PhD Project Proposal

ECIT Interdisciplinary PhD Programme

Proposed Project Title: Beyond Massive MIMO: Where Shannon Meets Maxwell

Principal Supervisor(s): Dr Michalis Matthaiou

Project Description:

Massive MIMO (MaMi), where a base station deploys an unconventionally large number of antennas (hundreds or even thousands) at base-stations (BSs) to serve dozens or even hundreds of users, is now making its to the 3GPP standardization exercise (Release 15) and numerous trials are currently being conducted across the globe to verify the practical potential of this disruptive technology. Yet, the development of (MaMi), has been based on the fundamental Claude Shannon's theory, which was developed 70 years ago. Most importantly, to date, MaMi has been exclusively considered as a cellular technology, although, its applications can be (and will be!) far more general: optical wireless communications, circuit design, photonics, imaging and plasmonics to name a few. Therefore, the integration of MaMi in non-cellular applications requires a radical and disruptive way we model, characterise and understand the operation of this technology. This project aims to break the barriers between electromagnetic and information theory and pave the way for an extended range of applications supported by massive antenna arrays after 2025.

Objectives:

The specific project objectives are to:

- Formulate a novel and holistic analytical framework whose pillars will be Shannon's IT and Maxwell's E/M theory. This will allow us to re-define the fundamental performance limits of concurrent and future MaMi-based systems.
- Develop new solutions, methodologies and algorithms for high-speed communication by harnessing knowledge about the EM properties of the transceivers and the propagation medium.

This can be achieved by harnessing the renowned expertise of our research team, which has recently reported a number of breakthroughs in the electromagnetic characterisation of MaMi, to innovate across some fundamental concepts, such as super-directivity and super-oscillatory antenna arrays by leveraging recent advances in large intelligent surfaces, active metamaterials, and millimetre-wave communications.

Academic Requirements:

Students entering the programme will normally be required to have a 2.1 BSc/BEng in Computer Science, Electrical and Electronic Engineering, or a maths based engineering or physical science degree, or equivalent qualification recognised by the University. Students holding an appropriate MEng or MSc (Software conversion) will normally be required to have a 2.1 or commendation (distinction) respectively. Furthermore, additional criteria may be applied. All applicants must have significant mathematical and programming experience.

GENERAL INFORMATION:

This 4 year PhD studentship, potentially funded by the Department for Employment and Learning (DEL), commences on 1 October 2019.

Eligibility for both fees and maintenance depends on the applicants being either an ordinary UK resident or those EU residents who have lived permanently in the UK for the 3 years immediately preceding the start of the studentship. Non UK residents who hold EU residency may also apply but if successful may receive fees only.

Applicants should apply electronically through the Queen's online application portal at: https://dap.qub.ac.uk/portal/

Deadline for applications: Friday 1 March 2019

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