UNNC – Yongjiang Laboratory Doctoral Training Partnership

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

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

Research areas

1. New Material
2. Advanced Manufacturing

Available PhD topics

PhD topic	**Autonomous Continuous Photocycloaddition in Flow**
YLAB Supervisor	Prof. Zhenghui Wen
UNNC Supervisor(s)	Prof. Bencan Tang
Short introduction & description of the PhD project	Photochemical cycloadditions and cyclization reactions provide a powerful synthetic tool for the construction of carbon–carbon and carbon–heteroatom bonds in a variety of (strained) ring systems, and have thus featured prominently in the synthesis of complex bioactive compounds and new materials. However, traditional methods using UV-irradiation to promote these processes typically suffer from competitive and uncontrollable side reactions, and so limit their widespread synthetic applicability. Considering this, these reactions are ideal targets for the development of mild visible-light-mediated strategies using energy transfer (EnT) catalysis and flow chemistry. Meanwhile, a detailed screening is still required to handle the complex EnT photocatalyst design, reaction optimization, and scale-up of photocycloaddition process. In response to the need for efficient optimization of complex EnT photocycloaddition reaction conditions, we will aim to develop an autonomous continuous-flow platform with this project, facilitating the virtual photocatalyst design, reaction optimization, and scale-up of photocycloaddition process.
Contact points	Informal inquiries may be addressed to Prof. Zhenghui Wen (zhenghui-wen@ylab.ac.cn) and Prof. Bencan Tang (bencan.tang@nottingham.edu.cn).
PhD topic	**Novel 3D mechanical metamaterials for vibration and acoustic control**
YLAB Supervisor	Dr Biwei DENG
UNNC Supervisor(s)	Assoc. Prof. Dunant Halim
Short introduction & description of the PhD project	Metamaterials are newly emerged materials in the past few decades that possess outstanding physical properties beyond nature's reach. By designing the periodic structures of metamaterials, one can manipulate the propagation behaviour of various forms of waves, such as electromagnetic waves, elastic waves and acoustic waves, within or on the surfaces of the metamaterials. In

	view of mechanics, this unique tunability of metamaterials gives rise to the potential applications in versatile scenarios such as vibration suppression, sound attenuation and so on. The grand challenge in the field of mechanical metamaterials lies in both design and manufacturing. Currently the design of mechanical metamaterials in 2D space is well developed, whereas the case in 3D space is faced with greater challenges due to the increased complexity associated with the additional dimension. In this project, we seek to explore the general theory of designing novel 3D mechanical metamaterials aiming for the specific applications of vibration and acoustic control. The realization of 3D mechanical metamaterials with advanced manufacturing tools, such as 3D printing, is the other emphasis of this project.
Contact points	Informal inquiries may be addressed to Dr Dunant Halim (dunant.halim@nottingham.edu.cn) and Dr Biwei Deng (biwei-deng@ylab.ac.cn).
PhD topic	**Comparative Strategies for 3D Printing of Metallic Thin Films with in situ Non-Thermal Plasma Jet Treatment**
YLAB Supervisor	Dr. Ruitao Su
UNNC Supervisor(s)	Dr. Di Hu
Short introduction & description of the PhD project	This PhD project focuses on the comparative study of two novel strategies for 3D printing metallic thin films, in the background of printed electronics, using non-thermal plasma jet treatments. 1. Direct 3D Printing of Metallic Particles: In this approach, metallic particles are deposited through 3D printing and subsequently treated with an inert non-thermal plasma jet to enhance the particle bonding and surface properties. 2. In-Situ Reduction of Metal Oxide Particles: In this strategy, metal oxide particles are 3D printed and treated with a non-thermal plasma jet in the presence of hydrogen (H_2) as a reducing agent. This process facilitates the in-situ conversion of metal oxide particles into metallic particles followed by a metallic film growth process. This PhD project will provide critical insights into the design of efficient and sustainable strategies for 3D printing metallic thin films. By comparing these two innovative approaches, the research will identify optimal processing conditions and establish guidelines for tailoring thin film properties, such as electric conductivity, adhesion to substrates, and conformability to 3D surfaces to meet the demands of printed electronics. The outcomes of this work have the potential to advance the fields of additive manufacturing, materials science, and plasma processing technologies.
Contact points	Informal inquiries may be addressed to Prof. Ruitao Su (ruitao-su@ylab.ac.cn) and Dr. Di Hu (di.hu@nottingham.edu.cn)
PhD topic	**Research on distributed intelligent DC power distribution system for multi-electric aircraft/ships**
YLAB Supervisor	Dr. Chunyang Gu
UNNC Supervisor(s)	Prof. Giampaolo Buticchi
Short introduction & description of the PhD project	Modelling and stability analysis of multi-electric aircraft power distribution system: Complete real-time integrated power monitoring and management system of aircraft HVDC system; It provides an effective means for real-time monitoring and management of aircraft DC power supply system. A control scheme for high-power DC-DC battery chargers/converters suitable for aviation

