UNNC – SIAT/SUAT Doctoral Training Partnership

It's essential that you have contacted the UNNC and SIAT/SUAT supervisors before applying.

Formal applications should follow the instructions in 'How to apply' section.

Research areas

- Biomedical Engineering
- Composite
- Electrical and Electronic Engineering
- Machines and Control
- Advanced and Intelligent Manufacturing
- Artificial Intelligence and Optimisation
- Big Data Analysis and Information System
- Advanced Energy and Environmental Materials

Available PhD topics

PhD topic	**A novel hybrid bio-nanocomposite fabricated by 3D printing for orthopaedic implant**
SIAT Supervisor	Yuanmiao Sun
UNNC Supervisor(s)	Dr. AKM Asif Iqbal Dr. Yi Nie
Short introduction & description of the PhD project	Biomaterial-based artificial bone implants are becoming popular for treating human bone problems. Developing artificial bone implants for bone repair is a significant topic in advanced bio-manufacturing. Traditional metallic biomaterials are permanent and non-degradable in physiological environments. These materials used in bone-fixing implants require re-surgery to retract following tissue healing. In addition, metallic materials have a higher elastic modulus and strength than real bone. This elastic modulus mismatch causes stress shielding, which limits bone development and remodeling to meet mineral content requirements. Eventually, the surrounding bone becomes weak and porous, causing implant failure. One prospective solution to the above problem is to develop a suitable material that shows similar mechanical properties to human bone, accelerates the healing process, and can be completely resorbed in the human body after the healing of the fractured bone. Therefore, we propose to develop a novel hybrid metal matrix composite that can possess all the properties necessary for the bone implant. The metallic composite will be fabricated by hydroxyapatite (HA) and graphene (GNP) reinforcement by using 3D printing. Their mechanical corrosion and degradation properties will be evaluated by experimental investigation and numerical modelling.
Contact points	Informal inquiries may be addressed to Dr. Yi Nie (yi-nie@nottingham.edu.cn) and Dr. Yuanmiao Sun (sunym@siat.ac.cn).

PhD topic	**Adaptive ultrasonic scanning for elasticity characterization and 3D ultrasonic imaging of soft human bodies with complex shape and acoustic property**
SIAT Supervisor	Prof. Shifeng Guo
UNNC Supervisor(s)	Prof. Jian Yang
Short introduction & description of the PhD project	Human organs generally have complex surfaces, medium heterogeneity, and multi-interface, resulting in complex ultrasound propagation behavior. Consequently, medical ultrasound diagnosis of such human organs has problems of poor image quality based on a simplified homogeneous model, difficulties in scan trajectory planning and posture control of ultrasonic transducer when scanning along a complex surface contour, and low efficiency in manual interpretation of two-dimensional images. This project aims at adaptive scan and three-dimensional ultrasound imaging of complex human structures. The critical scientific questions of this project include: (a) quantitative description of the spatial elasticity distribution of soft human organs and their impact on ultrasound propagation, (2) adaptive scan path planning and control for complex surfaces, (3) mapping and decoupling mechanisms between organ features and multi-dimensional ultrasound parameters. The following research activities will be implemented: (1) establishing an acoustic model that accurately reflects the interaction mechanism between ultrasound and organ through partitioned description of acoustic property distribution; (2) proposing an innovative scan strategy which uses a two-dimensional array probe to excite omnidirectional synthetic ultrasound beams, achieving full coverage scan with a fixed probe posture and a simple linear raster scan path. The unknown surface contour can also be reconstructed using surface reflection ultrasonic signals; (3) developing an ultrasonic ray tracing assisted imaging algorithm to achieve high-resolution three-dimensional imaging of human organs in full view; (4) combing the multi-dimensional acoustic parameters and machine learning algorithm for intelligent interpretation of human organ features to improve lesion detection sensitivity, quantitative sizing accuracy, and diagnosis automation level. Implementation of this project will provide theoretical guidance and new technical support for automated medical ultrasound scanning and imaging of human organs.
Contact points	Informal inquiries may be addressed to Prof. Shifeng Guo (sf.guo@siat.ac.cn) and Prof. Jian Yang (jian.yang@nottingham.edu.cn).
PhD topic	**Additive manufacturing of fullerite from fullerene**
SIAT Supervisor	Yang Bai
UNNC Supervisor(s)	Prof. Christos Spitas, Dr. Yi Nie
Short introduction & description of the PhD project	By ionising and accelerating fullerene molecules in vacuum to a precisely controlled narrow energy window, or by manipulating fullerene molecules with tightly focusd femtosecond laser, and directing them at a suitable substrate (e.g. graphene), we propose to cause controlled fusion of the fullerenes and the substrate, and subsequently of fullerenes to fullerenes in subsequent layers. We shall thereby develop an additive manufacturing process, capable of producing net shape fullerite to any scale, depending on application times, obtaining structures of unprecedented strength-to-weight ratio as well as several other beneficial multiphysical properties. The research will make use of both computational (MD, DFT) and physical models (new experimental apparatus) to prove the concept and produce a first demonstration of the process, the material, and their capabilities.

Contact points	Informal inquiries may be addressed to Dr. Yi Nie (yi-nie@nottingham.edu.cn) and Dr Yang Bai (y.bai@siat.ac.cn).
PhD topic	**Advanced materials for wide-temperature lithium batteries and related quantitative analysis method towards failure prediction**
SIAT Supervisor	Prof. Yongbing Tang
UNNC Supervisor(s)	Prof. Di Hu
Short introduction & description of the PhD project	Wide-temperature batteries are an essential advancement in electrochemical storage technology, catering to a broad spectrum of applications from electric vehicles operating in varying climatic conditions to space exploration. The necessity of wide-temperature lithium batteries stems from their ability to maintain performance and safety standards across a vast temperature range, typically from as low as -70°C to above 80°C. Traditional batteries often face challenges like decreased capacity, increased internal resistance, and risk of failure when subjected to such extremes. By enhancing the operational temperature range, these batteries not only expand the potential for existing technologies but also pave the way for new applications in harsh environments, underscoring their significance in the evolving landscape of battery technology. Wide-temperature batteries, however, are engineered with advanced materials and innovative design strategies to overcome these limitations. This research plan will focus on three aspects: high-performance electrolytes, where the ionic transport properties are closely related to its low-temperature performance, and its derivative interface are an important to mitigate cell aging; relevant failure analysis methods to achieve rapid and accurate material evaluation; advanced cell design for pouch/cylinder cell. This project touches upon the scientific issues related to wide-temperature lithium batteries, which are also of concern for large-scale energy storage applications. The project aims to expand candidate's knowledge in the field of practical lithium batteries.
Contact points	Informal inquiries may be addressed to Prof. Deng (w.deng@siat.ac.cn), Prof. Tang (tangyb@siat.ac.cn) and Prof. Hu (di.hu@nottingham.edu.cn).
PhD topic	**An Intelligent Computational Model for Early Detection of Alzheimer's Diseases**
SIAT Supervisor	Prof Zhanli Hu
UNNC Supervisor(s)	Asst. Prof. Fazl Ullah (Khan)
A short introduction and description of the PhD project	This project aims to use Artificial intelligence (AI) in developing efficient and reliable computational models for Alzheimer's disease (AD) prediction. AD is a neurodegenerative chronic disease that is one of the leading causes of dementia, an expensive disease all over the World reported in alz.org. Around 50 million people are affected by AD around the globe and the number is increasing as reported by WHO. In this regard, researchers have made lots of efforts to establish a system that can identify the disease's mechanism and causes, as well as prevent the disease from spreading. However, the high dimension with a small number of samples in analyzing brain images poses a significant barrier in research. In addition, due to the limited accuracy and explainability of existing techniques, Alzheimer's detection and progression prediction are still openly challenging problems. To overcome these issues, AI-based computation models are needed to be designed for the detection of AD in the early stage. In this project, the

	proposed system will use MRI and CT Scan images as well as sequential information of DNA, RNA, and some other proteins as information or patterns. The proposed systems will use AI algorithms for classification and detection.
Contact points	Informal inquiries may be addressed to Prof. Zhanli Hu (zl.hu@siat.ac.cn) and Prof. Fazlullah (Khan) (fazl.ullah@nottingham.edu.cn)
PhD topic	**Behavioral cognition and intention understanding of underwater small targets**
SIAT Supervisor	Yimin Zhou
UNNC Supervisor(s)	Dave Towey
Short introduction & description of the PhD project	The underwater environment is complex and changeable, and the adaptability and measurement accuracy of varied sensors in different spatial-temporal regions are quite diversified, hence the study on the underwater behavior understanding and behavioural trajectory prediction based on multimodal data is important for the underwater small target behavior understanding. It is of great significance for the underwater security system development towards intelligence and autonomy.
Contact points	Informal inquiries may be addressed to Yimin Zhou (ym.zhou@siat.ac.cn) and Dave Towy (dave.towey@ nottingham.edu.cn).
PhD topic	**Biodegradable polymer materials applied in the field of electronic packaging**
SIAT Supervisor	Prof. Rong Sun
UNNC Supervisor(s)	Dr Kok-Hoong Wong
Short introduction & description of the PhD project	With the popularity and rapid upgrading of mobile phones and computers and other electronic appliances, a large number of electronic waste needs to be disposed of. According to the United Nations, an average of 7.6 kg of e-waste was generated per person in 2021, meaning that more than 57.4 million tons of e-waste has been generated globally in 2021. If these e-waste is not properly dealt with, it will seriously endanger human survival, so it is an inevitable trend to develop environmentally friendly materials with degradable characteristics in the field of electronic packaging. This project will focus on biodegradable polymer materials through molecular design. After being utilized, the polymer materials can be decomposed in a mild acid environment such as acetic acid and soil, without causing environmental pollution, and alleviate the ecological pollution caused by e-waste from the source.
Contact points	Informal inquiries may be addressed to Prof. Rong Sun (rong.sun@siat.ac.cn) and Dr Kok-Hoong Wong (kok-hoong.wong@nottingham.edu.cn)
PhD topic	**Bioelectrochemical wastewater treatment system for ammonia production**
SIAT Supervisor	Prof. Lin XIA
UNNC Supervisor(s)	Dr Wai Siong CHAI
Short introduction & description of the PhD project	Ammonia is one of the most popular energy vectors with its zero carbon properties. The Haber-Bosch process producing ammonia has existed for more than a century and still requires high pressure high temperature condition for operation. The bioelectrochemical wastewater treatment system is anticipated to produce ammonia from the wastewater via

