



## **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: Petros Karadimas (Email: P.Karadimas@napier.ac.uk)
- 2<sup>ND</sup> SUPERVISOR:

**Subject Group:** Cyber-security and system engineering

**Research Areas:** Communications Engineering, Electrical Engineering, Electronic Engineering

**Project Title:** Compact MIMO antennas for 6G mobile devices

**Project description:**

Antennas are the corner stone of wireless communications as they are responsible for transmitting and receiving the electromagnetic wave that carries the information message. Although a very classical topic with more than 100 years of history since the first wireless transmission, the design of optimum antennas remains a timely issue. Multiple input-multiple output (MIMO) communication systems have been employed to offer parallel data streams and increase data rate. Particularly, in future 6G mobile devices, such as mobile phones, tablets, vehicles' on-board units (OBUs), a compact antenna design should be integrated in the limited device space. Starting from a very thorough literature review, the PhD candidate will have

to understand the radiation mechanisms of antennas and become familiar with the Maxwellian basis of antenna analysis and design. Accordingly, the PhD candidate will study existing MIMO antennas for mobile devices and evaluate them according to certain key performance metrics (KPMs) including the diversity antenna gain (DAG) and channel capacity (CC). The aforementioned step of studying and evaluating existing state-of-the-art MIMO antennas will enable the PhD candidate to gain significant experience to progress to the next level. That level and ultimate goal of this project is the PhD candidate to come up with novel brand new MIMO antenna designs (at least three) that will show better performance, i.e., higher DAG and CC, compared to the existing state-of-the-art designs.

**References:**

- [1] W. L. Stutzman WL and G. A. Thiele, "Antenna theory and design," John Wiley & Sons; 2012.
- [2] V. Papamichael and P. Karadimas, "On the Covariance Matrix and Diversity Performance Evaluation of Compact Multiport Antenna Systems," IEEE Transactions on Antennas and Propagation, vol. 65, no. 11, pp. 6140-6144, Nov. 2017.

## **Candidate characteristics**

**Education:**

A first-class honours degree, or a distinction at master level, or equivalent achievements in Electrical/Electronic Engineering, or Physics

**Subject knowledge:**

- Electromagnetic Theory
- Electromagnetic Wave Propagation
- Antennas
- Communication Principles
- Engineering Mathematics
- Vector Calculus

**Essential attributes:**

- Good written and oral communication skills
- Strong motivation with evidence of independent research skills relevant to the project
- Good time management

**Desirable attributes:**

- Experience with electromagnetic simulation tools such as CST, HFSS