UNNC – SDU (School of Qilu Transportation) Doctoral Training Partnership

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

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

Research areas

1. Smart Construction
2. Building Materials
3. Intelligent Transportation
4. Geotechnical Engineering

Available PhD topics

PhD topic	**Computer Vision-based Traffic Accident Risk Identification and Active Safety Control**
SDUTI Supervisor	Assoc. Prof. Dr. Xu Wang
UNNC Supervisor(s)	Assoc. Prof. Dr. Kian Ming Lim
Short introduction & description of the PhD project	The traffic flow on bottleneck sections of highways is continuous and dense, rendering these areas susceptible to temporal and spatial evolution of accident risks, which may ultimately result in collisions. This PhD project aims to investigate the spatiotemporal aggregation and dispersion characteristics of traffic risks, utilizing high-precision trajectory data extracted through computer vision techniques. Furthermore, the study delves into the macroscopic and microscopic characteristics of dynamic traffic flow evolution within controlled scenarios, thereby unveiling the potential impacts and mechanisms through which active control measures can mitigate traffic risks. Ultimately, this research endeavor seeks to provide theoretical underpinning for accident mechanism analysis and the formulation of precise prevention and control strategies on highways.
Contact points	Informal inquiries may be addressed to Dr. Xu Wang (xuwang@sdu.edu.cn) and Dr. Kian Ming Lim (Kian-Ming.Lim@nottingham.edu.cn).
PhD topic	**Investigation on damage evolution mechanism at two-phase interfaces of solid waste asphalt mixture and their durability synergistic improvement**
SDUTI Supervisor	Prof. Jizhe Zhang

UNNC Supervisor(s)	Dr. Shu Liu
Short introduction & description of the PhD project	Filler is an indispensable component of asphalt mixture. With the shortage of natural stone supply, it is urgent to develop alternative filler materials. Solid waste powders, such as red mud, steel slag, and flyash et al., have the potential to replace limestone filler due to their unique physical and chemical characteristics. However, the strength evolution mechanism of solid waste asphalt mixtures dfiffer from that of the conventional mixture. This study aims to investigate the evolution mechanism and the moisture permeation mechanism of the interfaces of powder-bitumen and solid waste asphalt mastic-aggregate, with the goal of enhancing the service performance of solid waste modified asphalt mixture. The success of this research would not only provide a theoretical basis for the modification and design of solid waste modified asphalt mixture, but also effectively improve its service durability and promote its large-scale application in road engineering.
Contact points	Informal inquiries may be addressed to Prof. Jizhe Zhang (jizhe.zhang@sdu.edu.cn)
PhD topic	**Seismic Behaviour and Resilience Evaluation of Transport Infrastructure Crossing Active Faults**
SDUTI Supervisor	Prof. Jianhong Wang
UNNC Supervisor(s)	Dr Yung-Tsang Chen
Short introduction & description of the PhD project	Transport Infrastructure such as tunnels and bridges crossing active faults is more vulnerable to earthquake damage due to the intense and unexpected ground movement from the faults. The seismic behaviour of the transport infrastructure near or cross active faults therefore needs to be analysed further to ensure their satisfactory seismic performance, as the near-fault ground movement may cause strong ground acceleration and permanent ground displacement to the infrastructure. In addition to conventional structural analysis following current design codes, a resilience analysis adopting the concepts of robustness, rapidity, redundancy, and resourcefulness (4R) should also be used to account for the seismic resistance and repairability of current existing transport infrastructure. In this project, relevant research literature review will be conducted first, followed by the analysis of the seismic behaviour of transport infrastructure near or crossing active faults. Numerical simulation of transportation infrastructure subjected to intense earthquake excitations will be conducted, and seismic behaviour and failure modes be analysed and compared with the current structural design codes. Scale-down model tests using shaking tables may as well be conducted to verify the simulation results. Meanwhile, the structural resilience of transport infrastructure under near-fault earthquakes will be investigated, with the aim of proposing indexes for the purpose of resilience evaluation. Measures for disaster prevention, in terms of disaster mitigation and post-disaster recovery methods, will be developed. Finally, a comprehensive resilience evaluation method and the associated resilience index will be proposed and applied in real engineering projects, such as Chuanzang Railway connecting Sichuan and Tibet.
Contact points	Informal inquiries may be addressed to Dr Yung-Tsang Chen (Yung-Tsang.Chen@nottingham.edu.cn) and Prof. Jianhong Wang (J.H.Wang@sdu.edu.cn).