	applications is investigated, and the control system is optimized based on linearization equations. For the aircraft distributed multi-converter system, a droop control strategy based on virtual impedance is analyzed to realize the combination with the energy storage system to effectively improve the power quality of the aircraft grid system and suppress system fluctuations. Research on DC multi-port energy router used for intelligent distribution of multi-electric aircraft: The circuit model of multi-winding transformer is analyzed, the power decoupling methods and voltage control methods of multiple active bridge converter are proposed, and a variety of soft switch phase-shift modulation methods of multiple active bridge converter are investigated to realize the soft switching control of multiple active bridge converter and reduce the current stress of the devices.
Contact points	Informal inquiries may be addressed to Prof. Giampaolo Buticchi (Giampaolo.Buticchi@nottingham.edu.cn) and Dr. Chunyang Gu (Chunyang-Gu@ylab.ac.cn).
PhD topic	**Research on advanced power electronics converters based on WBG semiconductor devices**
YLAB Supervisor	Dr. Chunyang Gu
UNNC Supervisor(s)	Prof. Jing Li
Short introduction & description of the PhD project	Third generation power electronic devices and their applications in aviation systems: The characteristics of SiC and GaN wide-band-gap (WBG) semiconductor devices and their applications in high frequency and high power density aviation power electronic power converters are investigated to improve the reliability of gate driver, and the optimal strategy for reducing conduction loss and switching loss is researched. Research on topology of multilevel converter for propulsion and grid-connected: Research on topology design method of overall efficiency and power density maximization of multilevel controller, explore the modulation mode and dv/dt mechanism of multilevel controller, and find out the influence law of multilevel controller on motor insulation life. Multiphase/multilevel modulation and control strategy research: The vector control system of three-phase permanent magnet synchronous motor is studied to reduce the voltage withstand on each power switch tube, so that it can be applied in high-power and high-voltage occasions to reduce the phase current harmonics.
Contact points	Informal inquiries may be addressed to Prof. Jing Li (Jing.Li@nottingham.edu.cn) and Dr. Chunyang Gu (Chunyang-Gu@ylab.ac.cn).
PhD topic	**Research on high performance electric propulsion/traction motor design and control**
YLAB Supervisor	Dr. Chunyang Gu
UNNC Supervisor(s)	Dr. Weiduo Zhao
Short introduction & description of the PhD project	Research on control strategy of high speed motor: Design of high performance motor for electric propulsion or traction applications. Establish the calculation model of iron loss, analyze the high frequency characteristic of iron core material and the variation rule of magnetic field in iron core. Iron consumption calculation considering the effects of harmonic and rotating magnetization. An efficient optimal control strategy for iron consumption suppression is researched.