	environmentally-friendly process. The lifecycle analysis and environmental impact of such system also has to be evaluated. Based on this background, this project will focus on three dimensions (i) set up the bioelectrochemical wastewater treatment systems; (ii) test the efficiency for wastewater to fuel conversion; and (iii) perform the lifecycle analysis. The project would contribute to carbon neutrality and point the way for a sustainable future.
Contact points	Informal inquiries may be addressed to Dr Wai Siong CHAI (wai-siong.chai@nottingham.edu.cn) and Prof. Lin XIA (lin.xia@siat.ac.cn).
PhD topic	**Biomimetic construction and biological application of non-cellular hybrid systems**
SIAT Supervisor	Prof. Ping Gong
UNNC Supervisor(s)	Dr. Yong Ren
Short introduction & description of the PhD project	Using the designability characteristics of artificial components such as supramolecules, fluorescent probes, micro-nano particles, nucleic acid aptamers, peptides, etc., combined with the advantages of biological components such as antibodies, enzymes, cell membranes, vesicles, etc., to construct bionic non-cell hybrid systems, giving non-cell hybrid systems perception and autonomous movement functions, and applying them to the diagnosis and treatment of gastrointestinal tumors.
Contact points	Informal inquiries may be addressed to Yong Ren (email yong.ren@nottingham.edu.cn) and Ping Gong (ping.gong@siat.ac.cn).
PhD topic	**Care Quality Assessment and Health Economic Analysis based on Electronic Health Record Data to Improve Quality and Efficiency of Care in Hospital Settings**
SIAT Supervisor	Professor Jinling Tang
UNNC Supervisor(s)	Professor Zhuo Chen
Short introduction & description of the PhD project	It is important to continue to improve the quality and cost-effectiveness of health care in hospitals in China, the predominant care provider, to tackle the consistent increasing disease burden and healthcare costs in China due to population aging and people's demand for high quality medical care. Care quality can be revealed by service variations and further assessed by comparing particular selected care items with guidelines or internal standards. Health economic analysis can be conducted by comparing the effectiveness of selected actual care items with costs required. The student will work with a collaborative team of SIAT and UNNC senior researchers to conduct studies based on data from electronic health records of some 5 million old hospital patients. The project is important for improving the quality and efficiency of hospital services. All analyses will be conducted with strict adherence to ethical and regulatory guidelines. Deliverables from the project will provide important evidence on quality and cost-effectiveness of selected care items with a long term goal of improving healthcare services and aiding future policymaking. The student will have opportunity to work with an international team including leading experts in evidence-based medicine and health economics.
Contact points	Informal inquiries may be addressed to Professor Zhuo Chen (Zhuo.Chen@nottingham.edu.cn) and Professor Jinling Tang (jltang@siat.ac.cn).

PhD topic	**Combining Deep Learning and Ontology Reasoning for Medical Image Semantic Segmentation**
SIAT Supervisor	Prof Shuqiang Wang
UNNC Supervisor(s)	Dr Heshan Du
Short introduction & description of the PhD project	Generative artificial intelligence refers to new technologies that employ existing data including images, text, and audio files to create new content. This new content has a similar underlying pattern of real-world data and has great potential applications in many areas. Synthetic data from generative AI can train machine learning models to be less biased and help robots to learn more abstract concepts both in the real and virtual world. An ontology refers to an explicit specification of a shared conceptualization and plays an important role in establishing a common vocabulary for people who need to share information. It defines the meanings of concepts and relations explicitly, and these definitions can be read and interpreted by machines automatically. Consider the image segmentation problem as an example. To improve the interpretability and reliability of deep learning-based image semantic segmentation methods, it is promising to represent domain knowledge and inference rules defined by human beings as ontologies and incorporate ontology reasoning into the deep learning framework. This research will explore (1) the advances, challenges, and prospects of brain image computing and brain network computing techniques using generative artificial intelligence; (2) the effectiveness of combining deep learning and ontology reasoning for medical image segmentation, object detection and classification, etc.
Contact points	Informal inquiries may be addressed to Prof Shuqiang Wang (sq.wang@siat.ac.cn) and Dr Heshan Du (heshan.du@nottingham.edu.cn).
PhD topic	**Complex spatiotemporal network control based on reinforcement learning**
SIAT Supervisor	Dr. Ling Yin
UNNC Supervisor(s)	Dr. Huan Jin
Short introduction & description of the PhD project	Complex spatiotemporal network control is of significance for many areas such as epidemic control and transportation control. Reinforcement learning (RL) is suggested as a useful tool to address these issues. However, there are some challenges to deal with a complex spatiotemporal network such as the uncertainty of environment in real-world situation, the large discrete action Space problem, the game and coordination between multiple agents, the complex spatiotemporal dynamics embedded within the networks and so on. This project aims to develop approaches to address the above challenges and apply these RL-based control methods to real-world problems in epidemic control and transportation control. This project is funded by National Natural Science Foundation of China and the Key R&D Program of the Ministry of Science and Technology of China.
Contact points	Informal inquiries may be addressed to Dr. Ling Yin (yinling@siat.ac.cn) and Dr. Huan Jin (Huan.Jin@nottingham.edu.cn).
PhD topic	**Computer-Aided Drug Design Based on Machine Learning**

SIAT Supervisor	Dr Jijun Tang
UNNC Supervisor(s)	Dr Weihua Meng
Short introduction & description of the PhD project	Traditional drug research and development is a time-consuming and laborious process. From target discovery to lead compound generation to candidate drugs, it requires a lot of human and financial resources. Computer-aided drug molecular design can accelerate the process of drug molecular research and development. The molecular design aims to generate molecular compounds with high affinity for certain receptor targets, and also have good biological function characteristics. According to the different representations of molecular compounds, the existing drug research and development directions can be roughly divided into three categories: molecular generation based on one-dimensional molecular description, molecular generation based on two-dimensional molecular description, and molecular generation based on three-dimensional molecular description. In addition, molecular generation tasks can be divided into two types according to the molecular generation tasks. The first type is molecular generation based on a single target, and the second type is molecular generation based on multiple targets, indicating that the generated molecules need to target more than two targets at the same time. The student will gain relevant research experience in the design of drug-like molecules. The student would cultivate the skills of study design, analysis of molecular data (one-dimensional representation, two-dimensional representation of drug-like molecules, etc.), constructing deep learning model architectures, and drug-related experimental processing methods. Molecule analysis, programming, and academic writing will be provided. The student will be supported to publish papers as the lead author during the Ph.D. The ideal candidate should have a Master's degree in Bioinformatics or computer science. Proficiency with Python is essential.
Contact points	Informal inquiries may be addressed to Dr Jijun Tang (jj.tang@siat.ac.cn) and Dr Weihua Meng (Weihua.Meng@nottingham.edu.cn).
PhD topic	**Cone-beam CT Guided Radiation Therapy**
SIAT Supervisor	Prof. Yaoqin Xie
UNNC Supervisor(s)	Prof. Sean He
Short introduction & description of the PhD project	Image Guidance is critical during radiation therapy, Medical imaging plays an essential role in cancer diagnosis, treating plan and radiotherapy. But during the treating course, tumors position would change caused by breathing and filling of hollow organs, and irregular movement caused by emotional stress. This my laed to target region inaccuracy and trouble on tumor track and the plan to continue treatment. Image processing techniques based on machine learning can improve these problems, by learning natural mark supervised learning the matching relation, or by learning multimodal fusion problem. These problems will be the main focus during the project.
Contact points	Informal inquiries may be addressed to Prof Sean He (sean.he@nottingham.edu.cn) and Prof Yaoqin XIE (yq.xie@siat.ac.cn).
PhD topic	**De Novo Molecular Design Against Given Targets Using Large Language Models**
SIAT Supervisor	Dr Yi Pan
UNNC Supervisor(s)	Dr Bencan Tang

