensing
- Indoor positioning and navigation systems
- IoT security, mobile blockchain and privacy

Key Members:

Dr. David Chieng (Group leader) – IoT, mobile networks, wireless mesh, digital transformation

Dr. C. F. Kwong ,Dr. Zheng Chu,Dr. Jing Wang ,Dr. Sen Yang ,Dr. Waqas Khalid, Dr. Pengyuan Wang, Dr. Minglei You (University of Nottingham, UK), Prof. C. S. Tan, Prof. Theo, Dr. Mingda Zhu, Dr. Xiaoyu Song Dr. Pushpendu Kar (School of Computer Science), Dr. Alejandro Guerra Manzanares (School of Computer Science), Dr. Heng Yu (School of Computer Science), Dr. Fazlullah Khan (School of Computer Science) Chase Wang,

3. MRI – Magnetic Resonance Imaging Research Center

Key Research Areas:

- Cryogen-free rotatable MRI technology
- MRI pulse sequence development

- Clinical applications of MRI
- Hyperpolarized noble-gas MRI

Key Members:

Dr. Chengbo Wang (Group Leader)

Prof. Thomas Meersmann, Dr. Yulin Wang, Dr. Jichang Zhang

Department of Chemical and Environmental Engineering

Head of Department: Professor Philip Hall

Department PGR Director: Dr Moses Solomon

Staff profile page: People - University of Nottingham Ningbo China

Research areas:

The Department of Chemical and Environmental Engineering (CEE) develops the next generation of engineers to build a cleaner, more sustainable planet. We transform the fundamentals of food, energy, chemicals, and waste into valuable products while protecting our air, land, and water. CEE hosts two research groups, comprising a strong and multidisciplinary team of dynamic, capable, and multinational researchers, namely the Advanced Energy and Environmental Materials & Technologies (AEEMT) and Climate and Environmental Research (CER) Groups.

1. **AEEMT Research Focus:** Renewable Energy & Next-Generation Materials

- Novel materials and technologies for:
  - thermo-, photo-, electrochemical conversion;
  - efficient catalysis to value-added products; and
  - high-performance solar cells and energy storage systems
- Advanced Next-Generation Materials for:
  - medical devices, anticancer therapy, and electronics; and
  - catalysis, coatings, and corrosion inhibitors for electric vehicles, gas conversion, and metal protection.

Applications: Solar energy, energy storage, value-added products, antimicrobial medical materials, and materials preservation.

2. **CER Research Focus:** Industrial Optimisation and Environmental Sustainability

- Industrial Process Optimisation to:
  - improve efficiency, reduce energy use, and minimize environmental impact.
- Environmental Sustainability Innovations in:
  - carbon capture and utilisation;
  - waste separation and treatment technologies; and
  - green processing.

Applications: Chemical, metal, and cleaner coal processing; waste recycling; sustainable construction materials; wastewater treatment.

Here, you gain the space, support, skills, and connections to thrive. Create the products, processes, and systems that engineer a smarter, safer, and cleaner future. From career-advancing courses to groundbreaking research, we empower you to protect the world's resources and improve lives.

School of Geographical Sciences

Head of School: Professor Faith Chan

School PGR Director: Dr Meili Feng

Staff profile page: People - University of Nottingham Ningbo China

Research areas:

The School of Geographical Sciences undertakes internationally recognised research addressing some of the most pressing global environmental challenges. Our work integrates physical geography, geology, ecology, environmental science, and human–environment interactions, supported by strong expertise in field-based observation, laboratory analysis, modelling, geospatial analysis, and interdisciplinary collaboration. PhD students in the School of Geographical Sciences are supported by a strong culture of international collaboration, including long-standing doctoral training partnerships with leading research institutes such as the Chinese Academy of Sciences. Students gain extensive fieldwork experience across temperate and tropical environments, alongside training in advanced analytical and modelling techniques.

