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Research interests include:

- **Quantum information and control**
- **Digital control and network-based control**
- **Nonlinear dynamics**

On-going GRF project
Analysis and Feedback Control of Quantum Linear Systems

Abstract

Quantum technology allows us to engineer devices by exploiting non-classical features of quantum mechanics such as superposition, entanglement and tunneling. One of the prominent candidates for quantum technology is quantum optical systems and networks as photons are ideal information carriers for long-distance communication and light-matter interaction is the backbone of quantum networks. As optical quantum technology relies on designing quantum optical systems and organizing quantum optical networks so as to harness quantum states of light, a systematic framework for signal processing of quantum optical systems and networks is essential for a successful optical quantum technology.

In this project we investigate how quantum linear systems and networks process non-classical and classical signals along the following three directions.

1) Derive analytical forms in mathematical terms of the intensity and state of the output field of a fully quantum linear optical system driven by multi-photon states. This is useful because multi-photon states have wide applications in quantum communication, computation, metrology, lithography and cryptography, etc.

2) Extend the mathematical description in part 1) to linear mixed quantum-classical systems. This would enable one to better understand and describe multi-photon state processing by optical systems involving quantum components (such as optical cavities, beamsplitters, optical parametric amplifiers) and classical components (such as photodetectors, piezoelectric actuators).

3) Design an estimator in the form of mixed quantum-classical linear systems to estimate an unknown classical time-varying signal, and minimize the estimation error with respect to the structure of the estimator and its interconnection with the quantum system driven by the classical signal. The proposed estimation via interconnection method will provide powerful innovative tools for quantum estimation.

The proposed research provides theoretical insight to the state-of-the-art research in the emerging discipline of optical quantum technology.