Short introduction & description of the PhD project	De novo molecular design is a computational technique aimed at generating novel compounds with desirable property profiles from the ground up. It serves as a complement to virtual screening, where extensive virtual compound libraries are pregenerated, stored, and subsequently ranked as needed. The chemical space in virtual screening, encompassing all possible molecules, is vast. Although enumerated virtual screening libraries have become enormous by drug discovery standards, with many containing over a billion molecules, they represent only a minuscule portion of the entire chemical space. Furthermore, in evaluating libraries of such magnitude, methods may inevitably sacrifice predictive validity. By adopting a directed approach to generate compounds through de novo design, computational practitioners aim to navigate chemical space more effectively. This project aims to investigate the design and generation of de novo molecules using large language models. We will conduct a systematic review of machine learning and deep learning-based de novo molecular design studies to consolidate relevant evidence and identify critical gaps for future research. Additionally, we will explore the application of large language models in de novo molecular design. The student involved in this project will gain expertise in machine learning-based molecular design research and the analysis of biomedical data. They will develop skills in conducting systematic literature reviews, study design, statistical programming, and data analysis. Support will be provided for the student to publish peer-reviewed papers as the lead author during their Ph.D. The training will cover artificial intelligence-based drug design methods, advanced statistics, programming, and academic writing. The ideal candidate should hold a Master's degree in Pharmaceutical Sciences, Computer Science, Mathematics, or Biomedical Engineering. Proficiency in Python programming, PyTorch, AutoDock, and Maestro is essential.
Contact points	Informal inquiries may be addressed to Dr Yi Pan (yi.pan@siat.ac.cn).
PhD topic	**Deep Multimodal Representation Learning for Mental Health Diagnosis**
SIAT Supervisor	Dr. Wenjian Qin
UNNC Supervisor(s)	Prof. Ruibin Bai
Short introduction & description of the PhD project	Mental disorders, such as depression, schizophrenia, attention-deficit hyperactivity disorder (ADHD), and autism spectrum disorder (ASD), etc, are highly prevalent and have been shown to harm to an individual's physical and mental health. Moreover, mental health illnesses have also been one of the most serious and prevalent public health problems, leading to an increased risk for suicidal ideation and suicide attempts. However, the mechanisms of mental disorders are complexity and heterogeneity. It makes difficulty to identify precision diagnosis markers from single source and unimodality. Consequently, there is no unique and efficient clinical characterization of mental disorders. Therefore, to utilize multimodal data including multimodal neuroimaging, electroencephalography (EEG) et.al. for large-scale screening, detection, early finding and precision diagnosis of mental health problems might be a promising solution. Artificial intelligence (AI) technologies are being applied to improve our understanding of mental health conditions and have been engaged to assist mental health providers for improved clinical decision-making. Especially, deep multimodal representation learning has benefited various applications involving screen, diagnosis, treatment plan and prognosis. However, one of

	the great challenges we are confronted with is the heterogeneity gap in multimodal data. This project will focus on three challenges:(a) Multimodal neuroimaging image processing and registration algorithm design. (b) EEG signals feature information extraction. (c) Deep multimodal representation learning model for screening, detection, early finding and diagnosis of mental illnesses to extract a representation from multimodal neuroimaging image, EEG signals and electronic health records information.
Contact points	Informal inquiries may be addressed to Dr Wenjian Qin (wj.qin@siat.ac.cn) and Prof Ruibin Bai (Ruibin.bai@nottingham.edu.cn).
PhD topic	**Design of high performance low dielectric polymer composites for integrated circuit packaging materials**
SIAT Supervisor	Prof. Shuhui Yu
UNNC Supervisor(s)	Dr. Yong Ren
Short introduction & description of the PhD project	With the development of 5G and 6G high-speed communication technology, the demand for high-speed data transmission has increased tremendously. This has put forward extremely high performance requirements for electronic packaging media materials, from physical properties to process suitability and reliability. The key technical issues include: reducing high frequency signal transmission loss, reducing package warpage, and improving high temperature resistance. This requires dielectric materials for packaging to have low dielectric constant (D_k), low dielectric loss (D_f), low coefficient of thermal expansion (CTE) and high glass transition temperature (T_g) in high frequency applications. This project will regulate the rheological, thermal, mechanical and electrical properties of resin composites by means of molecular structure design and modification of fillers. Meanwhile, the correlation between the microstructure and macroscopic properties will be investigated deeply to achieve the balance of D_k, D_f, CTE and T_g.
Contact points	Informal inquiries may be addressed to Prof Shuhui YU (sh.yu@siat.ac.cn) and Dr. Yong Ren (Yong.Ren@nottingham.edu.cn).
PhD topic	**Design, Control and Application of Soft Medical Robots**
SIAT Supervisor	Prof Zeyang Xia
UNNC Supervisor(s)	Dr Dunant Halim
Short introduction & description of the PhD project	Soft robots have high flexibility and continuous deformability that can cover complex task spaces by using soft materials, and therefore have a wide range of applications in medical science. However, there are still several challenges in soft medical robots. First, a well-designed structure can reduce the control difficulty of soft robots and improve the accuracy and performance. However, traditional example-oriented methods are not capable to satisfy the requirement of design optimization. Second, traditional control strategies also need to be improved due to the high flexibility of soft medical robots in order to avoid organ damage and improve treatment prediction. Finally, application of soft medical robots requires a methodology of customization that satisfies patient specific requirements. This project will focus on three major objectives: (i) design (design optimization of soft actuator), (ii) control (control algorithms towards soft robots), and (iii) innovative applications of soft medical robots.

Contact points	Informal inquiries may be addressed to Prof. Zeyang Xia (zy.xia@siat.ac.cn) and Assoc. Prof Dunant Halim (dunant.halim@nottingham.edu.cn).
PhD topic	**Developing ultrasensitive diagnostics by combining directed evolution and surface plasmon resonance**
SIAT Supervisor	Dr Xiao Yi
UNNC Supervisor(s)	Dr Jing Wang
Short introduction & description of the PhD project	Surface Plasmon Resonance (SPR) technology uses a surface-sensitive optical instrument to detect heavy metals, viruses or pathogenic bacteria by specific binding of these targets with probing molecules such as proteins. While a robust and versatile probe, naturally occurring proteins are usually insufficient in their binding affinity to the targets, thereby limiting the sensitivity of SPR based diagnostics. Directed evolution mimics the cycle of mutagenesis and natural selection in nature to evolve novel or improved protein functions, and have been serving a workhorse for engineering proteins for industrial and medical applications. Recent advances of this technology such as Targeted Artificial DNA Replisome (TADR) further boosts the capacity of optimizing protein functions. TADR is able to (i) target a region no less than a gene and show low off-target mutagenesis, (ii) carry out a high mutation rate that can be turned on and off, and (iii) work with any trait that can be screened. This project will focus on (i) constructing TADR in *Saccharomyces cerevisiae* and (ii) evolving probe proteins to be used in SPR sensor chips.
Contact points	Informal inquiries may be addressed to Dr Jing Wang (Jing.Wang@nottingham.edu.cn) and Dr Xiao Yi (xiao.yi@siat.ac.cn).
PhD topic	**Development and application of microfluidic tumor-immune interaction models**
SIAT Supervisor	Dr. Jiandong Wu
UNNC Supervisor(s)	Dr. Yong Shi
Short introduction & description of the PhD project	The high specificity of the tumor microenvironment (TME) and the species differences between animal models and humans lead to significant disparities between traditional in vitro and in vivo models and the actual TME. Leveraging techniques from engineering, biology, and physics, microfluidic device holds the promise to provide a more authentic, precise, and controllable physiological environment, presenting a substantial advantage in the creation of in vitro cancer models. This project will focus on development of microfluidic tumor-immune interaction models characterized by high throughput, high vascularity, and the ability to replicate the role of immune system in cancer development. Potential applications of these sophisticated models will include understanding of role of the immune system in cancer progression, as well as evaluating different immunotherapy methods such as the immune cell therapy and immune checkpoint therapy.
Contact points	Informal inquiries may be addressed to Dr. Yong Shi (Yong.Shi@nottingham.edu.cn) and Dr. Jiandong Wu (jd.wu@siat.ac.cn).
PhD topic	**Development of stretchable electronics for biomedical applications**
SIAT Supervisor	Prof. Zhiyuan Liu
UNNC Supervisor(s)	Dr. Yong Ren

