Applications of controlled quantum procesesses in quantum opics

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Abstract

We will start by looking at quantum probability. We will introduce the notion of a quantum probability space, explain the spectral theorem, introduce a noncommutative version of the conditional expectation and show that we can realize Wiener processes by operators on the Fock space. Then we will turn to modelling some typical quantum optical systems within the framework of quantum probability. We will introduce quantum stochastic differential equations to describe the interaction of a quantum mechanical system with the electromagnetic field. We will show how we can incorporate feedback control in this description, find the controlled quantum filter and show how to solve an optimal control problem using dynamic programming.

Introductory references:

- An introduction to quantum filtering, Luc Bouten, Ramon van Handel and Matthew James, arxiv:math.OC/0601741
- A discrete invitation to quantum filtering and feedback control, Luc Bouten, Ramon van Handel and Matthew James, arxiv:math.PR/0606118
- On the separation principle of quantum control, Luc Bouten and Ramon van Handel, arxiv:math-ph/0511021