Department	School of Engineering and the Built Environment
Supervisors	DoS: Dr. Chan Hwang See, SS: Dr. Naser Ojaroudi Parchin, Dr. Dongyang Sun, Dr. Zhilun Lu
Project Title	Design and Development of Green miniaturised Balanced Antennas and Antenna Arrays for Internet of Things Applications

PROJECT DESCRIPTION

The advances in wireless networks and electronics have led to the emergence of Wireless Sensor Networks (WSNs), which are considered to be one of the most important technologies that can revolutionize healthcare systems. This technology has impacted the medical devices field, replacing thousands of wires connected to tranditional sensors as found in hospitals and providing enchanced mobility. However, miniaturization is one of the key requirements for both wearbable and and implantable devices.

Antenna is the key elementin the wireless communication devices to transmit and receive radio signals. It acts as an omnipresent crical component in any wireless devices, i.e. smart phones, tablets, implanatable wireless biomedical devices, radio frequency identification systems, radars, etc. Compact antenna reply on an EM wave resonance, and therefore typically have a sizeo of more than one-tenth of the EM wavelength. The limmitataion on antenna size miniaturization has made it very challenging to achieve compact antennas and antenna arrays, particularly at very-high frequency (VHF, 30-300 MHz) and ultra-high frequency (UHF, 0.3- 3GHz) with large wavelength, thus putting several constraints on implantable medical devcies and Internet of Medical Things (IoMT) transceivers.

The aim of the proposed PhD research is to develop miniaturised antennas by using optimized structures/material combinations for biomedical wireless sensing and communication applications. By incorporating metamaterial structures, cellulose nanomaterials, conductive polymer and carbon nanotubes, the electromagnetic constitutive parameters of the host substrate can be enhanced and thus the size of the antenna reduced and the performances improved, i.e. impedance bandwidth, radiation characteristics, etc. The work proposed herein is novel and can be distinguished by its innovation to ultilize new flexible, renewable, biodegradable, recyclable materials as the device materials, with these, well-tailored magnetic and electric properties offer great potential in realizing compact antennas with adequate bandwidth and efficiency. The outcomes of this research will provide necessary leap within biomedical and wireless communication research to satisfy the ever-growing demands for miniaturised and “green” transceivers.

This project is a collaboration between two engineering subject areas, i.e. Advanced Materials and Microwave Engineering within School of Computing, Engineering and the Built Environment (SCEBE). It is suitable for applicants with interests and good background in applied electromagnetics, materials science, and particularly in antenna/antenna arrays, metamaterial and nannocellulose.

Academic qualifications

A first degree (at least a 2.1) ideally in Electrical and Electronic Engineering with a good fundamental knowledge of Electromagnetics, Antennas, Antenna Array, Metamaterial, Materials Science and Microwave Theory and Techniques.

English language requirement

IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other, equivalent qualifications will be accepted. Full details of the University’s policy are available online.

Essential attributes:

- Experience of fundamental antenna design, modelling and measurement

- Competent in Electromagnetics Theory and Fields
- Knowledge of Material Science, Microwave/millimetre wave transmission systems and devices
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:
This project is suitable for applicants with interests and good back ground in materials science, electromagnetic and electromagnetics design and particularly in electromagnetic wave propagation, microwave circuits, antenna and antenna arrays for communications systems and RF energy harvesting systems.

Indicative Bibliography	1. M.Alibakhshikenari, Bal. S. Virdee, S. Salekzamankhani, S. Aissa, **C.H. See**, N. Soin, S.J. Fishlock, A.A. Althuwayb ,R.A.Abd-Alhameed, I. Huynen, J.A. McLaughlin, F. Falcone, and Ernesto Limiti, "High-Isolation Antenna Array Using SIW and Realized with a Graphene Layer for Sub-Terahertz Wireless Applications," *Scientific Reports,* vol.11, Article no. 10218, May 2021, https://doi.org/10.1038/s41598-021-87712-y 2. D.Wang, B.L.H. Saw, A. J. Onyianta, B. Wang, C. Wilson, D. O'Rourke, C.H. See, C-M. Popescu, M.Dorris, I.Shyha, Z.Lu, "Preparation of Elastomeric Nanocomposites Using Nanocellulose and Recycled Alum Sludge for Flexible Dielectric Materials", Journal of Advanced Dielectrics, (Accepted, November 2022)
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