PhD Position in Quantum Communications

Thu, 2019-01-31 12:40 - Mohsen Razavi [1] **At:** University of Leeds
Deadline: 22 February, 2019

Location

School of Electronic and Electrical Eng, University of Leeds Leeds LS2 9JT United Kingdom
See map: Google Maps [2]

- Funded PhD project: Worldwide (International, UK and EU)
- Value: Funding covers the cost of tuition fees as well as a maintenance grant of £12,000 per annum. Funding duration is 3 years. The successful candidate is also encouraged to take part in up to 250 hours per annum of teaching assistant activities, for which up to an additional £3,000 can be earned.
- Number of awards: 1
- Deadline: 22/02/2019
- Supervisors: m [dot] razavi [at] leeds [dot] ac [dot] uk (Dr Mohsen Razavi) and a [dot] q [dot] lawey [at] leeds [dot] ac [dot] uk (Dr Ahmed Lawey) in collaboration with Dr Bruno Clerckx at Imperial College, London. Contact m [dot] razavi [at] leeds [dot] ac [dot] uk (Dr Mohsen Razavi) to discuss this project further informally.

In the quantum era, where quantum computers are in operation, our existing techniques for cryptography would fail to provide us with data security. Quantum key distribution (QKD) offers an alternative solution to our cryptographic needs whose security is neither threatened by quantum computers, nor by any other advancement in technology.

As a new technology, QKD has its own niche markets in finance and governmental sectors, but, in order to make QKD accessible on a large scale, several hurdles must be overcome. On the one hand, QKD must offer a user friendly interface so that customers can conveniently use it in a wireless mobile mode. On the other, QKD should provide service at any distances and for multiple end users without possibly trusting intermediate nodes.

This project would address both above issues in the context of wireless systems. At the access level, the candidate will investigate the prospect of using multiple-input multiple-output (MIMO) techniques in high-dimensional indoor QKD systems [1,2]. The same techniques will also be applied to satellite QKD links, which can offer long-distance key-exchange services.

MIMO is the essential technology behind 4G and future 5G wireless communication systems and offers orders of magnitude enhancements thanks to its potential to drastically increase throughput and reliability of transmission and mitigate various sources of noise and interference [3]. In the multiple-user scenario, we should additionally adopt an optimisation framework that possibly enables different users to be associated with different quantum nodes. The optimal choice of the quantum node will take into consideration the quantum channel state, noise and interference levels to yield an optimal association that maximises the secret key rate for users [4]. If relevant, we would be considering various carrier options, including optical, terahertz, and even microwave domains, and the relevant channel assignment therein.

In each case various discrete- and continuous-variable schemes will be investigated and compared. New schemes are expected to emerge as a result of this research, which suits the particular scenarios under investigation. This project takes a necessary step toward the widespread adoption of QKD technologies.

[1] Osama Elmabrok and Mohsen Razavi, Wireless Quantum Key Distribution in Indoor Environments

(Editor Pick), J. Opt Soc. Am. B. 35, Issue 2, pp. 197-207 (2018).

[2] Osama Elmabrok, Masoud Ghalaii, Mohsen Razavi, Quantum-Classical Access Networks with Embedded Optical Wireless Links, J. Opt Soc. Am. B. 35, 487-499 (2018).

[3] B. Clerckx and C. Oestges, MIMO Wireless Networks: Channels, Techniques and Standards for Multi-Antenna, Multi-User and Multi-Cell Systems, Academic Press (Elsevier), Oxford, UK, Jan 2013.

[4] M. S. Hadi, A. Q. Lawey, T. E. H. El-Gorashi, and J. M. H. Elmirghani, “Big data analytics for wireless and wired network design: A survey,” Comput. Networks, vol. 132, pp. 180–199, Feb. 2018

Entry requirements

Applications are invited from candidates with an equivalent of a UK first class Bachelor’s degree in science or engineering, or an MSc with Research Degree with a 2:1 or higher in science or engineering.

How to apply

Formal applications for research degree study should be made online through the university's website [3]. Please state clearly in the research information section that the PhD you wish to be considered for is the 'Wireless quantum key distribution with multiple-input multiple-output enhancement' as well as Dr Mohsen Razavi, Dr Ahmed Lawey and Dr Bruno Clerckx (Imperial College, London) as your proposed supervisor(s).

If English is not your first language, you must provide evidence that you meet the University’s minimum English Language requirements [4].

- PhD [5]

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