Key Research Areas

1. Climate Change, Earth Surface Processes, and Environmental Change

Research in this area focuses on understanding past, present, and future environmental change across a range of spatial and temporal scales. Key themes include climate change and glacier modelling, glacial/fluvial/coastal/eolian geomorphology, morphodynamics, palaeo-environmental reconstruction, Quaternary palaeoecology (e.g. pollen and diatoms), pedogenesis, environmental archaeology, and radiocarbon and cosmogenic nuclide dating. This work provides critical insights into landscape/biological/human evolution, climate–environment feedbacks, and long-term Earth system dynamics.

2. Hydrology, Water Systems, and Urban Environments

The School has strong expertise in hydrology and aquatic systems, including flood modelling, hydrodynamics, palaeo-flood reconstruction, water quality modelling, eco-hydraulics, and carbon emissions in aquatic environments. Research addresses flood risk, sustainable water management, hydropower development, and the food–water–energy nexus, with relevance to climate adaptation and urban resilience in rapidly changing regions. Research on urban systems examines interactions between environmental processes, infrastructure, and policy. Key topics include urban flood policy, Sponge City

development, urban planning, and soil–water pollution control. This work supports evidence-based solutions for sustainable and climate-resilient cities.

3. Pollution, Environmental Quality, and Ecosystem Health

The School conducts interdisciplinary research on environmental pollution and its impacts on ecosystems and human health. Areas of focus include atmospheric pollution, plastics and microplastics pollution, water and wastewater contamination, air quality, biodiversity, and environmental risk assessment. These studies combine field measurements, laboratory analysis, and modelling to inform mitigation strategies and environmental governance.

4. Geospatial Science, Remote Sensing, and Big Data

Geospatial technologies underpin much of the School's research. Expertise includes GIS, remote sensing, geospatial analytics, and the use of big data to study environmental change, health, air quality, biodiversity, and land–water interactions. PhD researchers benefit from advanced analytical tools and applications across both natural and human-environment systems.

School of Mathematical Sciences

Head of School: Dr Hayk Mikayelyan

School PGR Director: Dr Hamid Reza Daneshpajouh

Staff profile page: People - University of Nottingham Ningbo China

Research areas:

- **Actuarial Risk Theory and Stochastic Dependence** addresses the rigorous modeling of insurance solvency and multivariate risk structures. It investigates ruin-theoretic functionals, such as the probability of ruin and the expected area in the red, within the frameworks of Lévy processes and discrete-time stochastic models. A central theme is the characterization of non-linear dependence, employing stochastic ordering methods and Fréchet–Höffding bounds to derive sharp limits for rank correlation coefficients like Spearman's rho and Kendall's tau, particularly in discrete settings. Furthermore, the research examines statistical phenomena such as Simpson's paradox to elucidate the impact of confounding variables on dependence measures.
- **Financial Mathematics:** (1) Stochastic differential equations (SDE): Solve some specific types of stochastic derivative equations such as the equations derived by the Ito integral and the Stratonovich integral with the Malliavin derivative operator. (2) q-Differential dynamical system: Apply the q-derivation operator and the derivation operator satisfying q-product rule to the vector spaces of the functions on finite fields. Then, using these operators to derive the option price of the European call option according to a non-standard financial model based on the famous Cox Ross-Rubinstein model. (3) Stochastic volatility model: Motivated by Heston model, stochastic volatility model can be applied to deal with the volatility smile and the financial leverage. Regime switching model is also considered as a part of this research.