Short introduction & description of the PhD project	Stretchable electronics has evolved with the synthesis of new soft materials and new device architectures that require significant deformability; therefore, it has high application potentials in wide range of biomedical areas such as biosensors. This project will focus on study of the solid-liquid phase transition and plastic deformation of liquid metal alloy and fabrication of liquid metal alloy based flexible electronic devices which are composed of 3D circuits. Our work will lead to the development of 3D structured wearable sensor and a multilayer flexible circuit board. It will provide a facile strategy for constructing highly integrated electronics of hierarchical structure involving complicated 3D circuits.
Contact points	Informal inquiries may be addressed Prof. Zhiyuan Liu (zy.liu1@siat.ac.cn) and Dr Yong Ren (yong.ren@nottingham.edu.cn).
PhD topic	**Development, evaluation, and clinical trials of biomaterials & medical devices**
SIAT Supervisor	Prof. William Weijia Lu
UNNC Supervisor(s)	Dr Enrico Marsili
Short introduction & description of the PhD project	1. 3D-bioprinted osteoblast-laden hydrogel constructs with induced microenvironments promote cell viability, differentiation, and osteogenesis both in vitro and in vivo 2. Drug& device modulates osteogenic activity of bone biomaterials for bone formations
Contact points	Informal inquiries may be addressed to Prof. William Lv (wwlu@siat.ac.cn) and Prof. Enrico Marsili (enrico.marsili@nottingham.edu.cn).
PhD topic	**Differential Regulation of Cellular and Bacterial Behaviors Based on Nanostructures and Investigation of Underlying Mechanisms**
SIAT Supervisor	Prof. Guocheng Wang
UNNC Supervisor(s)	A/Prof. Enrico Marsili
Short introduction & description of the PhD project	Titanium and its alloys, collectively referred to as titanium alloys, possess high mechanical strength, excellent biocompatibility, strong corrosion resistance, and wear resistance. As a result, they have become widely used materials for the repair of hard tissues such as bones and teeth. However, there are two significant issues with clinical titanium alloy implants: inadequate bone-inducing capacity and a lack of antimicrobial and antibiofilm activity. Therefore, the current focus and challenge in research lie in how to endow implants with antimicrobial and antibiofilm capabilities and achieve bone integration through surface modification strategies. In recent years, the promotion of cellular functions and the inhibition of bacterial adhesion by nanostructures have received considerable attention. Based on this, the aim of this project is to develop a novel strategy for constructing nanostructured surfaces on implants, systematically investigate the differential regulatory mechanisms of nanostructures on cells and bacteria, and develop an implant surface that not only possesses antimicrobial functionality but also inhibits biofilm formation and bacterial activity to prevent bacterial infections.
Contact points	Informal inquiries may be addressed to A/Prof. Enrico Marsili (enrico.marsili@nottingham.edu.cn) and Prof. Guocheng Wang (gc.wang@siat.ac.cn).
PhD topic	**Efficient Test for Safety of Autonomous Driving Systems**

SIAT Supervisor	Huiyun Li
UNNC Supervisor(s)	Jian Yang
Short introduction & description of the PhD project	Nowadays, the industrialization and wide ranges of applications of autonomous driving technologies still face challenges. Test the safety of Autonomous Driving Systems (ADS) with realistic traffic conditions is important to the insurance industry, legislators, and third-party technical services. However, the scarcity of risky driving events distributed in real-world driving often makes sampling inefficient. A unified and hierarchical testing framework for efficient and unbiased tests of ADS is targeted.
Contact points	Informal inquiries may be addressed to Prof Huiyun Li (hy.li@siat.ac.cn) and Prof Jian Yang (jian.yang@nottingham.edu.cn).
PhD topic	**Engineering living building material**
SIAT Supervisor	Dr Zhuojun Dai
UNNC Supervisor(s)	Dr Bo Li
Short introduction & description of the PhD project	Living building materials utilize microorganisms to produce construction materials that exhibit mechanical and biological properties. The resultant materials could have the capacity to self-repair and self-replicate, sense local and distant disturbances in their environment, and respond with functionalities for reporting, actuation or remediation. However, few engineered living materials are capable of both responsivity and use in macroscopic structures. Therefore, we proposed to engineer microbial consortia that can form mouldable, foldable and regenerative living structures. This living building material could be further strengthened and optimized by integrating with the nano-materials. By this strategy, we can facilitate the development of living biomaterials with new properties and functionalities.
Contact points	Informal inquiries may be addressed to Dr. Bo Li (bo.li@nottingham.edu.cn) and Prof Zhuojun Dai (zj.dai@siat.ac.cn).
PhD topic	**Federated Fusion-based Privacy-preserved multi-stage multi-classification System**
SIAT Supervisor	Prof. Na Zhang
UNNC Supervisor(s)	Prof Xiangjian (Sean) He
A short introduction and description of the PhD project	The Internet of Things (IoT), especially in healthcare, generates a vast amount of complex data. This requires significant attention in managing the data influx to perform timely and accurate diagnoses. As a result, numerous AI and data fusion models have been proposed but these are prone to issues, such as privacy, complex structure, and variance in healthcare data. In this project, we aim to propose a two-stage multi-classification model in IoT-enabled federated fusion for Breast Cancer (BC). The proposed model integrates an enhanced VGG-16 (eVGG-16) Convolutional Neural Network with L1 regularization and a dropout layer to identify BC and its associated stages. First, we identify cancer cells via binary classification, and then we identify cancer stages using multi-classification. However, in multi-classification, standard models struggle to capture patterns from data due to their complex structure. Therefore, federated learning (FL) is used to train eVGG-16 on a fused dataset of BC, which is then deployed on client devices (hospital). The proposed arrangements ensure the preservation of privacy, while the data

	fusion adds depth and context to the complex BC data, enabling us to circumvent complexities and achieve higher precision.
Contact points	Informal inquiries may be addressed to Prof. Na Zhang (na.zhang@siat.ac.cn) and Xiangjian (Sean) He (sean.he@nottingham.edu.cn).
PhD topic	**Fiber-optic sensors for soft robots and stretchable electronics**
SIAT Supervisor	Prof. Zhengkun Yi
UNNC Supervisor(s)	Dr. Jing Wang
Short introduction & description of the PhD project	Soft robots are capable of mimicking complex motions of human beings and animals. Embedded soft sensors are important for soft robots to sense and response to its surroundings. Unfortunately, most sensors are made out of conventional electronics, which is rigid and is not suitable for soft robotic applications. Alternatively, fiber-optic sensor has a number of unique advantages compared with its electronics counterpart. Fiber-optic sensors have been a powerful tool for sensing a wealth of physical quantities such as strain, pressure, vibration, temperature and so on. This project will aim to develop fiber-optic sensor for soft robots and stretchable electronics., including 1) the development of novel fiber-optic sensor with large strains that can be used for soft robotics and stretchable electronics, 2) the development of advanced machine learning methods for interpreting optical signals, and 3) integration of the developed sensors and algorithms for various applications such as soft robot hand, tactile glove, exoskeleton robots.
Contact points	Informal inquiries may be addressed to Prof. Zhengkun Yi (zk.yi@siat.ac.cn) and Dr. Jing Wang (Jing.Wang@nottingham.edu.cn).
PhD topic	**Generative AI and computational intelligence for healthcare**
SIAT Supervisor	Shuqiang Wang
UNNC Supervisor(s)	Ruibin Bai
Short introduction & description of the PhD project	This topic mainly focus on the application of advanced algorithms and machine learning techniques in the field of healthcare to generate, analyze, and make sense of large amounts of data. This interdisciplinary approach combines the power of artificial intelligence and computational methods to develop innovative solutions for improving patient care, disease diagnosis, treatment planning, and medical research. By leveraging generative AI and computational intelligence, healthcare professionals can gain valuable insights, predict outcomes, and optimize medical processes, ultimately leading to more personalized and effective healthcare interventions.
Contact points	Informal inquiries may be addressed to Shuqiang Wang (sq.wang@siat.ac.cn) and Ruibin Bai (ruibin.bai@nottingham.edu.cn).
PhD topic	**Health monitoring and function assessment based on wireless sensor networks and machine learning**
SIAT Supervisor	Xiangxin Li
UNNC Supervisor(s)	Pushpendu Kar
Short introduction & description of the PhD project	Monitoring and analysis the human physiological information to assess the functions of human movement and cognition based on wireless sensor networks and machine learning.

	It mainly includes the researches of wireless sensor networks for the real-time acquisition of multimodal physiological information such as EEG, EMG, blood bleeding oxygen and ultrasonic image, biomedical signal processing, high-performance information mining and characterization, internet of things, and the development and application of machine learning algorithms.
Contact points	Informal inquiries may be addressed to Dr Pushpendu Kar (Pushpendu.Kar@nottingham.edu.cn) and Dr Xiangxin Li (lixx@siat.ac.cn).
PhD topic	**High adaptability and reliability of wearable device systems in Internet of medical Things dealing with the extremes of changing physical conditions and environment in special applications**
SIAT Supervisor	Ye Li
UNNC Supervisor(s)	Ruibin Bai
Short introduction & description of PhD project	Internet of Medical Things (IoMT) has been promoted in widespread digital health applications, with the technical development on wearable devices, Internet of Things, and artificial intelligence, etc.. Currently, the most common application scenarios are, for instance, daily healthcare and smart home. However, there are a variety of application scenarios to be covered, in which the environment differs extremely from normal use cases. For example, in the firefighting application, the safety of firefighters should be ensured with the use of wearable devices. Real-time health monitoring needs to be realized by collecting firefighters' physiological data, while accurate localization and mapping by integrating the fire ground environmental data. For such special applications, new wearable devices and systems are in need of development to deal with the interrupt and disturbance by the extremes of changing environment, such as signal lost, energy shortage and equipment fault caused by heat, smoke, damp, dust, etc.. The heterogeneous structure of Internet of Things and the substantial growth of communication and computation capacity provide an opportunity to wearable devices to exploit intelligent networking solutions merging with AI-assisted strategies. Therefore, the design and technology of wearable device equipment and system should address multi-factors of solving problems for special applications and other relevant issues. This project will focus on two major dimensions on (i) adaptive wearable device and system, looking at pre-warning and adaptable sensing in dynamic environment and (ii) accurate algorithms, including real-time processing and feedback and accurate decisions.
Contact points	Informal inquiries may be addressed to Prof. Ruibin BAI (ruibin.bai@nottingham.edu.cn) and Prof. Ye LI (ye.li@siat.ac.cn).
PhD topic	**High performance electrically conductive composites for electromagnetic interference (EMI) shielding**
SIAT Supervisor	Yougen Hu
UNNC Supervisor(s)	Xiaoling Liu
Short introduction & description of the PhD project	High performance EMI shielding materials with lightweight, mechanical toughness or flexibility have been an important research field because the development of high-speed communication technology (5G and beyond 5G) and new wearable electronic devices causes considerable EMI harmful effects on the equipment and human health. Electrically conductive

