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Title:

Combined continuous error suppression and error correction for quantum annealing

Abstract:

The scheme of Jordan, Farhi and Shor for error suppression during quantum annealing [Phys. Rev. A 74, 052322 (2006)] adds energy penalty terms to an encoded Hamiltonian. The role of these penalty terms is to suppress the occurrence of errors taking the encoded quantum state out of the code space. However, errors can still occur in this scheme, albeit with lowered probability. Here we address the question of whether error correction can enhance the performance of quantum annealing by further correcting the remaining unsuppressed errors. To answer this question we consider the continuous implementation of the three-qubit bit-flip code, where the error syndrome operators are simultaneously measured at the same time. We show that, under certain conditions, continuous error correction combined with error suppression can lead to significantly improved final ground state fidelities. A notable feature of the combined protocol is that it requires error correction operations that are somewhat different from those typically used in the operation of quantum memory under this encoding.