



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

PHD STUDENT PROJECT

Application instructions:

Detailed instructions are available at :

<https://www.napier.ac.uk/research-and-innovation/doctoral-college/how-to-apply>

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: Prof Petros Karadimas (Email: p.karadimas@napier.ac.uk)
- 2ND SUPERVISOR: tbc

Subject Group: Cyber Security and Systems Engineering

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

Project Title: Optimum 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 waves that carry information. 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 MIMO antenna 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 suitable for mobile devices and evaluate them according to certain key performance metrics (KPMs) such as 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 devise new optimum compact MIMO antennas (at least three) that will show better performance, that is, higher DAG and CC, compared to the existing ones.

References

1. W. L. Stutzman and G. A. Thiele, "Antenna theory and design," John Wiley & Sons, 2012.
2. C. A. Balanis, "Antenna theory: analysis and design," John Wiley & Sons, 2016.
3. 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.
4. A. Pour Sohrab, Y. Huang, and P. Karadimas, "Performance Analysis of Multiport Antennas in Vehicle-to-Vehicle Communication Channels." Wireless Pers. Commun. vol. 134, pp. 1231–1257, 2024.

Candidate characteristics

Education:

Minimum 2:1 degree Electrical/Electronic/Communications Engineering

Subject knowledge:

Electromagnetic Theory and Fields, Microwave and mm-Wave Transmission Systems/Devices, Communication Principles, Engineering Mathematics, Vector Calculus

Essential attributes:

- Knowledge of Electromagnetic Theory and Fields, Microwave and mm-Wave Transmission Systems/Devices, Communication Principles, Engineering Mathematics, Algorithms, Optimization Theory.
- Competent in Electromagnetic Wave Propagation, Antennas, Antenna Arrays, Programming
- Strong motivation with evidence of independent research skills relevant to the project
- Good written and oral communication skills
- Good time management

Desirable attributes:

- Experience with electromagnetic simulation tools such as CST, HFSS