Research project and supervisory team

Supervisory Team	Dr. David Chieng Dr. Zheng Chu Dr. Minglei You, University of Nottingham U.K.
Short introduction & description of research project	**Title: Passive 6G6D Sensing and Localization for Smart Transportation** 6D specifically refers to three spatial coordinates (X, Y, and Z) along with three rotational coordinates (roll, pitch, and yaw). With higher frequency ranges, wider bandwidths, and massive antenna arrays, 6G wireless communications not only enable ubiquitous connectivity up to terabits per second, but also promise super fine range, Doppler, and angular resolutions, as well as cm-level positioning. Driven by the 6G Integrated Sensing and Communication (ISAC) technology framework, this RF-based 6D sensing offers unique capabilities that are particularly advantageous in scenarios where visual systems face fundamental limitations due to environmental, privacy, or operational constraints. By combining ultra-high data rates and low latency communication with ubiquitous 6D sensing, 6G ISAC is envisioned to greatly enhance connectivity, improve safety, increase efficiency, and enable new capabilities for autonomous vehicles and smart infrastructures. These capabilities reduce the likelihood of accidents and improve traffic flow by enabling more precise and reliable situational awareness, vehicle/pedestrian positioning, and path planning. Furthermore, pedestrian, vehicles and infrastructure can share 6D sensing data in real-time, optimizing traffic patterns and reducing congestion while enhancing safety and energy efficiency. This can lead to a more integrated approach to transportation management where vehicles are part of an interconnected system rather than individual entities. Despite the promises that each technique offers, it also opens up a wide spectrum of new issues such as: • How can high-resolution 6D sensing/imaging be achieved by taking advantage of these 6G key enablers collectively, especially in a passive manner? • How to perform wide-area 6D sensing in high mobility scenarios with multiple targets, high dynamics, and potentially cluttered environments such as in transportation use cases. • How can AI/ML techniques enhance high-resolution 6D sensing in the presence of limited, unstructured and noisy data?
Contact points	Dr. David Chieng: David.Chieng@nottingham.edu.cn

Supervisory Team	John Xu Ahmed Abdelwahed
Short introduction & description of research project	**Enhancing Low-Voltage Ride-Through Capability for Grid-Forming Converters under Deep Asymmetrical Voltage Sags** The rapid integration of renewable energy sources into power grids has heightened dependence on virtual synchronous generators (VSGs), which mimic conventional synchronous generators to bolster grid stability. However, during low-voltage ride-through (LVRT) events—particularly under deep asymmetrical faults—existing VSG control strategies face critical challenges. Current methods often sacrifice transient stability for resilience (or vice versa), leading to compromised performance. Key shortcomings include: 1. Overcurrent risks from delayed/ineffective fault detection, 2. Non-compliance with grid codes due to inaccurate voltage regulation, and 3. Loss of voltage source behavior, undermining grid support capabilities. This project proposes an advanced LVRT control strategy to enhance both resilience and transient stability in VSGs during severe asymmetrical faults. The approach integrates real-time fault detection, dynamic reactive power compensation, and fault-tolerant algorithms to address existing gaps. Key innovations include: • Fault I-V characteristic modeling to predict and mitigate overcurrent, • Dynamic reactive power support ensuring adherence to grid codes, and • Voltage source retention via adaptive current limitation, avoiding reliance on additional hardware. The strategy prioritizes rapid fault identification, transient stability optimization, and seamless post-fault recovery. It eliminates the need for complex parameter tuning while maintaining synchronism with the grid during faults. Rigorous transient stability analysis will validate the method's ability to shorten fault-current limiting intervals, outperforming conventional voltage-current (VI) techniques. Validation via simulation and experimental testing will demonstrate the strategy's superiority in balancing resilience and stability, ultimately supporting safer, more reliable renewable integration. Success would mark a critical step toward future-proofing grids against asymmetrical faults in high-renewable scenarios.
Contact points	John XU: john.xu@nottingham.edu.cn

