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Towards Scalable Quantum Annealing Correction for Optimization and Sampling

Quantum Error Correction is critical to ensure the success of quantum computation. However, we do not have a formal theory of fault-tolerance in the adiabatic scheme. In the context of finite-temperature quantum annealing, an important ingredient in achieving fault-tolerance is an error correcting scheme that provides a scalable reduction of the effective temperature at which a quantum annealer operates. I will discuss recent developments on Nested Quantum Annealing Correction (NQAC), the first error correction method that can be implemented on currently available quantum annealers and that allows to control the level of protection against thermal errors. Theoretical mean-field analyses suggest that NQAC has the potential to provide a scalable temperature reduction. This is supported by experimental data obtained from a fourth-generation D-Wave 2000Q quantum annealer. Data show that NQAC scales up to the size of the device. This effective temperature reduction can also be exploited for sampling applications.