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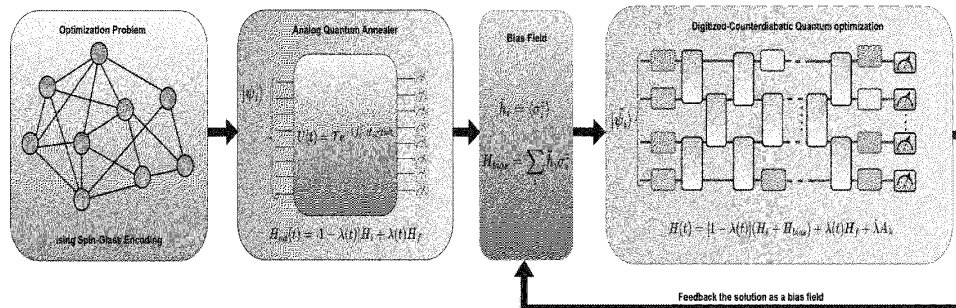
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(54) Title: QUANTUM COMPUTING WITH SEQUENTIAL QUANTUM PROCESSORS THROUGH BIAS TERMS

Figure 1



(57) Abstract: The invention relates to a computer-implemented method for solving a combinatorial optimization problem encoded in the ground state of an Ising spin-glass model. In particular, the invention introduces a method called bias field digitized counterdiabatic quantum optimization (bf-DCQO) for solving combinatorial optimization problems on digital quantum computers. This method integrates auxiliary counterdiabatic (CD) terms into the adiabatic Hamiltonian and introduces bias terms derived from classical methods, quantum annealers, or iterative DCQO applications. This approach addresses the limitations of current quantum computers, particularly their limited coherence times, and improves the time to solution for large-scale problems compared to traditional DCQO and finite-time adiabatic quantum optimization. The bf-DCQO method is entirely quantum, avoiding the trainability issues of variational quantum optimization algorithms. It significantly outperforms the Quantum Approximate Optimization Algorithm (QAOA) in success probability and approximation ratio. Experimental implementation on a trapped-ion quantum computer and a superconducting processor demonstrated its effectiveness on a maximum weighted independent set problem with 36 qubits and a spin-glass problem on a heavy-hex lattice with 100 qubits. This represents the largest such problem solved on a gate-based quantum computer using a purely quantum algorithm.

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