- **Mathematical Analysis and Modeling of Nonlinear PDEs** centers on the rigorous analysis of nonlinear partial differential equations, with a focus on regularity theory and global existence versus finite-time blow-up of solutions. It involves developing PDE frameworks to model complex phenomena in fluid dynamics, materials science, and biological systems such as chemotaxis and pattern formation. A key component is the construction of predictive mathematical models for analyzing complex datasets from interdisciplinary applications. Employing tools from variational analysis, the work investigates the underlying mechanisms of self-organization and structure formation. The approach is characterized by a synergy of deep theoretical investigation and applied mathematical modeling to address fundamental questions in science and engineering. Incorporating stochastic forcing terms into PDEs is used to model phenomena that exhibit behaviours which are easier to describe statistically than from first principles. The introduction of randomness to the analysis of existence, uniqueness, and long-time behaviour, as well as to the convergence analysis of numerical schemes, drive investigations at the intersection of functional analysis and probability theory of great current interest.
- **Mathematical Physics** research explores the rigorous formulation of physical theories using advanced mathematical structures, with one active subfield focusing on quantum field theory in curved spacetime (QFTCS). This subfield aims at understanding quantum phenomena in gravitational backgrounds like expanding cosmologies and black hole geometries, where effects such as Hawking and Gibbons-Hawking radiation arise. Since direct experimental tests in these regimes are presently infeasible, recent work uses analog simulators, where tailored interactions and environmental coupling can mimic spacetime curvature and enable laboratory studies of phenomena like Unruh and Hawking radiation, thereby offering a viable route to test QFTCS predictions in laboratory setting.
- **Optimization Methods for Sparse and High-Dimensional Problems** centers on the development of efficient algorithms for high-dimensional optimization problems where solutions exhibit intrinsic sparsity. This research area focuses on designing and analyzing methods that exploit sparse structures to improve computational efficiency, numerical stability, and recovery accuracy. Key applications include signal processing and compressed sensing, where sparsity plays a central role in model interpretability. The work combines theoretical analysis with algorithm design, addressing challenges such as non-convexity, noise robustness, and large-scale implementation.
- **Scientific Computing and Mathematical Modeling in Biophysics** focuses on scientific computing and mathematical modeling of biophysical systems, with an emphasis on understanding how physical principles govern cellular organization. I develop continuum and phase-field models to study biomolecular phase separation, wetting phenomena, and the coupling between soft biological membranes and complex fluids. These models are complemented by advanced numerical methods and large-scale simulations to resolve nonlinear, multiscale dynamics. The work is highly interdisciplinary, bridging applied mathematics, physics, and cell biology, and is closely connected to experimental collaborations. PhD students in this area will gain strong training in mathematical modeling, numerical analysis, and computational biophysics.
- **Stochastic differential equations and their numerical analysis** is concerned with analysis of almost sure stability/asymptotic stability in distribution of superlinear autonomous/non-autonomous stochastic (functional) differential equations and their applications in

population/epidemic modelling; Construction of explicit/implicit numerical methods and finite-time convergence analysis, numerical reproduction of asymptotic properties, especially, numerical approximation to invariant measure of superlinear autonomous/non-autonomous stochastic (functional) differential equations.

- **Topological Combinatorics** broadly lies at the intersection of topology and combinatorics. This interdisciplinary field uses methods and tools from algebraic topology to study combinatorial problems, including graph and hypergraph coloring, fair division problems, embedding of simplicial complexes, and related questions in discrete geometry such as Tverberg's type problems. A central approach in this area involves assigning a "meaningful" simplicial complex to a combinatorial structure, analyzing its topological properties, and then interpreting these results in the original combinatorial setting.
- **Computational/Mathematical Modelling of Clinical Medicine:** Effect of Mechanical Ventilation on Human Physiology, Brain, Neural, Cardiovascular and Respiratory systems. Design, develop, and apply computational models (using scientific computation, optimisation, and genetic algorithms) of human organ systems to address issues of impact in critical illness and clinical crisis scenarios. These models are developed in collaboration with the Intensive Care Unit of the University of Nottingham Hospitals, Fisher & Paykel, and Medtronic.
- **Bioengineering Modelling of Systems Biology and Drug Discovery:** Dynamics of Gene Regulatory Networks and cellular signalling and its consequences of environmental hazards caused by chemical mixtures, soils, and waters. My models are based on sets of mathematical equations and experimental data that simulate key biological processes and are used by pharmaceutical companies to accelerate their internal drug discovery and development programs. These models are done in collaboration with Bayer Pharmaceuticals.
- **Mathematical/Statistical Modelling Environmental Ecology and Epidemiology:** Predator-prey, Food chain, Epidemiology, Eco-epidemiology, Chaos, Diffusion and Pattern Formation in Ecology and Epidemiology, Control of Diseases in Agricultural and natural Ecological systems.
- **Calculus of Variations of PDEs and Orbital Stability:** Functional Analysis of Banach spaces, Stability of standing of the non-linear Schrödinger equation and the non-linear Klein-Gordon equation, effect of the Schwarz symmetrization on functionals of coupled equations, Concentration-Compactness of minimizing sequences, uniqueness and non-degeneracy of the ground state.

