School of Computing, Engineering, and the Built Environment
Edinburgh Napier University

PHD STUDENT PROJECT

Funding and application details

Funding status: Self funded students only

Application instructions:
Detailed instructions are available at https://blogs.napier.ac.uk/scebe-research/available-phd-student-projects/

Prospective candidates are encouraged to contact the Director of Studies (see details below) to discuss the project and their suitability for it.

Project details

Supervisory Team:

- DIRECTOR OF STUDY: Chan Hwang See (Email: C.See@napier.ac.uk)
- 2ND SUPERVISOR: Naser Ojaroudi Parchin

Subject Group: Cyber-security and system engineering

Research Areas: Electronic Engineering

Project Title: Design and Development of Green miniaturized wearable Balanced 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.

References:

[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)

Candidate characteristics

Education:

A first-class honours degree, or a distinction at master level, or equivalent achievements in Electrical and Electronic Engineering, or Mobile Communication Engineering

Subject knowledge:

- Electromagnetics,

- Antennas,
- Antenna Array,
- Metamaterial,
- Materials Science,
- Microwave Theory and Techniques

Essential attributes:

- Experience of fundamental antenna design, modelling and measurement.
- Competent in Electromagnetics Theory and Fields
- Knowledge of Material Science, Microwave/millimetre wave tra

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 communic