Simulation Platform of Optical Fiber-based Quantum Communication Systems
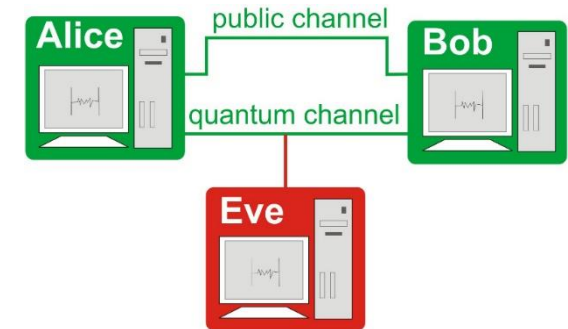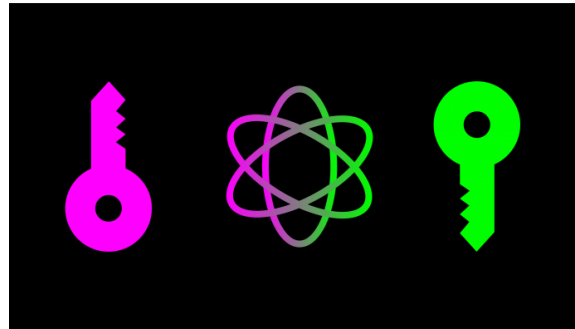
Motivation

The secure communication of sensitive data plays an ever-increasing role, today. However, it is well known that cryptographic keys based on computational complexity are breakable by quantum computers. Therefore, quantum communication based on quantum mechanics is expected to guarantee secure data transmission. Quantum key distribution (QKD), which is a certain type of quantum communication protocols, has been developed within the past few decades for distributing secure public keys among remote parties and is a promising candidate for enabling secure communication. Since optical fiber networks are the infrastructure of the global internet, it is important to implement QKD to it. Based on single-photon transmission, QKD protocols are realisable in optical fibers. A simulation platform modelling the behavior of photon transmission through fibers is an essential step towards developing novel features for QKD protocols and to evaluate the fidelity of current real-world systems.

The topic is suitable for a thesis of students in electrical engineering, physics, mechanical engineering, or similar studies with knowledge in signal processing, optical communications or quantum mechanics.

(1)   https://www.technologyreview.com/2019/02/14/103409/what-is-quantum-communications/
(2)   https://www.picoquant.com/applications/category/quantum-optics/quantum-communication

Tasks

- Comparison of different fiber-based QKD protocols

- Modelling of optical components

- Investigation of optical signal transmission

- QKD simulation

- Analysis of the impact of noise

The tasks can be selected individually and the extent can be flexibly adapted.

Keywords

quantum communication, QKD, optical fiber, simulation platform, Matlab, Simulink

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