Department of Mechanical, Materials and Manufacturing Engineering

Head of Department: Professor Jian Yang

Department PGR Director: Dr Adam Rushworth

Staff profile page: People - University of Nottingham Ningbo China

Research areas:

The Department of Mechanical, Materials and Manufacturing Engineering (M3) classifies its research along four disciplinary research areas (R.1-4) and two application areas (A.1-2), offering MRes and PhD

research opportunities accordingly. Please inquire with M3's professors and/ or consult the lists of advertised topics with the graduate school to learn more.

R.1. Thermofluids

We investigate the fundamental and applied aspects of fluid dynamics and thermal energy to solve critical efficiency challenges.

- **Heat Transfer and Exchange:** We focus on next-generation thermal management, specifically the **cooling of high-density computing centres**, addressing the thermal bottlenecks of the digital age.
- **Single-, Multi-phase and Reactive Flows:** Our research spans complex fluid dynamics, from optimising **mixers and reactors** for chemical processing to enhancing **combustion systems**.

R.2. Human-Product Interaction

This group bridges the gap between complex engineering systems and human users, ensuring technology is intuitive and responsive.

- **Sensing and HMI:** We are redefining **automotive user interfaces** by integrating advanced sensing technologies to create safer, more immersive cockpits.
- **User Experience:** Through **user-centered design**, we explore the ergonomic and psychological aspects of product interaction to inform engineering decisions.

R.3. Materials and Structures

We are at the forefront of designing advanced materials that offer superior performance through structural innovation.

- **Lattice and Morphing Structures:** We develop smart structures capable of physical adaptation, including **shape memory structures** and **flexures**. Our work on **shock absorbers** utilises novel lattice geometries for superior energy absorption.
- **Composite Structures:** We focus on high-performance applications like **aerostructures** and **wind turbine blades**. Crucially, we address sustainability through research into **recycling** and safety via **flame-retardant structures**.
- **Fused and Additive Structures:** Pushing the boundaries of metallurgy, we explore **Directed Energy Deposition (DED)**, **graded structures**, and **laser epitaxy**. We are also pioneering **high-gravity in-situ fusion** to alter material properties at the microstructural level.

R.4. Dynamical Systems and Control

This group focuses on the mathematics and mechanics of motion, stability, and autonomy in complex environments.

- **Mechanisms, Actuators and Drives:** We engineer the future of motion with **multi-DOF actuation**, **active bearings**, and soft **robots**. We also investigate **energy harvesting** to power autonomous remote systems.
- **Vibration and Sound:** We utilise rigorous **structural computational models** to solve challenges in **structural dynamical responses**, **damping** and **sound absorption**, improving the acoustic signature and lifespan of machinery.

- **Vehicle Systems:** We design novel architectures for autonomous mobility across all domains: **UAVs (Aerial)**, **UGVs (Ground)**, **AUVs (Underwater)**, and bio-inspired **walking robot architectures**.

A.1. Manufacturing and Devices

We are dedicated to the science of making, investigating both the precision removal and the advanced addition of materials.