	composites are one of the most critical materials to solve the EMI problems. This project will focus on the high performance electrically conductive composites through novel chemical and microstructure design, and dedicate to improving their versatility including flame retardant, thermal conductive and recyclability, etc. Moreover, the application of the high performance electrically conductive composites will also be demonstrated.
Contact points	Informal inquiries may be addressed to Prof Xiaoling Liu (Xiaoling.liu@nottingham.edu.cn) and Prof Yougen Hu (yg.hu@siat.ac.cn).
PhD topic	**High speed motor design and control**
SIAT Supervisor	Tianfu Sun
UNNC Supervisor(s)	Jing Li
Short introduction & description of the PhD project	Motor is the prime mover for both industry and domestic applications. With the increasing performance of power electronics and micro-processor (MCU), higher speed becomes the trend of the motor technique. Increase of the motor rated speed can significantly enhance the motor power density and make the whole system lighter and more compact. Therefore, high speed motor could be widely applied in automobile industry, robotics, aerospace industry, etc. However, higher speed will also bring more changelings. This project will focus on two major dimensions: (i) high speed motor design, including multi-physical field simulation analysis, electromagnetic optimization, thermal and stress analysis of high-speed motor; (ii) high speed motor control, including design and prototype of wide-bandgap power module-based motor drive, development of advanced sensor-less control strategy and etc.
Contact points	Informal inquiries may be addressed to Prof Tianfu Sun(tf.sun@siat.ac.cn) and Prof Jing Li (Jing.Li@nottingham.edu.cn).
PhD topic	**High throughput screen and optimized design of RNA-vaccine enzymes by natural language processing approaches.**
SIAT Supervisor	Chunbo Lou
UNNC Supervisor(s)	Xiangjian (Sean) He
Short introduction & description of the PhD project	By combining high-throughput experiment and natural language processing algorithm to mining and optimizing potent biological regulatory parts. Specially, we are interested in the design of regulatory elements for next generation RNA technology and gene therapy, e.g. efficient RNA Capping enzymes for RNA vaccine.
Contact points	Informal inquiries may be addressed to Xiangjian He (Sean.He@nottingham.edu.cn) and Chunbo Lou (cb.lou@siat.ac.cn).
PhD topic	**High-conductive electrolyte membrane with functionalized anisotropic nanochannels for solid-state lithium battery**
SIAT Supervisor	Prof. Baofu Ding
UNNC Supervisor(s)	Dr Yong Ren
Short introduction & description of the PhD project	Polymer electrolyte membranes are critical components in solid-state batteries, such as lithium-ion batteries. They conduct specific ions while isolating electrons, thereby facilitating and controlling specific electrochemical reactions and enhancing the energy density and safety of these batteries. Introducing ion conductive channels or ion-exchange functional groups into the polymer matrix through chemical and physical

	methods can effectively enhance ion conductivity. However, polymer electrolytes often encounter the task of low conductivity, limiting the development of solid-state battery performance. the trade-off between selectivity and throughput in electrolyte membranes remains a challenging issue. Based on this background, this project will focus on (i) Design and synthesis of new amphiphilic functionalized organic molecules, (ii) precise control of the self-assembly behaviour and polymerization kinetics of monomolecular entities, (iii) large-scale manufacturing processes for polymer electrolyte membranes. These efforts aim to strengthen the ion transport performance of polymer dielectrics, achieving precise sieving and efficient transport of specific ions.
Contact points	Informal inquiries may be addressed to Prof. Baofu Ding (bf.ding@siat.ac.cn) and Assoc. Prof. Nicholas Musyoka (yong.ren@nottingham.edu.cn).
PhD topic	**High-performance of microelectronic devices focusing on facile Mass production of perovskite-based ceramics materials and failure analysis of ultra-thin layer microelectronic devices**
SIAT Supervisor	Prof. Lei Zhan
UNNC Supervisor(s)	Prof. AKM Asif Iqbal
Short introduction & description of the PhD project	As the usage of ceramics capacitor has become broader, the environment in which ceramics capacitors have to be operated is now harsher than ever. They are applied in areas such as an automobile engine and electronic devices for severe environment and these applications require ceramics capacitors to work under conditions with a broad temperature range. The temperature dependence of dielectric nonlinearity can be alleviated by a complete solid solution with perovskite-based ceramics. (i) advanced perovskite-based ceramics materials and their microstructures/microchemistry for semiconductor /microelectronic devices; and (ii) failures analysis of semiconductor and microelectronic devices.
Contact points	Informal inquiries may be addressed to Prof. AKM Asif Iqbal (AKM-Asif.Iqbal@ nottingham.edu.cn) and Prof. Lei Zhang (zhanglei@siat.ac.cn).
PhD topic	**Intelligent biomimetic materials, neural interfaces, bioelectronics, tissue engineering, soft sensors/actuators, wearable/implantable biodevices**
SIAT Supervisor	Prof. Xuemin DU
UNNC Supervisor(s)	Prof Guang Zhu
Short introduction & description of the PhD project	Implantable neural interfaces and systems have attracted much attention due to their remarkable effects for treating diverse neuropsychiatric disorders, however, the low-affinity interface and large geometrical mismatch between the neural interface devices and tissues remain big challenges. Emerging stimuli-responsive shape-changing polymers have opened new avenues for addressing the above challenges for neural interface devices. This project will focus on i) developing new stimuli-responsive shape-changing polymers for enhancing the geometrical compliance of the neural interface devices to curved nerve tissues; ii) investigations into the cellular affinity to the shape-adaptable neural interface devices; and iii) applications of the shape-adaptable neural interface devices for

	treating neuropsychiatric isorders such as retinal degenerative diseases.
Contact points	Informal inquiries may be addressed to Prof Guang Zhu (Guang.Zhu@nottingham.edu.cn) and Prof Xuemin DU (xm.du@siat.ac.cn).
PhD topic	**Intelligent collaborative regulation of cross-scale electric vehicles**
SIAT Supervisor	Zhile Yang
UNNC Supervisor(s)	Prof Ruibin Bai
Short introduction & description of the PhD project	The generation, transmission, storage and application of energy is an important topic for human survival and development. Under the multiple pressures of environmental protection, energy structure transformation, energy conservation and emission reduction, the world is vigorously promoting the development of the electric vehicle industry. In the face of the characteristics of electric vehicle user behaviour and energy perception, such as strong spatiotemporal randomness, a large proportion of user willingness, and deep integration of multiple factors, the realization of high generalization and robust optimization and control of electric vehicle cluster energy interconnection, modelling and intelligent collaboration is a necessary research to improve vehicle owner economy, power grid stability, system operating costs, and operator benefits. To achieve the above goals, the project will focus on the following three directions: (i) Integration of multi-objective group intelligent optimization algorithms to achieve individual energy interconnection modelling and collaborative regulation. (ii) Establish a variety of energy interconnection regulation models within and across clusters, and introduce a large-scale swarm intelligence optimization algorithm to solve the difficulties of cluster energy interconnection collaborative optimization regulation. (iii) Integration of large language models to achieve model self-training and self-selection for group perceptual scheduling optimization of electric vehicles.
Contact points	Informal inquiries may be addressed to Prof. Zhile Yang (zl.yang@siat.ac.cn) and Prof Ruibin Bai (ruibin.bai@nottingham.edu.cn).
PhD topic	**Ion-permselective membranes with angstrom-scale nanochannels for wastewater treatment**
SIAT Supervisor	Prof. Baofu Ding
UNNC Supervisor(s)	Dr Wai Siong CHAI
Short introduction & description of the PhD project	The freshwater resources available for direct human use constitute only a tiny fraction (0.007%) of the global water resources. Membrane for water treatment, through selective separation and removal of ions from water, holds great potential in addressing water purity and scarcity issues. Conventional membrane-based water treatment technologies include electrodialysis, reverse osmosis, and forward osmosis. Forward osmosis, operating based on the natural osmotic pressure gradient across the membrane, stands out due to its extremely low energy consumption. However, the trade-off between selectivity and throughput in forward osmosis remains a challenging issue. Based on this background, this project will focus on (i) the uniform construction of anisotropic two-dimensional nanochannels, (ii) precise control of nanochannel dimensions, (iii) functionalization strategies of nanochannels. These efforts aim to enhance the ion rejection rate and water

