Numerical Optimal Control of Quantum Systems*

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Abstract

Designing optimal controls that steer the time evolution of a quantum system to a desired state is a crucial task in many application areas such as NMR spectroscopy, molecular physics, and more recently in the rapidly evolving field of quantum computing. In contrast to classical micro processors, quantum devices do not have logical gates predefined in hardware. Instead, external electromagnetic pulses are applied to control the device to perform the fundamental operations of a quantum algorithm, e.g. preparation of quantum states, application of logical gate operations and readout of the result of a quantum algorithm. The design of the control pulses is an optimal control problem, where the quantum state is governed by Schroedinger's equation and the control pulses are subject to amplitude bounds. In this talk, we give an overview of our efforts to develop efficient numerical methods for solving the optimal control problem in closed and open quantum systems.

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