	Multi-phase motor control strategy research: multi-phase motor fault-tolerant control strategy research. The variation of the output torque and phase current of the motor under fault-tolerant control is verified by finite element method. The electromagnetic torque fluctuation is calculated and compared with normal operation. The decoupled fault-tolerant control strategy of multiphase motor in fault-tolerant operation is investigated.
Contact points	Informal inquiries may be addressed to Dr. Weiduo Zhao (Weiduo.Zhao@nottingham.edu.cn) and Dr. Chunyang Gu (Chunyang-Gu@ylab.ac.cn).
PhD topic	**Next-generation electrical machines with shaped profile windings enabled by additive manufacturing technology**
YLAB Supervisor	Dr. Xiaochen Zhang
UNNC Supervisor(s)	Prof. Jing Li
Short introduction & description of the PhD project	The ongoing development of transportation electrification is driving an increasing demand for higher motor power density. Improved thermal design of electrical machines, including both heat generation and dissipation aspects, could be beneficial for enhancing motor power density beyond current state of the art. Due to the considerable manufacturing flexibility offered by additive manufacturing technologies, shaped profile windings with unconventional tailored geometries could serve as an ideal solution for effective loss suppression, particularly for high-frequency AC losses. Besides, the geometrical freedom of additively manufactured windings facilitates the integration of highly efficient cooling configurations, such as heat pipes and heat exchangers. Consequently, the thermal challenges of high power density motors can be addressed from both loss suppression and cooling enhancement aspects. This project will focus on the following major objectives: (1) Propose a novel winding configuration that integrates shaped profile windings with an effective direct cooling structure. (2) Loss and temperature distribution of the proposed winding configuration. (3) A geometric design methodology for shaped profiled windings based on combined motor electromagnetic and thermal behavior. (4) Motor prototyping with additively manufactured windings and experimental validation.
Contact points	Informal inquiries may be addressed to Prof. Jing Li (Jing.li@nottingham.edu.cn) and Dr. Xiaochen Zhang (Xiaochen-zhang@ ylab.ac.cn).
PhD topic	**Development of Advanced Active Bearings in Electrical Machines for Effective Vibration Attenuation**
YLAB Supervisor	Dr. Chunyang Gu
UNNC Supervisor(s)	Assoc. Prof. Dunant Halim
Short introduction & description of the PhD project	With an increasing requirement for electrical machines to operate at higher speeds, the problems associated with vibration and noise become more prominent. Therefore, there is a need to address these problems by developing an effective vibration and noise suppression strategy. The project aims to develop an effective control method for vibration/noise suppression of electrical machines using active bearings that can generate the required control force/torque to counter-act vibration experienced in the rotor system used in electrical machines. This is in contrast to the use of passive bearings widely used in electrical machines, which are not capable to effectively suppress rotor vibration. The development of active bearings with robust control strategy,

	which can address a wide range of uncertainties associated with system dynamics and external disturbances, will be investigated in this project.
Contact points	Informal inquiries may be addressed to Assoc. Prof. Dunant Halim (dunant.halim@nottingham.edu.cn) and Dr. Chunyang Gu (Chunyang-gu@ylab.ac.cn).
PhD topic	**High-Precision Control of Electrical Machines with Vibration Suppression Strategies**
YLAB Supervisor	Dr. Chunyang Gu
UNNC Supervisor(s)	Assoc. Prof. Dunant Halim
Short introduction & description of the PhD project	With the growing need to utilize electrical machines with more compact and lighter designs and higher operating speeds to undertake high-performance tasks, the implementation of effective vibration suppression strategy is essential as rotor vibration becomes more dominant due to its structural flexibility. The complex system dynamics of electrical machines under different operating conditions, compounded with its intricate rotor-dynamic behaviour, necessitates the development of robust control that can deal with internal and external disturbances, variable loads, and system nonlinearities. Therefore, an advanced control system which can effectively respond to changes in system dynamics and disturbances, will be required to achieve high precision control of electrical machines. This project thus aims to develop a control methodology for achieving high-precision control and effective vibration suppression of electrical machines.
Contact points	Informal inquiries may be addressed to Assoc. Prof. Dunant Halim (dunant.halim@nottingham.edu.cn) and Dr. Chunyang Gu (Chunyang-gu@ylab.ac.cn).
PhD topic	**Autonomous continuous HAT photocatalysis in flow**
YLAB Supervisor	Prof. Zhenghui Wen
UNNC Supervisor(s)	Prof. Tao Wu
Short introduction & description of the PhD project	In recent years, light-induced hydrogen atom transfer (HAT) presented itself as a versatile strategy for the late-stage functionalization of $C(sp^3)$–H bonds without involving transition-metal catalysis or strong oxidants. In HAT, the photoexcited catalyst abstracts a hydrogen atom resulting in the formation of reactive radical species, which are exploited for highly selective functionalization. To achieve this selectivity, careful tuning of the steric and electric properties of the HAT photocatalyst and substrate has to take place. Meanwhile, a detailed screening is required to handle the optimization, replication and scale-up of HAT photo catalytic process. In response to the need for efficient optimization of complex HAT photocatalytic reaction conditions, we will aim to develop an autonomous continuous-flow platform with this project, facilitating the self-optimization, intensification, and scale-up of HAT photocatalytic transformations.
Contact points	Informal inquiries may be addressed to Prof. Zhenghui Wen (zhenghui-wen@ylab.ac.cn) and Prof. Tao Wu (tao.wu@nottingham.edu.cn).

Other potential supervisors

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