	transport performance of water treatment membranes, as well as paving for carbon-neutral future.
Contact points	Informal inquiries may be addressed to Prof. Baofu Ding (bf.ding@siat.ac.cn) and Dr Wai Siong CHAI (wai-siong.chai@nottingham.edu.cn).
PhD topic	**IoT-based detection and solution of heart diseases**
SIAT Supervisor	Prof. Nie Zedong
UNNC Supervisor(s)	Dr. Pushpendu Kar
Short introduction & description of the PhD project	According to report, 30% of all deaths are related to circulatory systems problems, like arrhythmias, myocardial ischemia, or prolonged QT intervals. Thus the importance of the monitoring of our vital signals by an electrocardiogram (ECG) - the electrical activity of the heart recorded by electrocardiography, includes the measurement of the heart rate and the determination of the rhythm as well as the diagnosis of arrhythmias, myocardial ischemia, and prolonged QT intervals. Indeed, IoT-based detection of heart diseases have the potential to give maximum information and deliver information to medical staff. Our aim in this project is to identify and provide technological solution of heart diseases through IoT-based systems. The developed system will help to better monitor cardiovascular patients and elderly people as well as reach a better medical treatment to them.
Contact points	Prof. Nie Zedong (zd.nie@siat.ac.cn) and Dr. Pushpendu Kar (Pushpendu.Kar@nottingham.edu.cn).
PhD topic	**Light-driven carbon fixatio**
SIAT Supervisor	Prof. Chao Zhong
UNNC Supervisor(s)	Dr Wai Siong CHAI
Short introduction & description of the PhD project	Material-microorganism hybrid based artificial photosynthesis combines the broad absorption of semiconductors and the catalytic specificity of biosystems. They could achieve high-efficiency light-driven fixation of carbon dioxide to long-chain molecules. The impact to environment was still not fully understood, which hindered the practical usage and government decisions. So we need to calculate their LCA (life cycle analysis) and asses their environmental impact. Based on this background, this project will focus on three dimensions (i) set up the material-microorganism hybrid systems; (ii) test the efficiency for light to chemical conversion; and (iii) perform the LCA. The project would contribute to carbon neutral and point the way for a sustainable future.
Contact points	Informal inquiries may be addressed to Dr Wai Siong CHAI (wai-siong.chai@nottingham.edu.cn), Prof. Chao ZHONG (chao.zhong@siat.ac.cn) and Dr Xinyu Wang (xy.wang3@siat.ac.cn).
PhD topic	**Medical Image Processing and Artificial Intelligence**
SIAT Supervisor	Shanshan Wang
UNNC Supervisor(s)	Prof.Sean He
Short introduction & description of the PhD project	Artificial intelligence technology has garnered widespread attention across various domains. We anticipate leveraging AI-powered medical image processing and analysis to assist physicians and medical equipment, enhancing medical efficiency and accuracy, aiding individuals in obtaining

	superior healthcare services, elevating the standard of medical care, and reducing healthcare costs.
Contact points	Informal inquiries may be addressed to Shanshan Wang (ss.wang@siat.ac.cn) and Prof.Sean He (Sean.He@nottingham.edu.cn).
PhD topic	**Medical Image Processing and Artificial Intelligence**
SIAT Supervisor	Prof Zhanli Hu
UNNC Supervisor(s)	Prof Xiangjian (Sean) He
Short introduction & description of the PhD project	Artificial intelligence technology has gained widespread popularity in various fields. We expect to carry out medical image processing based on artificial intelligence technology, discover new imaging methods and means, and conduct research in combination with clinical data and imaging equipment. The team focuses on upstream and downstream ecological collaboration in medical imaging, and has carried out in-depth scientific research cooperation with leading high-end medical device companies and dozens of tertiary hospitals across the country, geared towards solving practical problems in the medical industry and medical clinics. Relevant technologies have been translated to leading high-end medical device companies and landed in domestic PET/MR, PET/CT and CT products. During his PhD, he expects to develop novel artificial intelligence imaging technologies, and he can choose from the following directions: 1) Intelligent image reconstruction technologies for PET/MR, PET/CT, and CT devices; 2) Intelligent diagnosis and analysis technologies for clinical medical images; 3) Intelligent prediction of disease
Contact points	Informal inquiries may be addressed to Prof Zhanli Hu (zl.hu@siat.ac.cn) and Prof Xiangjian (Sean) He (sean.he@nottingham.edu.cn)
PhD topic	**Medical image processing for AI assisted intervention and surgical navigation**
SIAT Supervisor	Prof. Shoujun Zhou
UNNC Supervisor(s)	Prof. Sean He
Short introduction & description of the PhD project	Artificial intelligence assisted intervention therapy is the trend of clinical development, but accurate navigation is still one of the clinical difficulties. In order to break through the technical bottleneck of interventional surgery, the key is to solve the core scientific problems such as accurate path planning, real-time navigation and safe operation. Therefore, the research of artificial intelligence methods for medical image big data and related conditions is of great significance.
Contact points	Informal inquiries may be addressed to Prof Sean He (Sean.He@nottingham.edu.cn) and Prof Shoujun Zhou (sj.zhou@siat.ac.cn)
PhD topic	**Medication reduction and its cost-effectiveness in patients with type 2 diabetes**
SIAT Supervisor	Dr Zhirong Yang
UNNC Supervisor(s)	Prof Zhuo Chen
Short introduction & description of the PhD project	Polypharmacy is common in older adults, especially in those with multiple chronic diseases. Previous studies showed that the prevalence of polypharmacy was more than 60% in older people with type 2 diabetes and it has been associated with adverse health outcomes, including hospitalization and death. However, it is unclear whether medication

	reduction in these patients could help address the health problems raised from polypharmacy, and if so, whether this could be cost-effective. In this project, we will examine these questions. We will systematically review randomized controlled trials and observational studies to summarize available relevant evidence and identify the important gaps for future research. We will use real-world clinical data from Shenzhen and the UK to assess the potential effectiveness and safety of medication reduction in patients with type 2 diabetes. We may also conduct cost-effectiveness analysis. The student will gain experience in pharmacoepidemiology and pharmacoeconomics research using large-scale real-world data. The student will develop skills in conducting systematic literature reviews, study design, statistical programming, data analysis and academic writing. Relevant training will be provided. The student will be supported to publish peer-reviewed papers as the lead author during the PhD. The ideal candidate should have a Master degree in epidemiology, data science, public health, or clinical medicine. Proficiency with STATA, R or SAS is essential.
Contact points	Informal inquiries may be addressed to Dr Zhirong Yang (zr.yang@siat.ac.cn) and Prof Zhuo Chen (Zhuo.Chen@nottingham.edu.cn)
PhD topic	**Membrane separation system with sub-1Å nanochannels for hydrogen separation and purification**
SIAT Supervisor	Assoc. Prof. Baofu Ding
UNNC Supervisor(s)	Assoc. Prof. Nicholas Musyoka
Short introduction & description of the PhD project	High-purity hydrogen is crucial for fuel cells, and H_2/CO_2 separation is a key technology in hydrogen production and purification. The H_2/CO_2 separation methods encompass absorption, adsorption, cryogenic separation, and membrane separation technologies. Among these, membrane separation technology stands out due to its lower energy input requirements and high selective separation of H_2/CO_2. However, the high selectivity often implies low throughput, thereby affecting the efficiency of gas separation. The trade-off between selectivity and throughput in gas separation remains a challenging issue. Based on this background, this project will focus on (i) the uniform construction of anisotropic two-dimensional nanochannels, (ii) precise control of nanochannel dimensions, (iii) functionalization strategies of nanochannels. These efforts aim to develop a gas separation membrane that combines precise H_2 sieving with efficient transport, thereby enabling effective capture of CO_2 molecules and efficient transport of H_2 molecules.
Contact points	Informal inquiries may be addressed to Prof. Baofu Ding (bf.ding@siat.ac.cn) and Assoc. Prof. Nicholas Musyoka (Nicholas.Musyoka@nottingham.edu.cn).
PhD topic	**Metallic matrix composite materials in advanced electronic packaging**
SIAT Supervisor	Prof Zhi-Quan LIU
UNNC Supervisor(s)	Dr Kok Hoong WONG
Short introduction & description of PhD	Integrated circuit (IC) technology plays a role of cornerstone in advanced electronic manufacturing and provides the hardware infrastructure in modern electronic information industry. The surging of 5G, interconnect of things (IoT) and artificial intelligence (AI) technology waves drives chips of customer electronics to higher levels of miniaturization, integration, and

	multi-function. Since semiconductor processing is approaching the physical limits of Moore's Law, advanced packaging technologies gain considerable attention as an alternative strategy for continued improvement of chip performances. The use of metallic matrix composites (MMC) in advanced packaging arouses widespread research interests, because they are able to combine the advantages of metals and the strengthening phases and endow optimized or even new physical properties. This research topic centres on the design, preparation and characterization of high-performance MMC for advanced packaging applications. It aims to address the challenging problems about the mechanical, thermal, and electrical properties of MMC at the real end product, and bridge the gap between fundamental studies and industrial applications in this field.
Contact points	Informal inquiries may be addressed to Dr Kok Hoong WONG (kok-hoong.wong@nottingham.edu.cn) and Prof Zhi-Quan LIU (zqliu@siat.ac.cn).
PhD topic	**Methods for analyzing population level single cell genomics data**
SIAT Supervisor	Dr. Hao Wu
UNNC Supervisor(s)	Dr Weihua Meng
Short introduction & description of the PhD project	The single cell genomic sequencing technology has revolutionized the biological and clinical research. The complexity of the single cell data requires specifically designed tools for analysis. There are many existing tools, but mostly design for data from single or small number of subjects. In this project, we aim to develop novel statistical and computational tools for the analysis of large-scale population level single cell data, with consideration of subjects' demographics and clinical conditions. Potentially questions include differential expression, cell type identification, novel cell type discovery, and molecular biomarker discovery for diseases. In addition, we will collaborate with local clinicians in China to recruit samples to perform single cell genomic sequencing and test our developed analysing tools using these data.
Contact points	Informal inquiries may be addressed to Dr. Hao Wu (wuhao@siat.ac.cn) and Dr. Weihua Meng (weihua.meng@nottingham.edu.cn)
PhD topic	**Multi-agent decision making based on action recognition and intention prediction in future "intelligent space"**
SIAT Supervisor	Prof. Qieshi Zhang
UNNC Supervisor(s)	Dr. Yuan Yao
Short introduction & description of the PhD project	The ability of autonomous systems to achieve their design objectives and to interact with other agents and humans is becoming a critical issue in a world in which transport, distribution and manufacture are increasingly automated. In conventional industrial automation, cooperation is typically achieved using a central controller, that dictates the order in which actions are performed so as to ensure effective synchronisation of the individual systems. This works well in a predictable and repetitive environment. However, in future "intelligent spaces", e.g., "smart cities", "smart roads", etc., where there are full of uncertainty and incomplete information, this approach is no longer practical. Rather systems must recognise and predict the actions performed by other agents or humans, and then decide what to do next in order to achieve their goals and ensure safe operation. The aim of this project is to investigate the theoretical underpinnings of