Supervisory Team	Shuo Wang Giampaolo Buticchi Jiajun Yang
Short introduction & description of research project	**The advanced multimode variable voltage control for bidirectional Quasi-Z Source inverter electric drive system** Background: Electric vehicles (EVs) rely on advanced motor drive systems to achieve high efficiency, dynamic performance, and energy regeneration. Permanent Magnet Synchronous Motors (PMSMs) are widely used in EVs due to their high power density and efficiency. However, traditional inverters driving PMSMs working as buck circuit face limitations in voltage boost capability. The bidirectional Quasi-Z Source inverter (qZSI) offers a promising solution, enabling voltage boost and buck functions in a single stage while providing bidirectional power flow capability. This research explores an advanced modulation strategy with multimode control for PMSM driven by a bidirectional qZSI, aiming to optimize performance across various operating conditions. By integrating flexible modulation techniques and adaptive control modes, the system enhances efficiency, extends battery life, and improves reliability, making it a compelling solution for next-generation EV, V2V, V2G systems. The area of work and the need for this work 1. Advanced Modulation Strategy Development used in qZSI 2. Multimode variable voltage Control Strategy for PMSM with qZSI 3. Integration and Application for qZSI based PMSM in Electric Vehicles (EVs)
Contact points	Shuo Wang, shuo.wang@nottingham.edu.cn

Supervisory Team	Liang Huang Giampaolo Buticchi
Short introduction & description of research project	**Project title: Research on Flexible Compensation Topologies for Wireless Power Transfer Systems** This research focuses on Wireless Power Transfer (WPT) systems, specifically for electric vehicle (EV) charging and its integration into smart grid infrastructure. With the rapid growth of EV adoption and the shift toward smart grids, wireless EV charging is a critical area of innovation, as it eliminates the need for physical connectors, enhancing convenience, safety, and reliability. Vehicle-to-grid (V2G) integration is essential for energy management, allowing EVs to act as both energy consumers and storage units that can supply power back to the grid. However, charging inefficiencies due to coil misalignment and load variations remain key challenges. Traditional fixed compensation circuits limit adaptability to varying loads and misalignment, compromising system efficiency and power transfer capability. This study aims to develop a flexible compensation topology for WPT systems, allowing real-time adaptation to load variations and coil misalignment. Current compensation circuits—such as series LC, parallel LC, LCC, and LCL—have fixed structures, each with specific advantages and limitations. This research will design a dynamically adjustable compensation circuit,

	integrating active switching to transition between different topologies based on operating conditions. By developing adaptive compensation circuits, this study contributes to the next generation of wireless charging—making V2G more efficient, reducing infrastructure costs, and improving grid stability. The outcomes will support the widespread deployment of WPT in EV charging, aligning with the broader vision of sustainable energy and intelligent power systems.
Contact points	Liang Huang, Liang.Huang@nottingham.edu.cn

Supervisory Team	Zheng Chu David Chieng Chiew Foong Kwong
Short introduction & description of research project	**Resource Management of Internet of Vehicles (IoV) Networks** This project aims to explore a novel 6G IoV framework, focusing on enabling multiple functionalities to meet the unique requirements of vehicular communications to address 6G IoV's challenges in communication, computing, sensing, and energy efficiency while ensuring robust performance in highly dynamic vehicular environments. This project mainly contributes the following three work packages (WPs): **WP1: DMA-empowered IoV networks** Novel techniques for IoV networks focuses on designing dynamic metasurface antennas (DMA) in vehicular contexts to enhance the multi-service demands of communication, computing, and sensing in IoV networks. This involves leveraging the unique properties of DMA to optimize signal transmission, resource allocation, and data processing in complex vehicular environments. **WP2: Multi-objective robust optimization in DMA-IoV networks** Multi-objective robust optimization in DMA-IoV networks focuses on addressing challenges in network performance under complex conditions. By leveraging channel uncertainties and correlations, as well as accounting for transceiver hardware impairments, this WP aims to develop novel robust modeling and hybrid beamforming techniques. These advancements enhance network throughput, computational capabilities, and target sensing performance. Additionally, innovative resource allocation strategies are explored to balance the trade-offs between these multi-service demands, ensuring optimal performance in dynamic IoV environments. **WP3: Generated AI (GAI) for IoV networks** Introduce GAI to address under dynamic vehicular constraints, focusing on latency, energy efficiency, and sensing accuracy. This integration leverages GAI to generate, process, and analyze vast amounts of data produced by connected vehicles and other IoT devices within the IoV ecosystem. GAI can enhance the efficiency, reliability, and security of data transmission in IoV networks by enabling more intelligent decision-making, dynamic resource allocation, and real-time optimization. It also holds the potential to drive advancements in autonomous driving, smart traffic management, and V2X communication, paving the way for a more connected and intelligent transportation future.
Contact points	Zheng Chu (zheng.chu@nottingham.edu.cn)