PhD topic	**Development of a Novel Anchor System for Offshore Floating Wind Turbine Foundation**
SDUTI Supervisor	Kai Yao
UNNC Supervisor(s)	Ahmad Mousa
Short introduction & description of the PhD project	The global transition to renewable energy has positioned offshore wind power as a leading source of energy. Floating wind platforms enable turbine installation in deep ocean waters beyond 50 meters, where traditional fixed foundations are not feasible. Projections indicate an installed capacity of 4,000 GW by 2050. However, high construction costs remain a challenge for the widespread of offshore floating wind technology. The anchoring foundation system, a crucial component of the platform, represents 30-40% of the total cost. In deep-water environments, these systems must withstand complex environmental forces, including waves, tides, ocean currents, and diverse seabed conditions, all of which affect platform stability and safety. Current anchor foundations demonstrate limitations in their load-bearing capacity, stability, and performance under severe marine conditions. This research proposes the development of an innovative and cost-effective anchoring system for deep-water floating wind platforms. The project encompasses three key aspects: design optimization, installation efficiency, and performance enhancement. In doing so, the research entails five objectives: 1.Optimize anchor structural parameters to suit diverse marine geological settings 2.Develop efficient, cost-effective installation methods for deep-water environments 3.Evaluate foundation performance using finite element analysis (FEA) and fluid-structure interaction simulations 4.Assess ultimate load-bearing capacity and analyze failure mechanisms under extreme conditions 5.Investigate system stability through nonlinear dynamics and vibration analysis The intended analysis integrates FEA and machine learning (ML) capabilities. Combining the strengths of FEA and ML will serve as an intelligent design optimization tool for developing the new anchoring systems. The research will ultimately provide more reliable anchorage foundation technology for floating wind turbines. The new system shall ensure operational safety in extreme marine environments at an attractive overall cost for large-scale use.
Contact points	Informal inquiries may be addressed to Kai Yao (yaokai@sdu.edu.cn) and Ahmad Mousa (Ahmad.Mousa@nottingham.edu.cn).
PhD topic	**Development of soil solidification materials and construction technology for offshore wind monopile foundation scour protection**
SDUTI Supervisor	Kai Yao
UNNC Supervisor(s)	Fangfang Zhu
Short introduction & description of the PhD project	Offshore wind produces clean electricity that competes with, and sometimes is cheaper than, existing fossil fuel-based technology and tackles the greenhouse effect and environmental pollution. Offshore wind turbines must be grounded on various types of foundations, among which monopile is the most widely used one. However, the monopile foundations are subjected to cyclic waves, due to which local scour of the sea bed around the foundation occurs and poses a severe threat to the safety of offshore wind turbines. Therefore, it is necessary to develop an

	anti-scouring solidification material for offshore wind turbine foundations by modifying the engineering properties of the soft soil of the seabed. In addition, developing an in-situ solidification technology significantly enhances the project's applicability. For in-situ solidification, the slurry should be grouted directly into the seabed surface around the monopile. Moreover, the grouting slurry should have good workability and scour resistance/anti-washout characteristics in addition to strength. The grouting slurry should flow autonomously to the area that needs protection and be unaffected by the waves and currents to maintain the stability of the foundation. In summary, the slurry should have anti-washout characteristics for rushing water, proper mechanical strength, and be harmless to the environment. The most popular method to strengthen and stabilize soft soil is the addition of additives, which include cement and lime. However, the use of cement production contributes to 10% of global carbon emissions and is extremely harmful to the geoenvironment due to its hyper-alkalinity and high carbon footprint. Moreover, the modern age demands sustainable infrastructure with minimal environmental impact, and therefore, low-carbon footprint construction materials that can contribute to the circular economy are being investigated extensively. In this way, geopolymerization techniques may present a viable alternative to cement and lime, offering the potential to improve the strength and durability of soil with a comparatively reduced carbon footprint. In geopolymer technology, raw materials rich in silica and alumina are made to react with suitable alkaline silicates or hydroxides to create a stable compound with a polymeric structure of interconnected -Si-O-Al-O-Si- bonds. The developed anti-scour-resistance material should also be durable enough in the seawater. This PhD project aims for a comprehensive evaluation of the development of new anti-scouring solidification materials with high water stability and low permeability for offshore wind turbine foundations, including research on the detailed reinforcement mechanism of the developed material, development of coupled numerical simulation method for foundation-seawater-seabed-solidified soil. Then the key design parameters of solidified soil will be summarized, forming a control index system for scour protection of solidified soil, and proposing a set of in-situ solidified soil design solutions.
Contact points	Informal inquiries may be addressed to Kai Yao (yaokai@sdu.edu.cn) and Fangfang Zhu (fangfang.zhu@nottingham.edu.cn).
PhD topic	**Development of sustainable cementitious materials for ground improvement**
SDUTI Supervisor	Zhanyong Yao
UNNC Supervisor(s)	Bo Li
Short introduction & description of the PhD project	Ground improvement techniques such as deep cement mixing (DCM) and jet grouting have become essential solutions for enhancing the engineering properties of weak soils, enabling the construction of infrastructure on challenging ground conditions. However, these methods often rely on conventional Portland cement, which is associated with high carbon dioxide emissions and environmental concerns. As the construction industry moves towards sustainable practices, there is a growing need to develop innovative cementitious materials that minimize environmental impact while maintaining or enhancing performance. This project aims to explore and develop sustainable cementitious materials tailored for ground improvement applications. The focus is on integrating alternative binders such as industrial by-products (e.g., fly ash, slag, silica fume), natural pozzolans, and novel geopolymers to replace or partially substitute traditional cement. By optimizing mix designs and assessing their