	techniques to allow autonomous systems to act and cooperate safely and effectively in future "intelligent spaces". This overall aim will be broken down into three key objectives: 1) recognising the actions performed by other agents and humans via computer vision techniques; 2) predicting the intention of other agents and humans based on the recognised actions; and 3) deciding how to act given these predictions.
Contact points	Informal inquiries may be addressed to Dr. Yuan Yao (Yuan.Yao@nottingham.edu.cn) and Prof. Qieshi Zhang (qs.zhang@siat.ac.cn).
PhD topic	**Multimodal Medical Image Analysis and Intelligent Diagnosis Based on Deep Learning**
SIAT Supervisor	Assoc. Prof. Na Zhang
UNNC Supervisor(s)	Asst. Prof. Fazl Ullah (Khan)
Short introduction & description of the PhD project	Multimodal medical image processing is a critical component in the field of contemporary medical diagnostics. It involves the integration of image data from different imaging technologies such as PET, MR, and CT, providing more comprehensive information on biological tissues. This integration enhances the accuracy of image analysis, leading to more refined disease diagnosis and monitoring. Artificial intelligence technologies, especially deep learning techniques that have emerged in recent years, offer efficient and accurate methods for the processing and analysis of multimodal medical images. We are interest in developing new technologies and methods for multimodal medical image diagnosis and treatment based on artificial intelligence. The team maintains deep collaborative relationships with leading medical imaging equipment manufacturers and various medical institutions. They are dedicated to bridging the gap between AI research outcomes in medical image processing and practical clinical applications, with the goal of addressing real-world problems in the healthcare industry. Several patents have been transferred to medical imaging equipment manufacturers and have been implemented in domestic MR and PET/MR products. During the PhD period, students can choose from the following research directions: 1) Multimodal intelligent image reconstruction techniques for multi-sequence MR and PET/MR; 2) Medical intelligence diagnostic and analysis combining natural language with medical images; 3) Disease intelligence prediction methods utilizing multimodal technologies.
Contact points	Informal inquiries may be addressed to Prof Na Zhang (na.zhang@siat.ac.cn) and Prof Fazl Ullah (Khan) (Fazl.Ullah@nottingham.edu.cn)
PhD topic	**Nanomedicine-based Mild-temperature Photothermal Therapy**
SIAT Supervisor	Prof. Pengfei Zhang
UNNC Supervisor(s)	Prof. Cheng Heng Pang
Short introduction & description of the PhD project	With the booming development of nanomedicine, mild photothermal therapy (mPTT, 42– 45°C) has exhibited promising potential in tumor therapy. Compared with traditional PTT (> 50°C), mPTT has less side effects and better biological effects conducive to tumor treatment, such as loosening the dense structure in tumor tissues, enhancing blood perfusion, and improving the immunosuppressive microenvironment. However, such a relatively low temperature cannot allow mPTT to completely eradicate tumors, and therefore, substantial efforts have been conducted to

	optimize the application of mPTT in tumor therapy. This project will focus on two major dimensions on (i) development of novel nanoagent with multifunction for **mild-temperature photothermal therapy** and (ii) understanding the mechanism of mild-temperature photothermal therapy.
Contact points	Informal inquiries may be addressed to Prof. Cheng Heng Pang (chengheng.pang@nottingham.edu.cn) and Prof. Pengfei Zhang (pf.zhang@siat.ac.cn).
PhD topic	**One-step-ahead: Accurate Viral Mutation Prediction for Early Preparedness of Government Policies and Pharmaceuticals**
SIAT Supervisor	Prof Jinyan Li
UNNC Supervisor(s)	Prof Vladimir Brusic
Short introduction & description of the PhD project	In the battle against COVID-19, we are always acting behind the mutation and evolution pace of the SARS-CoV-2 virus. We are jabbing Pfizer and Modena mRNA vaccines for Delta strain-infected populations, which were actually designed using the spike gene template of the original strain and were trial-tested on the population infected by the original strain as well. As the mutations from the original strain to the Delta strain of the virus is significant, the efficacy of the mRNA vaccines is remarkably sacrificed (from 95% to 65%) for the Delta-strain infected patients to prevent death. If the mutations in the Delta strain have had been accurately predicted at the emerging time of COVID-19, the design of the mRNA vaccines would be considering both the original sequence and the predicted Delta-strain sequence to get early preparedness to fight against the pandemic. Computational Challenges: Although there are millions of sequences of different strains of the virus publically available at the NCBI and GISAID sars-cov-2 databases, the time stamps and series of these sequences are hardly known, causing difficulties in the training data construction for advanced machine learning and prediction models. Without the prediction model, it's challenging to answer questions such as what's the next strain, it's a mild mutation or virulent or deadly? Potential impacts: We will use bioinformatics methods to investigate the epitope sites and receptor-binding sites at the spike gene of the predicted strains. If the predicted strain is virulent, we will collaborate with pharmaceutical companies for the design of future mRNA vaccines to win a one-step-ahead time to effectively control next waves of viral infections. We also investigate the therapeutic target sites of miRNA or siRNA drugs at the predicted spike mRNA sequences in an aim for effective treatment of future patients. We will also collaborate and discuss with Health Departments to discuss government policy adjustments to prevent and control future infectious diseases.
Contact points	Informal inquiries may be addressed to Prof Jinyan Li (jinyan.li@siat.ac.cn) and Prof Vladimir Brusic (Vladimir.brusic@nottingham.edu.cn).
PhD topic	**Optimal design methods of electric devices based on artificial intelligence**
SIAT Supervisor	Prof Weinong Fu
UNNC Supervisor(s)	Dr Nadia Mei Lin Tan Dr John Xu
Short introduction & description of PhD Project	This research project will focus on the optimal design of electric motors for driving electric vehicles in system level. Numerical methods such as finite element method will be used to simulate the operation of the motors. Optimization methods will be employed to find the best designs, and

	artificial intelligence will accelerate the computing process. The machine learning methodologies will be investigated to achieve the global optimal control for the motor with control modules. Hardware experiments will be carried out to validate the proposed models and methodologies. The applicants may have the basic knowledge of electrical engineering.
Contact points	Informal inquiries may be addressed to Prof. Weinong Fu (wn.fu@siat.ac.cn) and Dr. Nadia Mei Lin Tan (nadia.tan@nottingham.edu.cn).
PhD topic	**Photosynthetic biohybrid system based on metal-organic-framworks and *Escherichia coli* for sustainable solar energy conversion and valuable chemical production**
SIAT Supervisor	Dr. Bo Wang
UNNC Supervisor(s)	Prof. Xiaolei Fan
Short introduction & description of the PhD project	Photosynthetic biohybrid systems integrating light-harvesting semiconductor nanomaterials with highly specific whole-cell biocatalysts, represent a new trend for artificial photosynthesis with remarkable capabilities in solar-to-chemical conversion. The development of such systems is still in the early stages, and their applications have been hindered by limited conversion efficiency and product value. As one of the widely used industrial workhorse microorganism, *E. coli* has mature genetic engineering tools to expand the product spectrum. Moreover, engineered *E. coli* have been successfully integrated with different nanomaterials to produce valuable products including glucose, l-malate, l-tert-leucine, farnesyl and threonine. MOFs are a new class of porous crystalline materials constructed from organic ligands and metal ions/clusters. They have attracted much attentions in recent years and numerous studies have revealed their great potential in various applications. Excellent cytoprotective function of MOFs has already been demonstrated, however, their roles as photosensitizer to microbial cells have not yet been deeply investigated in biohybrid system. Therefore, design and construction of a MOF-*E. coli* biohybrid system for efficient light-driven valuable chemical production is of great significance. This project will focus on (1) synthesis and screening MOFs with excellent photoelectrochemical property and cytoprotective function agaist reactive oxygen species, (2) constructing a MOF-*E. coli* biohybrid system with highly efficiency electron transfer interface, (3) genetic engineering *E. coli* to achieve light-driven biosynthesis of different valuable production (such as amino acids and alcohols), (4) studying the underlying mechanism of material-cell energy transfer and intracellular energy conversion.
Contact points	Informal inquiries may be addressed to Prof. Xiaolei Fan (Xiaolei.Fan@nottingham.edu.cn) and Dr. Bo Wang (bo.wang@siat.ac.cn).
PhD topic	**Plasma catalysis for CO2 conversions or environmental remediation** **Cold plasma technology for biomedical applications**
SIAT Supervisor	Prof Zhitong Chen
UNNC Supervisor(s)	Prof Xiaolei Fan
Short introduction & description of the PhD project	As the fourth state of matter, plasma's unique properties and interactions with other states of matter offer many promising opportunities for investigation and discovery. In particular, cold atmospheric plasma (CAP), operating at atmospheric pressure and room temperature, has remarkable potential applications for catalysis, biomedicine, environment, materials,