Supervisory Team	Prof. Jing Li, Dr. Chunyang Gu, Prof. He Zhang
Short introduction & description of research project	This project aims to develop a novel AI-driven control strategy for ferrite-assisted synchronous reluctance machines (FaSynRMs), addressing their inherent nonlinearities, and parameter variation, particularly the significant operational dependency of inductances Ld , Lq and Mdq. Traditional control methods, such as FOC, struggle to adapt to these dynamic parameter variations, leading to low performance, such as low efficiency, significant torque ripples. Leveraging advancements in artificial intelligence (AI), this research will integrate deep reinforcement learning (DRL) and adaptive neural networks to propose a real-time, self-optimizing control framework. The proposed strategy will enhance the FaSynRM's performance in terms of efficiency, dynamic response, torque stability, and robustness under varying loads and speeds, with validation through simulation and experimental prototypes.
Contact points	Prof. Jing Li, Jing.Li@nottingham.edu.cn

Supervisory Team	Dr CF Kwong
Short introduction & description of research project	Next-Gen AI-Enhanced Network Intelligence for High-Density Vehicular Platooning in Future 6G V2X The rise of **autonomous and connected vehicles (CAVs)** has paved the way for **vehicle platooning**, a technique that enables a group of vehicles to move in a coordinated manner with minimal gaps, improving **fuel efficiency, road safety, and traffic congestion management**. However, platooning requires highly **reliable and low-latency communications**, posing significant challenges for **radio resource allocation** in **5G-based Cellular Vehicle-to-Everything (C-V2X) networks**. In conventional resource allocation methods, spectrum efficiency is often limited due to **static spectrum assignment and inefficient power control**. The **dynamic nature of vehicular environments**, especially in multi-lane highways with varying vehicle densities, demands an **intelligent, adaptive, and scalable** radio resource management solution. This research aims to **develop an AI-driven reinforcement learning (RL)-based radio resource allocation framework** that optimises **subchannel and power allocation** for vehicle platooning, ensuring **high reliability and low latency** while improving spectral efficiency using **Non-Orthogonal Multiple Access (NOMA)**.
Contact points	Chiew-Foong Kwong Chiew-Foong.Kwong@nottingham.edu.cn

Supervisory Team	Dr. Chengbo Wang, Electric and Electronic Engineering Department, UNNC Professor Thomas Meersmann, Strategic Development of Health Science and Technology UNNC and Sir Peter Mansfield Imaging Centre, UNUK Dr. Galina Pavlovskaya (School of Medicine UNUK)
Short introduction & description of research project	**Utilizing Material Science Applications of Hyperpolarized ^{129}Xe NMR Spectroscopy to Improve Clinical MRI of Pulmonary Diseases.** Pulmonary MRI of hyperpolarized xenon-129 (hp^{129}Xe) dissolved in the lung parenchyma and vascular phase is a novel methodology that is gaining increasing attention for clinical assessment of gas exchange in multiple pulmonary diseases. These conditions can involve fibrotic scarring that leads to the thickening of the lung barrier tissues between air and blood in alveolar and vascular space. Gas exchange can also be inhibited due to reduced capillary blood flow. Therefore, the ratios between hp^{129}Xe signals arising from (1) the lung membrane, (2) the red blood cells, and (3) the gas phase hold significant diagnostic value. However, comparing hp^{129}Xe signal ratios quantitatively across different studies poses significant challenges due to different instrumentation and new emerging MRI protocols. A solution to this problem arises from materials science applications of hp^{129}Xe, where xenon dissolved in materials such as polymers can display spectral signitures similar to those typically found in human lungs. This work focuses on advancing the technology using recent breakthrough in the development of a first phantom standard in collaboration between the University of Nottingham's international sites, namely UNUK (Nottingham) and UNNC (Ningbo) https://doi.org/10.1016/j.jmro.2024.100175. This is an opportunity to advance the new phantom technology through further development with new materials, 3D printing of microstructure similar to that found in lungs, gas exchange simulations, and systematic hp^{129}Xe gas exchange study in a real clinical MRI scanner at UNNC. The data will be compared in collaborative work with UNUK and other sites with real patients. This work requires a student with interest in hardware and software development for MRI in an interdisciplinary environment and willingness to spend a few months in the UK in a clinical environment.
Contact points	Dr. Chengbo Wang Chengbo.Wang@nottingham.edu.cn Professor Thomas Meersmann Thomas.Meersmann@Nottingham.ac.uk

