Day 4 (Poster F)

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Title: Behavior of Analog Quantum Algorithms

Abstract:

Analog quantum algorithms are formulated in terms of Hamiltonians rather than unitary gates and include quantum adiabatic computing, quantum annealing, and the quantum approximate optimization algorithm (QAOA). These algorithms are promising candidates for near-term quantum applications, but they often require fine tuning via the annealing schedule or variational parameters. In this work we connect all these algorithms to the optimal analog procedure. Notably, we explore how the optimal procedure approaches a smooth adiabatic procedure but with a superposed oscillatory pattern that can be explained in terms of the interactions between the ground state and first excited state that effect the coherent error cancellation of diabatic transitions. Furthermore, we provide numeric and analytic evidence that QAOA emulates this optimal procedure with the length of each QAOA layer equal to the period of the oscillatory pattern. Additionally, the ratios of the QAOA bangs are determined by the smooth, non-oscillatory part of the optimal procedure. We provide arguments for these phenomena in terms of the product formula expansion of the optimal procedure. All of this shows that these analog algorithms are all different limits and approximations of the same optimal quantum protocol.

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