	energy, and so on. In this project, we will co-supervise PhD students working on developing plasma technology for environmental remediation, waste valorisation, and biomedical applications. In addition, we also can supervise Ph.D. students developing plasma technology to assist in the rational design of new catalysts for CO2 conversions and biomedical applications.
Contact points	Informal inquiries may be addressed to Prof Xiaolei Fan (Xiaolei.Fan@nottingham.edu.cn) and Prof Zhitong Chen (zt.chen1@siat.ac.cn).
PhD topic	**Rebalancing inflammation during bacterial infections in aging models**
SIAT Supervisor	Aldo Tagliabue
UNNC Supervisor(s)	Enrico Marsili
Short introduction & description of PhD project	Infectious diseases represent a major health threat for mankind, in particular for subjects with weak immune defenses, such as patients with chronic diseases and elderly people. In these subjects, infectious microorganisms trigger an inappropriate reaction that encompasses both an insufficient capacity to destroy the infectious agent and an unbalanced inflammatory reaction that can cause pathological conditions in the host. Treating bacterial infections such as pneumonia is increasingly challenging, due to the large spread of antibiotic-resistant microorganisms. The WHO estimates over 10 million death/year for antibiotic-resistant infections by 2030, mostly affecting individuals with inadequate immune defenses. This project aims at addressing the threat posed by antibiotic-resistant *Klebsiella pneumoniae* biofilms during interaction with healthy and aged models of immune system. This will be done as follows: 1. Examining *in vitro* the innate and adaptive inflammatory reactions to bacteria in normal vs. immunologically frail condition (aged model); 2. Identifying immune mechanisms involved in the anomalous response to bacteria and express the related molecules in cell lines or animal models. 3. Exploring biophysical stimuli of surrounding extracellular matrix (stiffness, topography and adhesion) as a way to express tissue aging in the model. 4. Developing novel adjuvants for immune rebalancing in therapeutic and preventive strategies against bacteria. Enrico Marsili has developed an easy-to-use biofilm testing platform based on bioelectrochemical analysis. The candidate will learn basic biofilm methods and how to monitor/map the interactions between immune cells and biofilms in vitro using biochemical and bioelectrochemical methods. Aldo Tagliabue has decades of experience in immunology and related drug development, recently he is exploring the mechano-immunology as a mean to control the interaction between macrophages and bacteria by changing physical stimuli of microenvironment; a fundamental aspect during aging. The candidate will learn analytical techniques in biophysics characterizing mechanical properties of macrophages in different conditions. In this project, the student will work with both supervisors to implement a model system for accurate monitoring of immune cells/biofilm interactions and identification of therapeutic immunological strategies for biofilm control. Pending positive results, the candidate will implement the most successful approach into animal models.

Contact points	Informal inquiries may be addressed to Prof Enrico Marsili (enrico.marsili@nottingham.edu.cn) and Prof. Aldo Tagliabue (tagliabue@siat.ac.cn).
PhD topic	**Smart and complex energy systems controls and optimization focusing on systems decarbonization and power grid-friendly energy use**
SIAT Supervisor	Prof. Wei FENG
UNNC Supervisor(s)	Prof. Nadia Tan
Short introduction & description of the PhD project	Distributed energy resources (DERs) play important roles in decarbonizing energy systems and achieving a carbon natural target. The successful deployment of DERs (such as PV, storage etc.) requires a holistic optimization of local energy systems by considering, weather, energy demand, cost. In addition, local energy systems need to interact with the power grid to achieve grid-friendly energy use. The project will develop new energy systems optimization methods focusing on improving system cost, better power quality and/or lower carbon emissions. The project includes three dimension on DERs and local energy system controls: 1) optimization or DERs microgrid in multiple scenarios (including, but not limited to: island, city, remote locations); 2) multi-energy systems (heating/cooling/electricity/H2 etc.) optimization and controls, by using Model Predictive Control (MPC) and Machine Learning (ML) methods; 3) local energy systems demand response modelling focusing on end use technologies (e.g. air-conditioners, Electrical Vehicles -EV) demand response characteristics and optimal load aggregation strategies.
Contact points	Informal inquiries may be addressed to Dr Wei FENG (w.feng@siat.ac.cn) and Dr Nadia Tan (Nadia.Tan@nottingham.edu.cn)
PhD topic	**Spatiotemporal Reasoning over Knowledge Graphs**
SIAT Supervisor	Dr. Ling Yin
UNNC Supervisor(s)	Dr. Heshan Du
Short introduction & description of the PhD project	A knowledge graph is often used to represent real-world objects and their relationships. Spatiotemporal reasoning over knowledge graphs has various applications in different domains, including urban management, transportation, epidemic control, tourism and so on, which involves complex spatiotemporal relationships. The reasoning over knowledge graphs includes deductive reasoning and inductive reasoning. Deductive reasoning is based on first-order logic or description logic. To reason with spatial and temporal knowledge in knowledge graphs, qualitative spatial and temporal reasoning are required. This project aims to develop spatiotemporal reasoning methods and apply them to real-world knowledge graphs to obtain new knowledge and track how new knowledge is derived from existing knowledge. This project is funded by National Natural Science Foundation of China and the Key R&D Program of the Ministry of Science and Technology of China.
Contact points	Informal inquiries may be addressed to Dr. Ling Yin (yinling@siat.ac.cn) and Dr. Heshan Du (Heshan.Du@nottingham.edu.cn).
PhD topic	**Study on High-precision Thermal Control at the Micro and Nanoscale with High-performance Computing**
SIAT Supervisor	Prof. Rongliang Chen

UNNC Supervisor(s)	Dr.Yong Shi
Short introduction & description of the PhD project	Temperature nonuniform is a critical issue in many micro and nanoengineering applications, e.g., chip manufacture, and requires a high-precision thermal control. Under these circumstances, gas is often used as an available cooling medium; however, its thermal characteristics at such small scales manifests strong noncontinuum effects, and cannot be accurately described the conventional theory at the Navier-Stokes order. This brings formidable challenges to the corresponding thermal design and cooling setup, in particular when high control-accuracy is required. In this project, we study gas flow and heat transfer confined in such micro/nanostructures. We aim at proposing robust and effective kinetic-based models to describe gas cooling behaviours in a wide range of Knudsen numbers. In combination with different micro and nanoscale geometries, the corresponding parallel algorithms will also be developed, and validated and tested on supercomputers. The numerical results in this project will deepen our understanding on gas flow and heat transfer at the micro and nanoscale, and provide valuable insights into the design and optimization of high-sensitivity thermal control means for today's micro and nano manufacturing processes.
Contact points	Informal inquiries may be addressed to Dr. Yong Shi (yong.shi@nottingham.edu.cn) and Prof. Rongliang Chen (rl.chen@siat.ac.cn).
PhD topic	**The preparation and application of targeting modified engineered exosomes**
SIAT Supervisor	Jian Zhang
UNNC Supervisor(s)	Jing Wang
Short introduction & description of the PhD project	Engineered exosomes are the sort of exosome whose surface or internal molecules are modified with various methods to enhance their ability as the drug delivery system and reduce the drug-load loss rate and treatment-related adverse effects. The most common techniques include chemical modification, genetic manipulation, physical methodology, and microfluidic technology, which has its own benefits and disadvantages. The studies of engineered exosomes have been widely investigated worldwide, while many obstacles remain to overcome. By targeting specific modification on engineered exosomes, this project will focus on the engineered exosomes with three primary purposes, (i) improve the production of the modified engineered exosomes, (ii) enhance the targeting accuracy of engineered exosomes, (iii) expand the application of engineered exosomes in various diseases with minor adverse effects.
Contact points	Informal inquiries may be addressed to Prof Jian Zhang (jian.zhang@siat.ac.cn) and Dr.Jing Wang(Jing.Wang@nottingham.edu.cn).
PhD topic	**Thermoelectric-based thermal management design for lithium-ion battery**
SIAT Supervisor	Ruiheng Liu
UNNC Supervisor(s)	Yong Shi
Short introduction & description of the PhD project	With the rapid development of new energy vehicles, thermal management of Lithium-ion battery pack has become one of the most important issues related to the security, endurance and energy efficiency. Thermoelectric can realize the bothway temperature control through electricity, and also features static, miniaturization and high response speed. This PhD project

	will focus on designing and developing intelligent battery thermal management systems, by taking advantage of advanced thermoelectric materials and devices, for low-carbon electric vehicles.
Contact points	Informal inquiries may be addressed to Dr/Prof Ruiheng Liu (Rh.liu@siat.ac.cn) and Dr Yong Shi (Yong.Shi@nottingham.edu.cn).