Supervisory Team	Professor Thomas Meersmann, Strategic Development of Health Science and Technology UNNC and Sir Peter Mansfield Imaging Centre, UNUK Dr. Chengbo Wang, Electric and Electronic Engineering Department, UNNC Dr. Galina Pavlovskaya (School of Medicine UNUK)
Short introduction & description of research project	**Hyperpolarized ^{129}Xe MRI Contrast of Fibrotic Pulmonary Diseases for Precision Medicine.** Health technology developments in science and engineering can provide new diagnostic methodology to enable personalized medicine. Despite high success rates with many disease treatments, there are always patients who don't respond to an intervention and who require a different approach. Early identification of treatment response is often crucial to prevent irreparable tissue and organ damage. As an emerging technology, hyperpolarized xenon-129 (hp^{129}Xe) magnetic resonance imaging (MRI) enables significant advancement over current pulmonary diagnostics and prognostics with a high potential for efficacy monitoring in personalized medicine, but also in drug development and preventive care https://doi.org/10.1021/acs.chemrev.2c00534. One particularly exciting development, based on the tissue solubility of the inhaled gaseous contrast agent hp^{129}Xe, is MRI monitoring of gas exchange within the lung. For example, in interstitial lung diseases, lung tissue scarring reduces O_2 exchange from the inhaled air into the blood https://doi.org/10.1016/j.pnmrs.2020.11.002. The University of Nottingham, UK campus (UNUK) participated in a longitudinal, multi-centre study of Long-COVID patients where a persistent reduction in gas-blood exchange was demonstrated with using hp ^{129}Xe MRI despite improvements shown in other lung function tests https://doi.org/10.1183/13993003.congress-2023.OA4857. There are remaining technological challenges that require developmental work at the chemistry, physics, electrical engineering, and health sciences interface at the EEE department at University of Nottingham, Ningbo, China (UNNC), but also in collaboration with clinical colleagues the School of Medicine, UNUK and the Sir Peter Mansfield Imaging Centre (SPMIC) which is the noble price awarded birthplace of MRI. This demanding and awarding work requires a student with interest in learning about imaging and laser pumping technology but also in software development and MRI pulse programming withn a highly interdisciplinary environment. It offers the opportunity to spend a few months in a clinical environment and at SPMIC in the UK.
Contact points	Professor Thomas Meersmann Thomas.Meersmann@Nottingham.ac.uk Dr. Chengbo Wang Chengbo.Wang@nottingham.edu.cn Dr. Galina Pavlovskaya Galina.Pavlovskaya@Nottingham.ac.uk

Supervisory Team	Dr. Jing Wang
Short introduction & description of research project	Neonatal health monitoring is a critical aspect of pediatric medical care, especially for premature infants, low-birth-weight babies, or those with congenital diseases. Real-time, accurate, non-invasive and skin-friendly monitoring of physiological parameters is essential. However, traditional medical monitoring devices (such as rigid electrodes and wired sensors) have significant limitations: rigid materials can cause pressure marks or damage to the delicate skin of infants, wired connections restrict infant movement and may lead to fatal incidents, and the low integration of multi-parameter monitoring makes it difficult to meet comprehensive neonatal care needs. Moreover, the attachment of sensor heads onto skin usually relies on sticky interface, which induces skin damage and possible allergy. To address these challenges, this project aims to develop a flexible wearable sensor that enables real-time and continuous monitoring of key physiological indicators in newborns, such as body temperature, heart rate, blood oxygen saturation (SpO_2), respiratory rate, and movement status. The sensor will be developed by incorporating microfluidic techniques and flexible electronic sensing techniques. The measured data will be wirelessly transmitted to on-site external devices, hospital monitoring systems and/or parental mobile devices, for the recognition of symptoms pre-defined by doctors and issuing warning messages to doctors, nurses and parents. By integrating flexible electronics, IoT, and medical technologies, this project provides the possibility of shifting from "reactive treatment" to "proactive prevention." In the future, this technology can be expanded to remote monitoring for pediatric or elderly patients with chronic conditions, offering broad market potential and societal benefits.
Contact points	Informal inquiries may be addressed to Dr. Jing Wang (Jing.Wang@nottingham.edu.cn).