- **Material Removal:** We push the limits of subtractive manufacturing through **ultra-precision CNC machining** and precision **laser machining.**
- **Additive Manufacturing:** We are redefining production through **precision net-shape prototyping** and **hybrid rapid prototyping**. Key research areas include **epitaxial additive manufacturing**, **in-situ alloying**, and the study of **micro- and hyper-gravity powder feed** dynamics for space applications.

A.2. Vehicles and Powertrains

Our research addresses the future of mobility, focusing on energy efficiency and the emerging low-altitude economy.

- **Hybrid Powertrains:** We optimize **energy management** strategies for hybrid systems and are developing efficient **micro-gas-turbines** to decentralise power and propulsion.
- **Low Altitude UAVs:** We are enabling the "Low Altitude Economy" by developing specialised platforms, including **agricultural multicopters** and versatile **co-axial tilt-rotor** aircraft for urban mobility and logistics.

Research Centre

Human-centred Sustainable Interaction Research Centre

Head of Research Centre: Professor Wu Deng

Research areas:

- Low-Carbon, Smart Buildings & Urbanism: Designing energy-efficient, sustainable cities and buildings to reduce carbon footprints
- Digital Humanity and Heritage Preservation: Protecting cultural heritage while integrating AI technologies
- Urban Regeneration: Revitalizing underused urban spaces with sustainable redevelopment strategies.
- Indoor and outdoor thermal comfort: Investigating and optimizing thermal comfort in various indoor spaces; Addressing urban heat island effect and related challenges in cities through novel design approaches.
- Human-Computer Interaction: Intelligent sensing, augmented reality/virtual reality, human factor analysis, user interface design, signal processing.
- Human-centered integration: Developing technologies and systems that facilitate seamless human-to-human and human-to-machine collaboration, such as AI-assisted creative tools or co-working platforms.
- Intelligent transportation systems: Advancing self-driving vehicles with interactive technology to improve safety, efficiency, and user comfort
- User Centered Product Design: Involving end-users in the design process through co-creation workshops and feedback loops to ensure solutions meet real-world needs.
- Human factors and user experience design: Experience Design: Leveraging data on user behavior to inform design decisions, improving usability and engagement through evidence-based insights.

Power Electronics, Machines and Control Research Centre

Head of Research Centre: Dr Weiduo Zhao

Research areas:

- High performance electrical machine - electromagnetic, mechanical & thermal design
- High performance drive - advanced control algorithms, hardware design of machine controller
- Power electronic converters - energy control and conversion

Advanced Mechanical Engineering, Manufacturing and Mobility Research Centre

Head of Research Centre: Professor Yong Ren

Research areas:

(1) Strategic Research Themes in Materials and Structures

- Additive manufacturing and material processing
- Lattice structure design and optimization
- Composites manufacturing and recycling

(2) Strategic Research Themes in Advanced Intelligent Manufacturing

- Conventional & non-conventional material removal processes
- Processes for adding materials
- Modelling, dynamics and control of manufacturing processes
- Automation of manufacturing processes
- Chemical Reactors
- Reactive manufacturing processes
- Industrial innovative design
- Modeling of synthesis process of micro/nano functional particle materials
- Multiphase flow modeling and simulation
- Multiphase flow turbulence modeling
- Automation of Manufacturing Processes
- Process Planning and Lean Production

(3) Strategic Research Themes in Thermofluids

- Thermofluids within low-carbon energy technologies
- Thermofluids for intelligent and high-precision manufacturing
- Thermofluids in drones for low altitude economics
- AI-assisted studies on complex thermofluid systems

(4) Strategic Research Themes in Dynamics of Mechanical Systems and Control

- Mechanisms, Actuators and Drives (e.g., multi-DOF actuation; active bearings; robotics; energy harvesting)
- NVH and System Optimization (e.g., computational structural models; damping; sound absorption)
- Vehicle Systems (e.g., UAV architecture; UGV architecture)