	mechanical and durability properties, the project seeks to identify materials that exhibit lower carbon footprints, improved resource efficiency, and enhanced compatibility with soil stabilization techniques. The scope of the project includes: a) Material Development: Formulating cementitious blends incorporating sustainable alternatives, while ensuring their performance aligns with the requirements of DCM and jet grouting applications. b) Performance Evaluation: Conducting laboratory experiments to investigate the strength, stiffness, permeability, and durability of treated soils under varying environmental conditions. c) Environmental Assessment: Quantifying the carbon footprint and lifecycle environmental impacts of the proposed materials compared to conventional practices. d) Implementation and Scaling: Exploring the adaptability of the materials for large-scale field applications, considering practical challenges and economic feasibility. By developing sustainable alternatives, this research contributes to the global effort of reducing greenhouse gas emissions in construction, promoting resource efficiency, and achieving long-term stability in ground improvement projects. The outcomes will benefit a wide range of stakeholders, including engineers, policymakers, and contractors, enabling the industry to advance toward greener and more resilient infrastructure systems.
Contact points	Informal inquiries may be addressed to Zhanyong Yao (zhanyong-y@sdu.edu.cn) and Bo Li (Bo.Li@nottingham.edu.cn).
PhD topic	**Waste materials for sustainable construction of road fill embankments**
SDUTI Supervisor	Jizhe ZHANG
UNNC Supervisor(s)	Elsaid Zahran
Short introduction & description of the PhD project	The escalating global demand for high-quality soils in road-fill embankments, driven by rapid infrastructure development, faces a significant challenge due to the limited availability of such soils. To ensure the sustainability of road-fill embankments, it is crucial to utilise locally excavated soils for filling. However, these excavated soils often exhibit weak strength properties and are prone to excessive settlement, posing risks to transportation infrastructure safety. In response to this challenge, the construction industry has been exploring soil stabilisation techniques to enhance the undesirable geotechnical properties of excavated soils. One prevalent method involves soil mixing, which incorporates cementitious binders such as Ordinary Portland cement (OPC) or lime. Nevertheless, the production of these binders contributes to CO2 emissions and demands substantial energy input. Hence, this project aims to assess the viability of utilising waste materials for stabilising excavated soils in road-fill embankments, offering a more sustainable and environmentally friendly approach.
Contact points	Informal inquiries may be addressed to Dr Elsaid Zahran (Elsaid.Zahran@nottingham.edu.cn) and Dr Jizhe Zhang (jizhe.zhang@sdu.edu.cn)
PhD topic	**Disaster Mechanism and Intelligent Perception and Control of Transportation Geotechnical**
SDUTI Supervisor	Hongguang JIANG
UNNC Supervisor(s)	Juan WANG

Short introduction & description of the PhD project	This research focuses on the disaster evolution mechanism and intelligent compaction technology under the coupled effects of multiple environmental factors, the development of capillary blocking and drainage materials, the design of high-performance green composite materials for improving poor soil conditions, and the development of an intelligent sensing and collaborative prevention and control system based on sensor fusion.
Contact points	Informal inquiries may be addressed to Juan Wang (Juan.Wang@nottingham.edu.cn) and Hongguang Jiang (hongguang_jiang@sdu.edu.cn).

Other potential supervisors

UNNC		
Profile	**Research Area(s)**	**Email**
Dave TOWEY	Smart Construction Intelligent Transportation	Dave.Towey@nottingham.edu.cn
Faith Chan	Intelligent Transportation Building Materials	faith.chan@nottingham.edu.cn
Christos Spitas	Smart Construction Intelligent Transportation	christos.spitas@nottingham.edu.cn
Pushpendu Kar	Intelligent Transportation	Pushpendu.Kar@nottingham.edu.cn
Tengwen LONG	Geotechnical Engineering	tengwen.long@nottingham.edu.cn
Weizhuo SHI	Building Materials	Weizhuo.shi@nottingham.edu.cn
Xiaoling LIU	Building Materials	Xiaoling.Liu@nottingham.edu.cn
SDU (QILU)		
Profile	**Research Area(s)**	**Email**
Feng ZHANG	Geotechnical Engineering	zhangfeng2008@sdu.edu.cn
Jing Wang	Smart Construction	wjingsdu@163.com
Yifeng LING	Building Materials	yfling@sdu.edu.cn