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Accelerating projective quantum Monte Carlo simulations using data from quantum annealers

Adiabatic quantum computers, such as the quantum annealers developed by D-Wave Systems Inc., have gained significant attention in recent years due to their potential for quantum computation. They are also increasingly being used in hybrid classical-quantum approaches to solve complex problems.
For instance, autoregressive neural networks have been employed to accelerate Monte Carlo simulations of classical spin glasses through autoregressive neural networks [1].
Here, we investigate the potential of adiabatic quantum computers in enhancing projective quantum Monte Carlo (PQMC) algorithms for determining the ground-state of quantum spin models. We utilize low-energy spin configurations generated by a D-Wave quantum annealer to train neural quantum states represented as restricted Boltzmann machines. These models are then utilized as guiding wave functions in PQMC simulations.
We evaluate the efficiency of our approach in terms of equilibration time and suppression of systematic biases for ferromagnetic and random quantum Ising models. Our preliminary results demonstrate the potential for improved efficiency in these simulations.

[1] G Scriva, E Costa, B McNaughton, S Pilati, Accelerating equilibrium spin-glass simulations using quantum annealers via generative deep learning, arXiv:2210.11288 (2022)

Abstract category

Numerical Methods

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